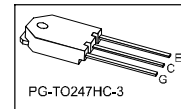
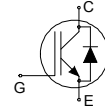


## Reverse conducting IGBT with monolithic body diode

## Features:

- Powerful monolithic body diode with low forward voltage designed for soft commutation only
- TrenchStop® technology offering:
  - very tight parameter distribution
  - high ruggedness, temperature stable behavior
  - low  $V_{CEsat}$
  - easy parallel switching capability due to positive temperature coefficient in  $V_{CEsat}$
- Low EMI
- New TO-247HC package offers increased air & creepage distances compared to TO247 package
- Qualified according to JEDEC J-STD-020 and JESD-022 for target applications
- Pb-free lead plating; RoHS compliant
- Halogen free (according to IEC 61249-2-21)
- Complete product spectrum and PSpice Models: <http://www.infineon.com/igbt/>



## Applications:

- Inductive cooking

Type	$V_{CE}$	$I_C$	$V_{CEsat}, T_{vj}=25^{\circ}C$	$T_{vjmax}$	Marking	Package
IHY20N120R3	1200V	20A	1.48V	175°C	H20R1203	PG-TO247HC-3

## Maximum ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	$V_{CE}$	1200	V
DC collector current, limited by $T_{vjmax}$ $T_C = 25^{\circ}C$ $T_C = 100^{\circ}C$	$I_C$	40.0 20.0	A
Pulsed collector current, $t_p$ limited by $T_{vjmax}$	$I_{Cpuls}$	60.0	A
Turn off safe operating area $V_{CE} \leq 1200V, T_{vj} \leq 175^{\circ}C$	-	60.0	A
Diode forward current, limited by $T_{vjmax}$ $T_C = 25^{\circ}C$ $T_C = 100^{\circ}C$	$I_F$	40.0 20.0	A
Diode pulsed current, $t_p$ limited by $T_{vjmax}$	$I_{Fpuls}$	60.0	A
Gate-emitter voltage Transient Gate-emitter voltage ( $t_p = 10\mu s, D < 0.010$ )	$V_{GE}$	$\pm 20$ $\pm 25$	V
Power dissipation $T_C = 25^{\circ}C$ Power dissipation $T_C = 100^{\circ}C$	$P_{tot}$	310.0 155.0	W
Operating junction temperature	$T_{vj}$	-40...+175	°C
Storage temperature	$T_{stg}$	-55...+175	°C
Soldering temperature, for 10 s (according to JEDEC J-STA-020A)		260	°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	$R_{th(j-c)}$		0.48	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		0.48	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		55	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	$V_{BR(ICES)}$	$V_{GE} = 0\text{V}$ , $I_C = 0.50\text{mA}$	1200	-	-	V
Collector-emitter saturation voltage	$V_{CEsat}$	$V_{GE} = 15.0\text{V}$ , $I_C = 20.0\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	-	1.48	1.70	V
			-	1.70	-	
			-	1.80	-	
Diode forward voltage	$V_F$	$V_{GE} = 0\text{V}$ , $I_F = 20.0\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	-	1.55	1.75	V
			-	1.70	-	
			-	1.80	-	
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 0.50\text{mA}$ , $V_{CE} = V_{GE}$	5.1	5.8	6.4	V
Zero gate voltage collector current	$I_{CES}$	$V_{CE} = 1200\text{V}$ , $V_{GE} = 0\text{V}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	-	-	100.0	$\mu\text{A}$
			-	-	2500.0	
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0\text{V}$ , $V_{GE} = 20\text{V}$	-	-	100	nA
Transconductance	$g_{fs}$	$V_{CE} = 20\text{V}$ , $I_C = 20.0\text{A}$	-	15.7	-	S
Integrated gate resistor	$r_G$			none		$\Omega$

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

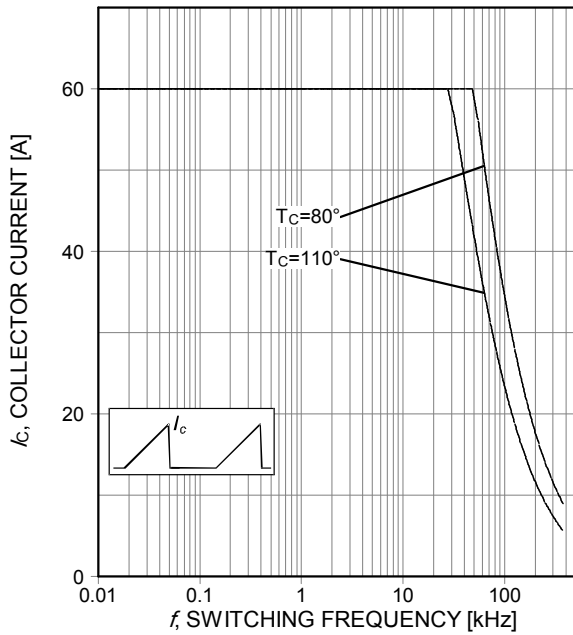
Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>Dynamic Characteristic</b>						
Input capacitance	$C_{ies}$	$V_{CE} = 25\text{V}$ , $V_{GE} = 0\text{V}$ , $f = 1\text{MHz}$	-	1503	-	pF
Output capacitance	$C_{oes}$		-	50	-	
Reverse transfer capacitance	$C_{res}$		-	42	-	
Gate charge	$Q_G$	$V_{CC} = 960\text{V}$ , $I_C = 20.0\text{A}$ , $V_{GE} = 15\text{V}$	-	211.0	-	nC

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

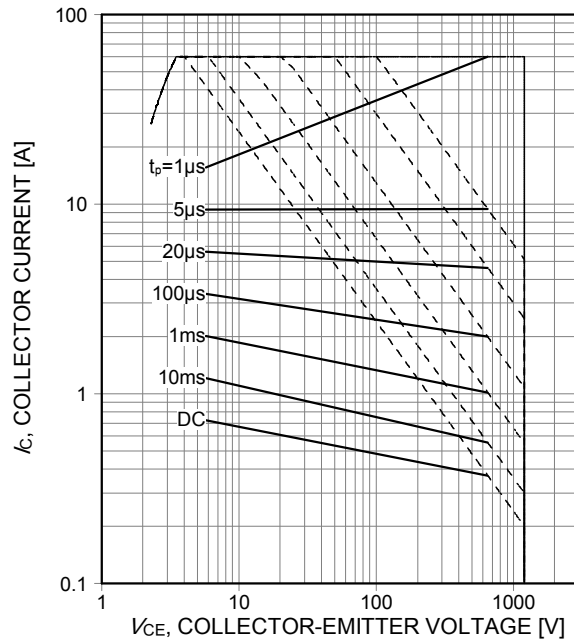
Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>IGBT Characteristic</b>						
Turn-off delay time	$t_{d(off)}$	$T_{vj} = 25^{\circ}\text{C}$ , $V_{CC} = 600\text{V}$ , $I_C = 20.0\text{A}$ , $V_{GE} = 0.0/15.0\text{V}$ , $r_G = 15.0\Omega$ , $L_{\sigma} = 180\text{nH}$ , $C_{\sigma} = 39\text{pF}$ $L_{\sigma}$ , $C_{\sigma}$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	387	-	ns
Fall time	$t_f$		-	25	-	ns
Turn-off energy	$E_{off}$		-	0.95	-	mJ

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

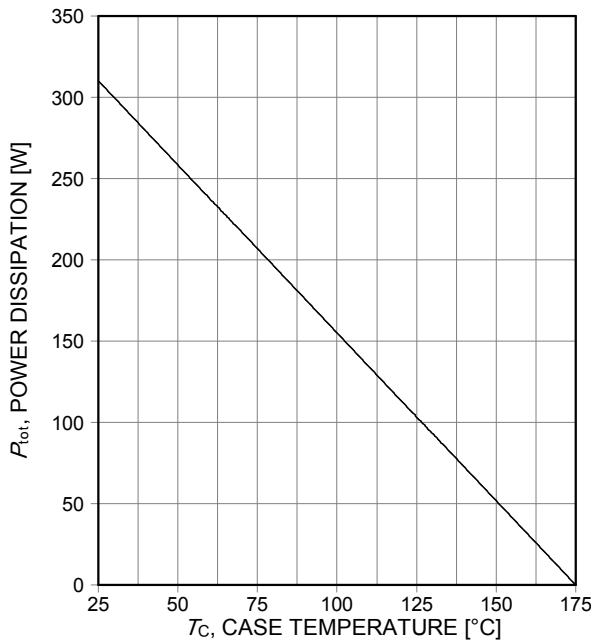
Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>IGBT Characteristic</b>						
Turn-off delay time	$t_{d(off)}$	$T_{vj} = 175^{\circ}\text{C}$ , $V_{CC} = 600\text{V}$ , $I_C = 20.0\text{A}$ , $V_{GE} = 0.0/15.0\text{V}$ , $r_G = 15.0\Omega$ , $L_{\sigma} = 180\text{nH}$ , $C_{\sigma} = 39\text{pF}$ $L_{\sigma}$ , $C_{\sigma}$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	454	-	ns
Fall time	$t_f$		-	84	-	ns
Turn-off energy	$E_{off}$		-	1.65	-	mJ



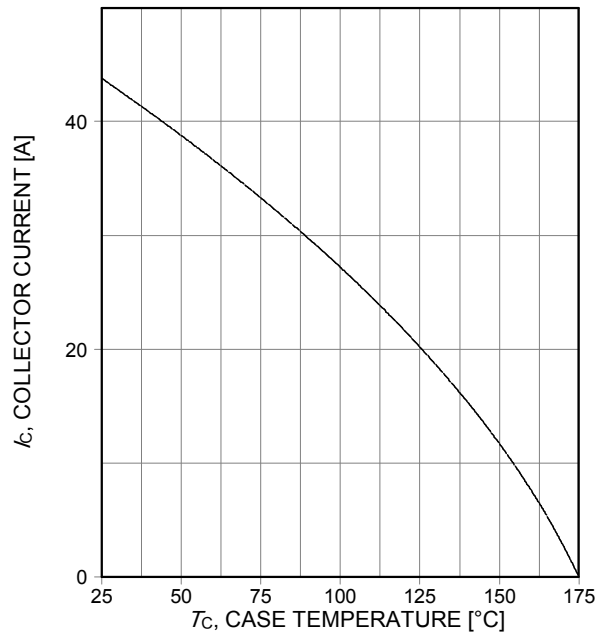
**Figure 1. Collector current as a function of switching frequency**  
 ( $T_j \leq 175^\circ\text{C}$ ,  $D=0.5$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $R_G=15\Omega$ )



**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**  
 ( $V_{GE} \geq 15\text{V}$ ,  $T_j \leq 175^\circ\text{C}$ )

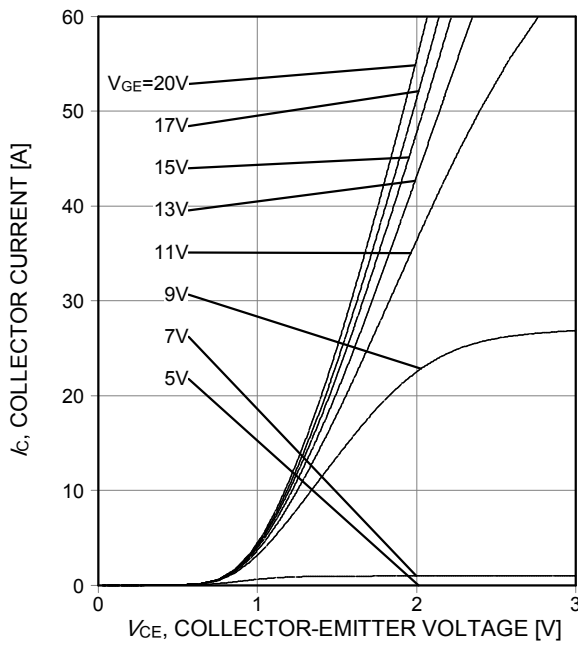


Figure 5. Typical output characteristic ( $T_j=25^\circ\text{C}$ )

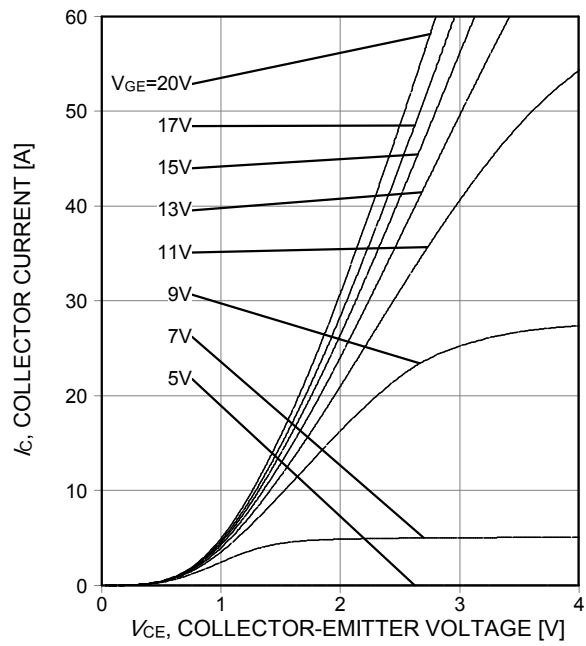


Figure 6. Typical output characteristic ( $T_j=175^\circ\text{C}$ )

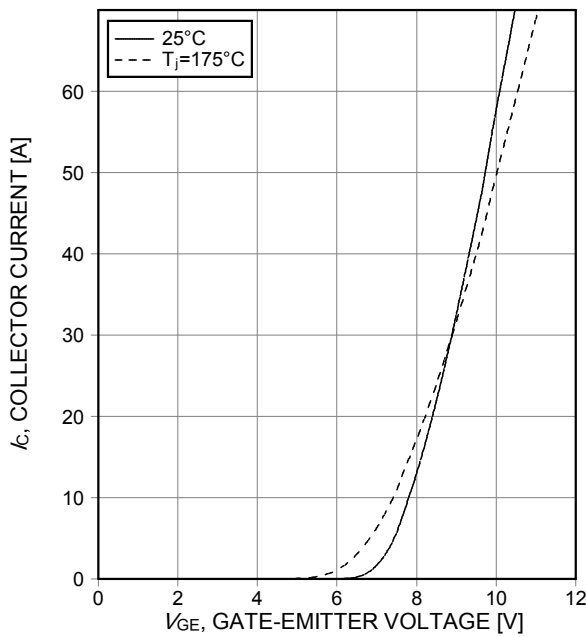


Figure 7. Typical transfer characteristic ( $V_{CE}=20\text{V}$ )

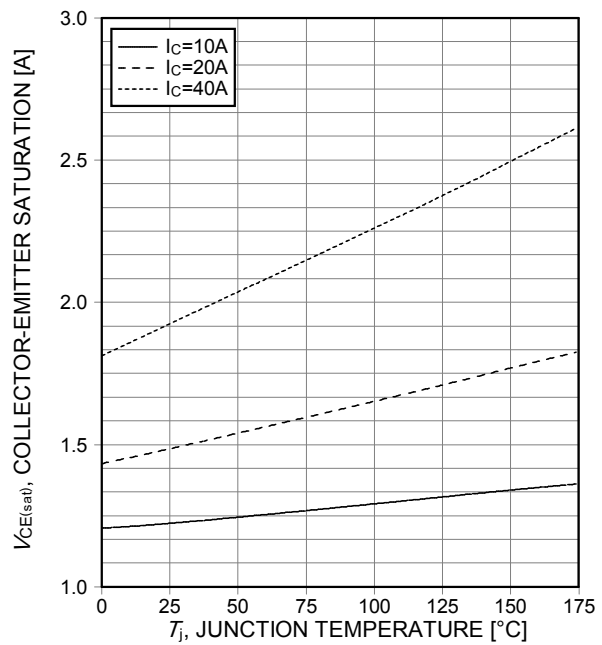
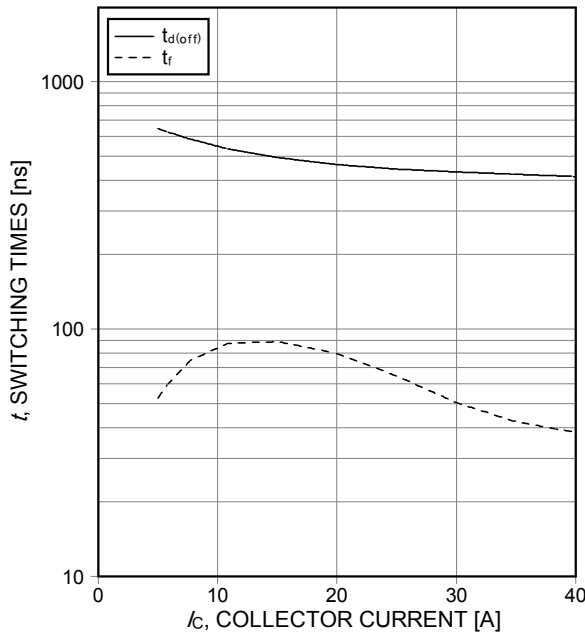
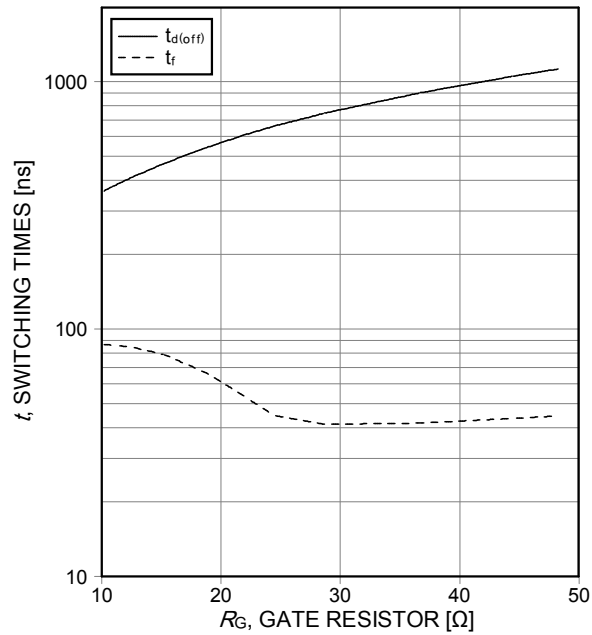


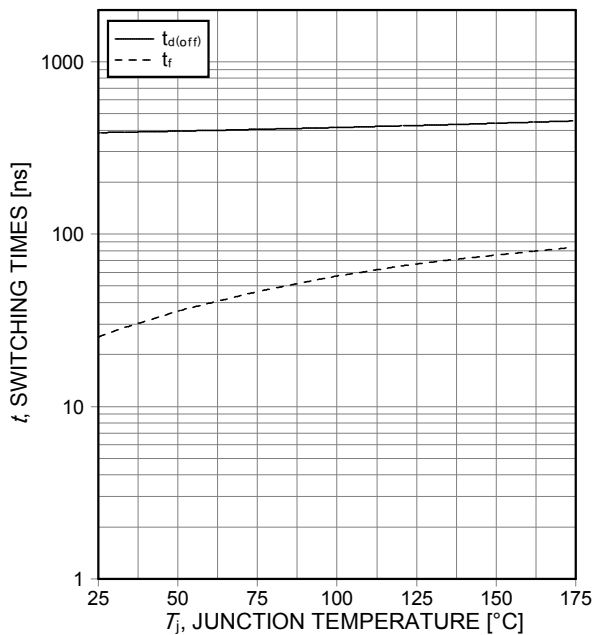
Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature ( $V_{GE}=15\text{V}$ )



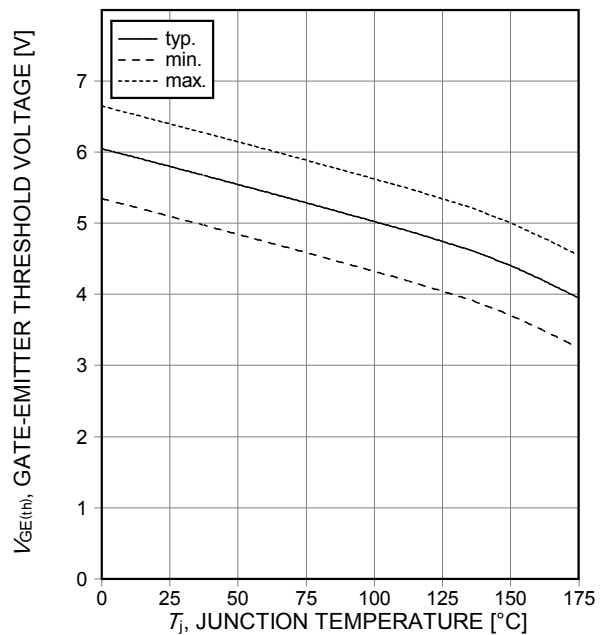
**Figure 9. Typical switching times as a function of collector current**  
 (ind. load,  $T_j=175^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $R_G=15\Omega$ , test circuit in Fig. E)



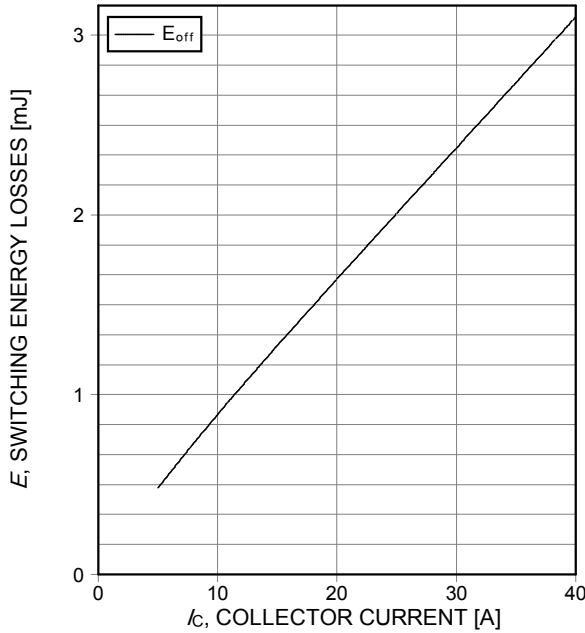
**Figure 10. Typical switching times as a function of gate resistor**  
 (ind. load,  $T_j=175^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $I_C=20\text{A}$ , test circuit in Fig. E)



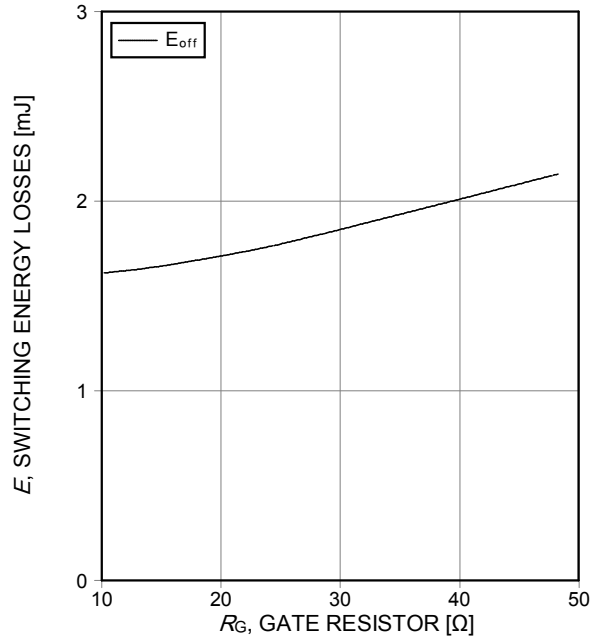
**Figure 11. Typical switching times as a function of junction temperature**  
 (ind. load,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $I_C=20\text{A}$ ,  $R_G=15\Omega$ , test circuit in Fig. E)



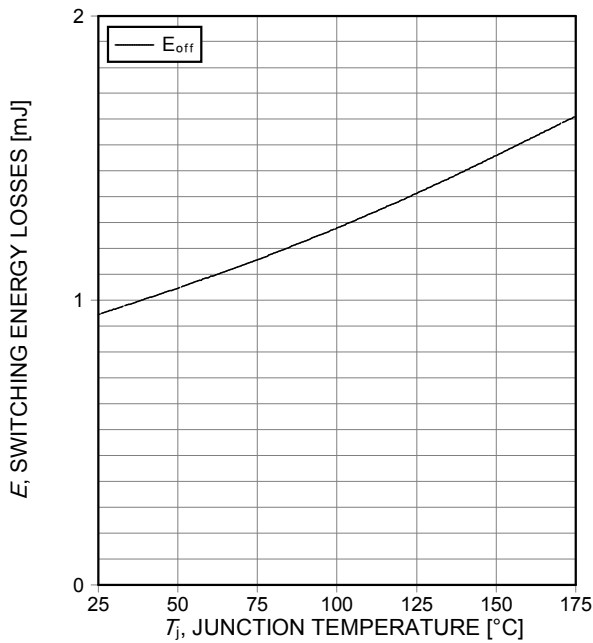
**Figure 12. Gate-emitter threshold voltage as a function of junction temperature**  
 ( $I_C=0.5\text{mA}$ )



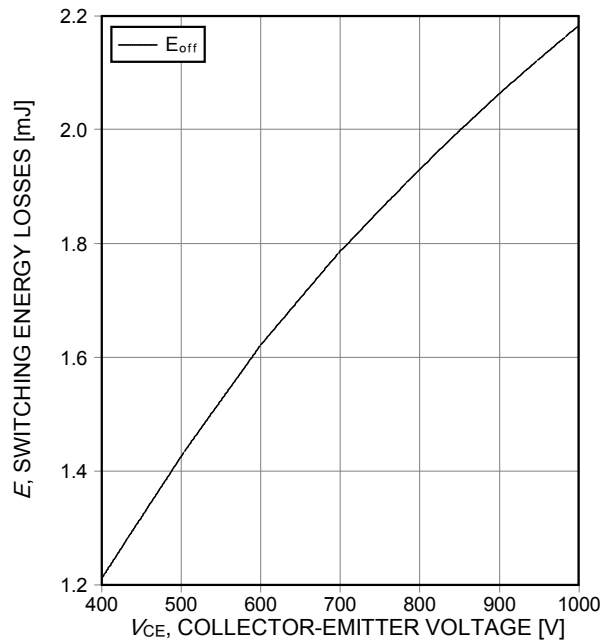
**Figure 13. Typical switching energy losses as a function of collector current**  
 (ind. load,  $T_j=175^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $R_G=15\Omega$ , test circuit in Fig. E)



**Figure 14. Typical switching energy losses as a function of gate resistor**  
 (ind. load,  $T_j=175^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15/0\text{V}$ , test circuit in Fig. E)



**Figure 15. Typical switching energy losses as a function of junction temperature**  
 (ind load,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $I_c=20\text{A}$ ,  $R_G=15\Omega$ , test circuit in Fig. E)



**Figure 16. Typical switching energy losses as a function of collector emitter voltage**  
 (ind. load,  $T_j=175^\circ\text{C}$ ,  $V_{GE}=15/0\text{V}$ ,  $I_c=20\text{A}$ ,  $R_G=15\Omega$ , test circuit in Fig. E)

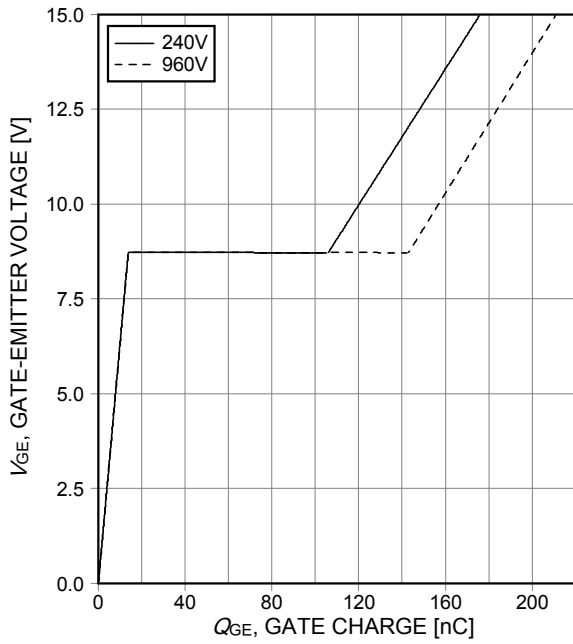


Figure 17. Typical gate charge ( $i_c=20A$ )

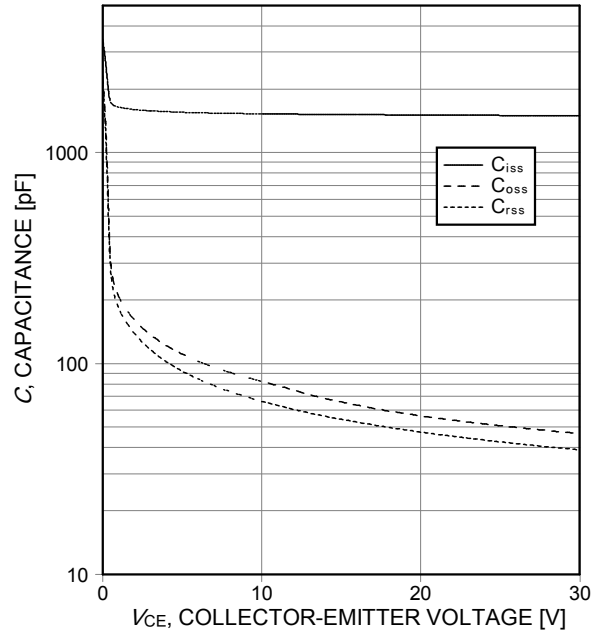


Figure 18. Typical capacitance as a function of collector-emitter voltage ( $V_{GE}=0V$ ,  $f=1MHz$ )

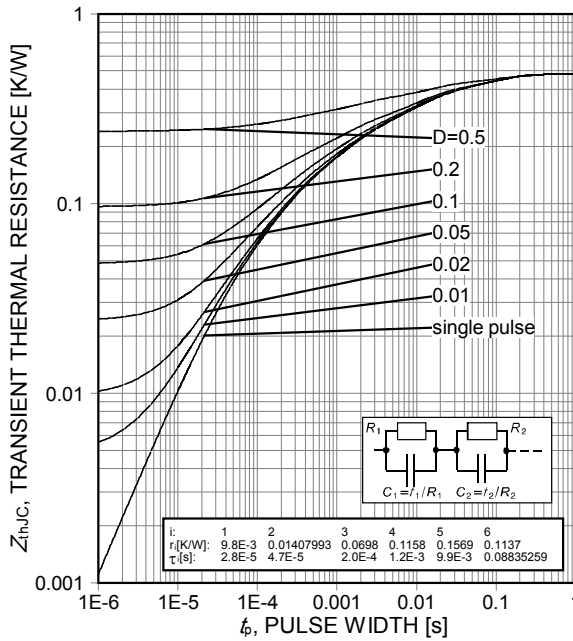


Figure 19. IGBT transient thermal resistance ( $D=t_p/T$ )

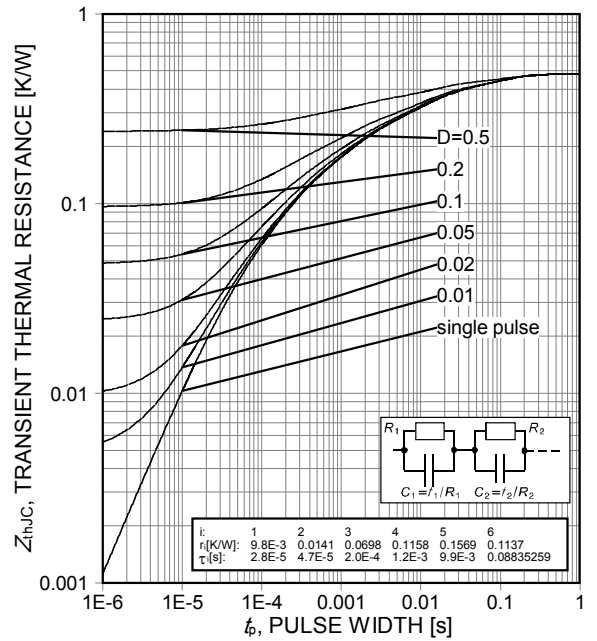


Figure 20. Diode transient thermal impedance as a function of pulse width ( $D=t_p/T$ )



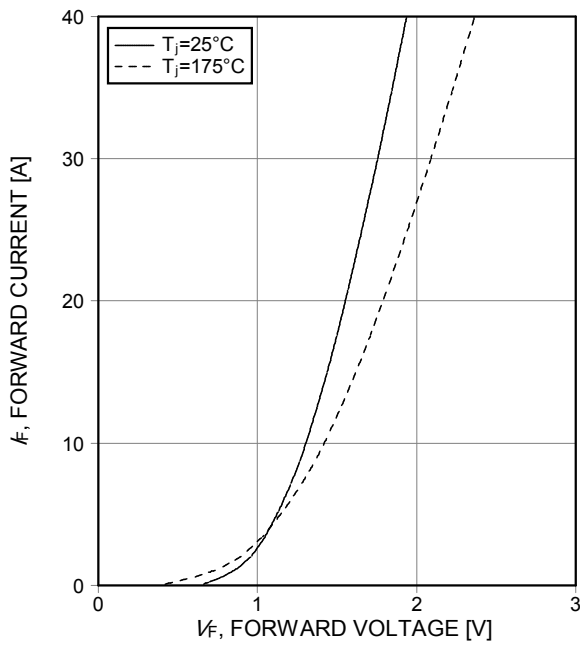


Figure 21. Typical diode forward current as a function of forward voltage

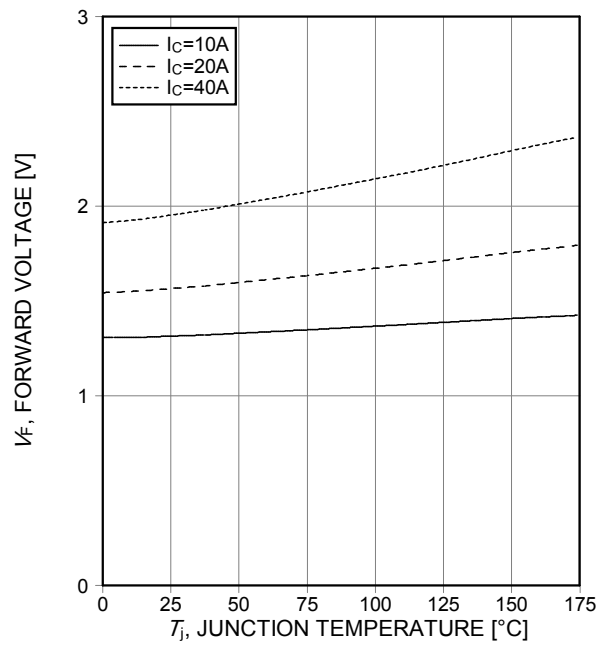
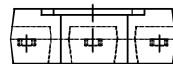
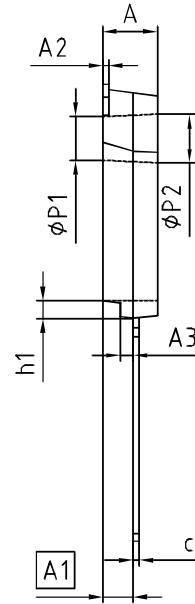
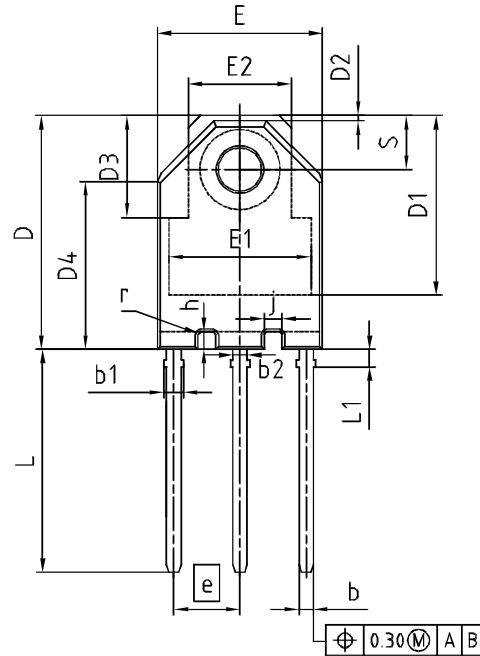


Figure 22. Typical diode forward voltage as a function of junction temperature

PG-TO247HC-3 (PG-TOHC-3)



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.40	4.60	0.173	0.181
A1	2.40	2.60	0.094	0.102
A2	0.40	0.60	0.016	0.024
A3	0.95	1.15	0.037	0.045
b	1.10	1.30	0.043	0.051
b1	1.50	1.70	0.059	0.067
b2	1.10	1.30	0.043	0.051
c	0.40	0.60	0.016	0.024
D	19.05	19.45	0.750	0.766
D1	14.69	14.89	0.578	0.586
D2	0.35	0.55	0.014	0.022
D3	8.30	8.50	0.327	0.335
D4	13.51	14.11	0.532	0.556
E	13.40	13.80	0.528	0.543
E1	11.60	11.80	0.457	0.465
E2	8.30	8.70	0.327	0.343
e	5.45		0.215	
N	3		3	
L	18.05	18.65	0.711	0.734
L1	1.35	1.55	0.053	0.061
øP1	3.51	3.71	0.138	0.146
øP2	4.00	4.10	0.157	0.161
S	4.35	4.55	0.171	0.179
j	1.35	1.55	0.053	0.061
h	1.35	1.55	0.053	0.061
r	max 0.2		max 0.008	
h1	1.35	1.55	0.053	0.061

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SCALE

EUROPEAN PROJECTION

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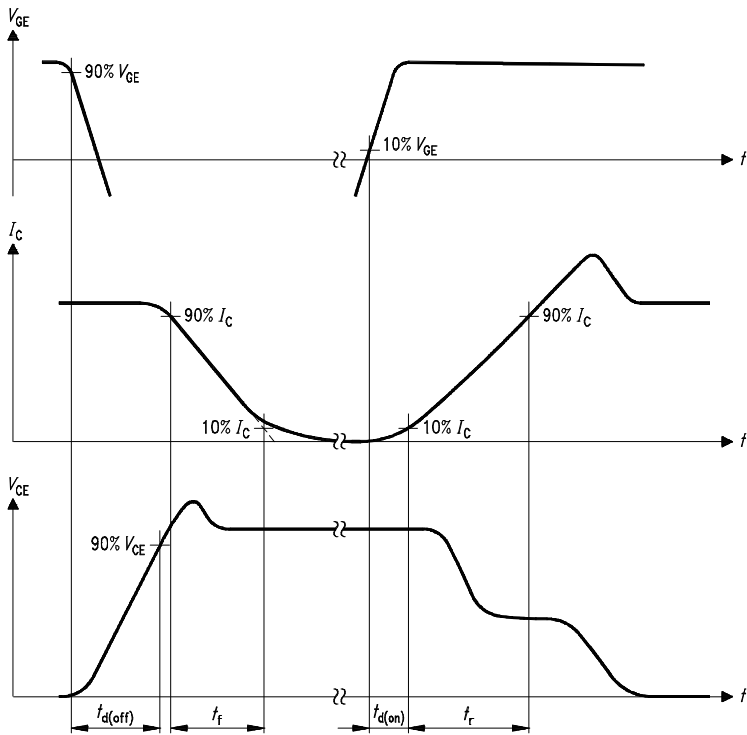


Figure A. Definition of switching times

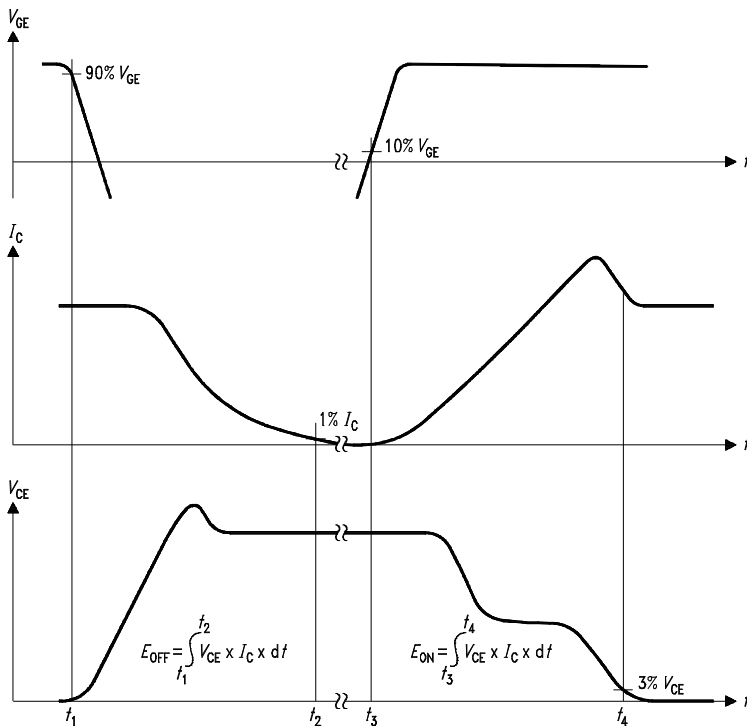


Figure B. Definition of switching losses

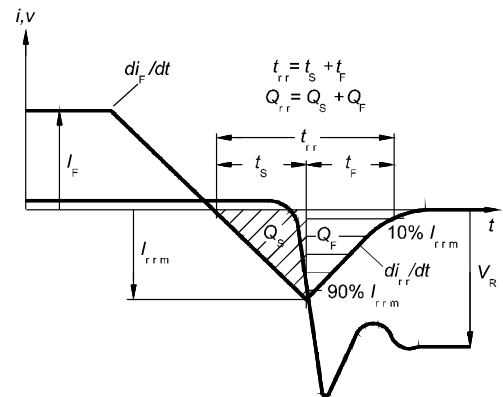


Figure C. Definition of diodes switching characteristics

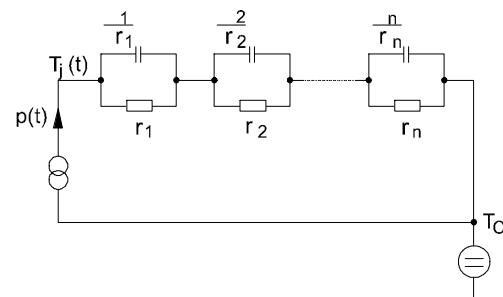


Figure D. Thermal equivalent circuit

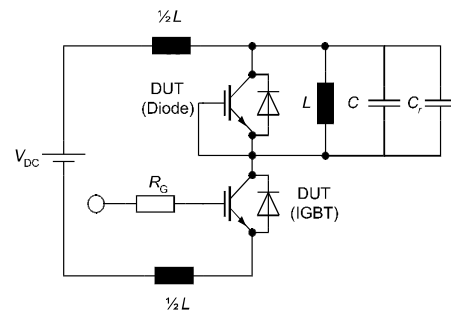


Figure E. Dynamic test circuit  
 Leakage inductance  $L = 180\text{nH}$ ,  
 Stray capacitor  $C_o = 40\text{pF}$ ,  
 Relief capacitor  $C_r = 1\text{nF}$   
 (only for ZVT switching)

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