IH-series
Reverse conducting IGBT with monolithic body diode

IHY20N135R3

Datasheet

Reverse conducting IGBT with monolithic body diode

Features:

• Offers new higher breakdown voltage to 1350V for improved reliability
• 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 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/
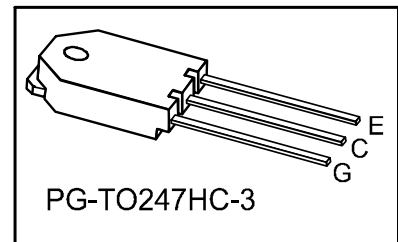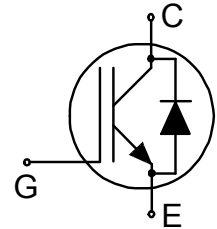
Applications:

• Inductive cooking

PG-TO247HC-3

Key Performance and Package Parameters

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IHY20N135R3	1350V	20A	1.6V	175°C	H20R1353	PG-TO247HC-3

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Maximum ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1350	V
DC collector current, limited by T_{vjmax} T_C = 25°C T_C = 100°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} ≤ 1350V, T_{vj} ≤ 175°C	-	60.0	A
Diode forward current, limited by T_{vjmax} T_C = 25°C T_C = 100°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 = 10µs, D < 0.010)	V_{GE}	±20 ±25	V
Power dissipation T_C = 25°C Power dissipation T_C = 100°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, wave soldering 1.6 mm (0.063 in.) 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	$R_{th(j-c)}$		0.48	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°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 = 0.50mA	1350	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 20.0A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	- - -	1.60 1.80 1.90	1.80 - -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 20.0A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	- - -	1.60 1.73 1.80	1.80 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.50mA, V_{CE} = V_{GE}	5.1	5.8	6.4	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 1350V, V_{GE} = 0V T_{vj} = 25°C T_{vj} = 175°C	- -	- -	100.0 2500.0	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 20.0A	-	14.8	-	S
Integrated gate resistor	r_G			none		Ω

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	-	1500	-	pF
Output capacitance	C_{oes}		-	55	-	
Reverse transfer capacitance	C_{res}		-	45	-	
Gate charge	Q_G	V_{CC} = 1080V, I_C = 20.0A, V_{GE} = 15V	-	195.0	-	nC

Switching Characteristic, Inductive Load, at T_{vj} = 25°C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-off delay time	$t_{d(off)}$	T_{vj} = 25°C, V_{CC} = 600V, I_C = 20.0A, V_{GE} = 0.0/15.0V, r_G = 15.0Ω, L_σ = 175nH, C_σ = 40pF L_σ, C_σ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	335	-	ns
Fall time	t_f		-	50	-	ns
Turn-off energy	E_{off}		-	1.30	-	mJ

Switching Characteristic, Inductive Load, at T_{vj} = 175°C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-off delay time	$t_{d(off)}$	T_{vj} = 175°C, V_{CC} = 600V, I_C = 20.0A, V_{GE} = 0.0/15.0V, r_G = 15.0Ω, L_σ = 175nH, C_σ = 40pF L_σ, C_σ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	405	-	ns
Fall time	t_f		-	100	-	ns
Turn-off energy	E_{off}		-	2.25	-	mJ

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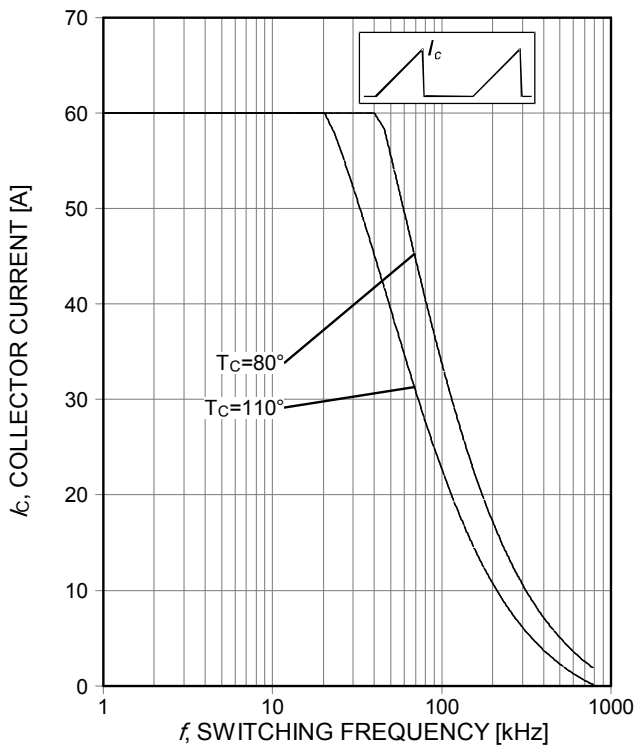
Figure 1. Collector current as a function of switching
frequency
(T_{vj}≤175°C, D=0.5, V_{CE}=600V,
V_{GE}=15/0V, r_G=15Ω)
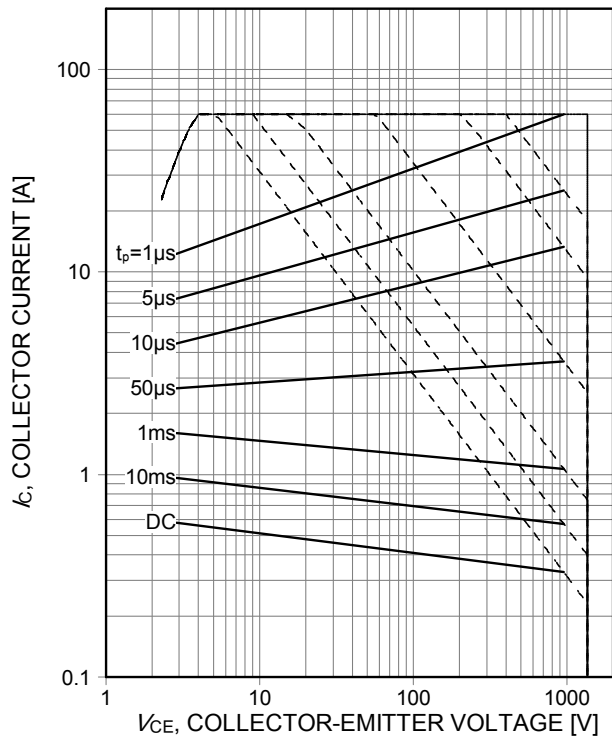
Figure 2. Forward bias safe operating area
(D=0, T_C=25°C, T_{vj}≤175°C; V_{GE}=15V)
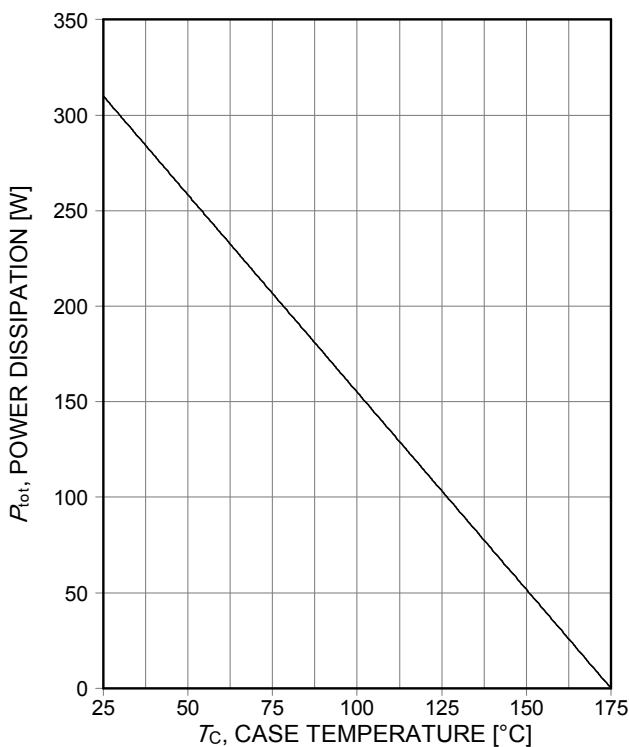
Figure 3. Power dissipation as a function of case
temperature
(T_{vj}≤175°C)
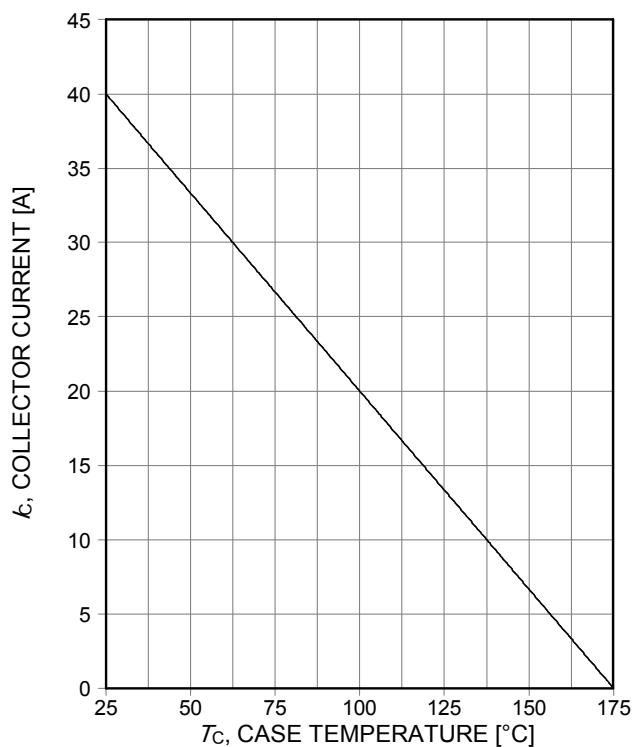
Figure 4. Collector current as a function of case
temperature
(V_{GE}≥15V, T_{vj}≤175°C)
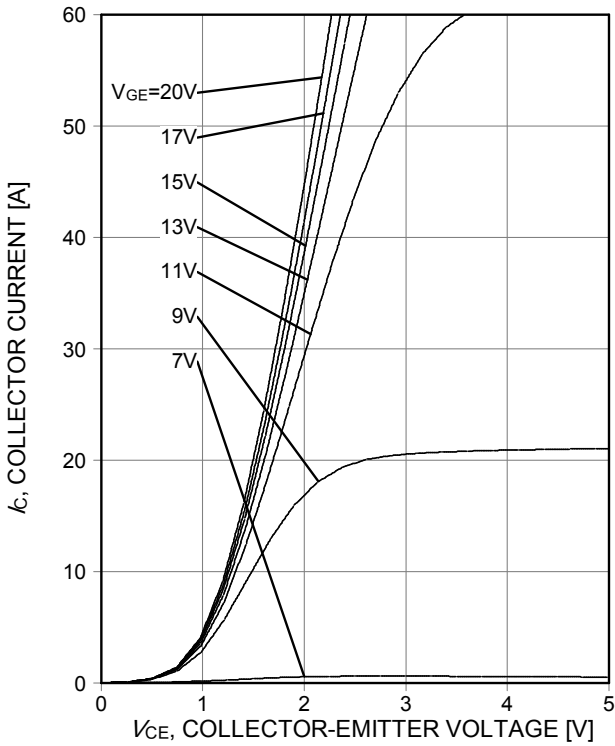
Figure 5. Typical output characteristic
(T_{vj}=25°C)
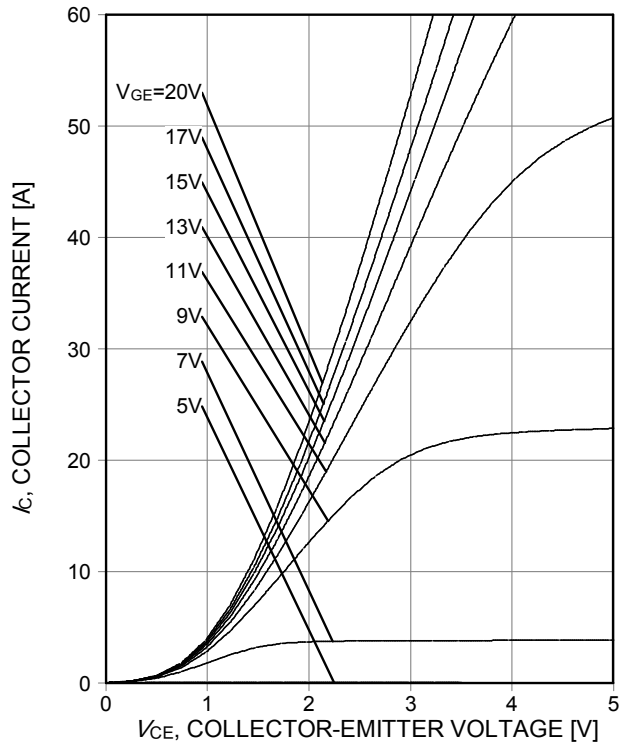
Figure 6. Typical output characteristic
(T_{vj}=175°C)
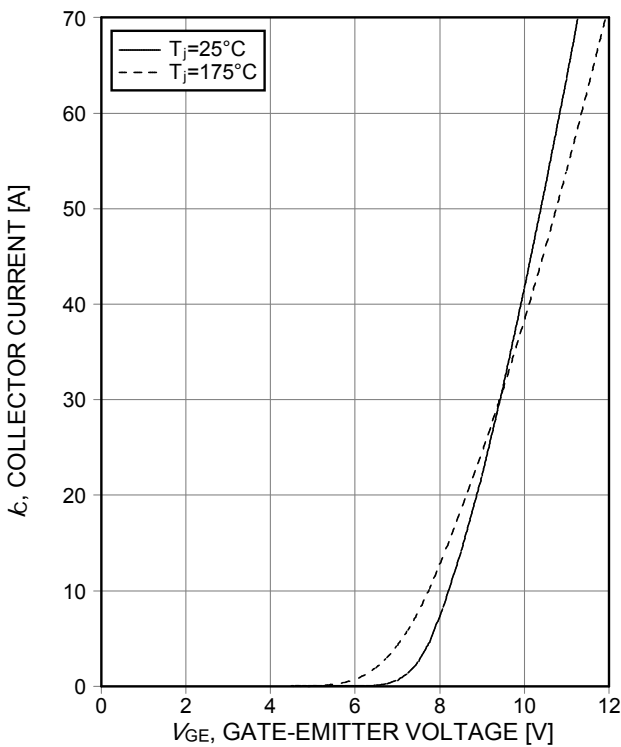
Figure 7. Typical transfer characteristic
(V_{CE}=20V)
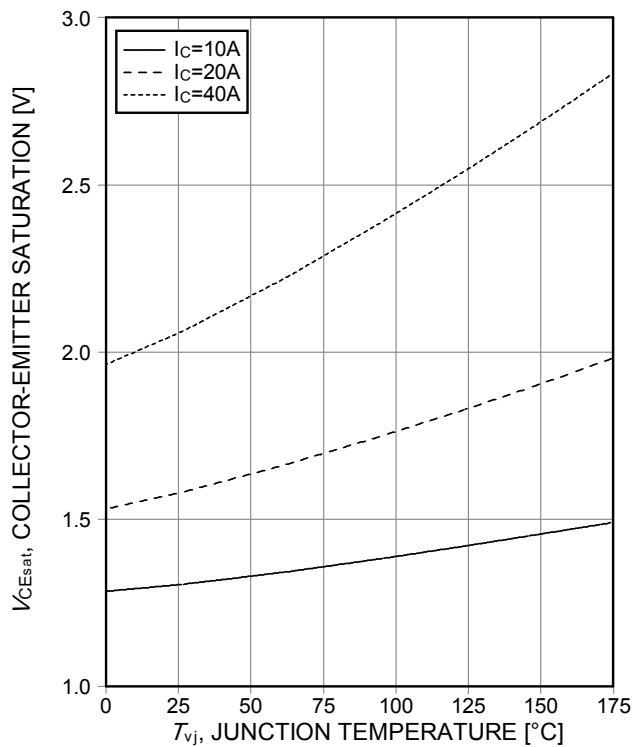
Figure 8. Typical collector-emitter saturation voltage
as a function of junction temperature
(V_{GE}=15V)
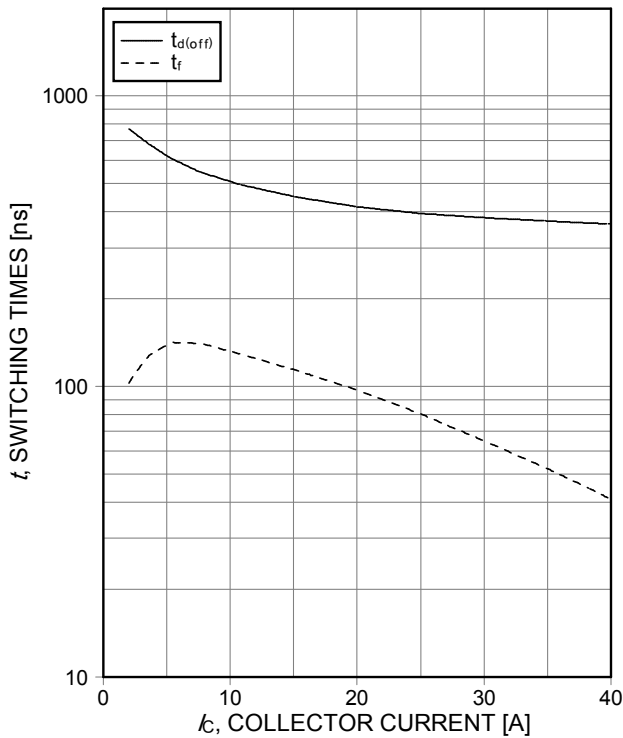
Figure 9. Typical switching times as a function of collector current
(inductive load, T_{vj}=175°C, V_{CE}=600V, V_{GE}=15/0V, r_G=15Ω, Dynamic test circuit in Figure E)
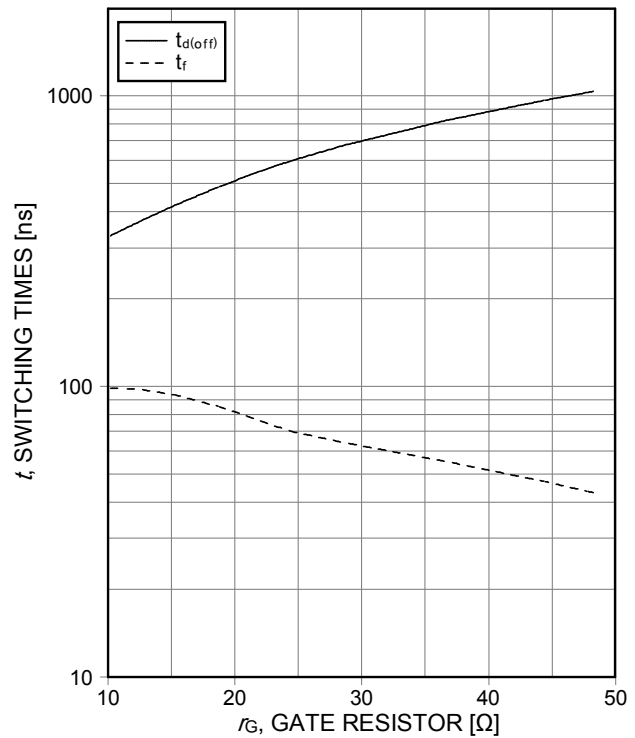
Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_{vj}=175°C, V_{CE}=600V, V_{GE}=15/0V, I_C=20A, Dynamic test circuit in Figure E)
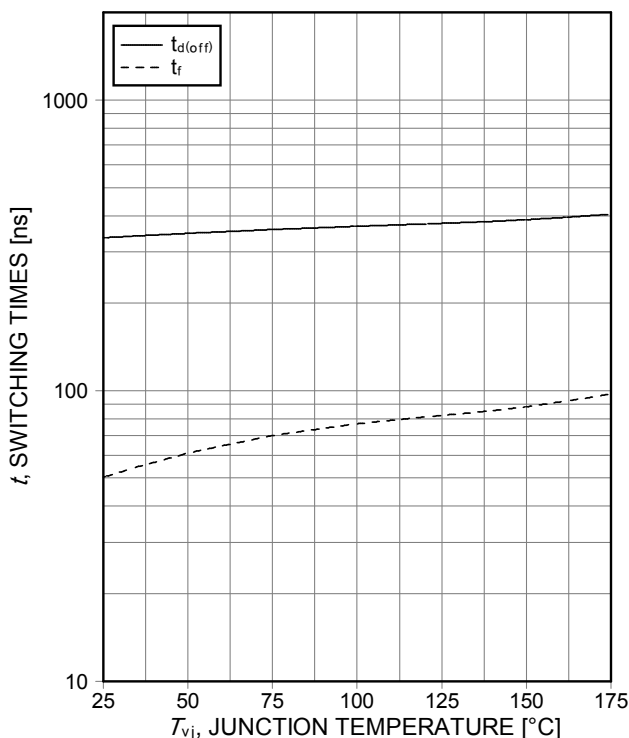
Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE}=600V, V_{GE}=15/0V, I_C=20A, r_G=15Ω, Dynamic test circuit in Figure E)
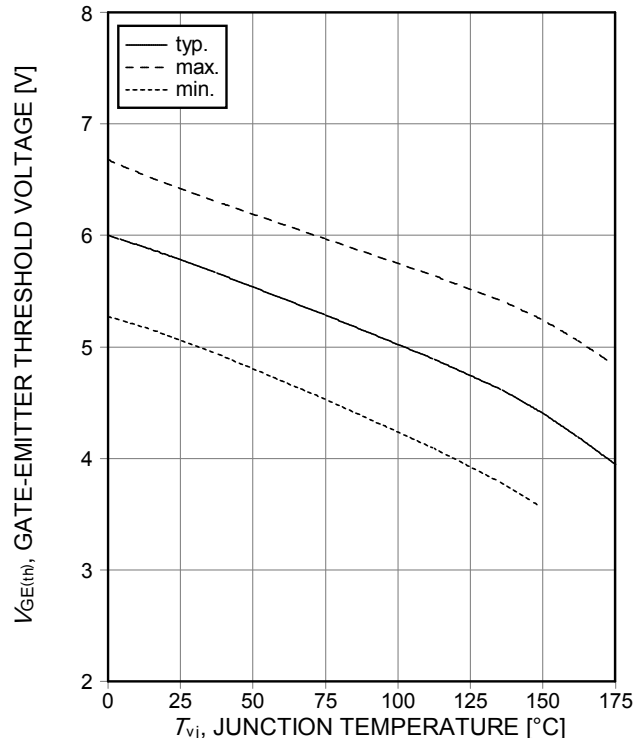
Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C=0.5mA)

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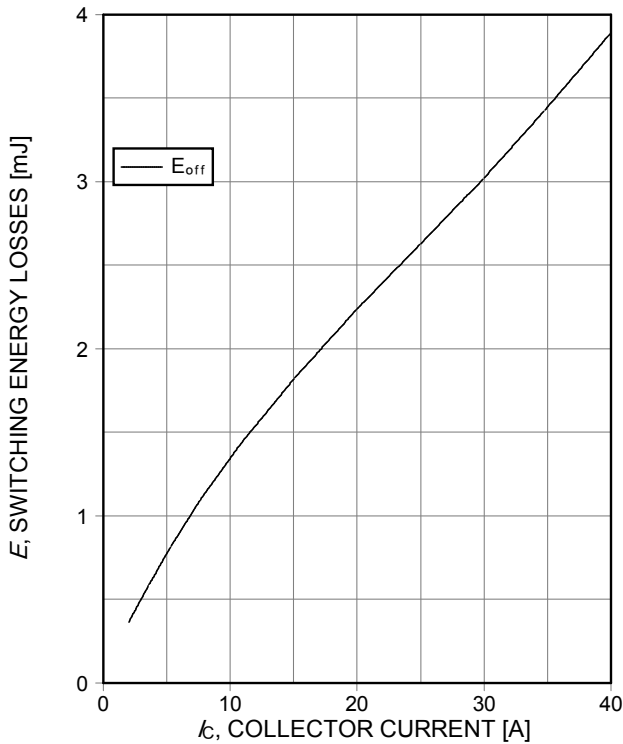
Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_{vj}=175°C, V_{CE}=600V, V_{GE}=15/0V, r_G=15Ω,Dynamic test circuit in Figure E)

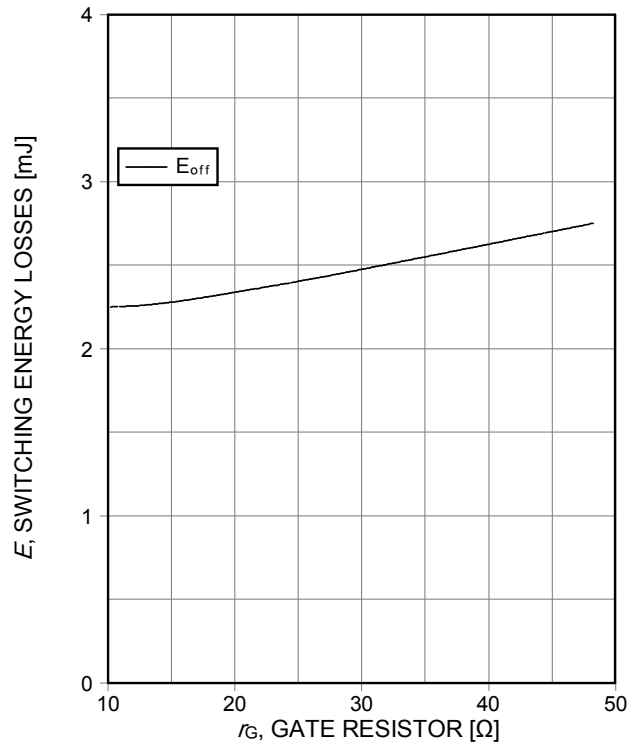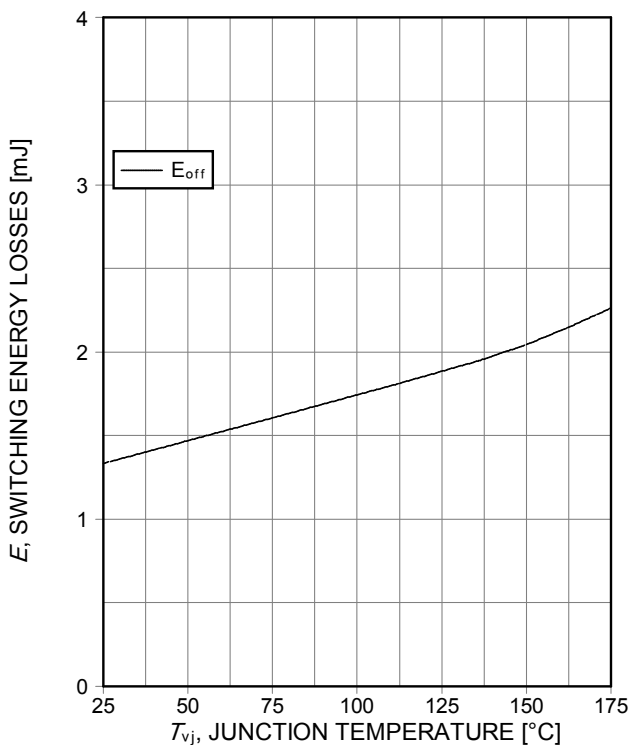**Figure 14. Typical switching energy losses as a function of gate resistor**
(inductive load, T_{vj}=175°C, V_{CE}=600V, V_{GE}=15/0V, I_C=20A, Dynamic test circuit in Figure E)

Figure 15. Typical switching energy losses as a function of junction temperature
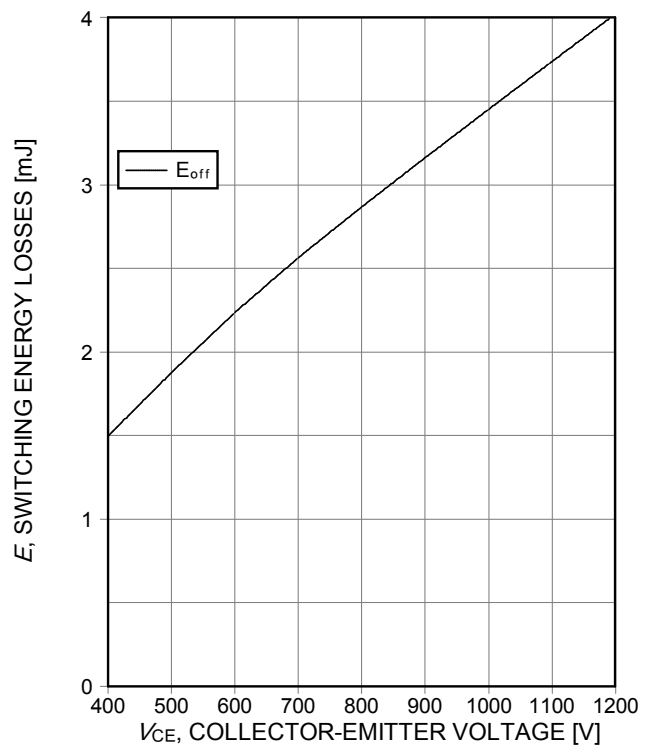(inductive load, V_{CE}=600V, V_{GE}=15/0V, I_C=20A, r_G=15Ω,Dynamic test circuit in Figure E)

Figure 16. Typical switching energy losses as a function of collector emitter voltage
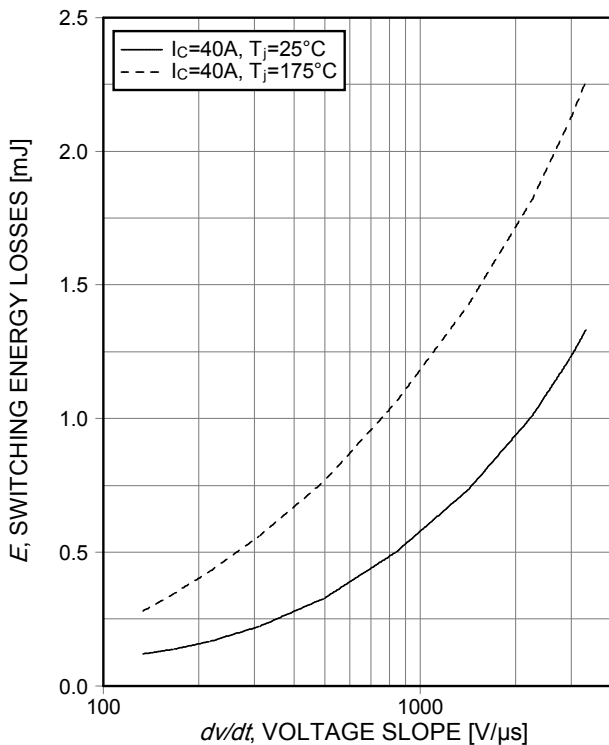(inductive load, T_{vj}=175°C, V_{GE}=15/0V, I_C=20A, r_G=15Ω,Dynamic test circuit in Figure E)

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Figure 17. Typical turn off switching energy loss for soft switching
(inductive load, T_{vj}=175°C, V_{GE}=15/0V, I_C=20A, r_G=15Ω, Dynamic test circuit in Figure E)

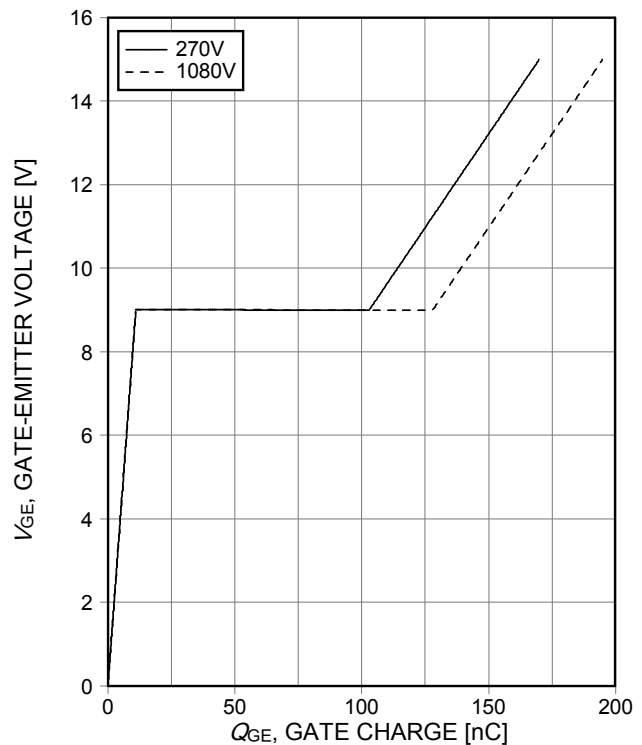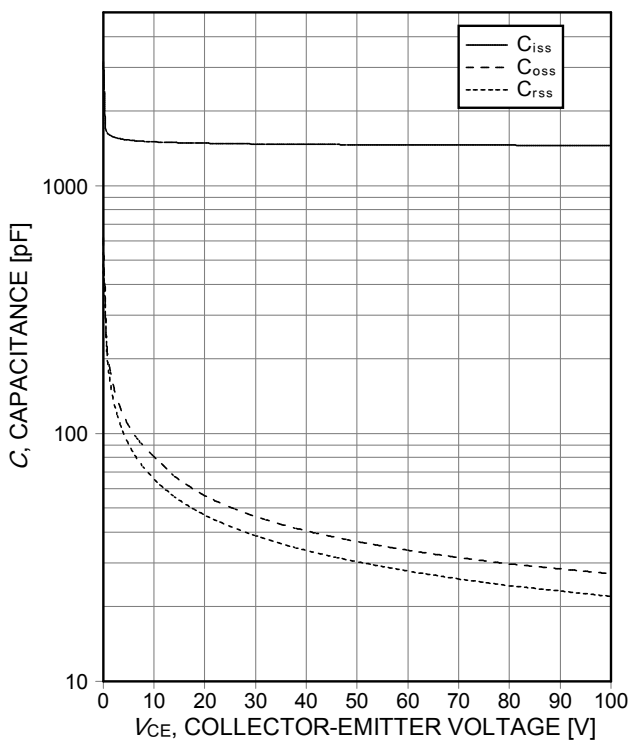**Figure 18. Typical gate charge**
(I_C=20A)

Figure 19. Typical capacitance as a function of collector-emitter voltage
(V_{GE}=0V, f=1MHz)

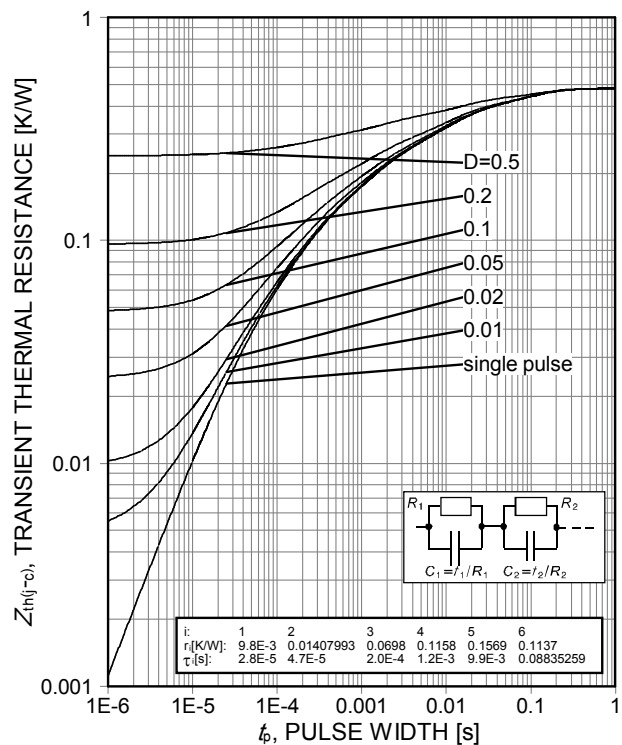**Figure 20. IGBT transient thermal resistance**
(D=t_p/T)

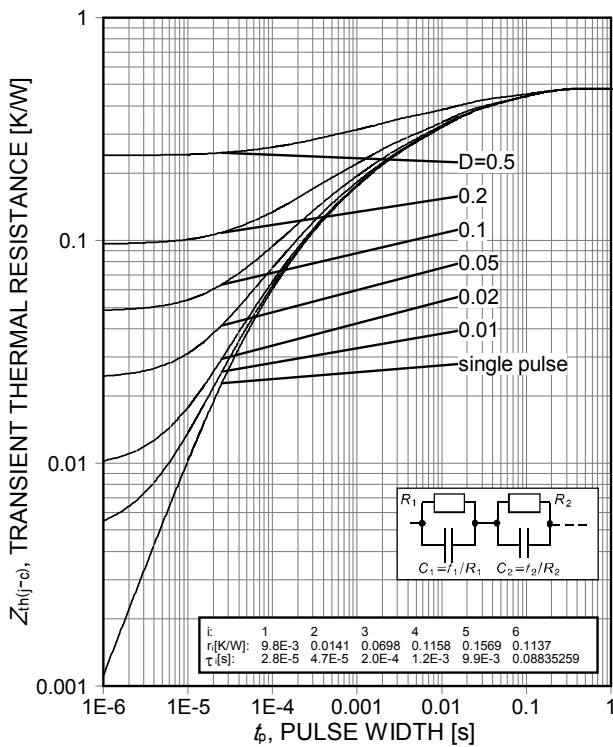| i:	1	2	3	4	5	6
r_i[K/W]:	9.8E-3	0.01407993	0.0698	0.1158	0.1569	0.1137
τ_i[s]:	2.8E-5	4.7E-5	2.0E-4	1.2E-3	9.9E-3	0.08835259

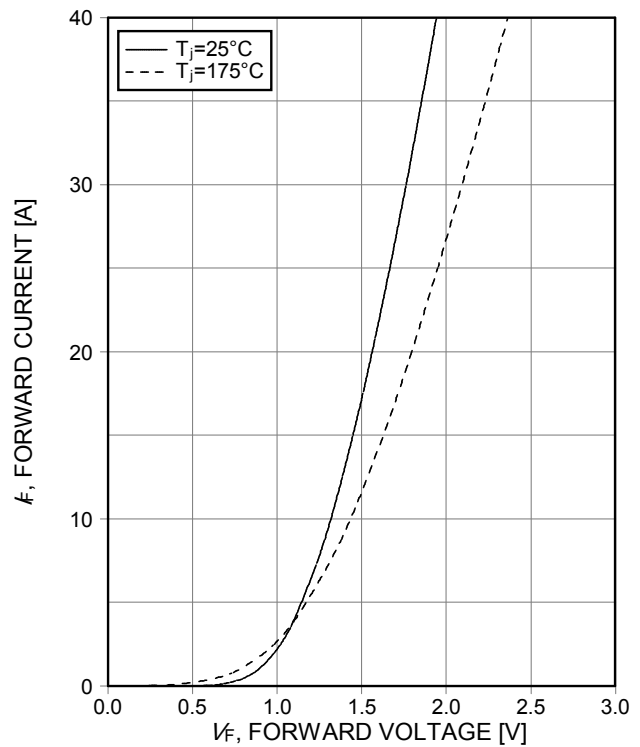**Figure 21. Diode transient thermal impedance as a function of pulse width ($D=t_p/T$)**

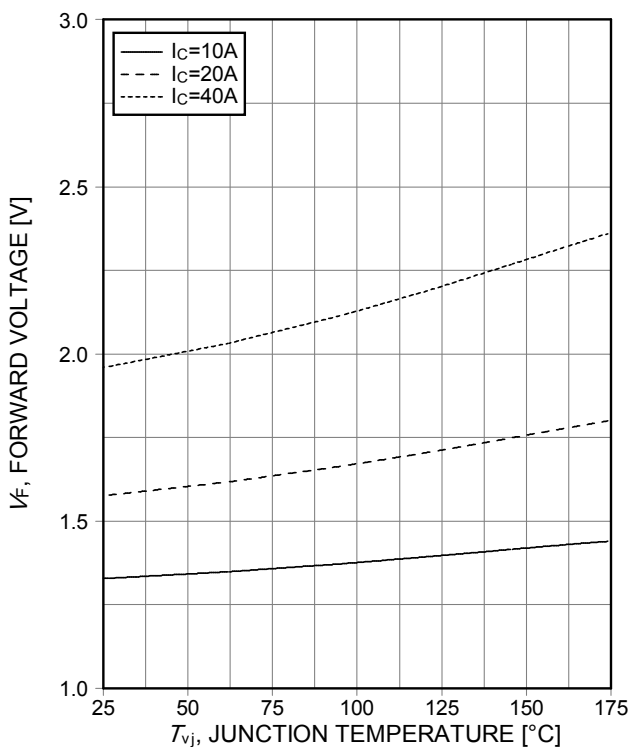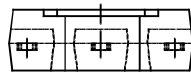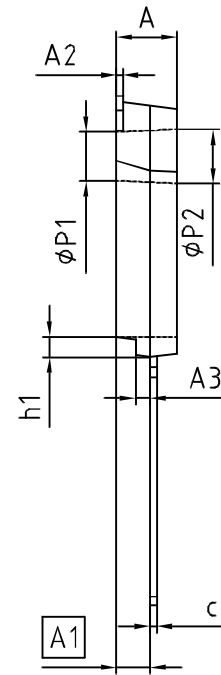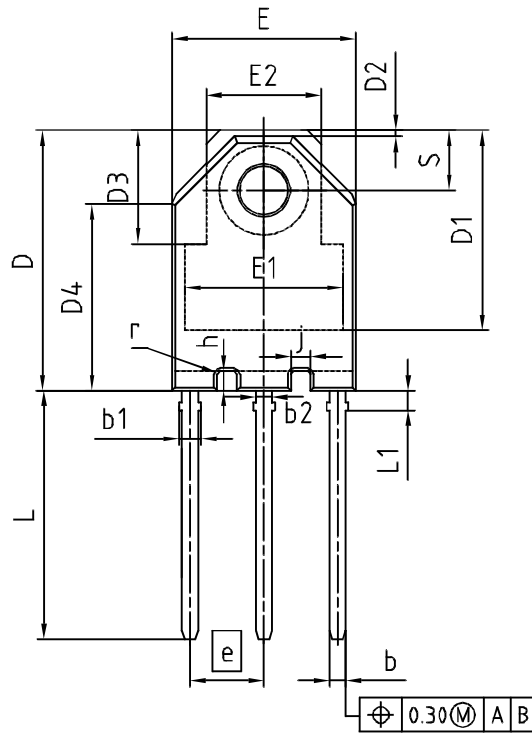**Figure 22. Typical diode forward current as a function of forward voltage**

Figure 23. 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

DOCUMENT NO.
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SCALE

EUROPEAN PROJECTION
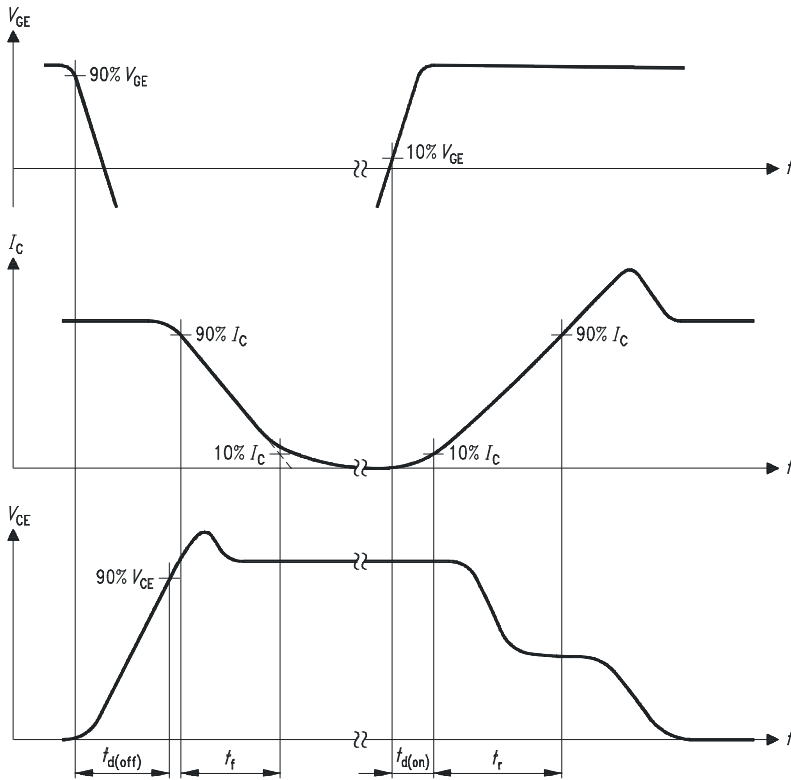
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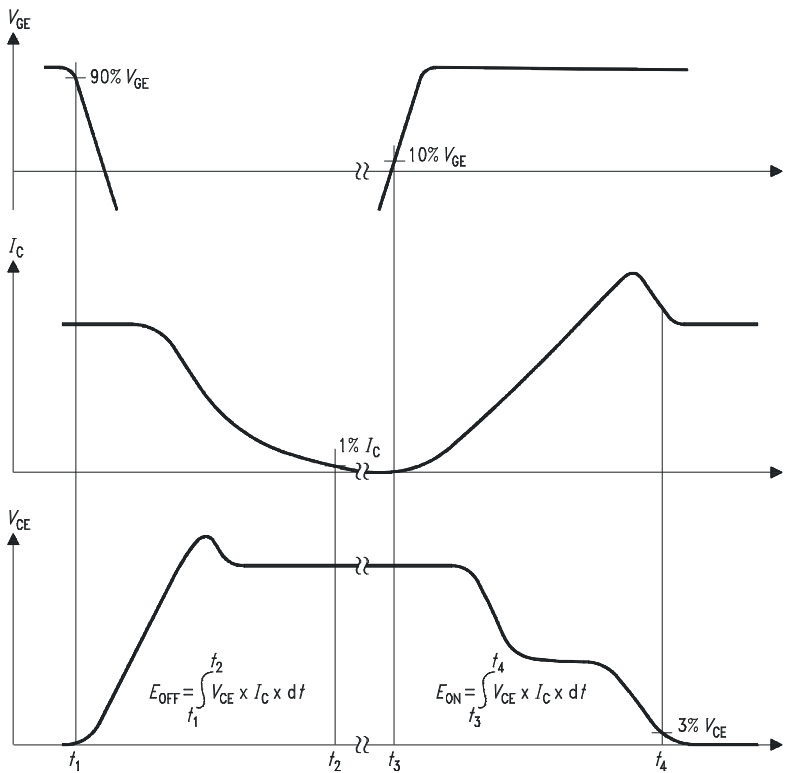
REVISION
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Figure A. Definition of switching times
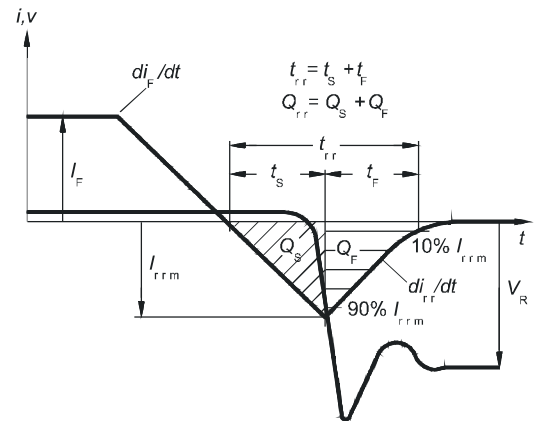

Figure B. Definition of switching losses

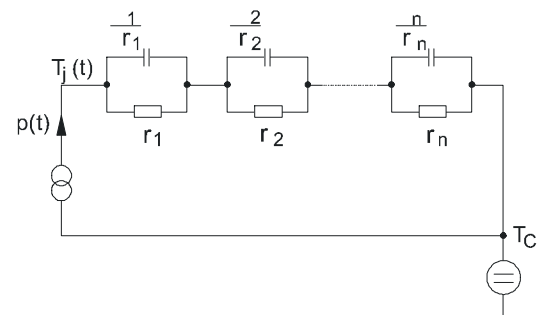**Figure C. Definition of diodes switching characteristics**

Figure D. Thermal equivalent circuit
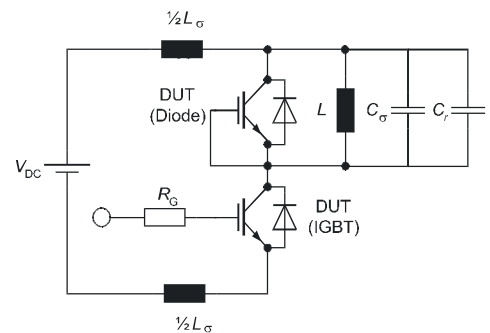

Figure E. Dynamic test circuit
Parasitic inductance L_σ,
Parasitic capacitor C_σ,
Relief capacitor C_r
(only for ZVT switching)

Revision History

IHY20N135R3

Revision: 2010-07-13, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
0.1	2010-01-11	-
1.1	2010-02-04	-
2.1	-	Cover sheet, features list

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