Resonant Switching Series
Reverse conducting IGBT with monolithic body diode

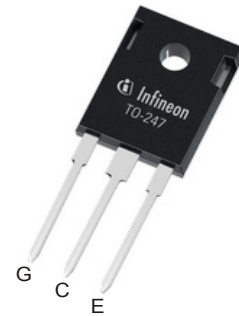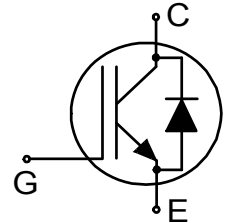# IHW15N120R3

Data sheet

Industrial Power Control

Reverse conducting IGBT with monolithic body diode

Features:

• Powerful monolithic body diode with low forward voltage designed for soft commutation only
• TRENCHSTOP™ technology applications offers:
- 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
• Qualified according to JESD-022 for target applications
• Pb-free lead plating; RoHS compliant
• Complete product spectrum and PSpice Models:
http://www.infineon.com/igbt/

Applications:

• Inductive cooking
• Inverterized microwave ovens
• Resonant converters
• Soft switching applications

Key Performance and Package Parameters

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IHW15N120R3	1200V	15A	1.48V	175°C	H15R1203	PG-TO247-3

Table of Contents

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°C T_C = 100°C	I_C	30.0 15.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	45.0	A
Turn off safe operating area $V_{CE} \leq 1200V$, $T_{vj} \leq 175°C$	-	45.0	A
Diode forward current, limited by T_{vjmax} T_C = 25°C T_C = 100°C	I_F	30.0 15.0	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	45.0	A
Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10\mu s$, D < 0.010)	V_{GE}	±20 ±25	V
Power dissipation T_C = 25°C Power dissipation T_C = 100°C	P_{tot}	254.0 127.0	W
Operating junction temperature	T_{vj}	-40...+175	°C
Storage temperature	T_{stg}	-55...+175	°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	$R_{th(j-c)}$		0.59	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		0.59	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		40	K/W

Rev. 2.4, 2015-01-26

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 = 0.50mA	1200	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 15.0A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	- - -	1.48 1.70 1.80	1.70 - -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 15.0A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	- - -	1.55 1.70 1.80	1.75 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.40mA, V_{CE} = V_{GE}	5.1	5.8	6.4	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 1200V, 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 = 15.0A	-	13.9	-	S
Integrated gate resistor	r_G			none		Ω

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

Parameter	Symbol	Conditions	Value min.	Value typ.	Value max.	Unit
Dynamic Characteristic						
Input capacitance	C_{ies}		-	1165	-	
Output capacitance	C_{oes}	V_{CE} = 25V, V_{GE} = 0V, f = 1MHz	-	40	-	pF
Reverse transfer capacitance	C_{res}		-	32	-	
Gate charge	Q_G	V_{CC} = 960V, I_C = 15.0A, V_{GE} = 15V	-	165.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13.0	-	nH

Switching Characteristic, Inductive Load

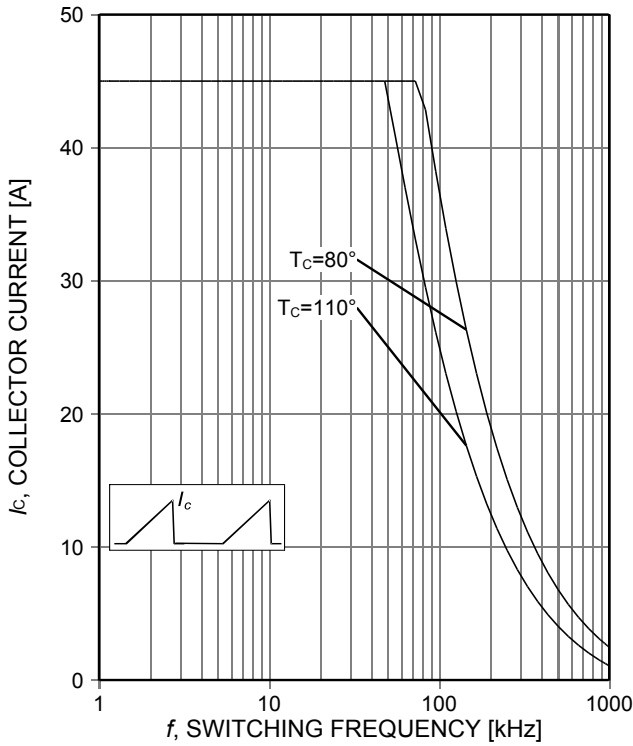| Parameter	Symbol	Conditions	Value min.	Value typ.	Value max.	Unit
IGBT Characteristic, at T_{vj} = 25°C						
Turn-off delay time	$t_{d(off)}$	T_{vj} = 25°C, V_{CC} = 600V, I_C = 15.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 14.6Ω, $R_{G(off)}$ = 14.6Ω, $L\sigma$ = 180nH, $C\sigma$ = 39pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	300	-	ns
Fall time	t_f		-	46	-	ns
Turn-off energy	E_{off}		-	0.70	-	mJ

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at T_{vj} = 175°C						
Turn-off delay time	$t_{d(off)}$	T_{vj} = 175°C, V_{CC} = 600V, I_C = 15.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 14.6Ω, $R_{G(off)}$ = 14.6Ω, $L\sigma$ = 180nH, $C\sigma$ = 39pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	370	-	ns
Fall time	t_f		-	90	-	ns
Turn-off energy	E_{off}		-	1.25	-	mJ

Figure 1. **Collector current as a function of switching frequency**
($T_j \leq 175°C$, D=0.5, V_{CE}=600V, V_{GE}=15/0V, R_G=14,6Ω)
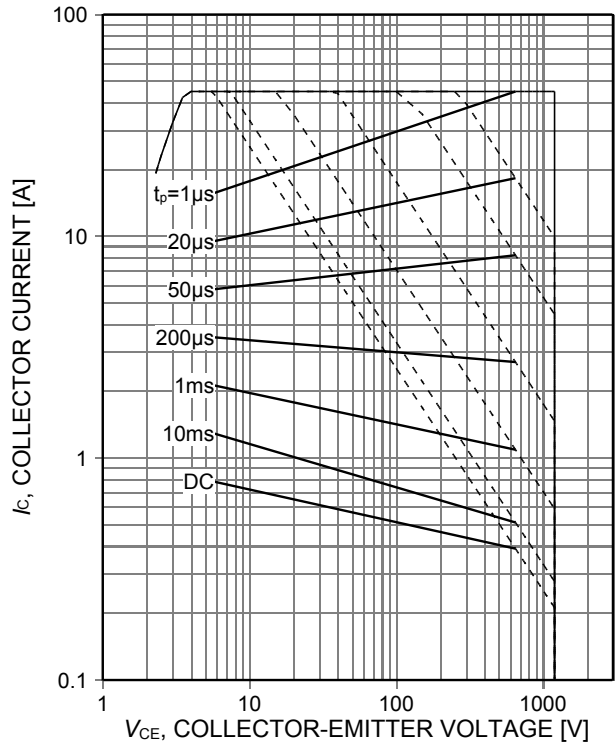
Figure 2. **Forward bias safe operating area**
(D=0, T_C=25°C, $T_j \leq 175°C$; V_{GE}=15V)
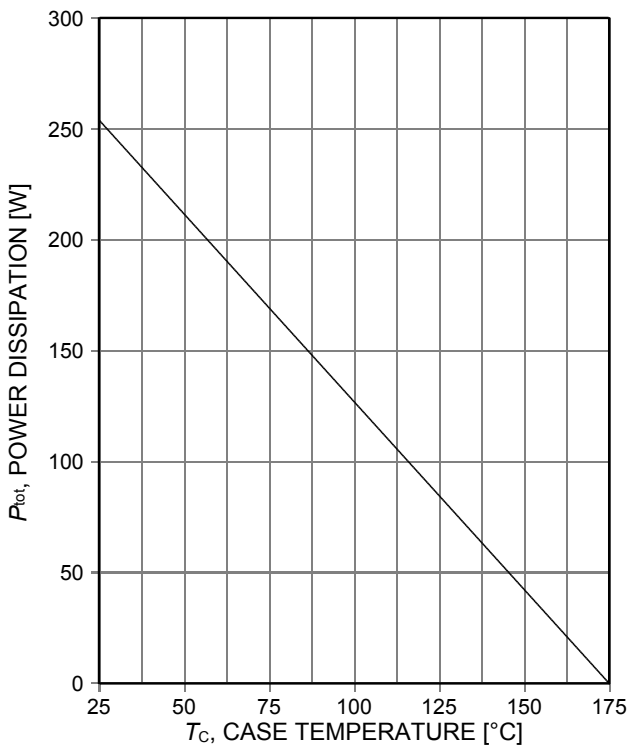
Figure 3. **Power dissipation as a function of case temperature**
($T_j \leq 175°C$)
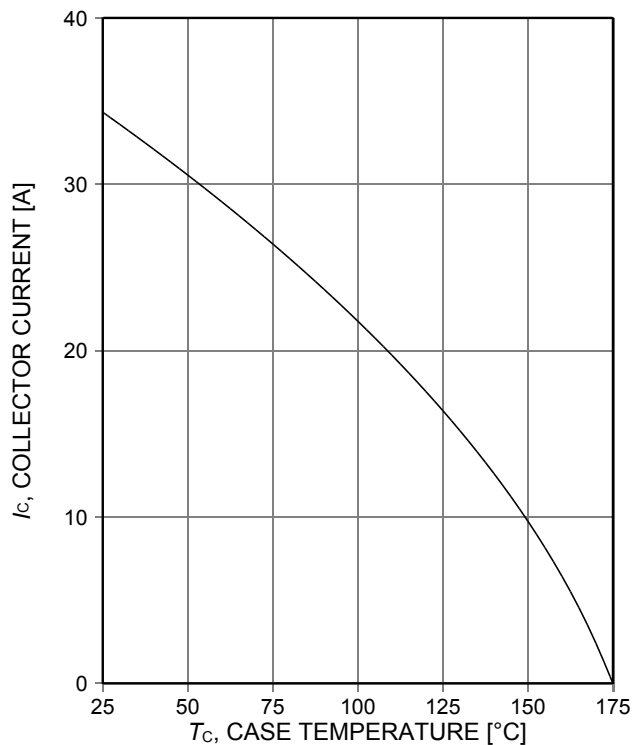
Figure 4. **Collector current as a function of case temperature**
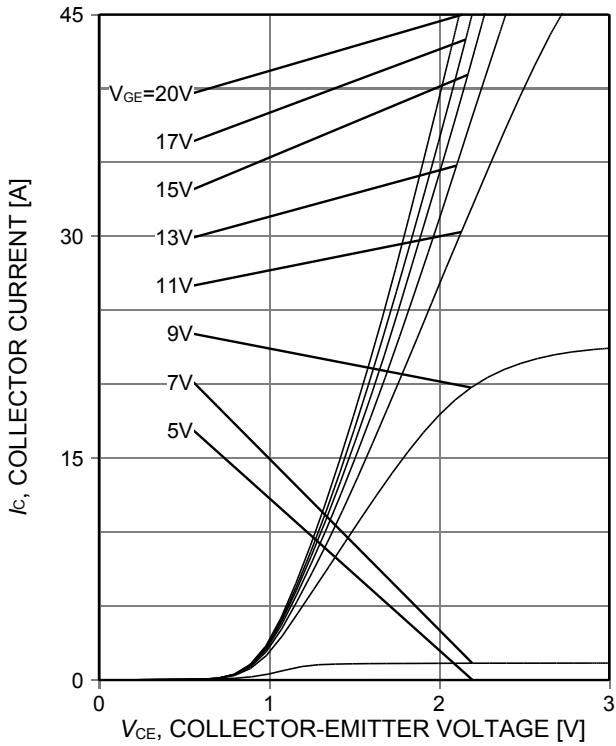($V_{GE} \geq 15V$, $T_j \leq 175°C$)

Rev. 2.4, 2015-01-26

Figure 5. **Typical output characteristic**
(T_j=25°C)
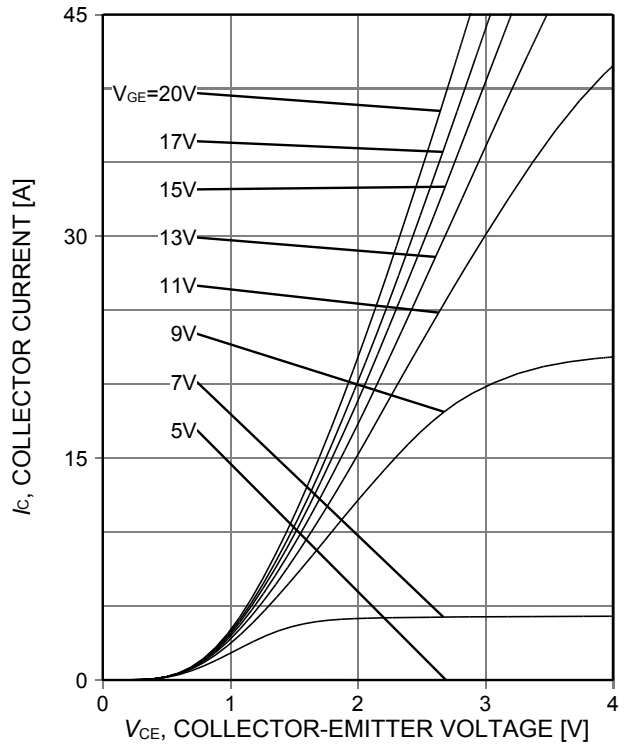
Figure 6. **Typical output characteristic**
(T_j=175°C)
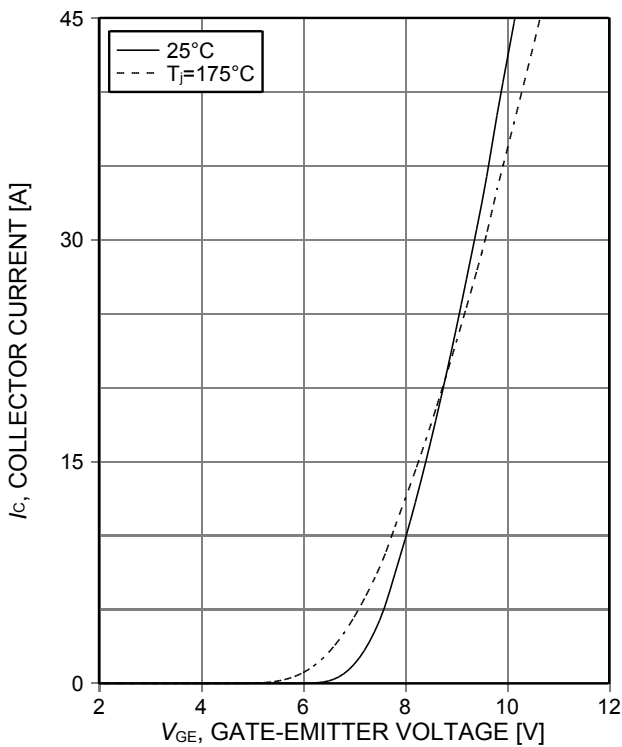
Figure 7. **Typical transfer characteristic**
(V_{CE}=20V)
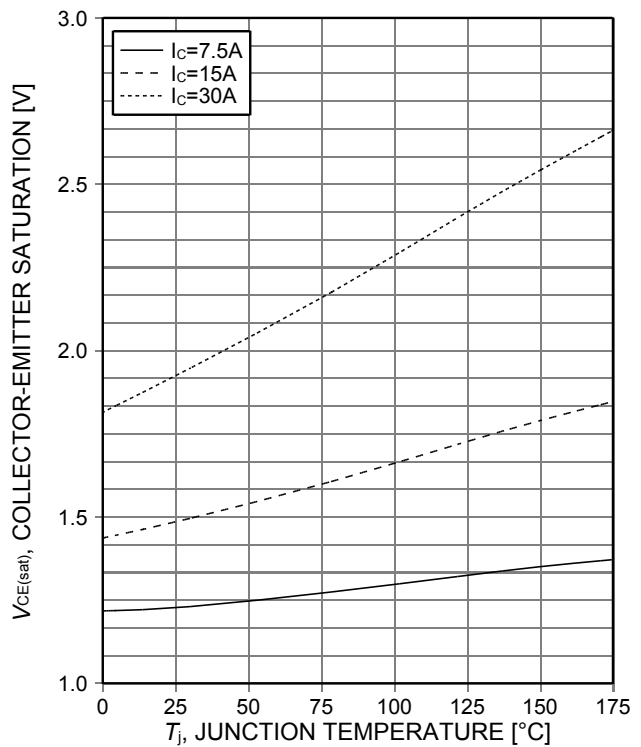
Figure 8. **Typical collector-emitter saturation voltage as a function of junction temperature**
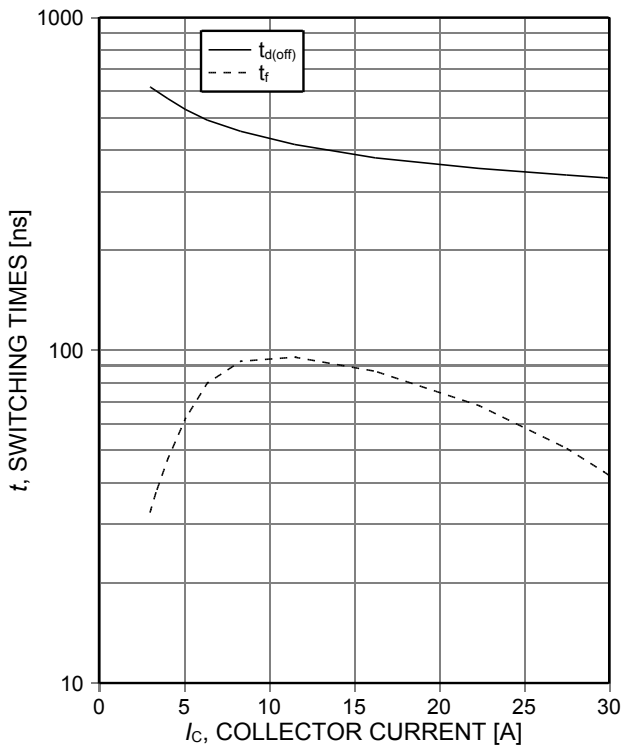(V_{GE}=15V)

Rev. 2.4, 2015-01-26

Figure 9. **Typical switching times as a function of collector current**
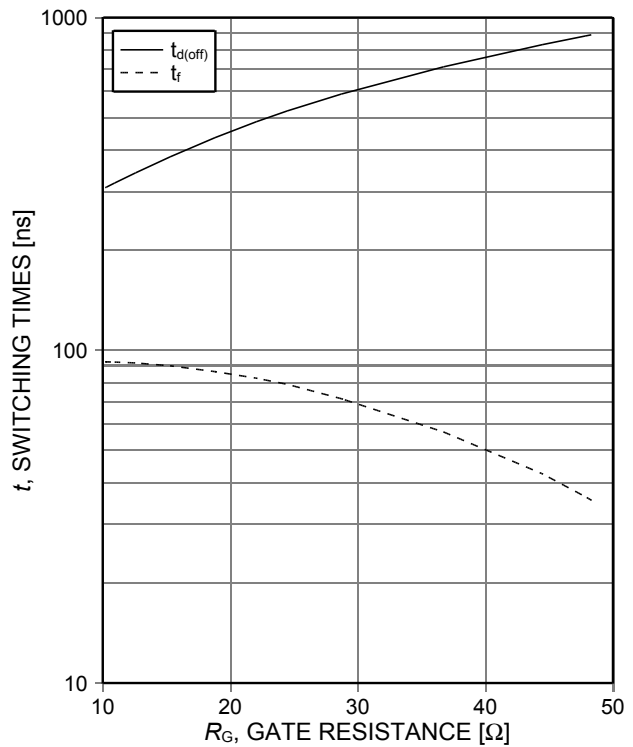(ind. load, T_j=175°C, V_{CE}=600V, V_{GE}=0/15V, $R_{G(on)}$=14,6Ω, $R_{G(off)}$=14,6Ω, test circuit in Fig. E)

Figure 10. **Typical switching times as a function of gate resistance**
(ind. load, T_j=175°C, V_{CE}=600V, V_{GE}=0/15V, I_C=15A, test circuit in Fig. E)
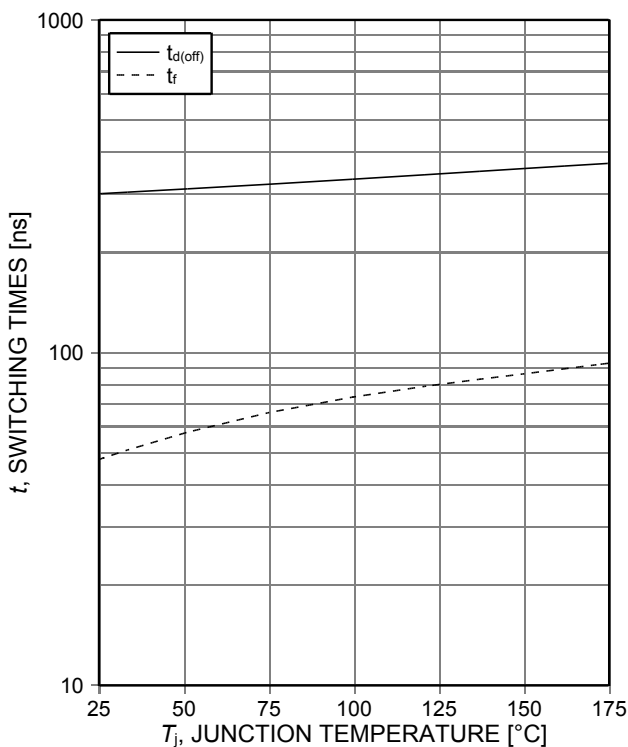
Figure 11. **Typical switching times as a function of junction temperature**
(ind. load, V_{CE}=600V, V_{GE}=0/15V, I_C=15A, $R_{G(on)}$=14,6Ω, $R_{G(off)}$=14,6Ω, test circuit in Fig. E)
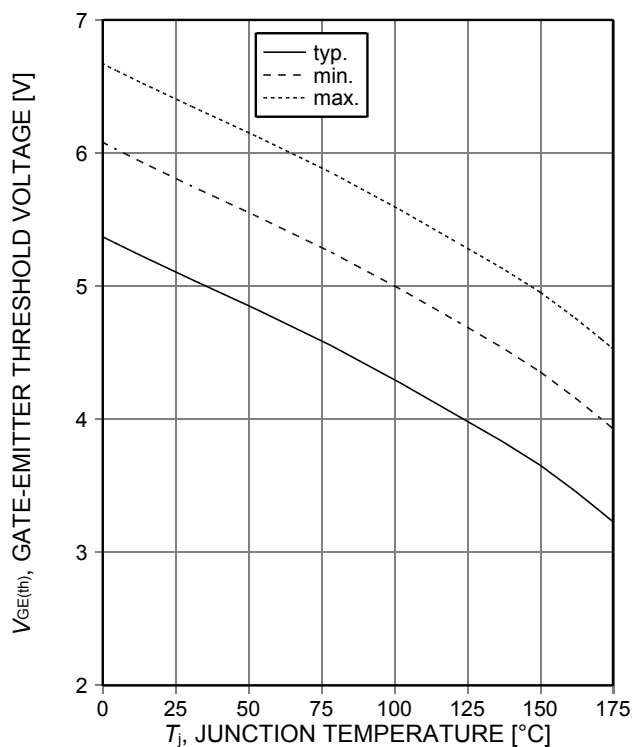

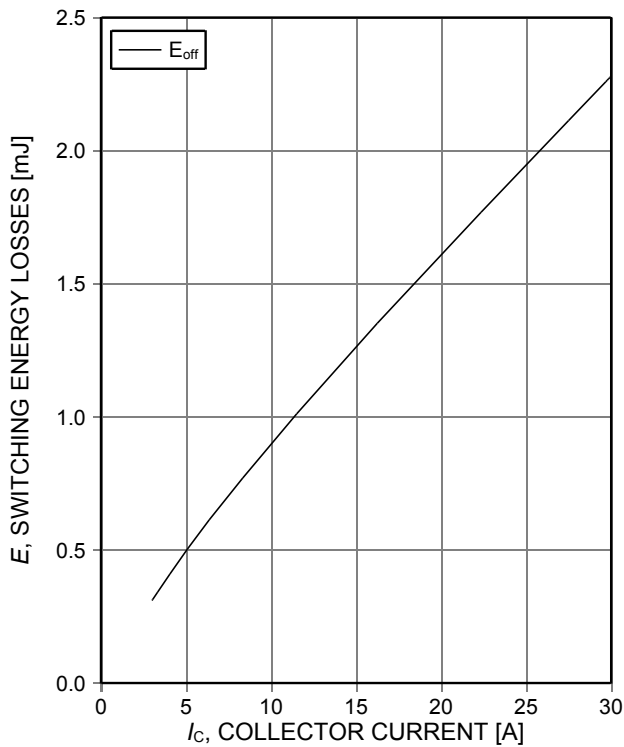Figure 12. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=0.4mA)

Rev. 2.4, 2015-01-26

Figure 13. **Typical switching energy losses as a function of collector current**
(ind. load, T_j=175°C, V_{CE}=600V, V_{GE}=0/15V, $R_{G(on)}$=14,6Ω, $R_{G(off)}$=14,6Ω, test circuit in Fig. E)
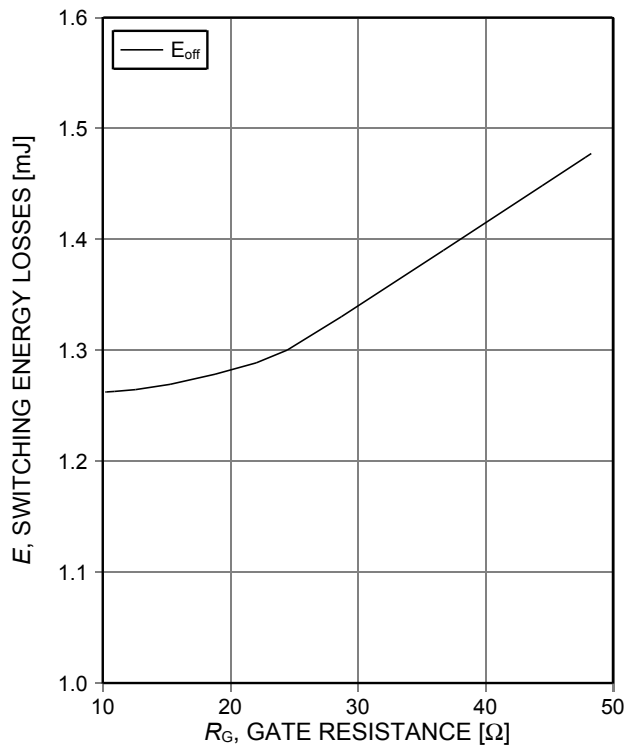

Figure 14. **Typical switching energy losses as a function of gate resistance**
(ind. load, T_j=175°C, V_{CE}=600V, V_{GE}=0/15V, I_C=15A, test circuit in Fig. E)
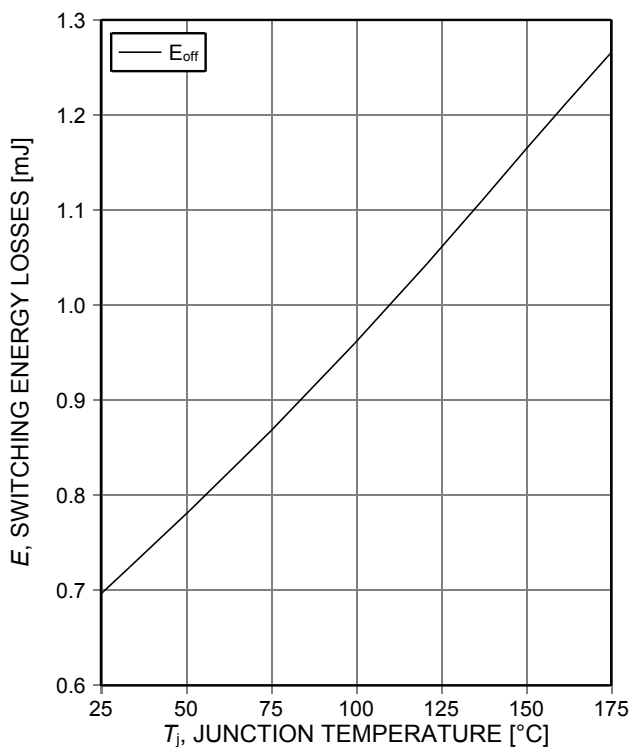

Figure 15. **Typical switching energy losses as a function of junction temperature**
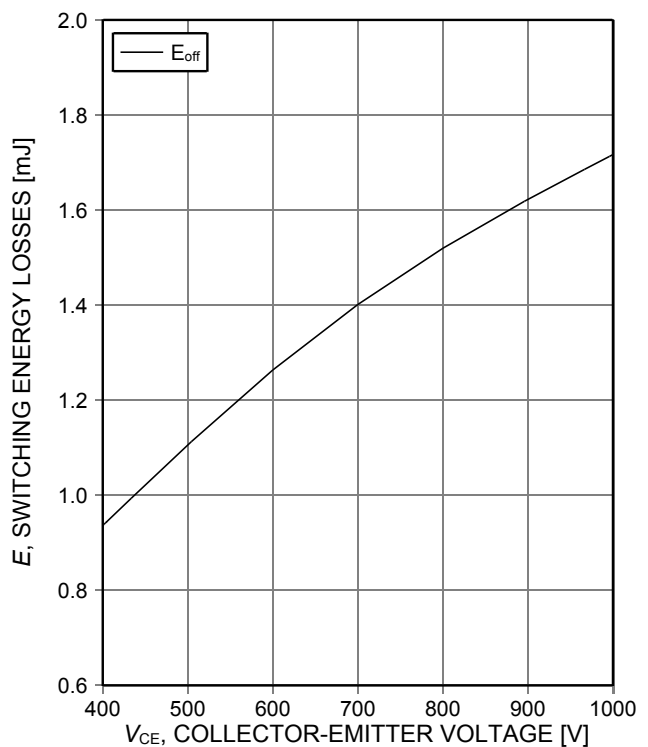(ind load, V_{CE}=600V, V_{GE}=0/15V, I_C=15A, $R_{G(on)}$=14,6Ω, $R_{G(off)}$=14,6Ω, test circuit in Fig. E)

Figure 16. **Typical switching energy losses as a function of collector emitter voltage**
(ind. load, T_j=175°C, V_{GE}=0/15V, I_C=15A, $R_{G(on)}$=14,6Ω, $R_{G(off)}$=14,6Ω, test circuit in Fig. E)
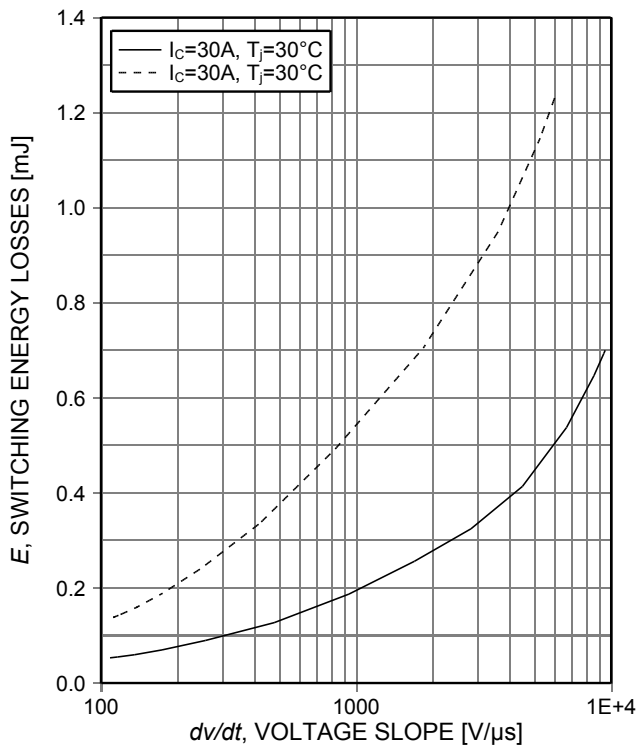
Rev. 2.4, 2015-01-26

Figure 17. **Typical turn off switching energy loss for soft switching**
(ind load, V_{CE}=600V, V_{GE}=15/0V, I_C=15A, R_G=14,6Ω, test circuit in Fig. E)

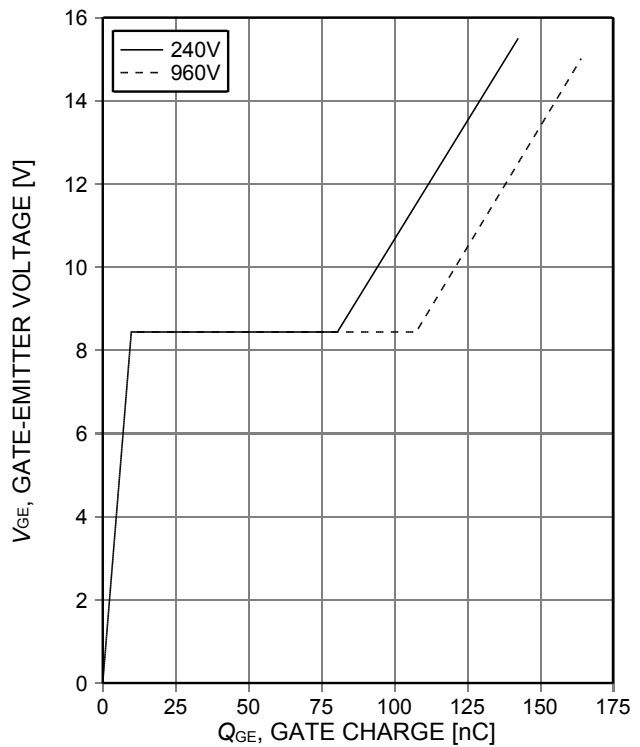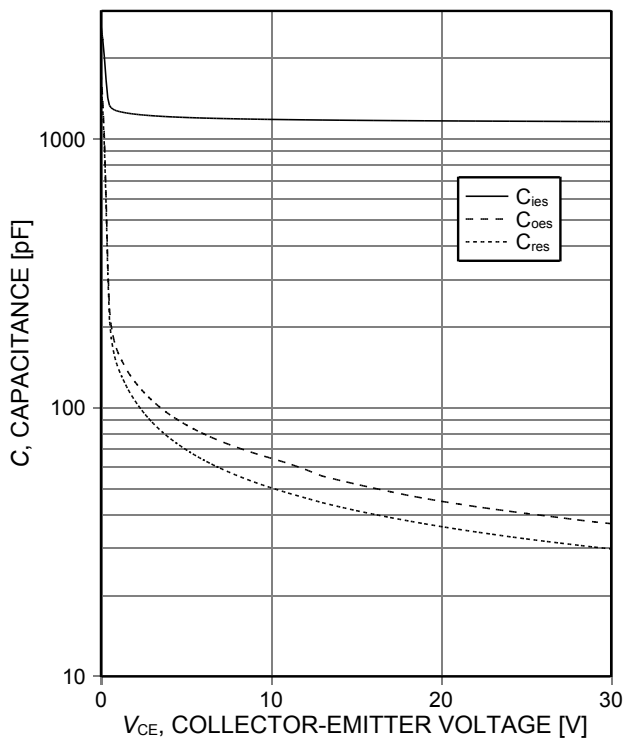

Figure 18. **Typical gate charge**
(I_C=15A)

Figure 19. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)
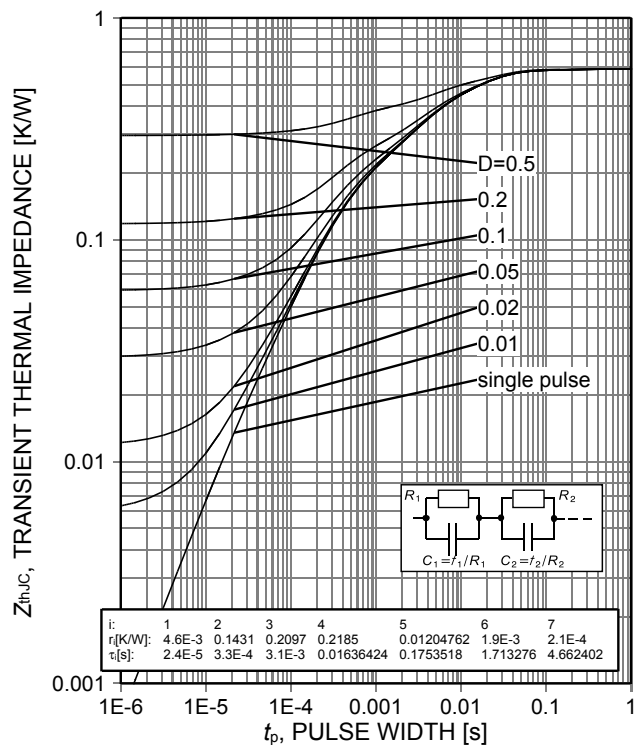
Figure 20. **IGBT transient thermal impedance**
($D=t_p$/T)

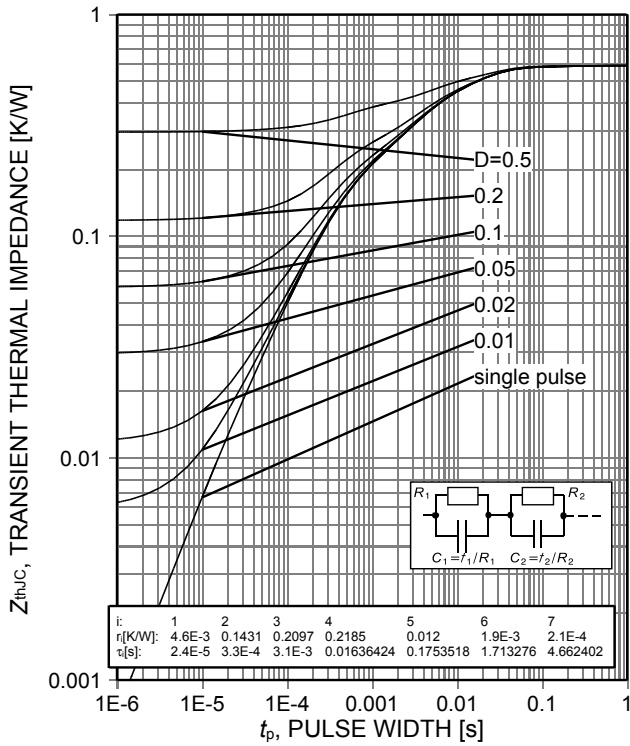| i:	1	2	3	4	5	6	7
r_i[K/W]:	4.6E-3	0.1431	0.2097	0.2185	0.01204762	1.9E-3	2.1E-4
τ_i[s]:	2.4E-5	3.3E-4	3.1E-3	0.01636424	0.1753518	1.713276	4.662402

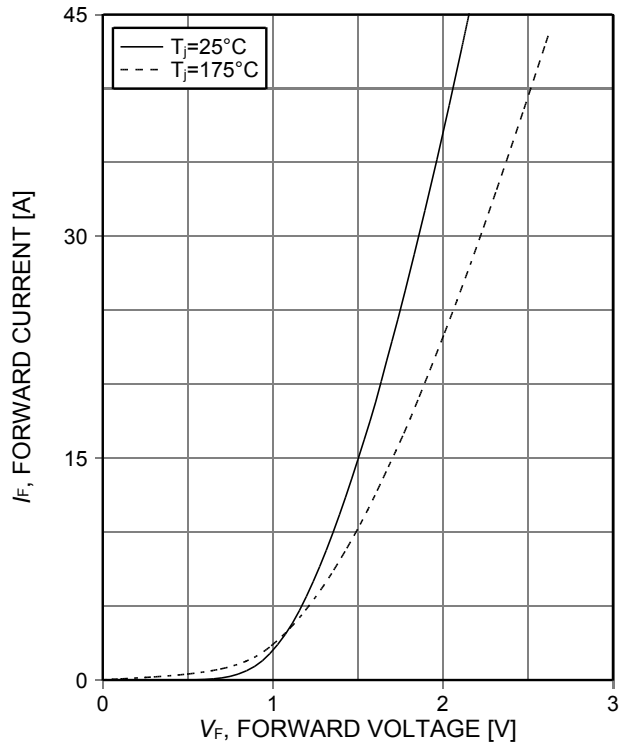Figure 21. **Diode transient thermal impedance as a function of pulse width** ($D=t_p/T$)

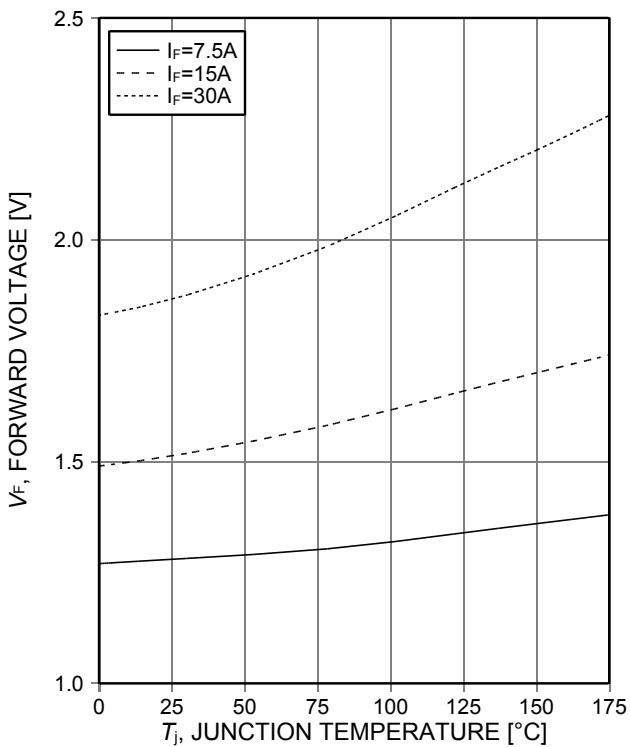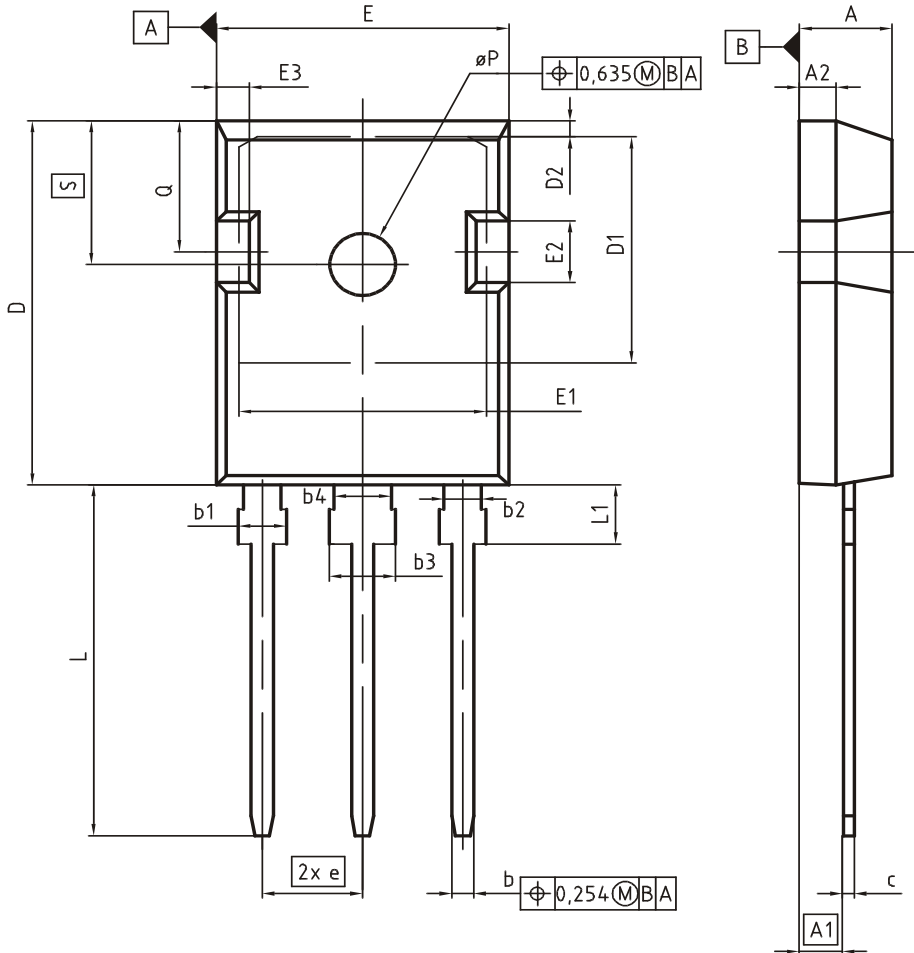Figure 22. **Typical diode forward current as a function of forward voltage**

Figure 23. **Typical diode forward voltage as a function of junction temperature**

PG-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

EUROPEAN PROJECTION

ISSUE DATE
09-07-2010

REVISION
05

$V_{GE}(t)$

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
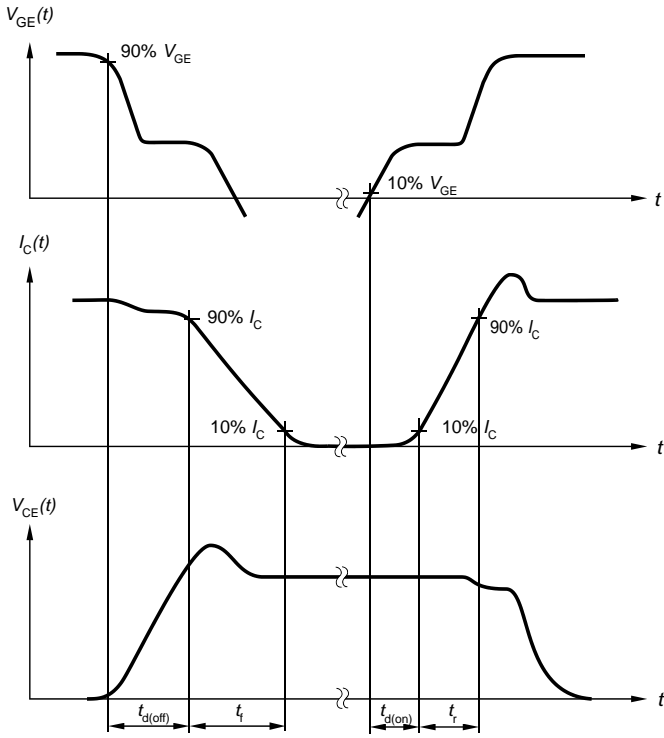
Figure A. **Definition of switching times**

$V_{GE}(t)$

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_1 t_2 t_3 t_4 t
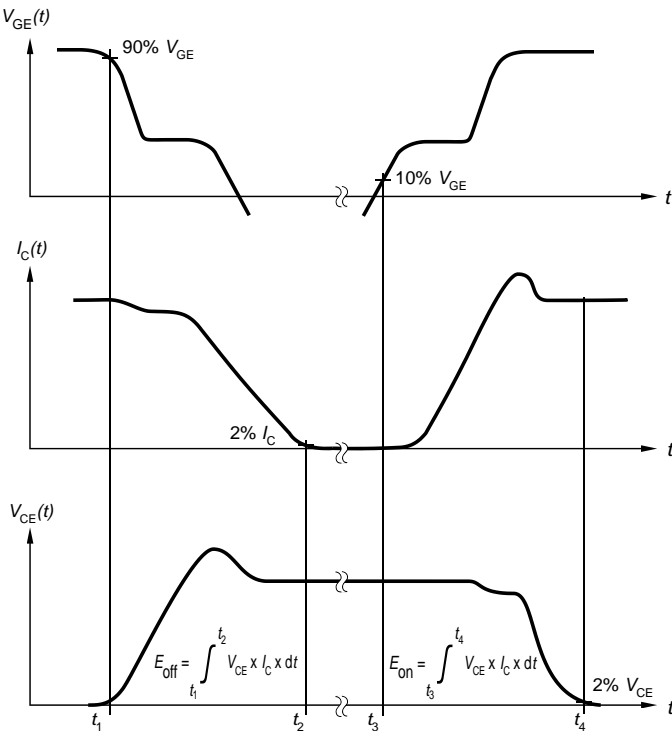
Figure B. **Definition of switching losses**

I, V

dI_F/dt

I_F

$t_{rr} = t_a + t_b$
$Q_{rr} = Q_a + Q_b$

t_{rr}

t_a t_b

Q_a Q_b 10% I_{rrm} t

I_{rrm}

dI_r/dt V_R

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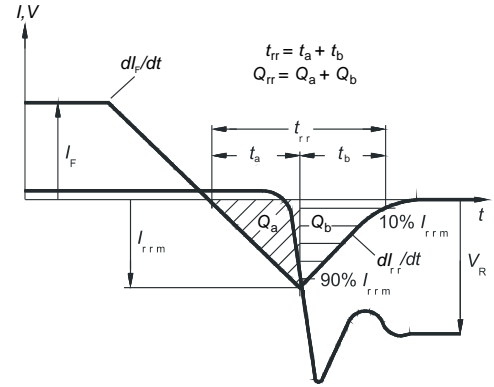
Figure C. **Definition of diode switching characteristics**

τ_1 τ_2 τ_n
r_1 r_2 r_n

$T_j(t)$

$p(t)$

r_1 r_2 r_n

T_C
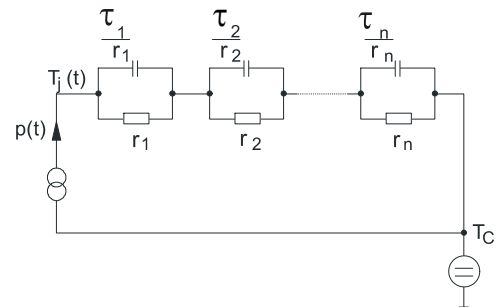
Figure D. **Thermal equivalent circuit**

½L_σ

DUT (Diode)

L C_σ C_r

V_{CC}

R_G

DUT (IGBT)

½L_σ
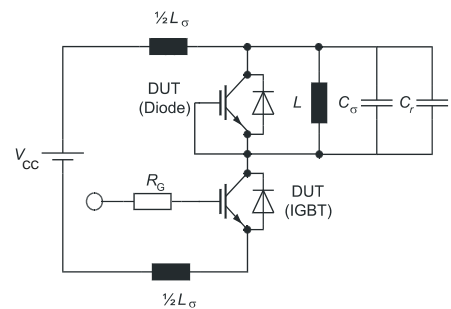
Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Revision History

IHW15N120R3

Revision: 2015-01-26, Rev. 2.4

Previous Revision

Revision	Date	Subjects (major changes since last revision)
1.1	2009-04-01	-
2.1	2009-05-27	-
2.2	2011-04-05	Pack. draw. rev. 05, marking update
2.3	2013-02-12	Layout change
2.4	2015-01-26	Minor changes

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