

Resonant Switching Series

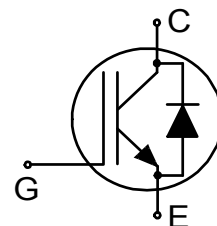
Reverse conducting IGBT with monolithic body diode

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 JEDEC 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	$V_{CEsat}, T_{vj}=25^{\circ}C$	T_{vjmax}	Marking	Package
IHW15N120R3	1200V	15A	1.48V	175°C	H15R1203	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	30.0 15.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	45.0	A
Turn off safe operating area $V_{CE} \leq 1200\text{V}$, $T_{vj} \leq 175^\circ\text{C}$	-	45.0	A
Diode forward current, limited by T_{vjmax} $T_c = 25^\circ\text{C}$ $T_c = 100^\circ\text{C}$	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 ($t_p \leq 10\mu\text{s}$, $D < 0.010$)	V_{GE}	± 20 ± 25	V
Power dissipation $T_c = 25^\circ\text{C}$ Power dissipation $T_c = 100^\circ\text{C}$	P_{tot}	254.0 127.0	W
Operating junction temperature	T_{vj}	$-40 \dots +175$	$^\circ\text{C}$
Storage temperature	T_{stg}	$-55 \dots +175$	$^\circ\text{C}$
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	Value			Unit
			min.	typ.	max.	

 R_{th} Characteristics

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

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

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Static Characteristic						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0V, I_C = 0.50mA$	1200	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	$V_{GE} = 15.0V, I_C = 15.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 125^{\circ}C$ $T_{vj} = 175^{\circ}C$	- - -	1.48 1.70 1.80	1.70 - -	V
Diode forward voltage	V_F	$V_{GE} = 0V, I_F = 15.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 125^{\circ}C$ $T_{vj} = 175^{\circ}C$	- - -	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}	$V_{CE} = 1200V, V_{GE} = 0V$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	- -	100 2500	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 $T_{vj} = 25^{\circ}\text{C}$, 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	-	1165	-	pF
Output capacitance	C _{oes}		-	40	-	
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			Unit
			min.	typ.	max.	
Turn-off delay time	$t_{d(off)}$	$T_{vj} = 25^{\circ}\text{C}$, $V_{CC} = 600\text{V}$, $I_C = 15.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 14.6\Omega$, $R_{G(off)} = 14.6\Omega$, $L_{\sigma} = 180\text{nH}$, $C_{\sigma} = 39\text{pF}$ L_{σ} , C_{σ} 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

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Switching Characteristic, Inductive Load

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

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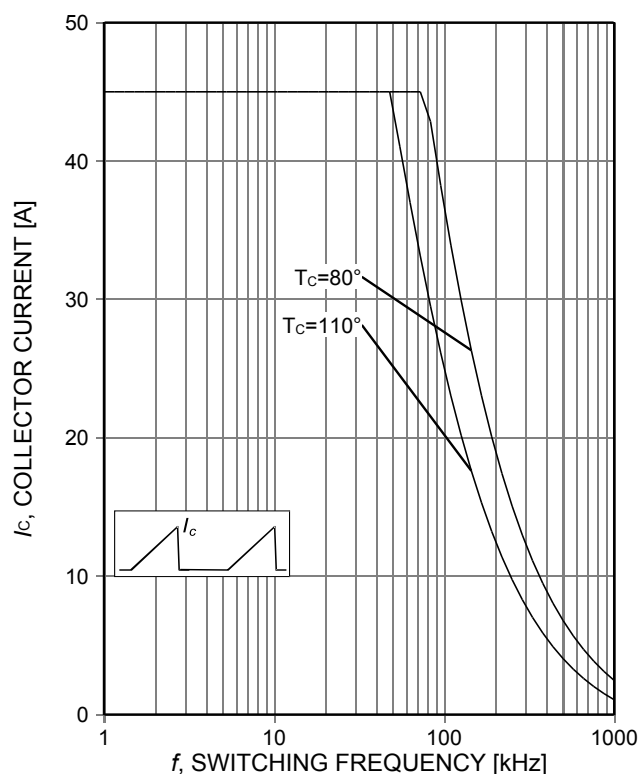


Figure 1. **Collector current as a function of switching frequency**
 $(T_J \leq 175^\circ\text{C}, D=0.5, V_{CE}=600\text{V}, V_{GE}=15/0\text{V}, R_G=14,6\Omega)$

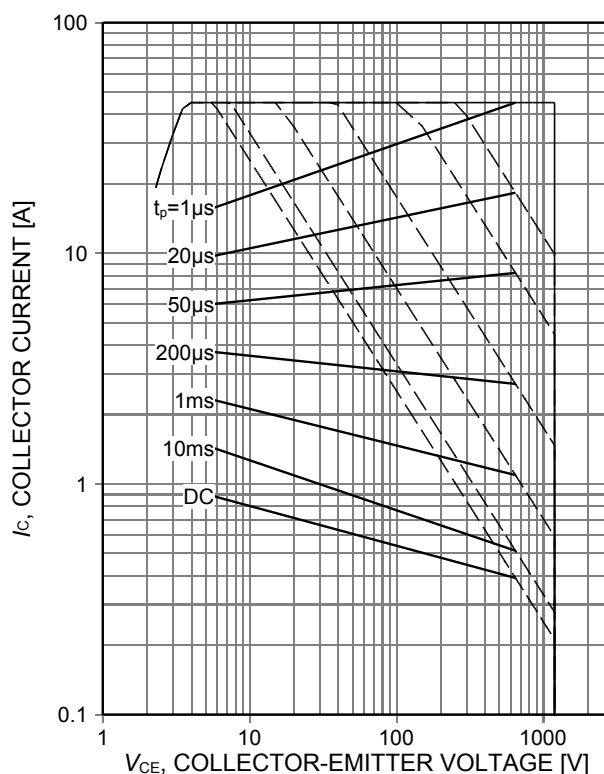


Figure 2. **Forward bias safe operating area**
 $(D=0, T_C=25^\circ\text{C}, T_J \leq 175^\circ\text{C}; V_{GE}=15\text{V})$

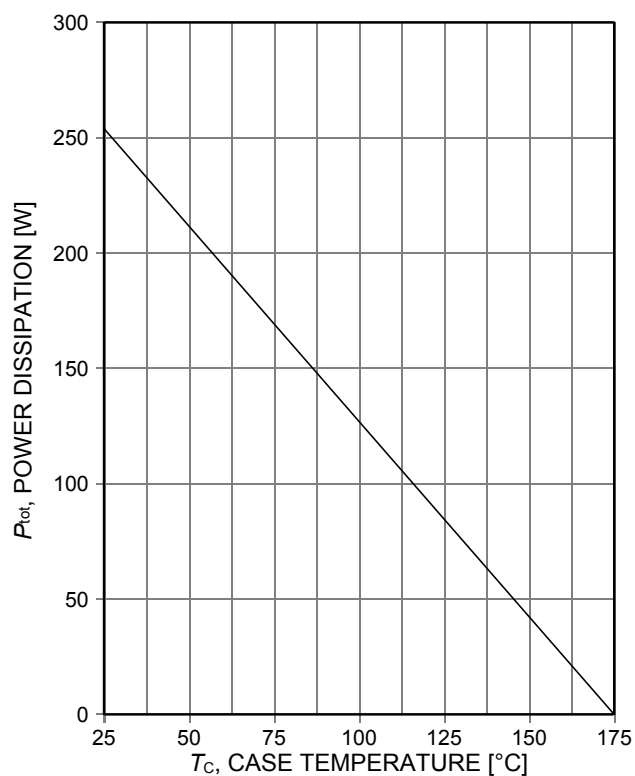


Figure 3. **Power dissipation as a function of case temperature**
 $(T_J \leq 175^\circ\text{C})$

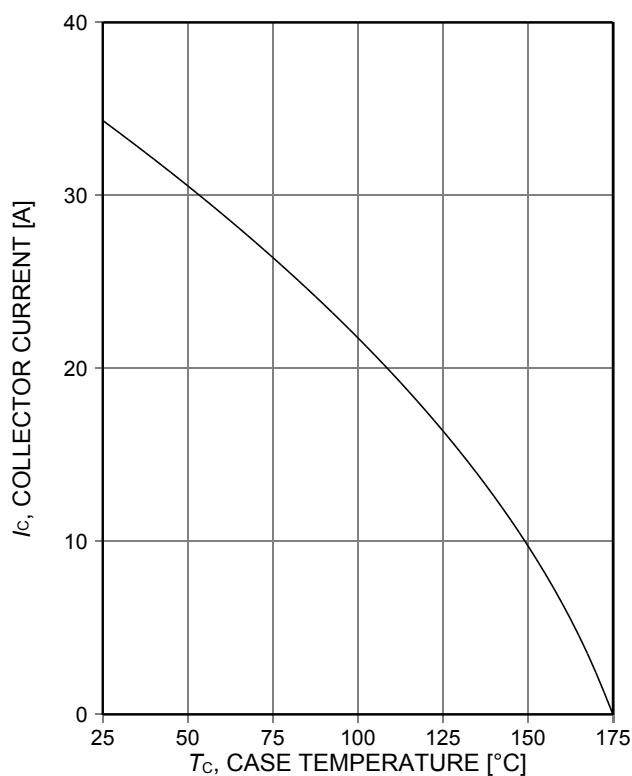


Figure 4. **Collector current as a function of case temperature**
 $(V_{GE} \geq 15\text{V}, T_J \leq 175^\circ\text{C})$

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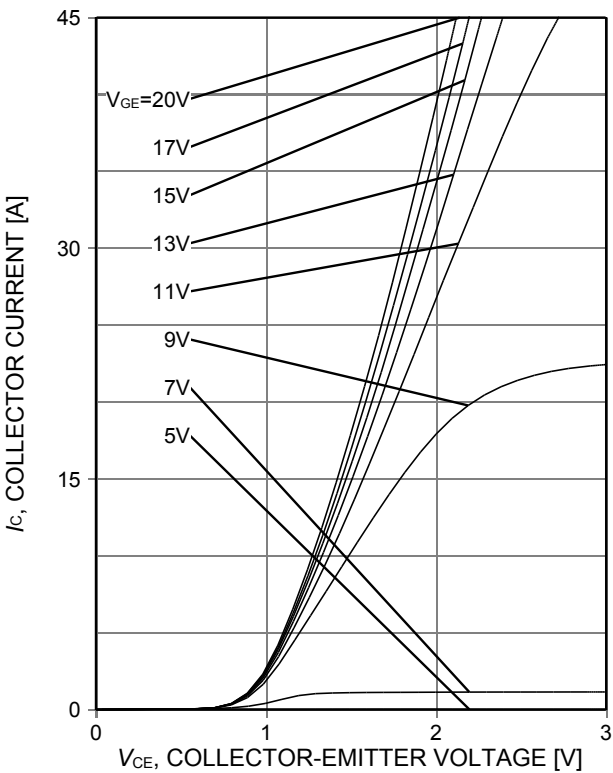


Figure 5. **Typical output characteristic**
($T_j=25^{\circ}\text{C}$)

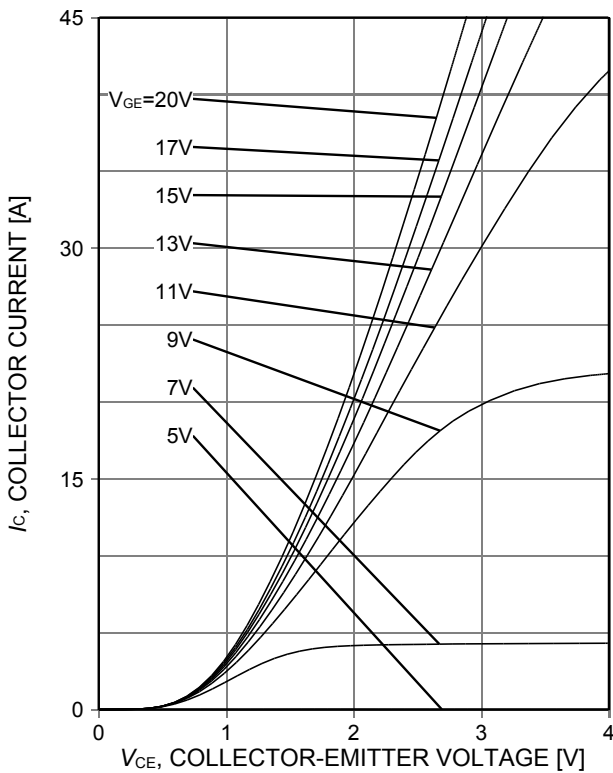


Figure 6. **Typical output characteristic**
($T_j=175^{\circ}\text{C}$)

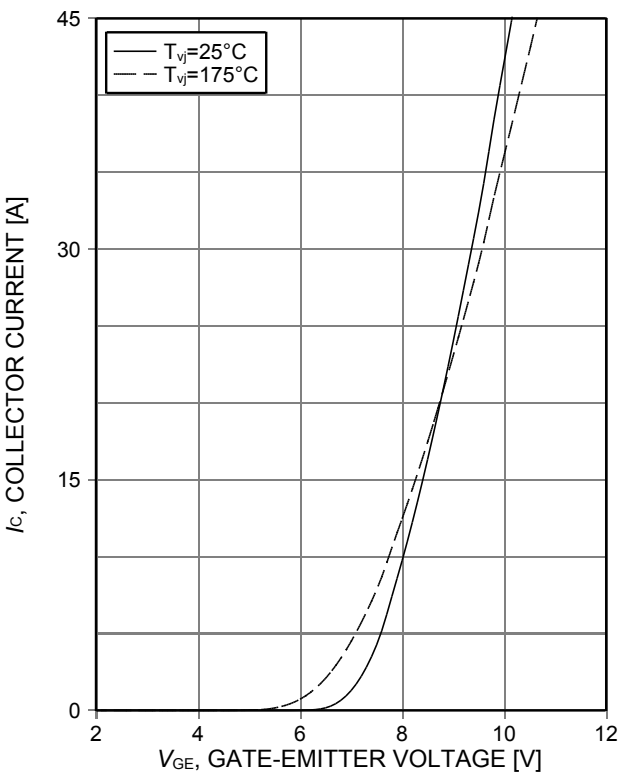


Figure 7. **Typical transfer characteristic**
($V_{CE}=20\text{V}$)

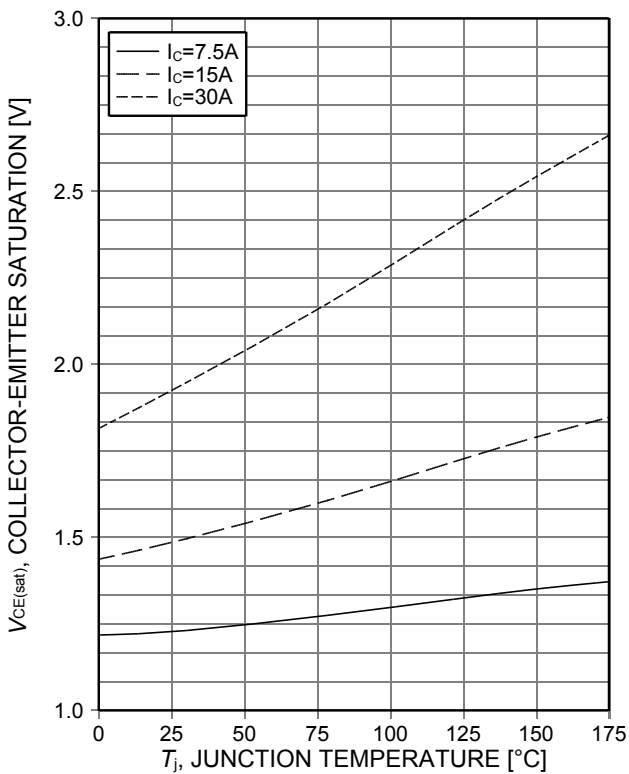


Figure 8. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}=15\text{V}$)

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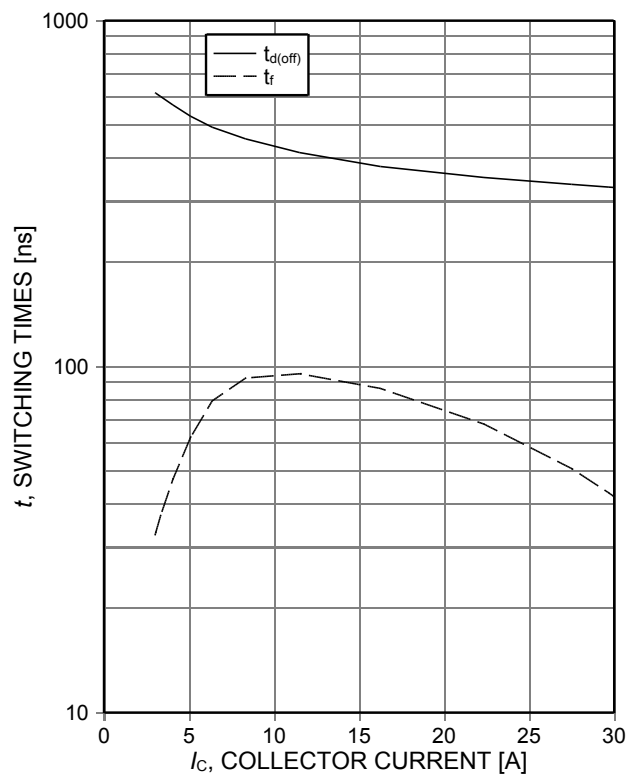


Figure 9. **Typical switching times as a function of collector current**
(ind. load, $T_J=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_{G(on)}=14,6\Omega$, $R_{G(off)}=14,6\Omega$, test circuit in Fig. E)

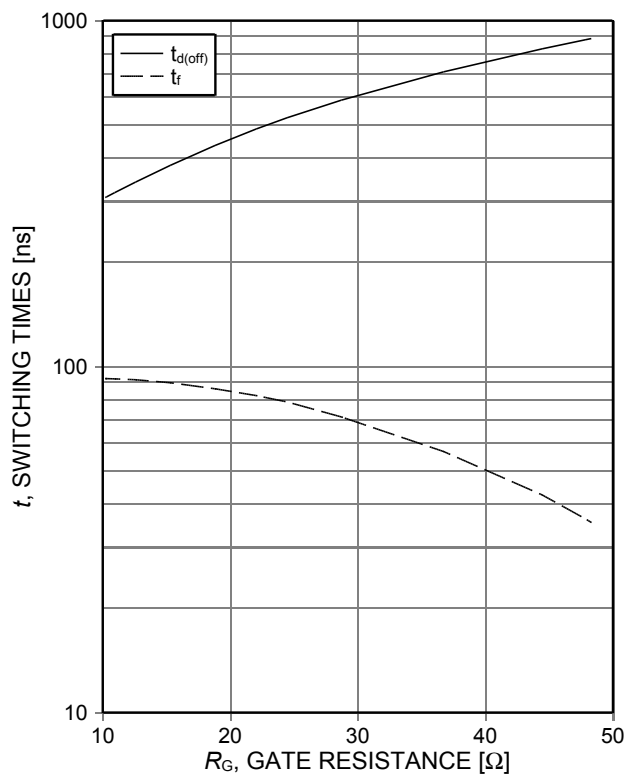


Figure 10. **Typical switching times as a function of gate resistance**
(ind. load, $T_J=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=15\text{A}$, test circuit in Fig. E)

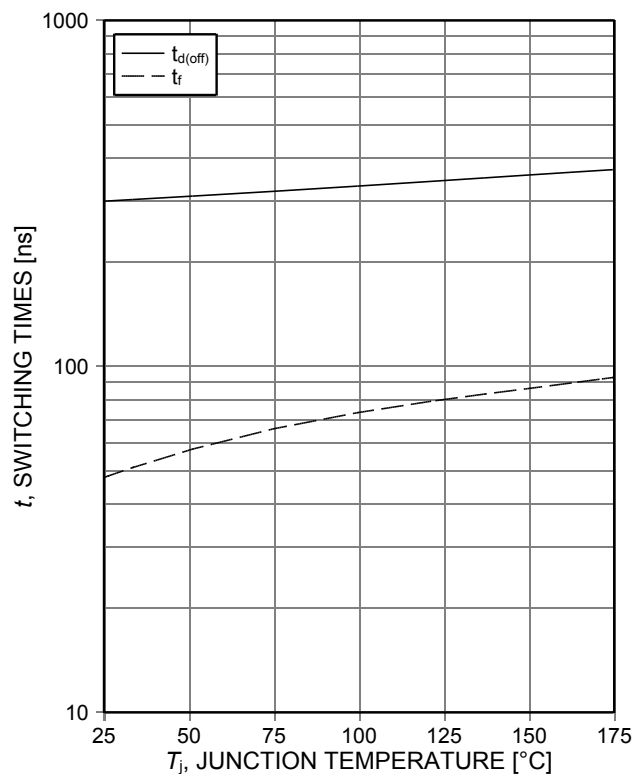


Figure 11. **Typical switching times as a function of junction temperature**
(ind. load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=15\text{A}$, $R_{G(on)}=14,6\Omega$, $R_{G(off)}=14,6\Omega$, test circuit in Fig. E)

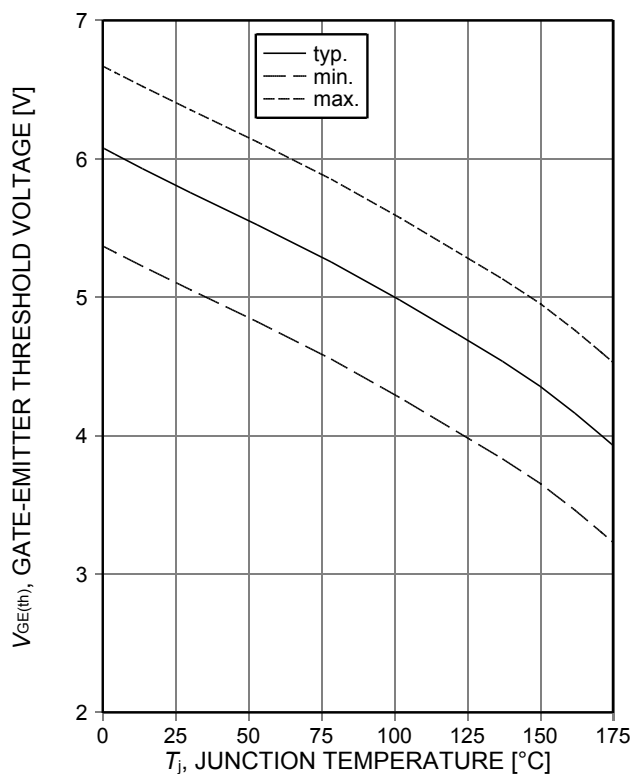


Figure 12. **Gate-emitter threshold voltage as a function of junction temperature**
($I_C=0.4\text{mA}$)

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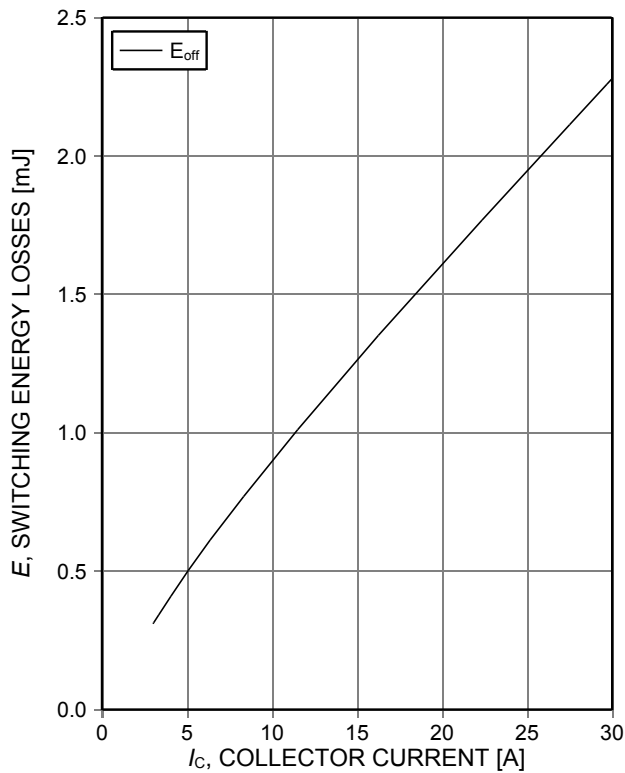


Figure 13. **Typical switching energy losses as a function of collector current**
(ind. load, $T_j=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_{G(on)}=14,6\Omega$, $R_{G(off)}=14,6\Omega$, test circuit in Fig. E)

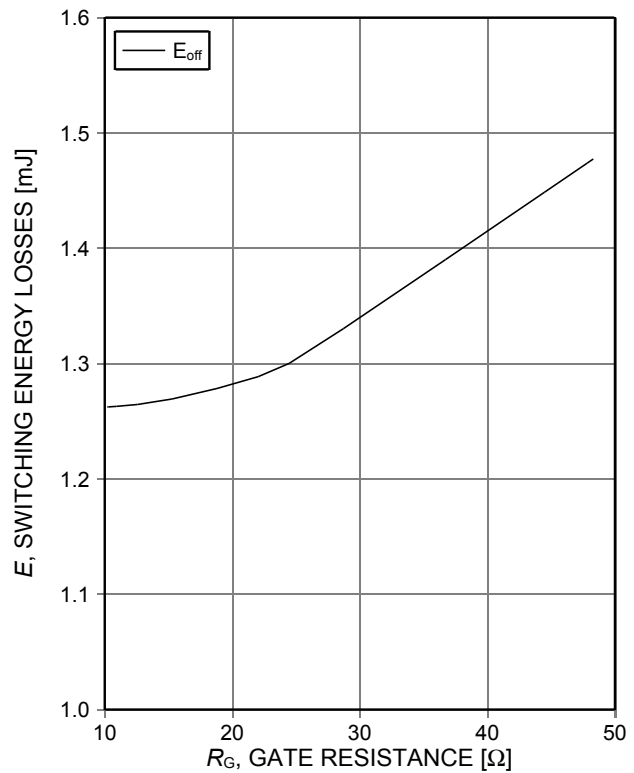


Figure 14. **Typical switching energy losses as a function of gate resistance**
(ind. load, $T_j=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=15\text{A}$, test circuit in Fig. E)

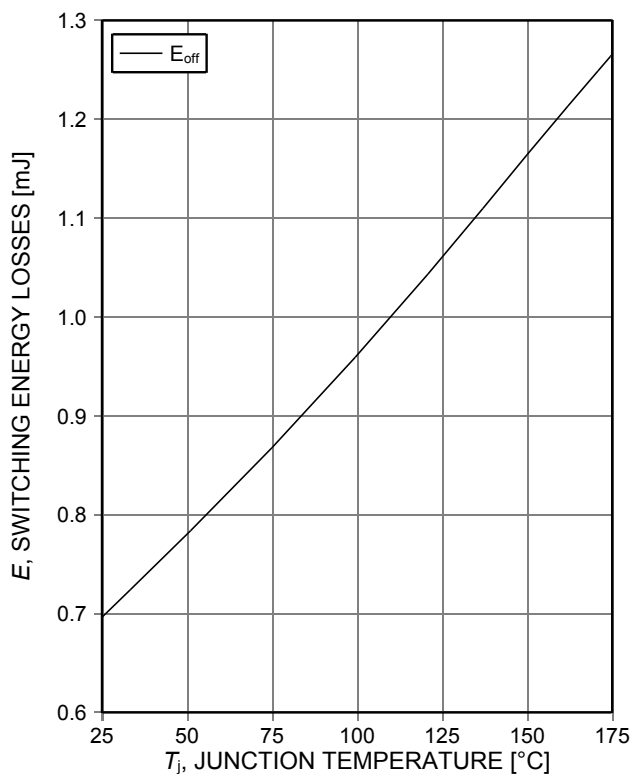


Figure 15. **Typical switching energy losses as a function of junction temperature**
(ind. load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=15\text{A}$, $R_{G(on)}=14,6\Omega$, $R_{G(off)}=14,6\Omega$, test circuit in Fig. E)

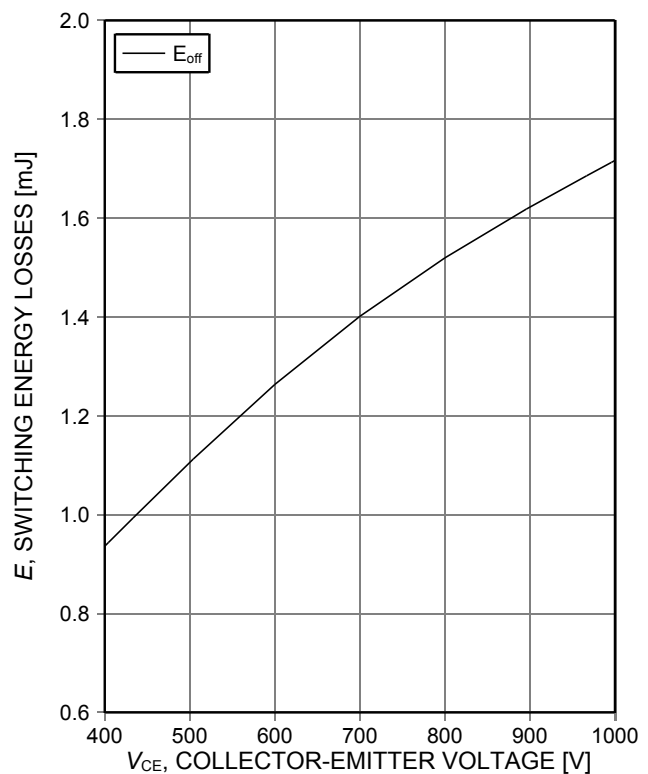


Figure 16. **Typical switching energy losses as a function of collector emitter voltage**
(ind. load, $T_j=175^\circ\text{C}$, $V_{GE}=0/15\text{V}$, $I_C=15\text{A}$, $R_{G(on)}=14,6\Omega$, $R_{G(off)}=14,6\Omega$, test circuit in Fig. E)

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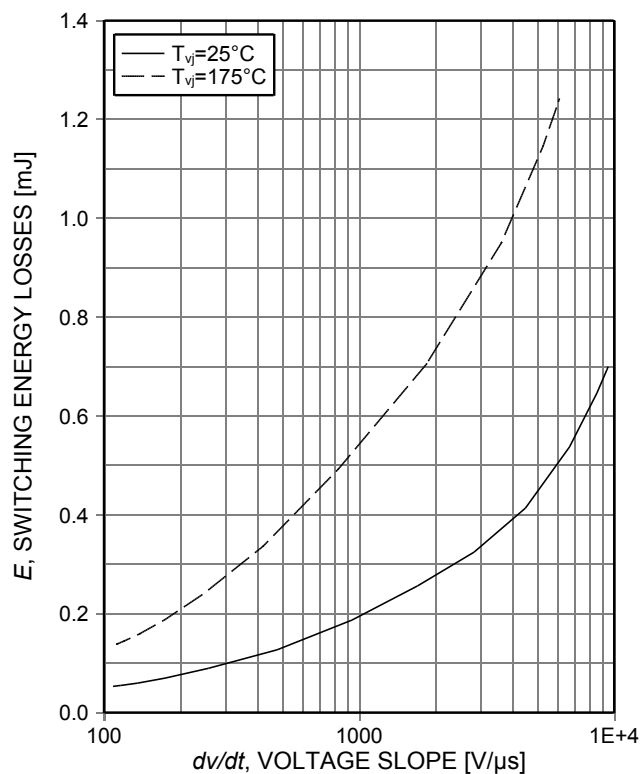


Figure 17. **Typical turn off switching energy loss for soft switching**
(ind load, $V_{CE}=600V$, $V_{GE}=15/0V$, $I_C=15A$, $R_G=14,6\Omega$, test circuit in Fig. E)

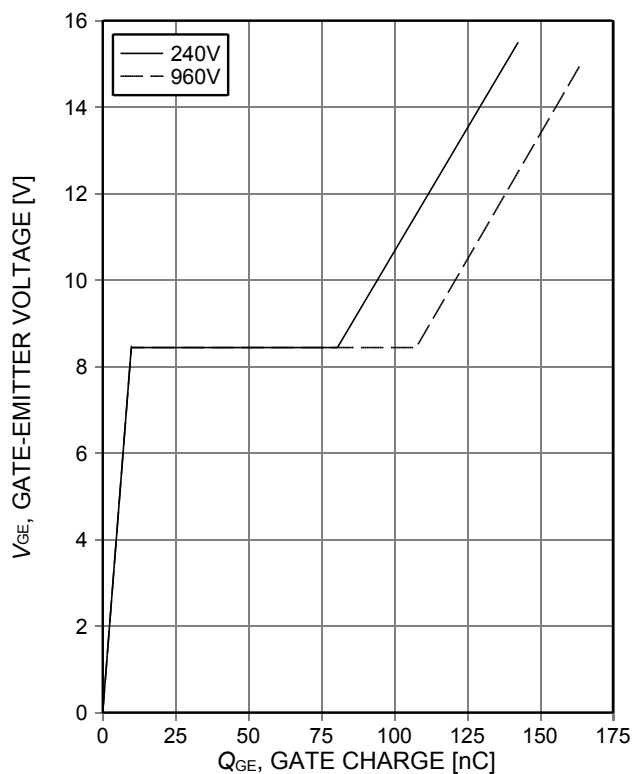


Figure 18. **Typical gate charge**
($I_C=15A$)

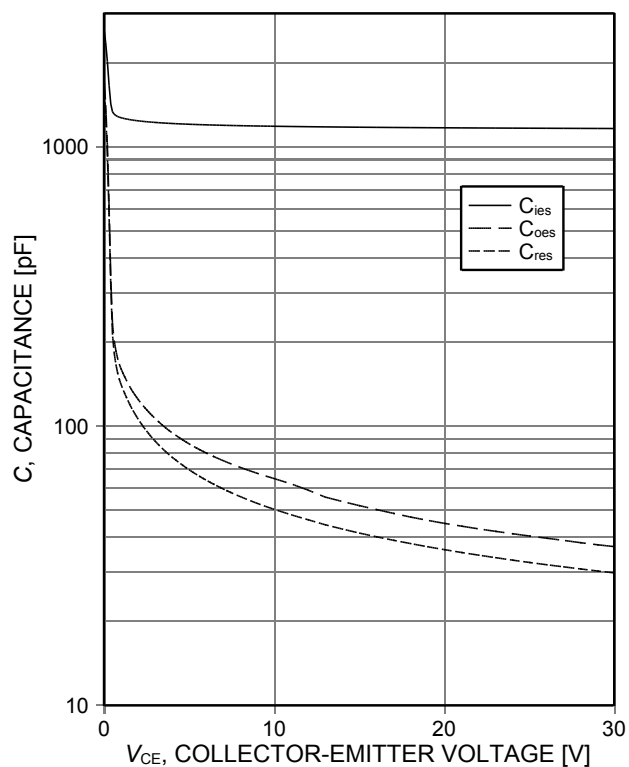


Figure 19. **Typical capacitance as a function of collector-emitter voltage**
($V_{GE}=0V$, $f=1MHz$)

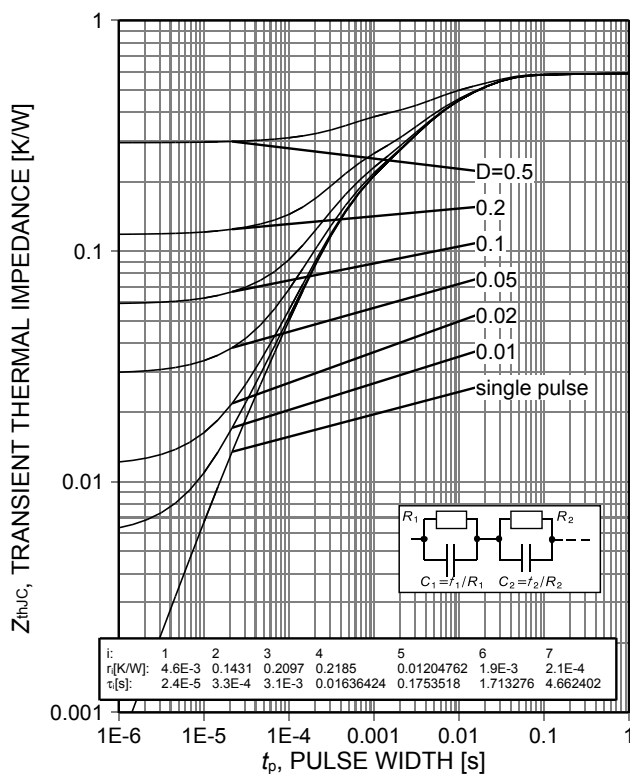


Figure 20. **IGBT transient thermal impedance**
($D=t_p/T$)

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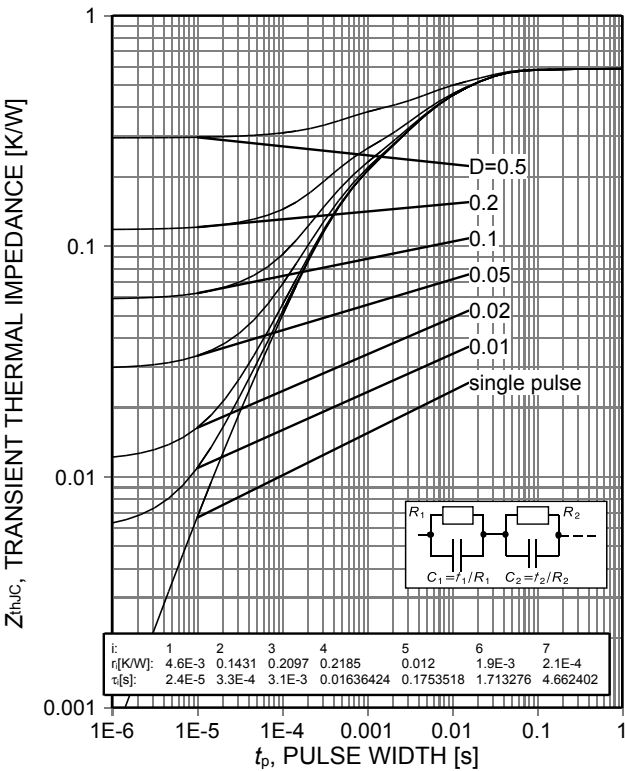


Figure 21. Diode transient thermal impedance as a function of pulse width ($D = t_p/T$)

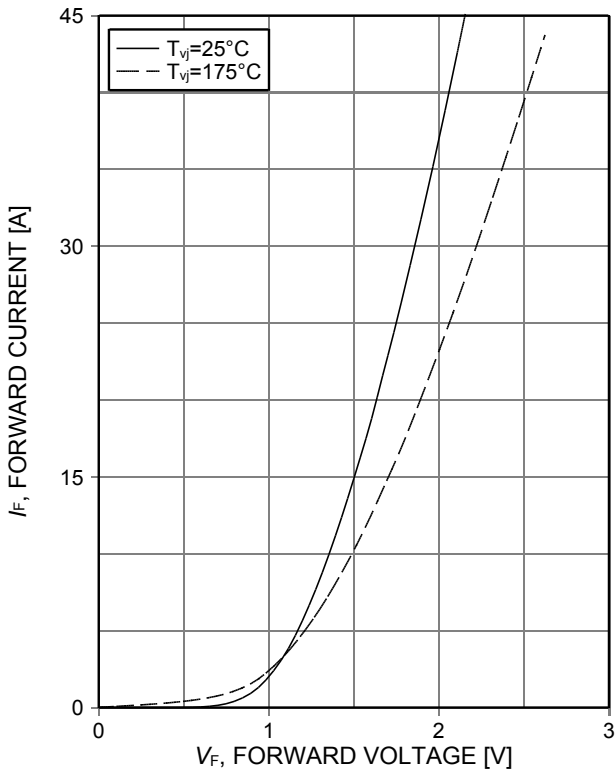


Figure 22. Typical diode forward current as a function of forward voltage

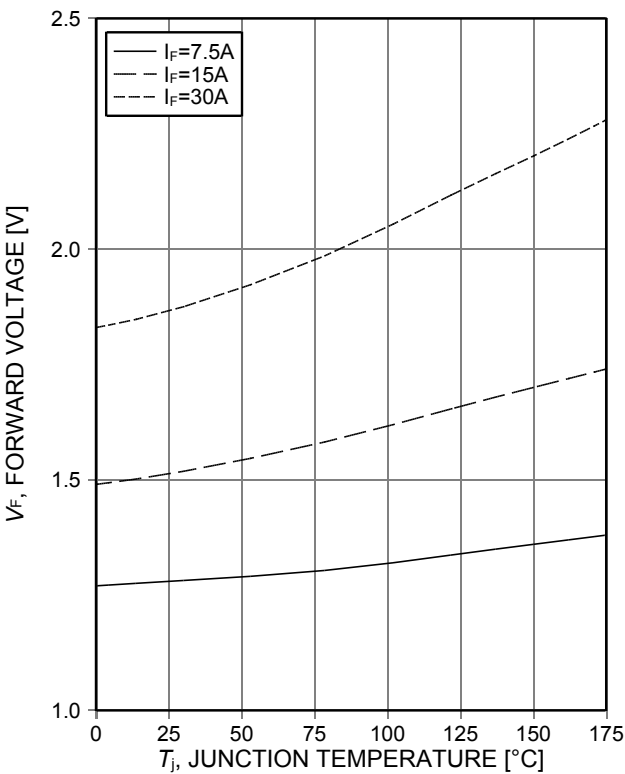
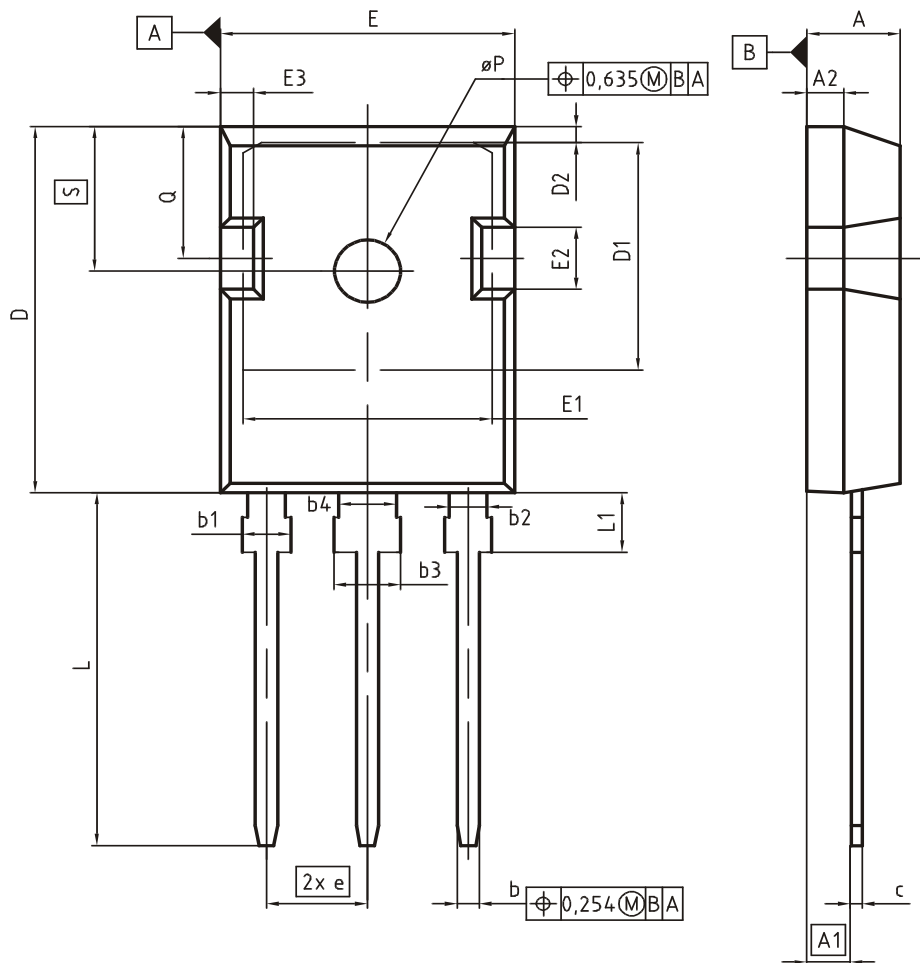


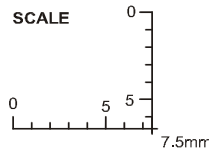
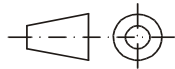
Figure 23. Typical diode forward voltage as a function of junction temperature

Resonant Switching Series

Package Drawing PG-T0247-3



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

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EUROPEAN PROJECTION	
	
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Testing Conditions

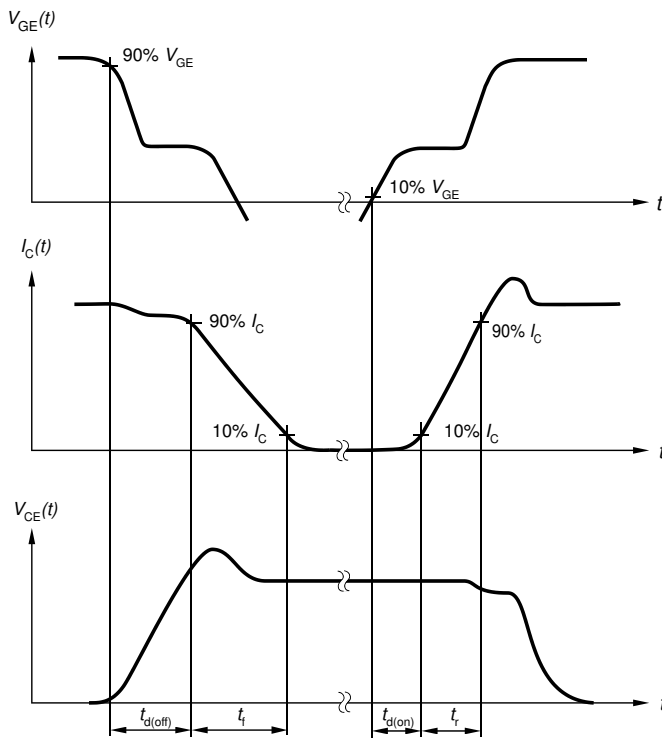


Figure A. Definition of switching times

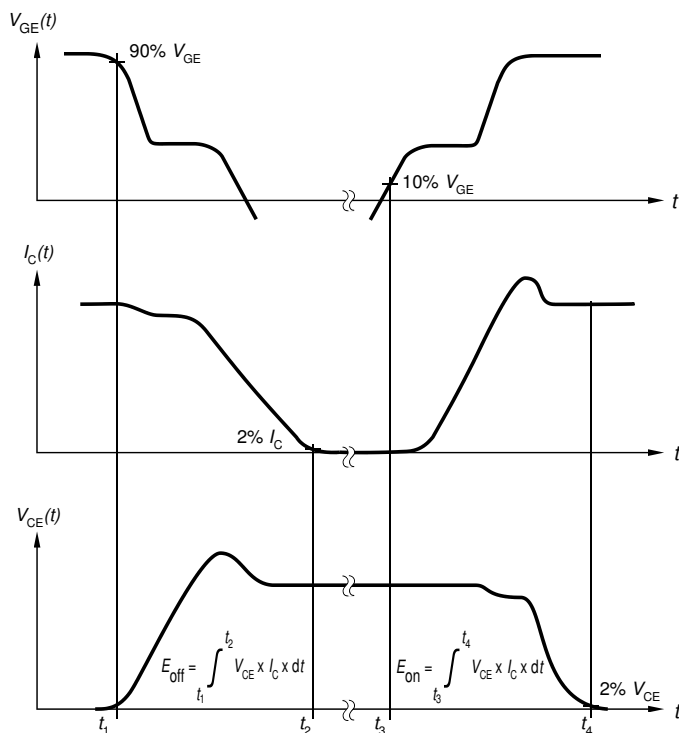


Figure B. Definition of switching losses

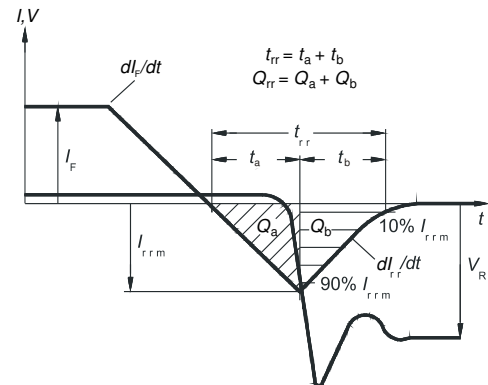


Figure C. Definition of diode switching characteristics

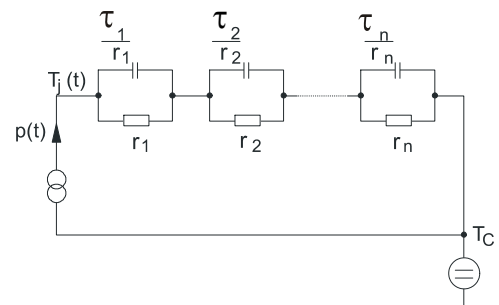


Figure D. Thermal equivalent circuit

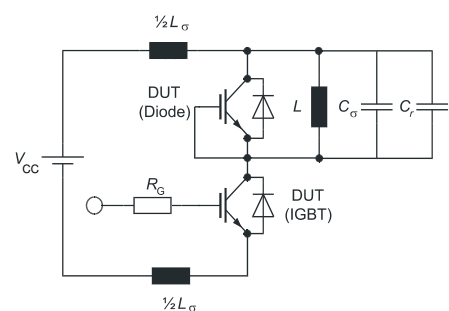


Figure E. **Dynamic test circuit**
 Parasitic inductance L_σ ,
 parasitic capacitor C_σ ,
 relief capacitor C_r ,
 (only for ZVT switching)

Resonant Switching Series**Revision History**

IHW15N120R3**Revision: 2018-03-29, Rev. 2.5**

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
2.5	2018-03-29	Fig.12 and Fig.17 minor change of legend

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