

Resonant Switching Series

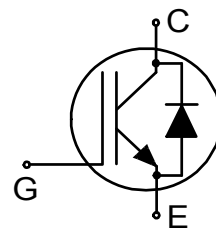
Reverse Conducting IGBT with monolithic body diode

Features:

- Offers high breakdown voltage of 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
- 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
- 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
IHW20N135R5	1350V	20A	1.65V	175°C	H20PR5	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}	1350	V
DC collector current, limited by T_{vjmax} $T_c = 25^\circ\text{C}$ $T_c = 100^\circ\text{C}$	I_C	40.0 20.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	60.0	A
Non repetitive peak collector current ¹⁾	I_{CSM}	200	A
Turn off safe operating area $V_{CE} \leq 1350\text{V}$, $T_{vj} \leq 175^\circ\text{C}$	-	60.0	A
Diode forward current, limited by T_{vjmax} $T_c = 25^\circ\text{C}$ $T_c = 100^\circ\text{C}$	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 ($t_p \leq 10\mu\text{s}$, $D < 0.010$)	V_{GE}	± 20 ± 25	V
Power dissipation $T_c = 25^\circ\text{C}$ Power dissipation $T_c = 100^\circ\text{C}$	P_{tot}	288.0 144.0	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	Value			Unit
			min.	typ.	max.	
R _{th} Characteristics						
IGBT thermal resistance, junction - case	R _{th(j-c)}		-	-	0.52	K/W
Diode thermal resistance, junction - case	R _{th(j-c)}		-	-	0.52	K/W
Thermal resistance junction - ambient	R _{th(j-a)}		-	-	40	K/W

¹⁾ capacitor charging saturation current limited by $T_{vjmax} < 175^\circ\text{C}$ and $t_p < 3\mu\text{s}$

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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	$V_{(BR)CES}$	$V_{GE} = 0V, I_C = 0.50mA$	1350	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	$V_{GE} = 15.0V, I_C = 20.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 125^{\circ}C$ $T_{vj} = 175^{\circ}C$	- - -	1.65 1.85 1.95	1.85 - -	V
Diode forward voltage	V_F	$V_{GE} = 0V, I_F = 20.0A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 125^{\circ}C$ $T_{vj} = 175^{\circ}C$	- - -	1.65 1.85 1.95	1.90 - -	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}	$V_{CE} = 1350V, V_{GE} = 0V$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	- 350	100 -	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0V, V_{GE} = 20V$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE} = 20V, I_C = 20.0A$	-	15.8	-	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	-	1360	-	pF
Output capacitance	C _{Oes}		-	43	-	
Reverse transfer capacitance	C _{res}		-	34	-	
Gate charge	Q _G	V _{CC} = 1080V, I _C = 20.0A, V _{GE} = 15V	-	170.0	-	nC

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at $T_{vj} = 25^{\circ}\text{C}$						
Turn-off delay time	$t_{d(\text{off})}$	$T_{vj} = 25^{\circ}\text{C},$ $V_{CC} = 600\text{V}, I_C = 20.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(\text{on})} = 10.0\Omega, R_{G(\text{off})} = 10.0\Omega,$ $L\sigma = 175\text{nH}, C\sigma = 40\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	235	-	ns
Fall time	t_f		-	50	-	ns
Turn-off energy	E_{off}		-	0.95	-	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	$t_{d(\text{off})}$	$T_{vj} = 175^{\circ}\text{C}$, $V_{CC} = 600\text{V}$, $I_C = 20.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(\text{on})} = 10.0\Omega$, $R_{G(\text{off})} = 10.0\Omega$, $L\sigma = 175\text{nH}$, $C\sigma = 40\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	350	-	ns
Fall time	t_f		-	100	-	ns
Turn-off energy	E_{off}		-	2.00	-	mJ

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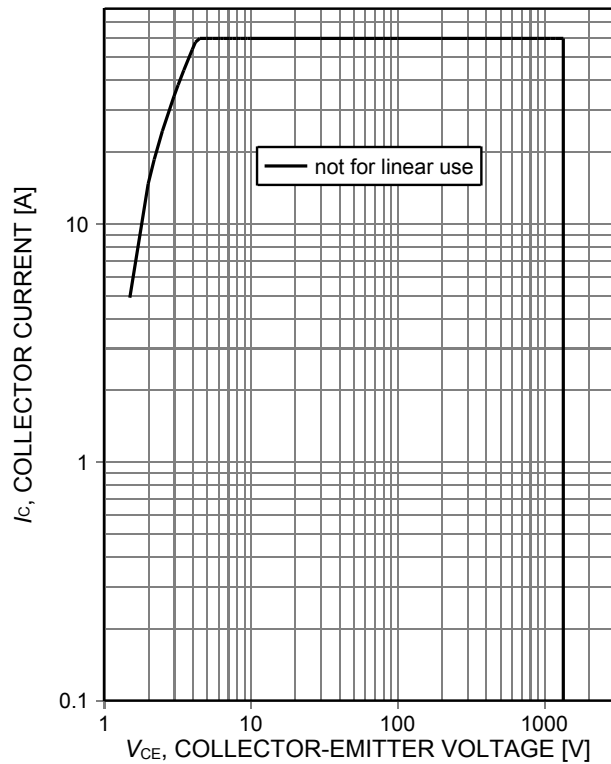


Figure 1. **Safe operating area**
($D=0$, $T_C=25^\circ\text{C}$, $T_{vj}=175^\circ\text{C}$; $V_{GE}=15\text{V}$, $t_p=1\mu\text{s}$)

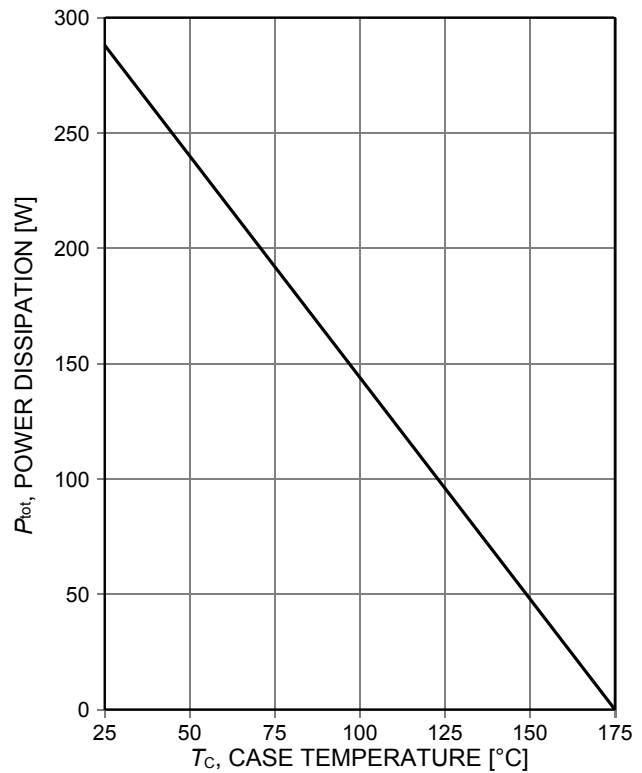


Figure 2. **Power dissipation as a function of case temperature**
($T_{vj} \leq 175^\circ\text{C}$)

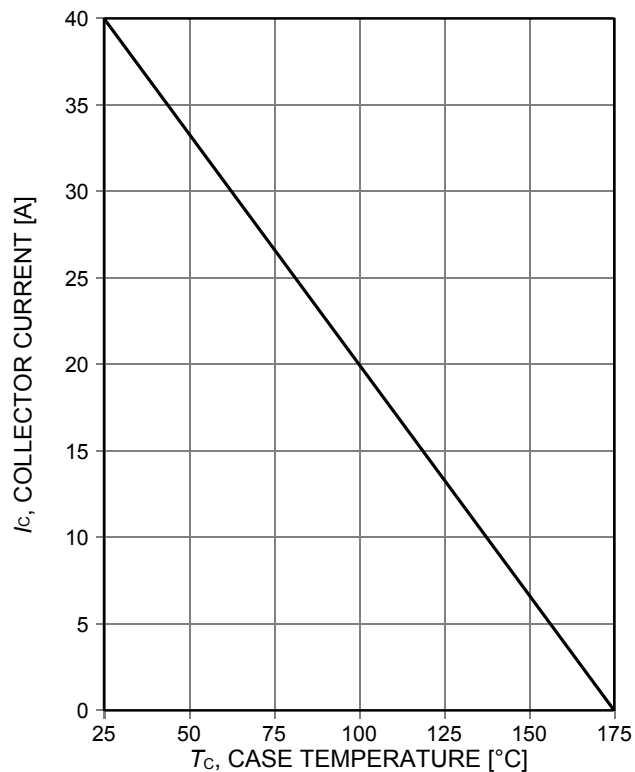


Figure 3. **Collector current as a function of case temperature**
($V_{GE} \geq 15\text{V}$, $T_{vj} \leq 175^\circ\text{C}$)

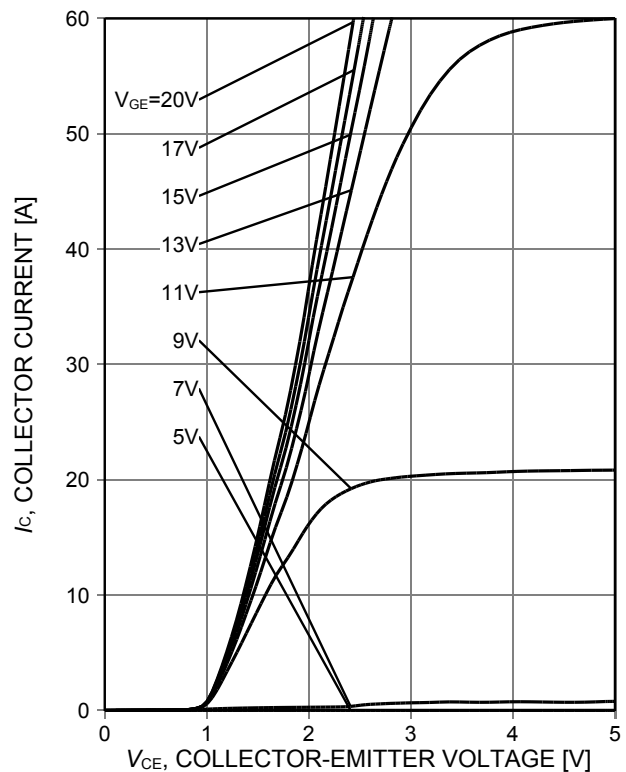


Figure 4. **Typical output characteristic**
($T_{vj}=25^\circ\text{C}$)

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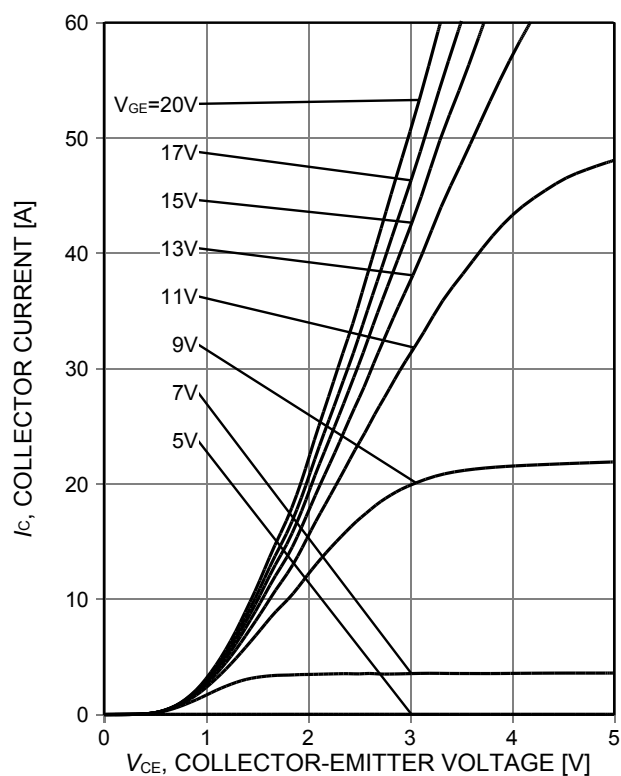


Figure 5. **Typical output characteristic**
($T_{vj}=175^{\circ}\text{C}$)

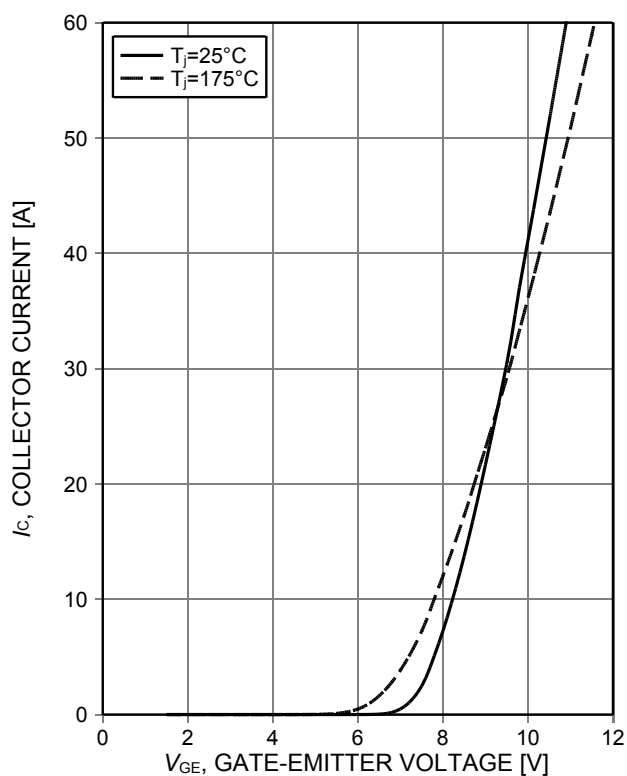


Figure 6. **Typical transfer characteristic**
($V_{CE}=20\text{V}$)

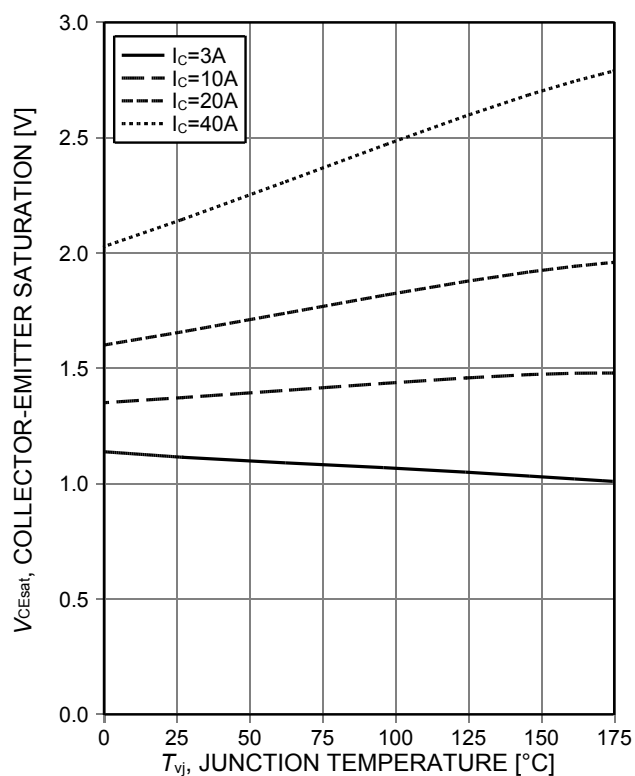


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}=15\text{V}$)

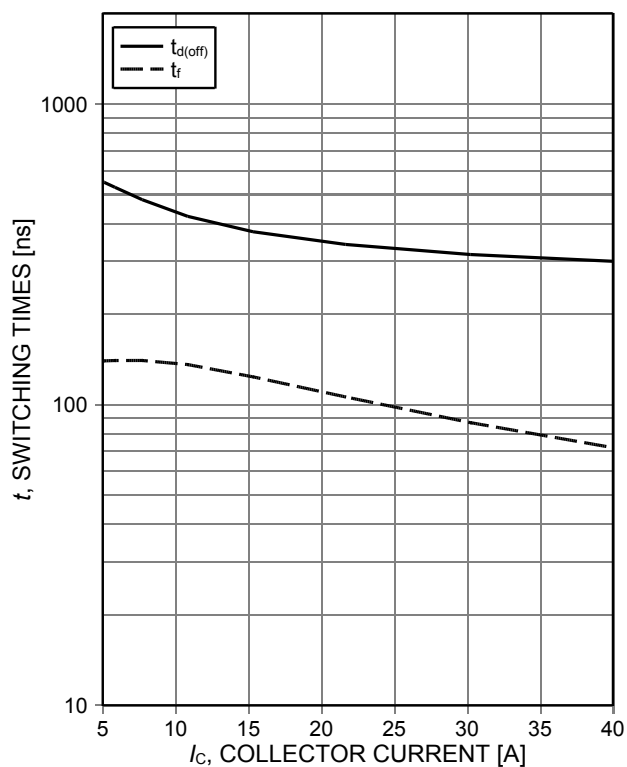


Figure 8. **Typical switching times as a function of collector current**
(inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_{G(on)}=10\Omega$, $R_{G(off)}=10\Omega$, dynamic test circuit in Figure E)

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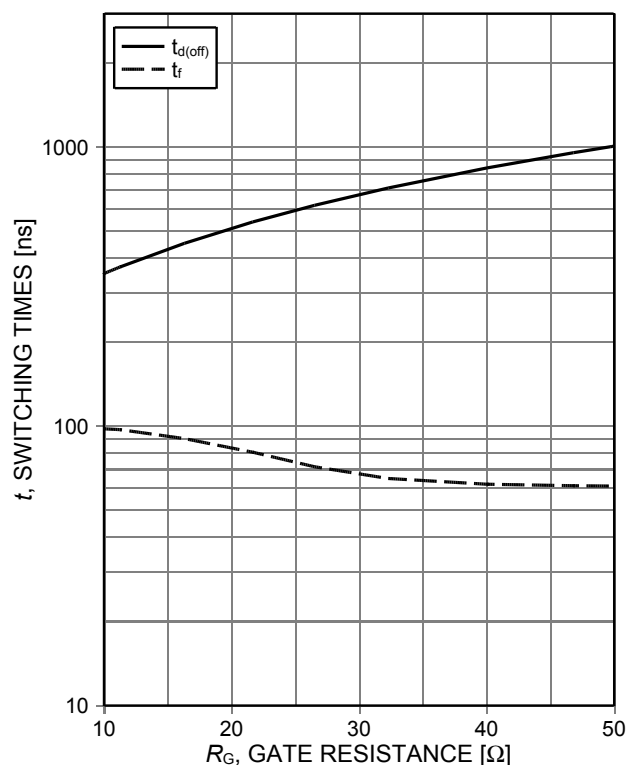


Figure 9. **Typical switching times as a function of gate resistance**
(inductive load, $T_{vj}=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, dynamic test circuit in Figure E)

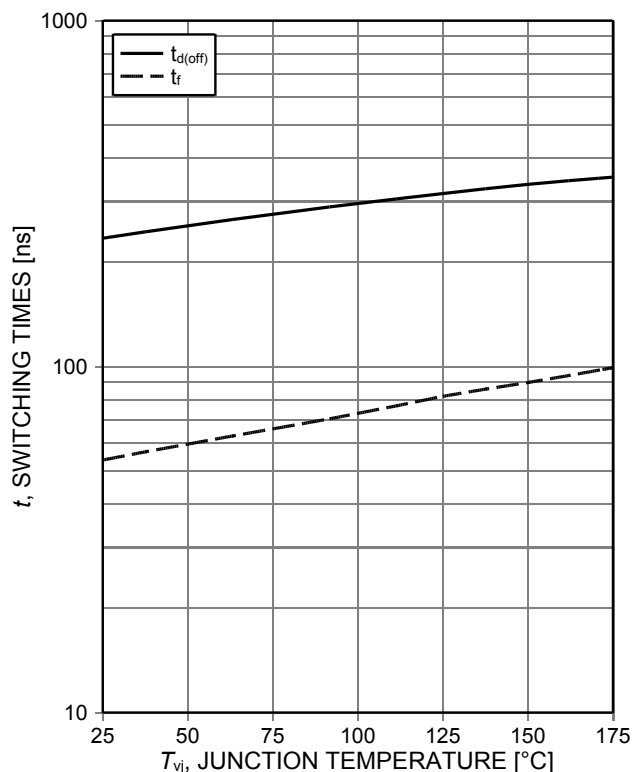


Figure 10. **Typical switching times as a function of junction temperature**
(inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, $R_{G(on)}=10\Omega$, $R_{G(off)}=10\Omega$, dynamic test circuit in Figure E)

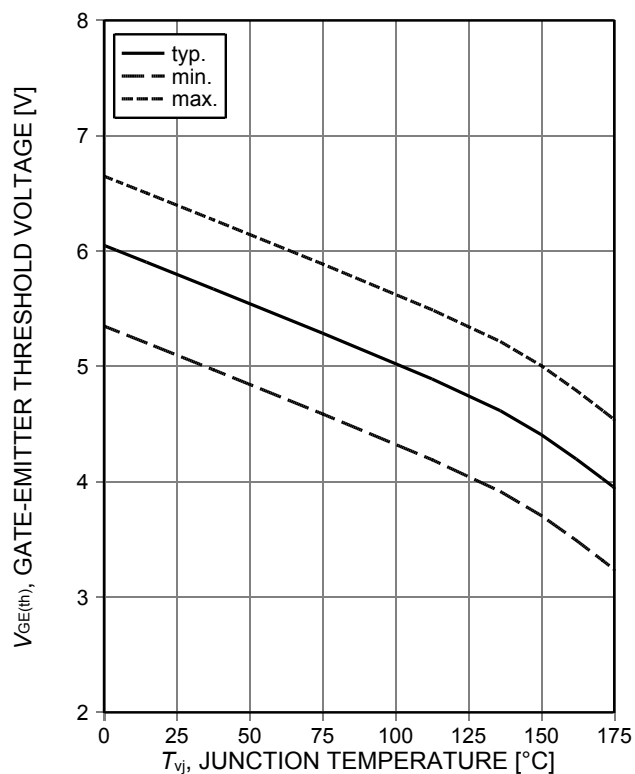


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
($I_C=0.5\text{mA}$, min / max values verified by design)

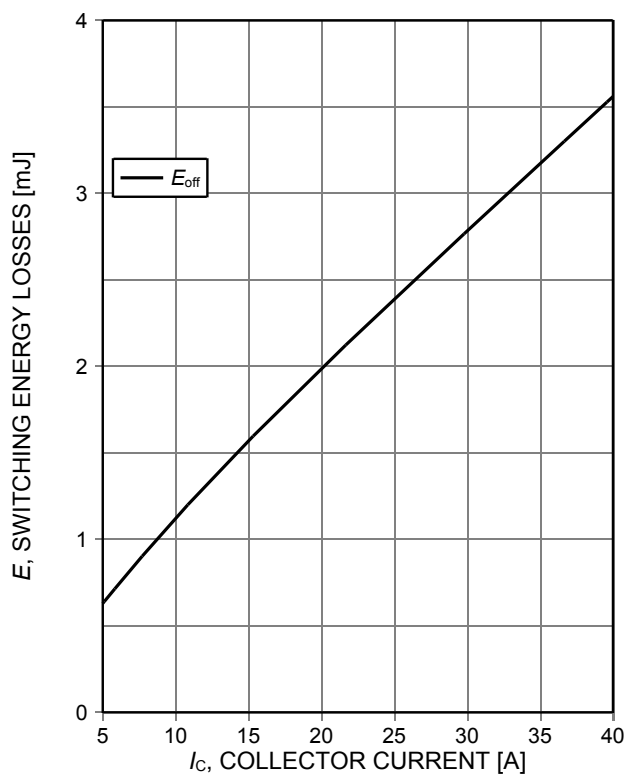


Figure 12. **Typical switching energy losses as a function of collector current**
(inductive load, $T_{vj}=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_{G(on)}=10\Omega$, $R_{G(off)}=10\Omega$, dynamic test circuit in Figure E)

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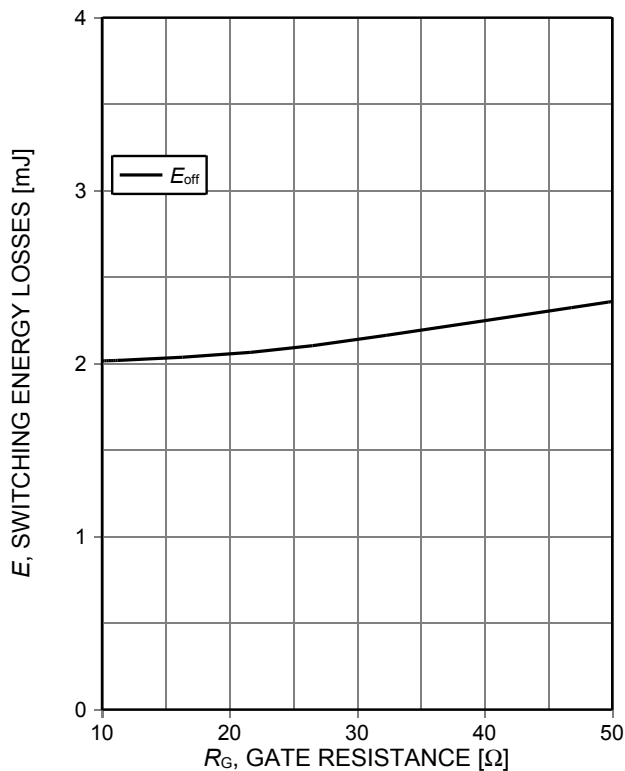


Figure 13. **Typical switching energy losses as a function of gate resistance**
(inductive load, $T_{vj}=175^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, dynamic test circuit in Figure E)

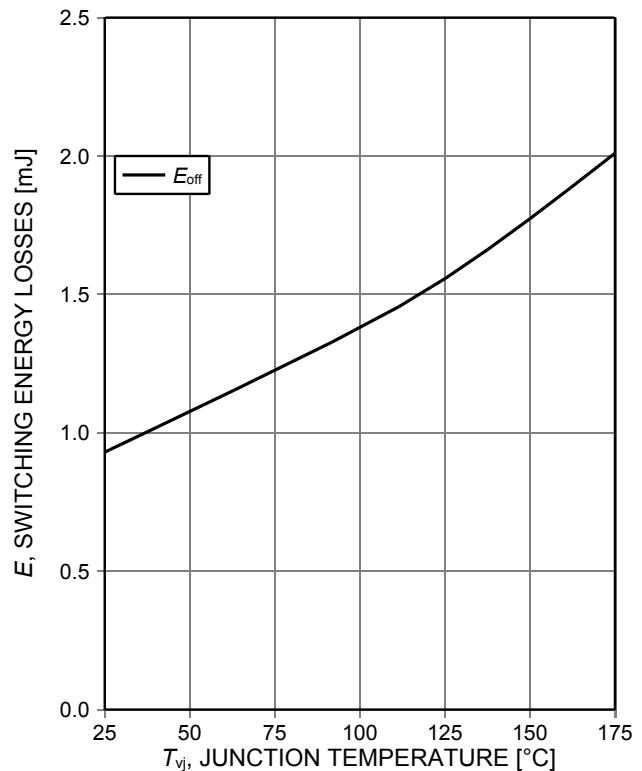


Figure 14. **Typical switching energy losses as a function of junction temperature**
(inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, $R_{G(on)}=10\Omega$, $R_{G(off)}=10\Omega$, dynamic test circuit in Figure E)

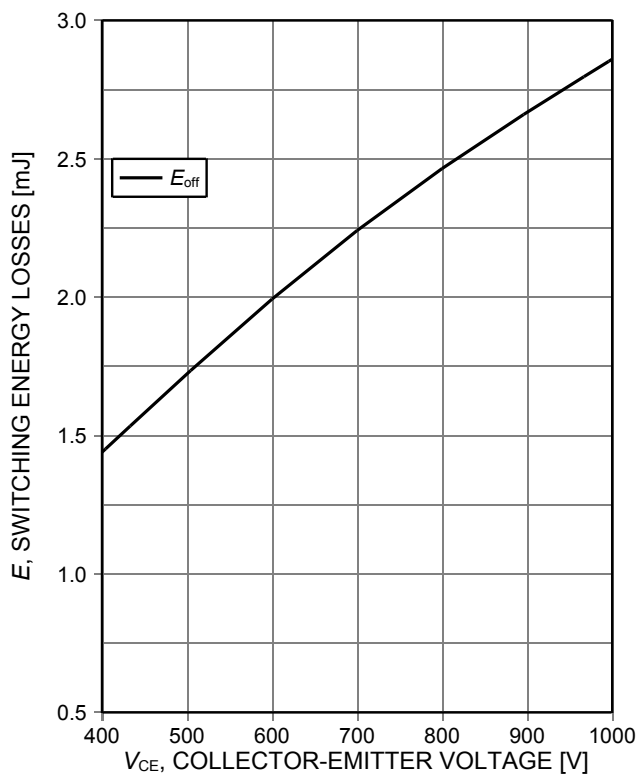


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, $T_{vj}=175^\circ\text{C}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, $R_{G(on)}=10\Omega$, $R_{G(off)}=10\Omega$, dynamic test circuit in Figure E)

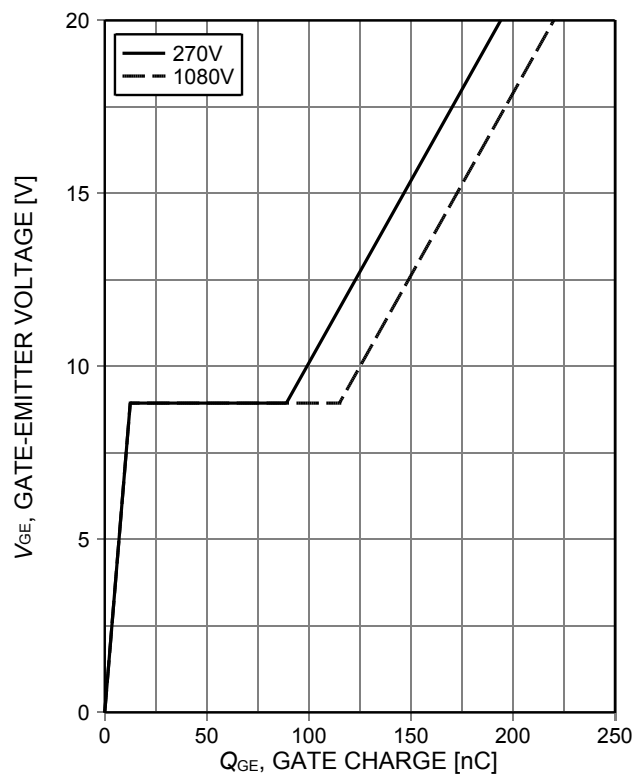


Figure 16. **Typical gate charge**
($I_C=20\text{A}$)

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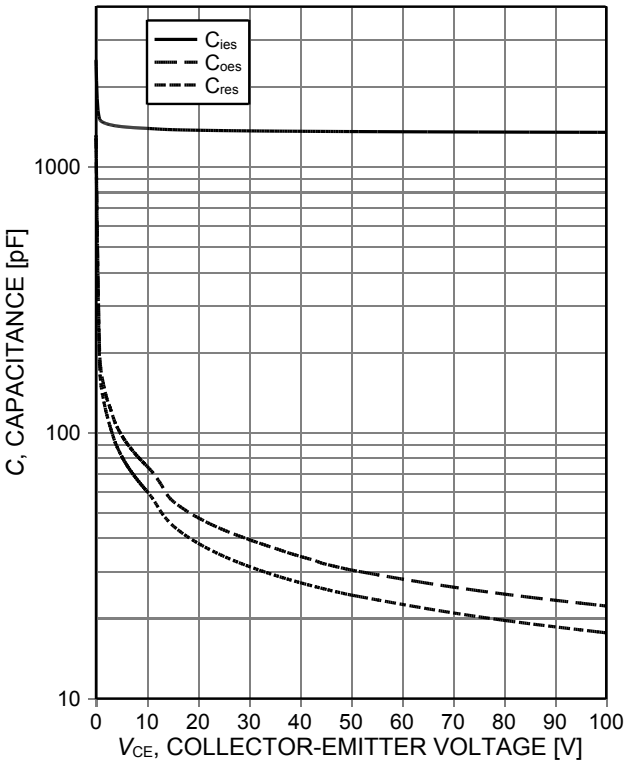


Figure 17. Typical capacitance as a function of collector-emitter voltage ($V_{GE}=0V$, $f=1MHz$)

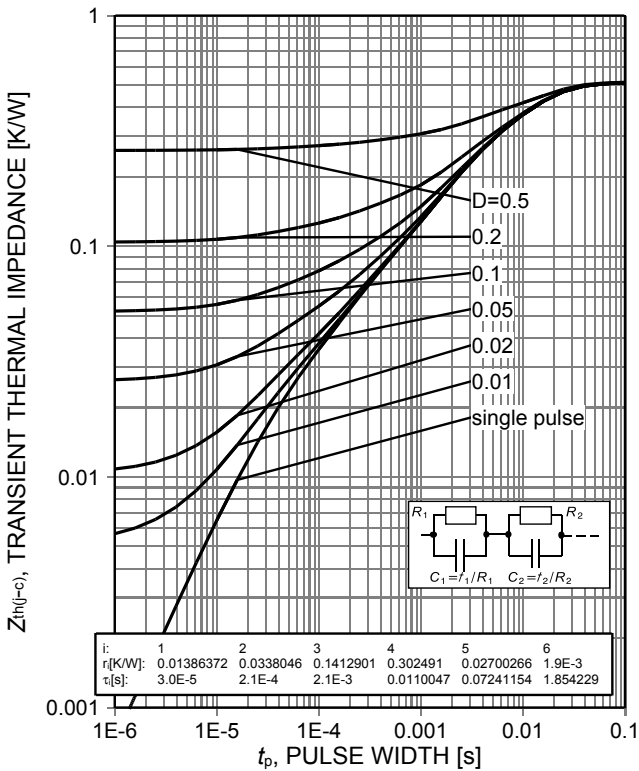


Figure 18. IGBT transient thermal impedance ($D=t_p/T$)

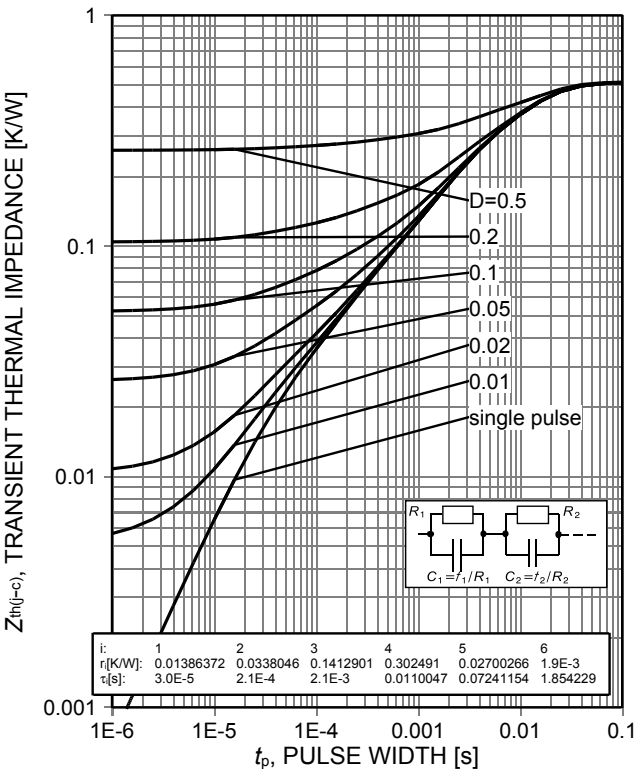


Figure 19. Diode transient thermal impedance as a function of pulse width ($D=t_p/T$)

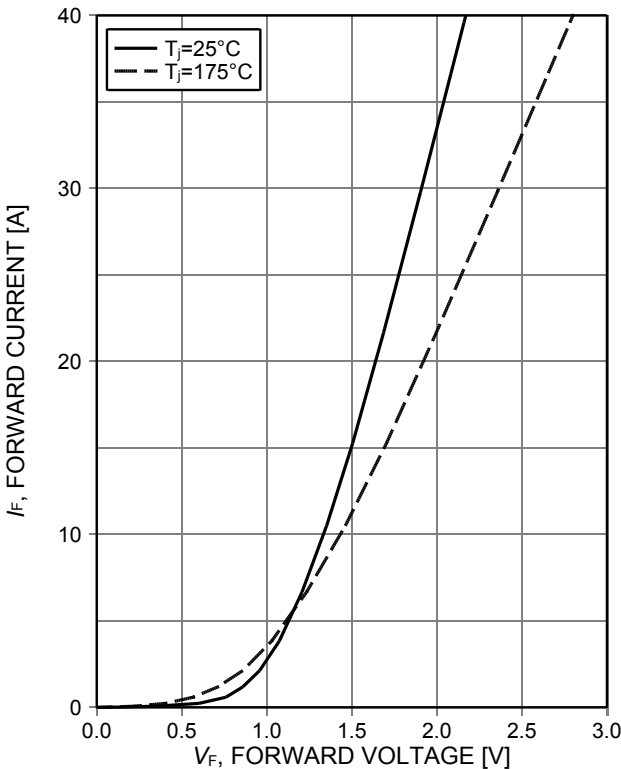


Figure 20. Typical diode forward current as a function of forward voltage

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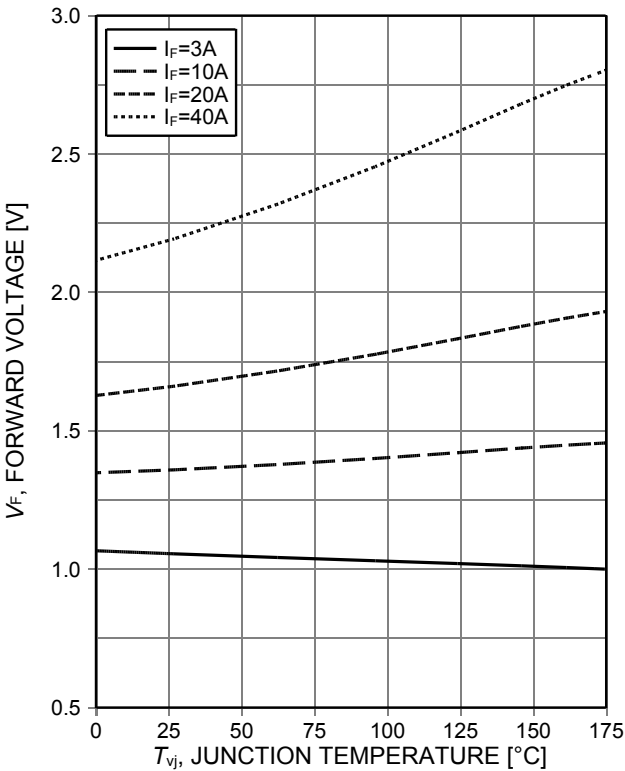
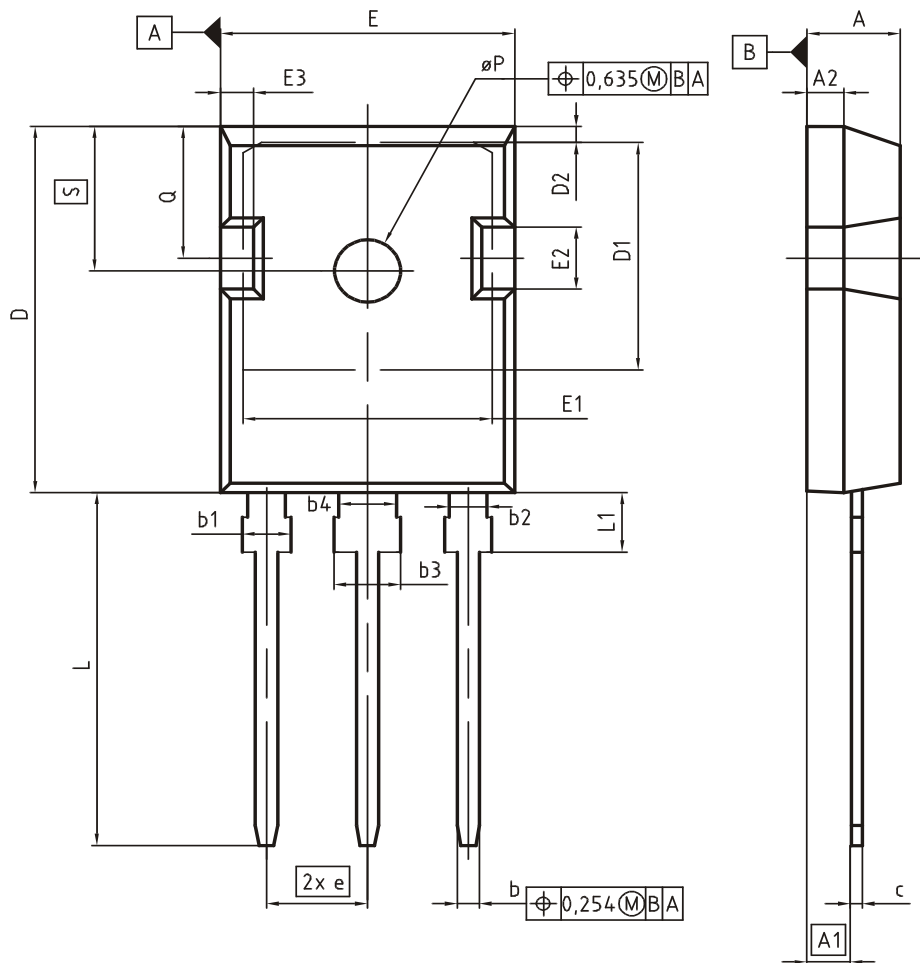


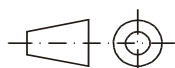
Figure 21. Typical diode forward voltage as a function of junction temperature

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Package Drawing 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

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EUROPEAN PROJECTION 
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REVISION 05

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Testing Conditions

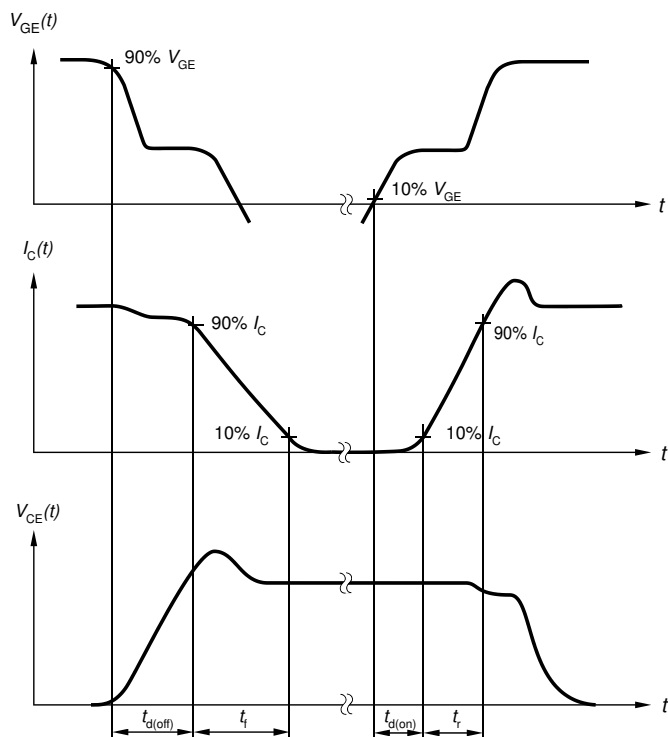


Figure A. Definition of switching times

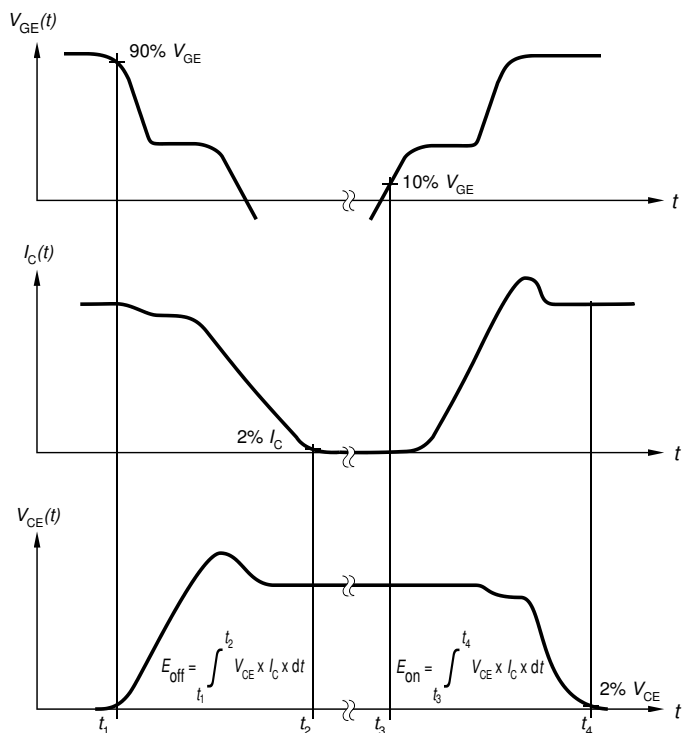


Figure B. Definition of switching losses

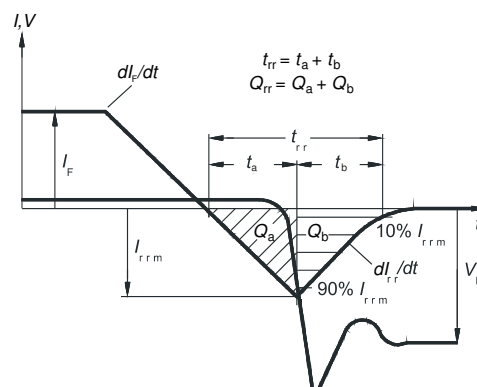


Figure C. Definition of diode switching characteristics

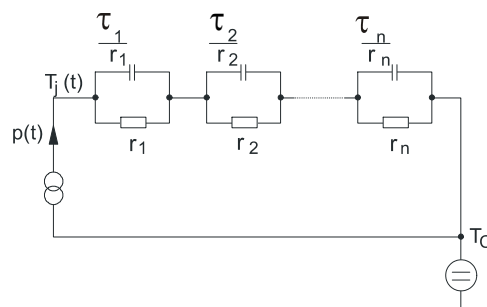


Figure D. Thermal equivalent circuit

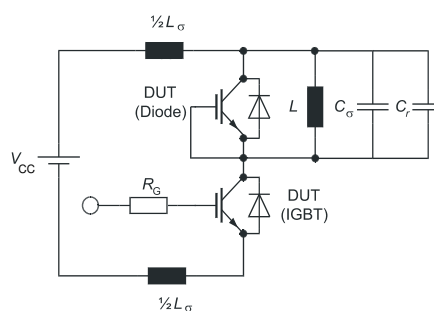


Figure E. **Dynamic test circuit**
 Parasitic inductance L_σ ,
 parasitic capacitor C_σ ,
 relief capacitor C_r ,
 (only for ZVT switching)

Resonant Switching Series**Revision History**

IHW20N135R5**Revision: 2019-09-19, Rev. 2.2**

Previous Revision

Revision	Date	Subjects (major changes since last revision)
1.1	2014-01-23	Preliminary data sheet
2.1	2015-01-26	Final data sheet
2.2	2019-09-19	additional parameter in maximum ratings table: non repetitive peak collector current

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