IGBT

Reverse conducting IGBT

IHW40N60RF

Resonant Switching Series

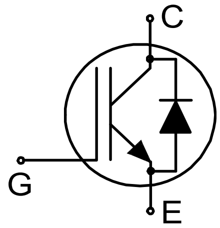
Data sheet

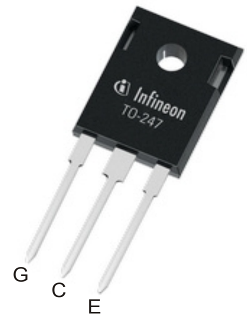
Industrial Power Control

Reverse conducting IGBT

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}
• 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
IHW40N60RF	600V	40A	1.85V	175°C	H40RF60	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, $T_{vj} \geq 25°C$	V_{CE}	600	V
DC collector current, limited by T_{vjmax} $T_C = 25°C$ $T_C = 100°C$	I_C	 80.0 40.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	120.0	A
Turn off safe operating area $V_{CE} \leq 600V$, $T_{vj} \leq 175°C$, $t_p = 1µs$	-	120.0	A
Diode forward current, limited by T_{vjmax} $T_C = 25°C$ $T_C = 100°C$	I_F	 80.0 40.0	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	120.0	A
Gate-emitter voltage	V_{GE}	±20	V
Power dissipation $T_C = 25°C$ Power dissipation $T_C = 100°C$	P_{tot}	305.0 152.5	W
Operating junction temperature	T_{vj}	-40...+175	°C
Storage temperature	T_{stg}	-55...+150	°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	$R_{th(j-c)}$		0.49	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		0.49	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		40	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	600	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 40.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.85 2.30	2.40 -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 40.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.75 2.00	2.20 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.58mA, V_{CE} = V_{GE}	4.1	4.9	5.7	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 600V, V_{GE} = 0V T_{vj} = 25°C T_{vj} = 175°C	- -	- -	40.0 3000.0	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 40.0A	-	24.0	-	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	-	2400	-	pF
Output capacitance	C_{oes}		-	88	-	
Reverse transfer capacitance	C_{res}		-	68	-	
Gate charge	Q_G	V_{CC} = 480V, I_C = 40.0A, V_{GE} = 15V	-	220.0	-	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.	
IGBT Characteristic, at T_{vj} = 25°C						
Turn-off delay time	$t_{d(off)}$	T_{vj} = 25°C, V_{CC} = 400V, I_C = 40.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 5.6Ω, $R_{G(off)}$ = 5.6Ω, $L\sigma$ = 90nH, $C\sigma$ = 67pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	175	-	ns
Fall time	t_f		-	14	-	ns
Turn-off energy	E_{off}		-	0.56	-	mJ

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at T_{vj} = 125°C						
Turn-off delay time	$t_{d(off)}$	T_{vj} = 125°C, V_{CC} = 400V, I_C = 40.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 5.6Ω, $R_{G(off)}$ = 5.6Ω, $L\sigma$ = 90nH, $C\sigma$ = 67pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	205	-	ns
Fall time	t_f		-	23	-	ns
Turn-off energy	E_{off}		-	0.79	-	mJ

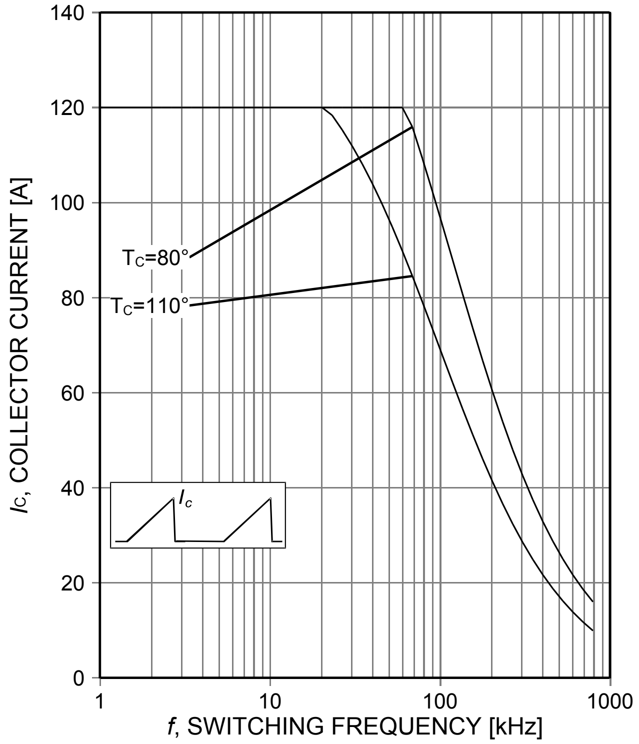

Figure 1. **Collector current as a function of switching frequency**
(T_{vj}≤175°C, D=0.5, V_{CE}=400V, V_{GE}=0/15V, R_G=5.6Ω)

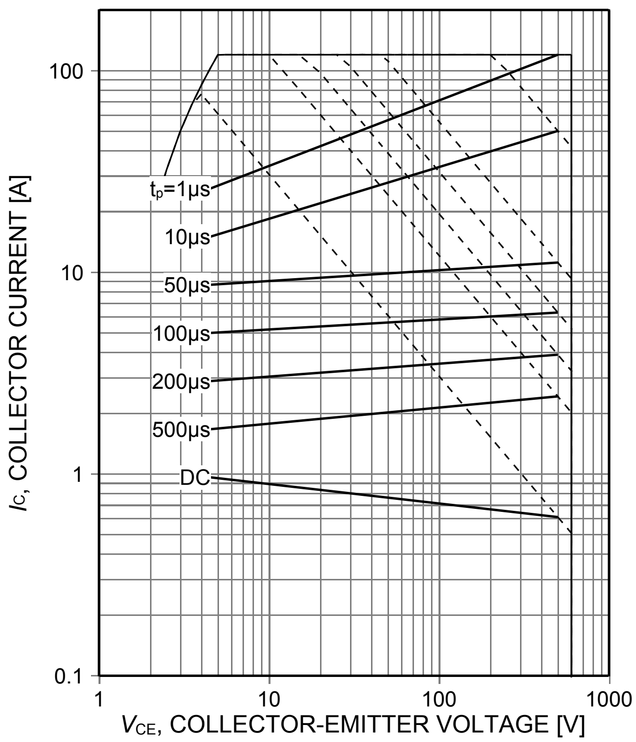

Figure 2. **Forward bias safe operating area**
(D=0, T_C=25°C, T_{vj}≤175°C; V_{GE}=15V)

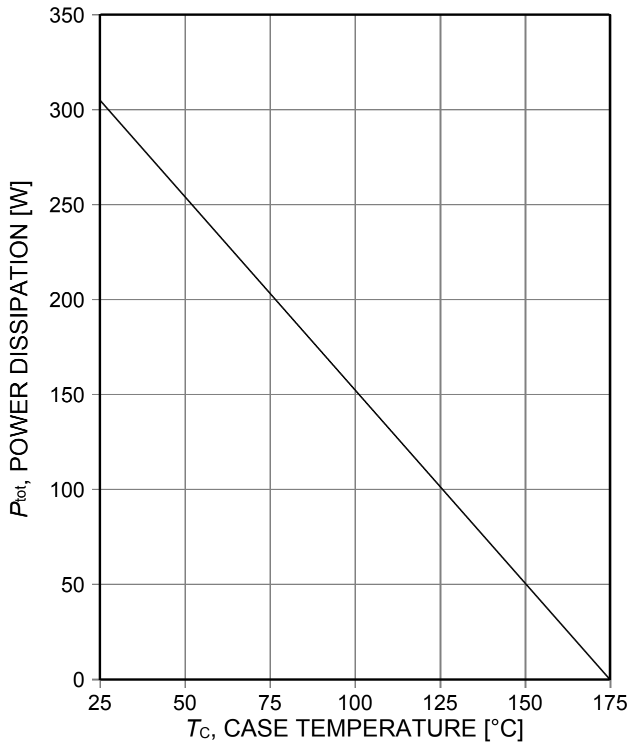

Figure 3. **Power dissipation as a function of case temperature**
(T_{vj}≤175°C)

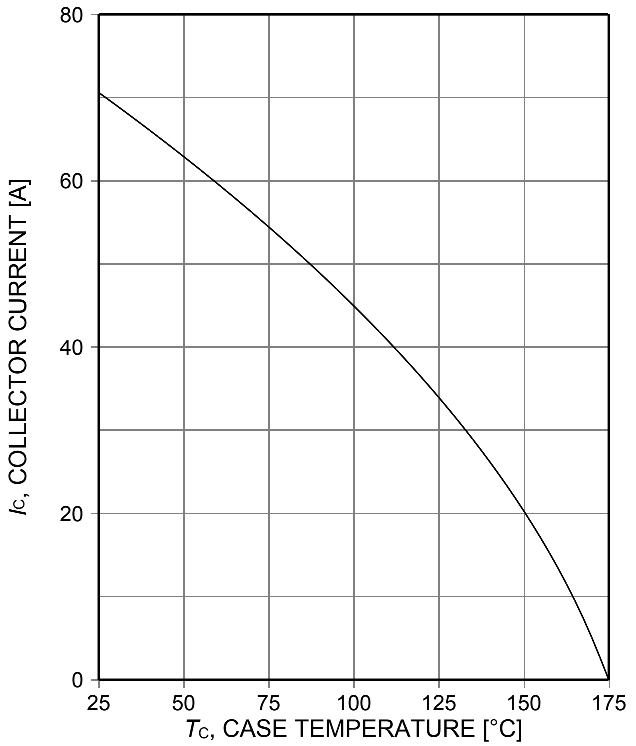

Figure 4. **Collector current as a function of case temperature**
(V_{GE}≥15V, T_{vj}≤175°C)

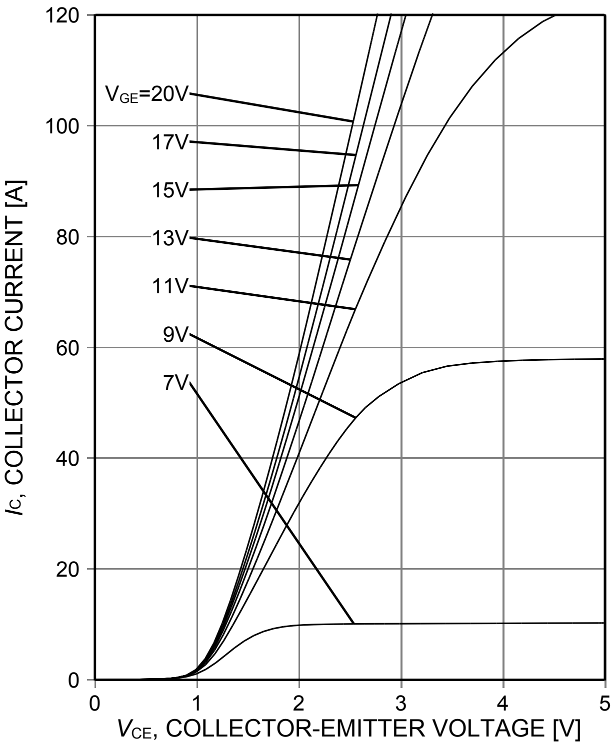

Figure 5. **Typical output characteristic**
(T_{vj}=25°C)

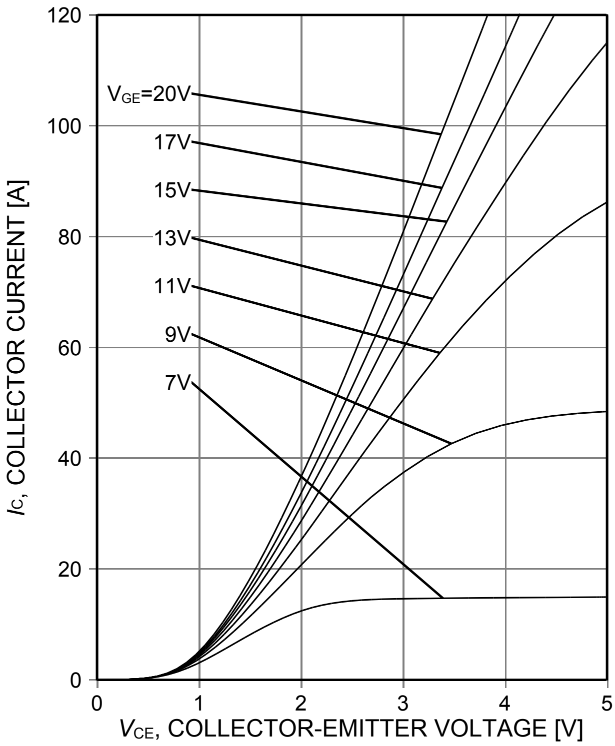

Figure 6. **Typical output characteristic**
(T_{vj}=175°C)

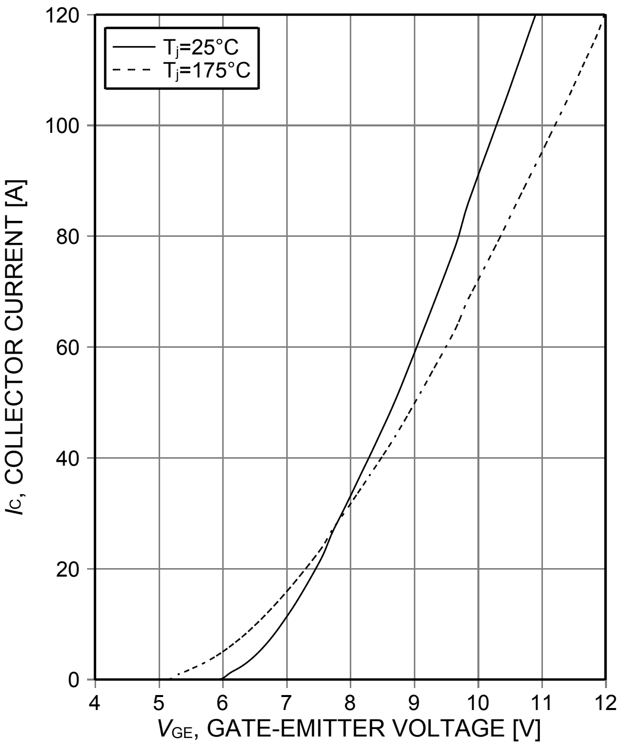

Figure 7. **Typical transfer characteristic**
(V_{CE}=20V)

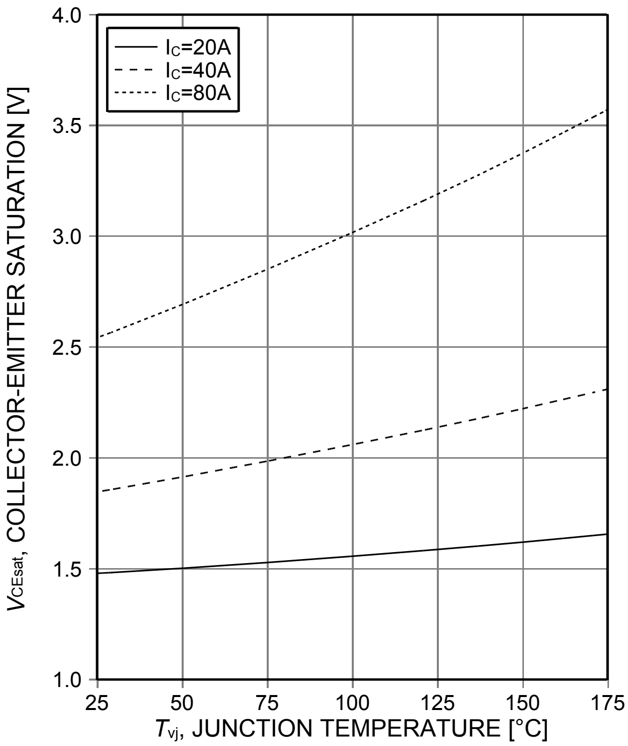

Figure 8. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

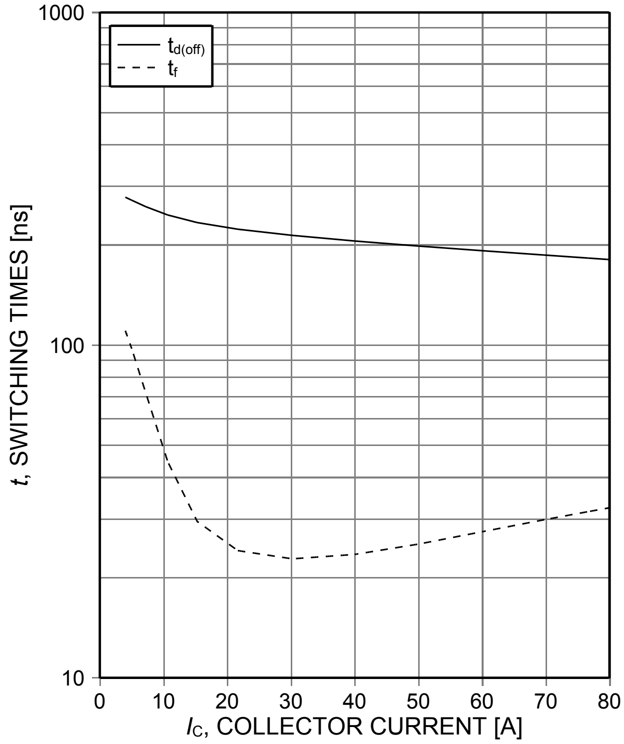

Figure 9. **Typical switching times as a function of collector current**
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=0/15V, $R_{G(on)}$=5.6Ω, $R_{G(off)}$=5.6Ω, dynamic test circuit in Figure E)

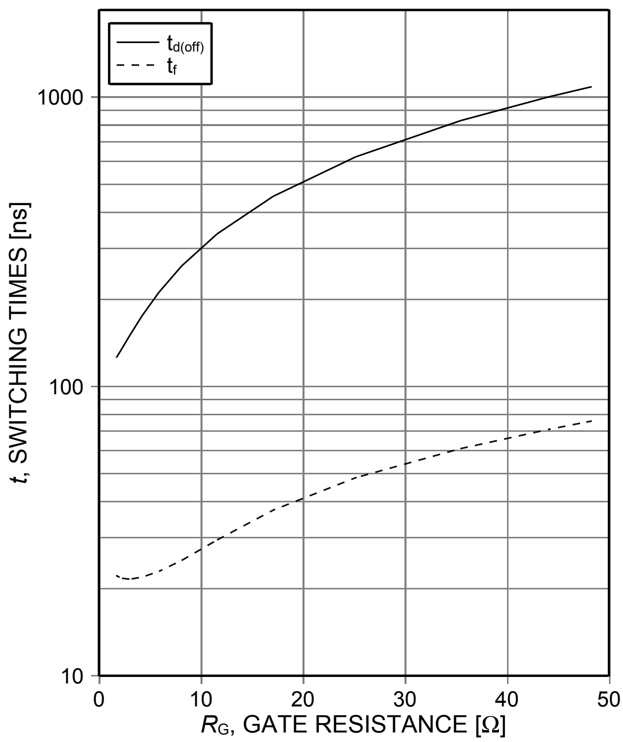

Figure 10. **Typical switching times as a function of gate resistance**
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=0/15V, I_C=40A, dynamic test circuit in Figure E)

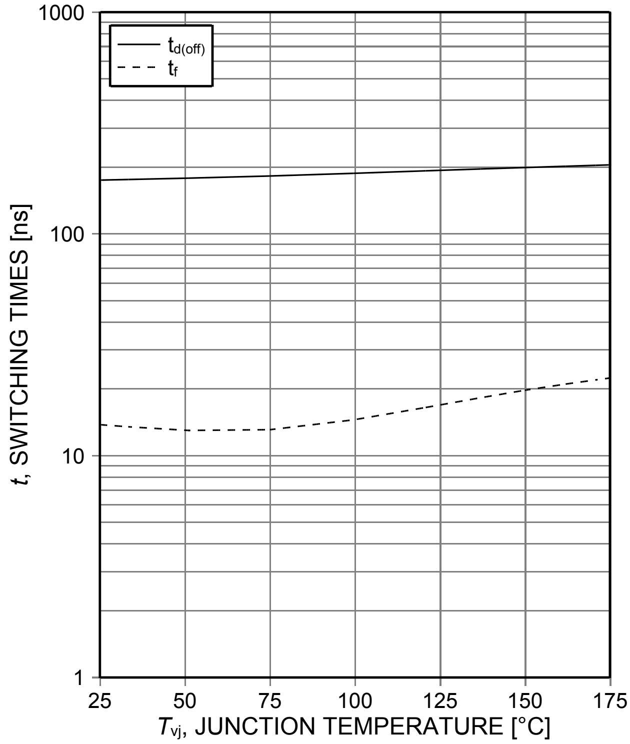

Figure 11. **Typical switching times as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=0/15V, I_C=40A, $R_{G(on)}$=5.6Ω, $R_{G(off)}$=5.6Ω, dynamic test circuit in Figure E)

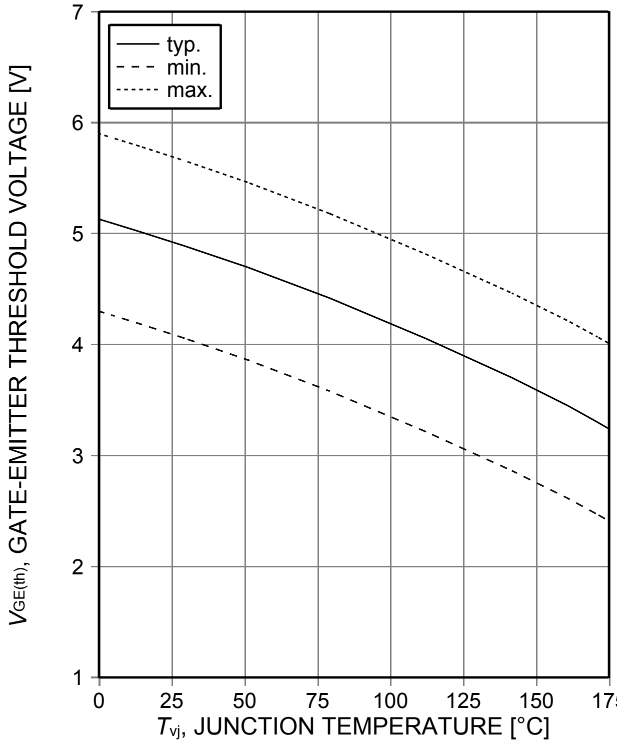

Figure 12. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=0.58mA)

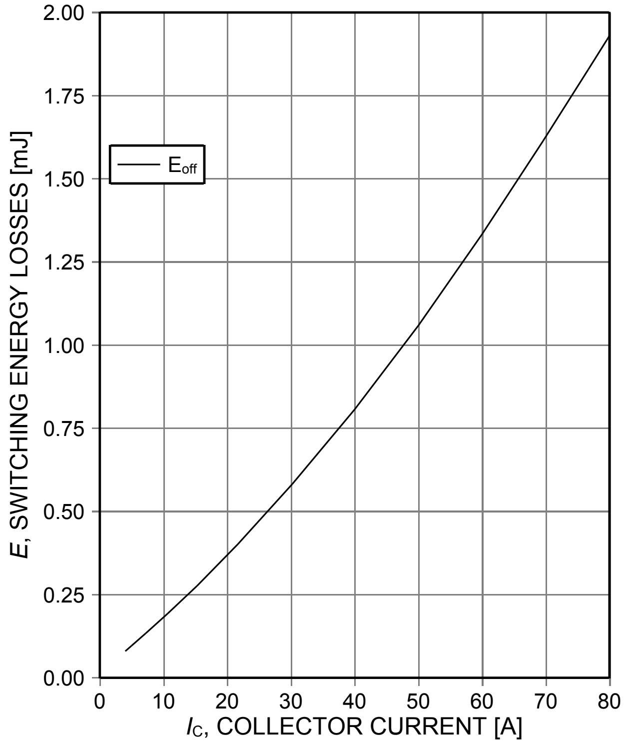

Figure 13. **Typical switching energy losses as a function of collector current**
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=0/15V, $R_{G(on)}$=5.6Ω, $R_{G(off)}$=5.6Ω, dynamic test circuit in Figure E)

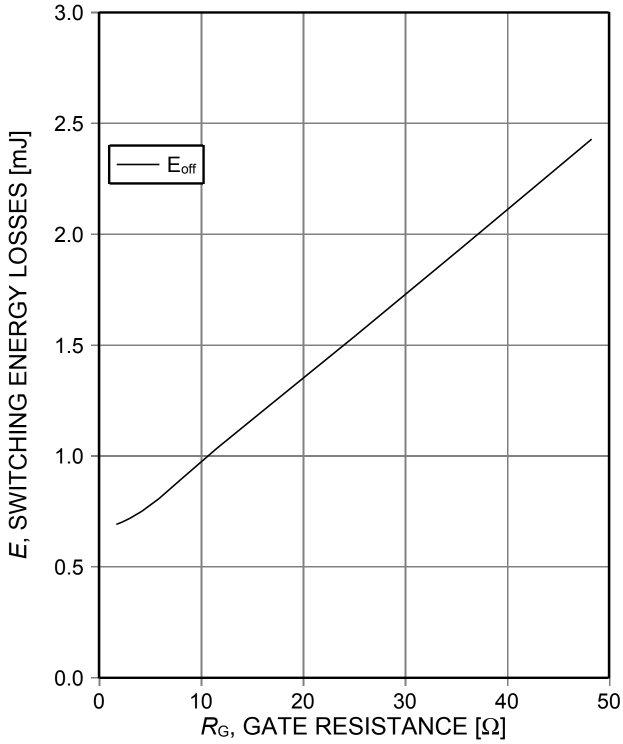

Figure 14. **Typical switching energy losses as a function of gate resistance**
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=0/15V, I_C=40A, dynamic test circuit in Figure E)

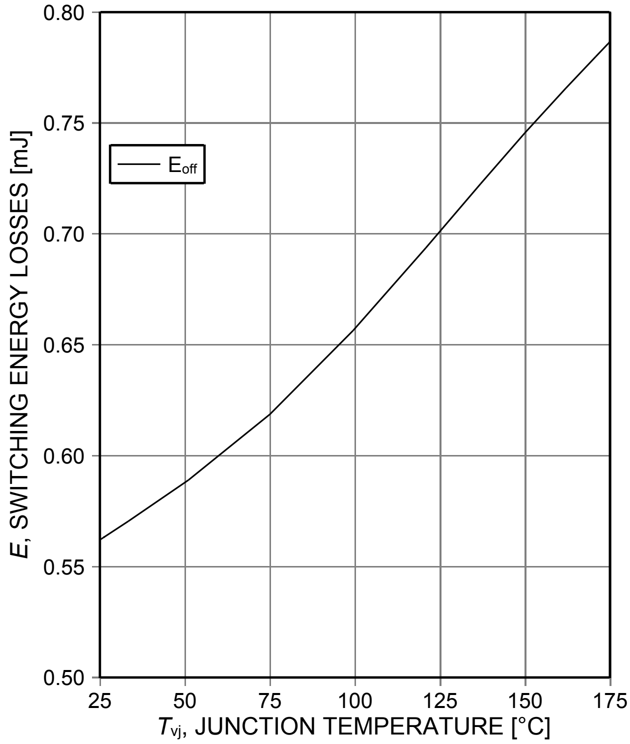

Figure 15. **Typical switching energy losses as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=0/15V, I_C=40A, $R_{G(on)}$=5.6Ω, $R_{G(off)}$=5.6Ω, dynamic test circuit in Figure E)

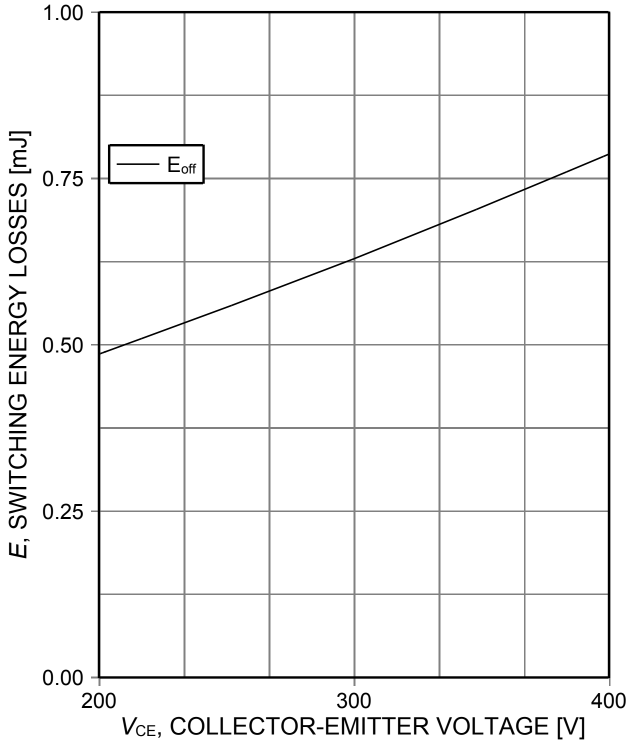

Figure 16. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, T_{vj}=175°C, V_{GE}=0/15V, I_C=40A, $R_{G(on)}$=5.6Ω, $R_{G(off)}$=5.6Ω, dynamic test circuit in Figure E)

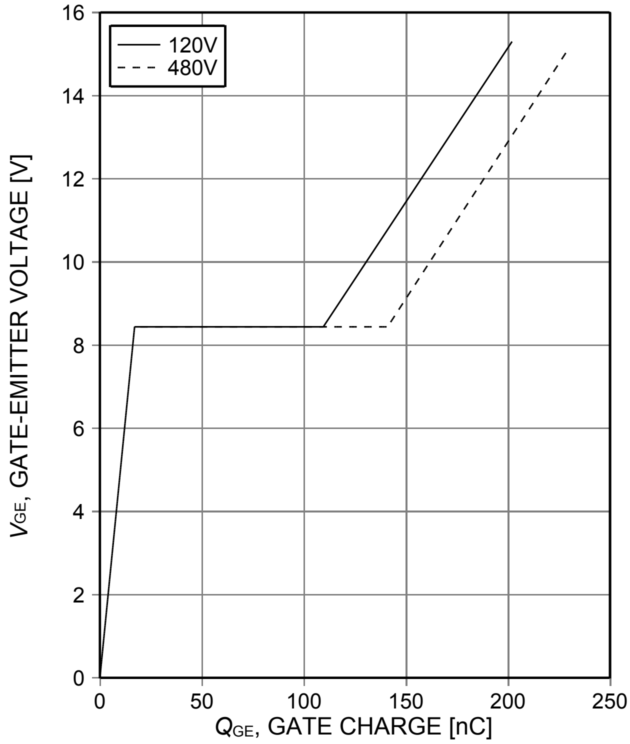

Figure 17. **Typical gate charge**
(I_C=40A)

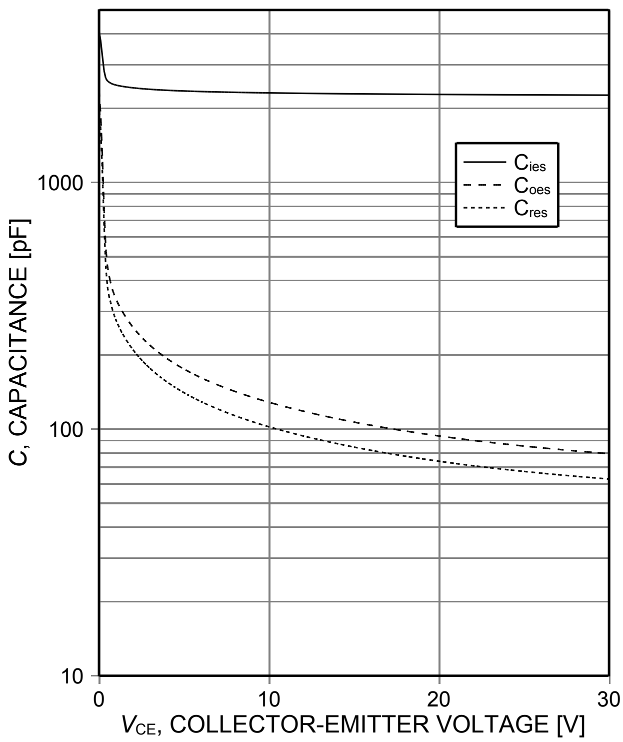

Figure 18. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)

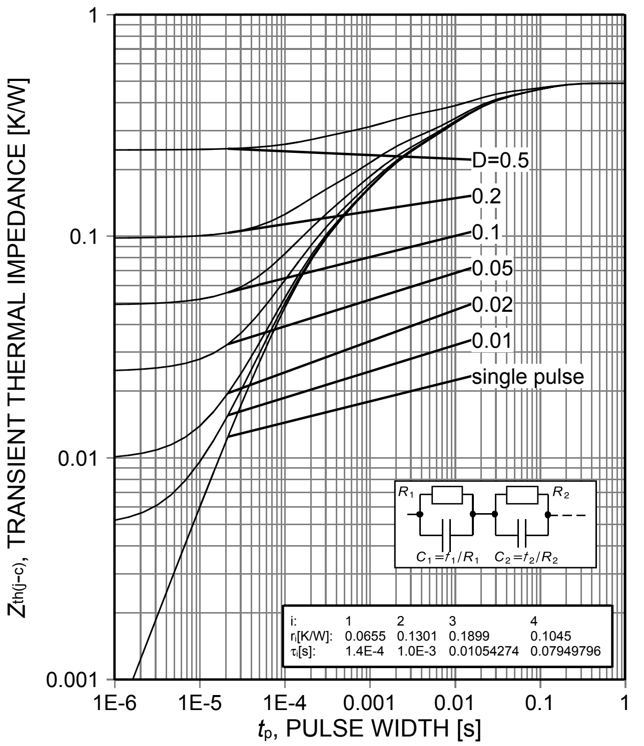

Figure 19. **IGBT transient thermal impedance**
(D=t_p/T)

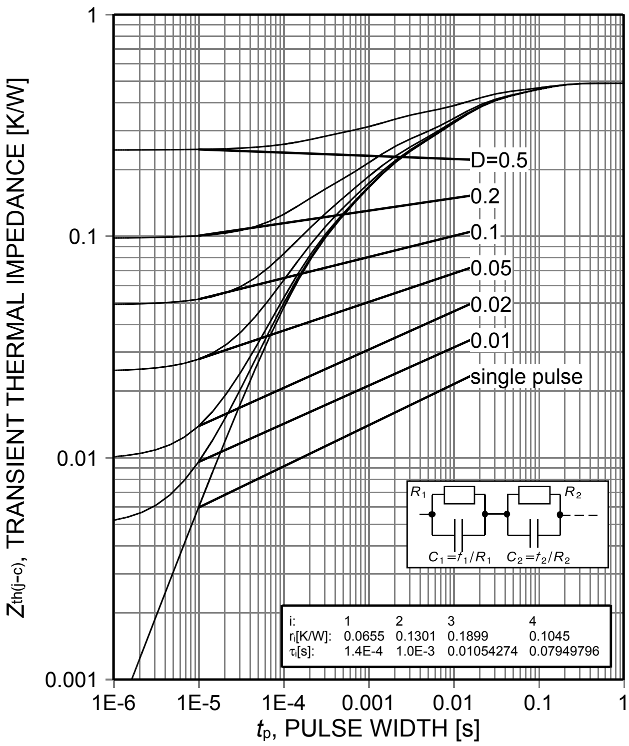

Figure 20. **Diode transient thermal impedance as a function of pulse width**
(D=t_p/T)

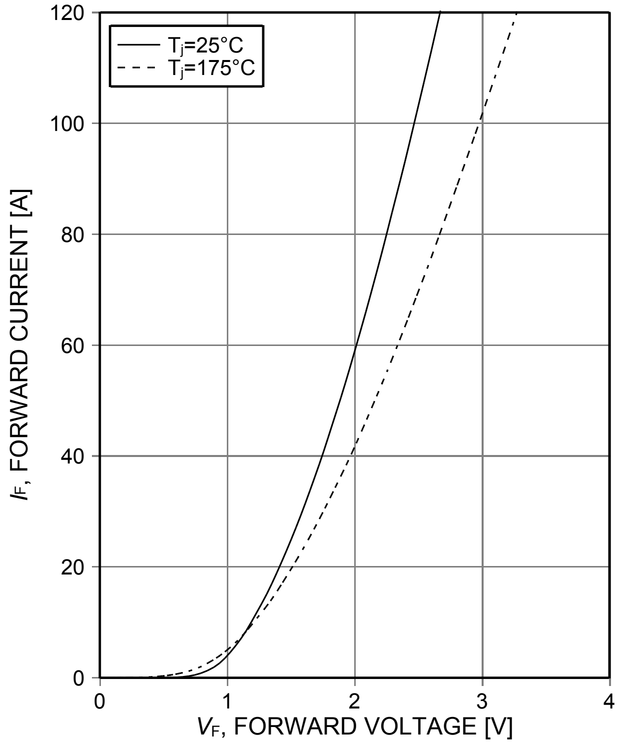

Figure 21. **Typical diode forward current as a function of forward voltage**

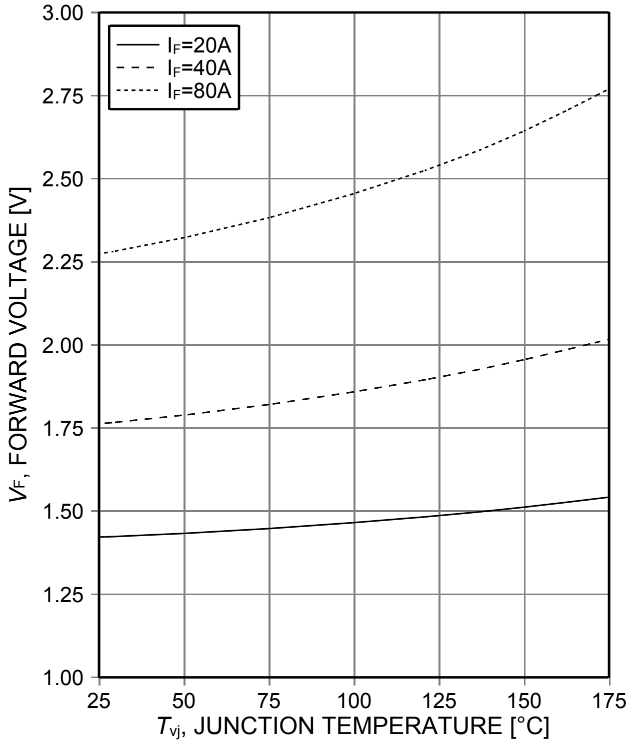

Figure 22. **Typical diode forward voltage as a function of junction temperature**

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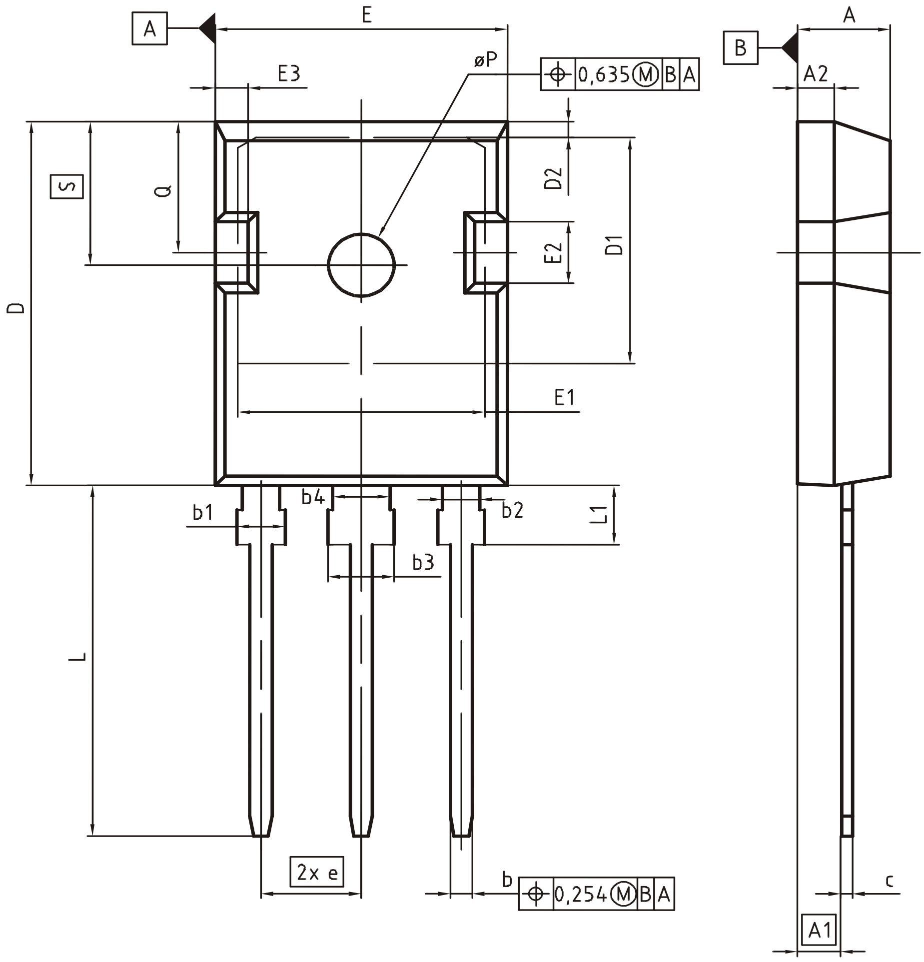


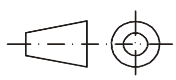
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.27	2.54	0.089	0.100
A2	1.85	2.16	0.073	0.085
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	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

0 5 7.5mm

EUROPEAN PROJECTION



ISSUE DATE
09-07-2010

REVISION
05

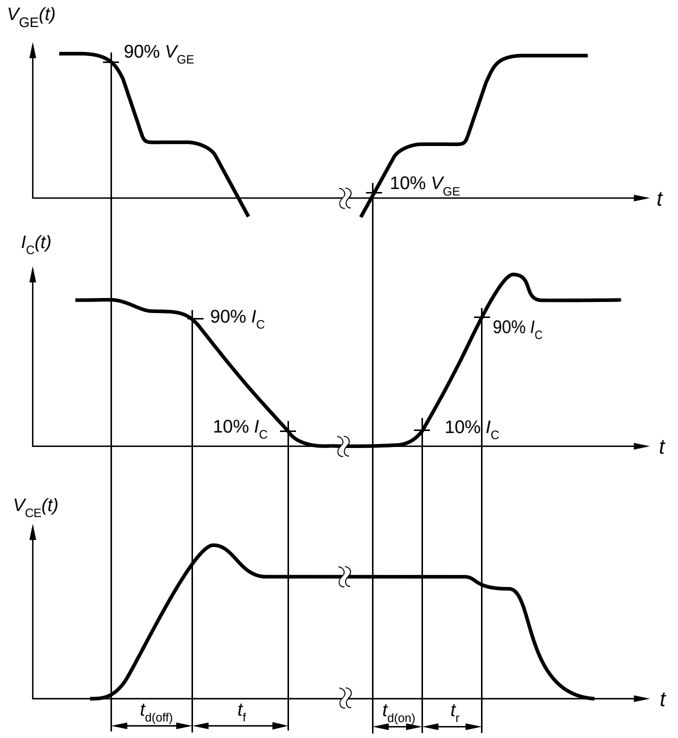


Figure A. **Definition of switching times**

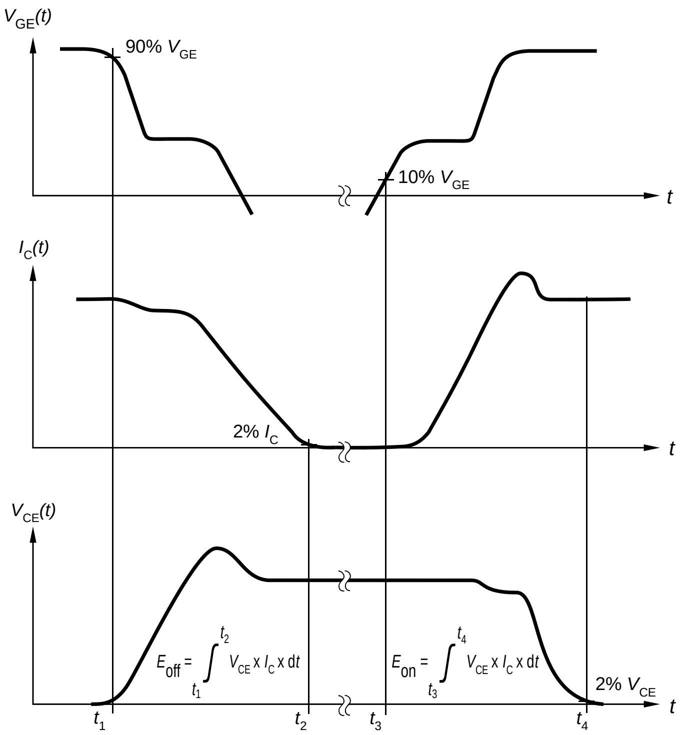


Figure B. **Definition of switching losses**

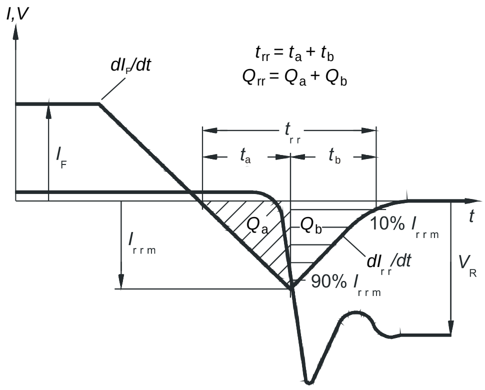


Figure C. **Definition of diode switching characteristics**

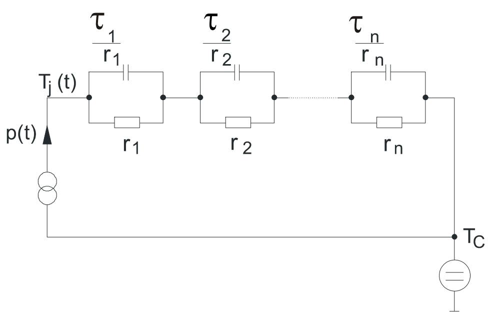


Figure D. **Thermal equivalent circuit**

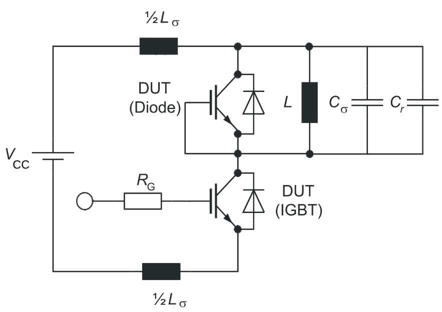


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Revision History

IHW40N60RF

Revision: 2015-01-26, Rev. 2.6

Previous Revision

Revision	Date	Subjects (major changes since last revision)
0.1	2009-06-15	-
0.2	2010-03-02	-
2.3	2010-03-02	-
2.4	2013-12-10	New value ICES max limit at 175°C
2.5	2014-03-12	Storage temp -55...+150°C
2.6	2015-01-26	Minor changes

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