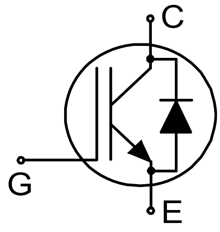
TRENCHSTOP^{TM} RC-Series for hard switching applications

IGBT with integrated diode in packages offering space saving advantage

Features:



TRENCHSTOP^{TM} Reverse Conducting (RC) technology for 600V applications offering

- Optimised V_{CEsat} and V_F for low conduction losses
- Smooth switching performance leading to low EMI levels
- Very tight parameter distribution
- Operating range of 1 to 20kHz
- Maximum junction temperature 175°C
- Dynamically stress tested
- Short circuit capability of 5µs
- Best in class current versus package size performance
- Qualified according to AECQ101
- Pb-free lead plating; RoHS compliant (for PG-TO252: solder temperature 260°C, MSL1)

  Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/

Applications:

- HID lighting
- Piezo injection

Key Performance and Package Parameters

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
AIHD10N60R	600V	10A	1.65V	175°C	AH10DR	PG-TO252-3

Table of Contents

TRENCHSTOP™ RC-Series for hard switching applications

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	600	V
DC collector current, limited by T_{vjmax} T_C = 25°C T_C = 100°C	I_C	 20.0 10.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	30.0	A
Turn off safe operating area $V_{CE} \leq$ 600V, $T_{vj} \leq$ 175°C	-	30.0	A
Diode forward current, limited by T_{vjmax} T_C = 25°C T_C = 100°C	I_F	 20.0 10.0	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	30.0	A
Gate-emitter voltage	V_{GE}	±20	V
Short circuit withstand time V_{GE} = 15.0V, $V_{CC} \leq$ 400V Allowed number of short circuits < 1000 Time between short circuits: ≥ 1.0s T_{vj} = 150°C	t_{SC}	 5	µs
Power dissipation T_C = 25°C	P_{tot}	150.0	W
Operating junction temperature	T_{vj}	-40...+175	°C
Storage temperature	T_{stg}	-55...+175	°C
Soldering temperature, reflow soldering (MSL1 according to JEDEC J-STA-020)		 260	°C

Thermal Resistance

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
R_{th} Characteristics						
IGBT thermal resistance,[1] junction - case	$R_{th(j-c)}$		-	-	1.00	K/W
Diode thermal resistance,[2] junction - case	$R_{th(j-c)}$		-	-	2.60	K/W
Thermal resistance, min. footprint junction - ambient	$R_{th(j-a)}$		-	-	75	K/W
Thermal resistance, 6cm² Cu on PCB junction - ambient	$R_{th(j-a)}$		-	-	50	K/W

[1] Rth/Zth based on single cooling pulse. Please be aware that a correct Rth measurement of the IGBT, is not possible using a thermocouple.
[2] Rth/Zth based on single cooling pulse. Please be aware that a correct Rth measurement of the Diode, is not possible using a thermocouple.

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 = 0.20mA	600	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 10.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.65 1.85	2.10 -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 10.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.70 1.70	2.10 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.17mA, V_{CE} = V_{GE}	4.3	5.0	5.7	V
Zero gate voltage collector current[1)]	I_{CES}	V_{CE} = 600V, V_{GE} = 0V T_{vj} = 25°C T_{vj} = 175°C	- -	- 440	40 -	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 10.0A	-	6.1	-	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}	V_{CE} = 25V, V_{GE} = 0V, f = 1MHz	-	655	-	pF
Output capacitance	C_{oes}		-	37	-	
Reverse transfer capacitance	C_{res}		-	22	-	
Gate charge	Q_G	V_{CC} = 480V, I_C = 10.0A, V_{GE} = 15V	-	64.0	-	nC
Short circuit collector current Max. 1000 short circuits Time between short circuits: ≥ 1.0s	$I_{C(SC)}$	V_{GE} = 15.0V, V_{CC} ≤ 400V, t_{SC} ≤ 5µs T_{vj} = 25°C	-	74	-	A

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value min.	Value typ.	Value max.	Unit
IGBT Characteristic, at T_{vj} = 25°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 400V, I_C = 10.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 23.0Ω, $R_{G(off)}$ = 23.0Ω, $L\sigma$ = 60nH, $C\sigma$ = 40pF $L\sigma$, $C\sigma$ from Fig. E	-	14	-	ns
Rise time	t_r		-	10	-	ns
Turn-off delay time	$t_{d(off)}$		-	192	-	ns
Fall time	t_f		-	139	-	ns
Turn-on energy	E_{on}		-	0.21	-	mJ
Turn-off energy	E_{off}		-	0.38	-	mJ
Total switching energy	E_{ts}		-	0.59	-	mJ

[1)] Not subject to production test - verified by design/characterization

Diode Characteristic, at T_{vj} = 25°C

Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 400V, I_F = 10.0A, di_F/dt = 1000A/µs	-	62	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.56	-	µC
Diode peak reverse recovery current	I_{rrm}		-	20.3	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-260	-	A/µs

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at T_{vj} = 175°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 175°C, V_{CC} = 400V, I_C = 10.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 23.0Ω, $R_{G(off)}$ = 23.0Ω, $L\sigma$ = 60nH, $C\sigma$ = 40pF $L\sigma$, $C\sigma$ from Fig. E	-	13	-	ns
Rise time	t_r		-	11	-	ns
Turn-off delay time	$t_{d(off)}$		-	217	-	ns
Fall time	t_f		-	211	-	ns
Turn-on energy	E_{on}		-	0.35	-	mJ
Turn-off energy	E_{off}		-	0.58	-	mJ
Total switching energy	E_{ts}		-	0.93	-	mJ

Diode Characteristic, at T_{vj} = 175°C

Diode reverse recovery time	t_{rr}	T_{vj} = 175°C, V_R = 400V, I_F = 10.0A, di_F/dt = 1000A/µs	-	98	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.22	-	µC
Diode peak reverse recovery current	I_{rrm}		-	20.5	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-259	-	A/µs

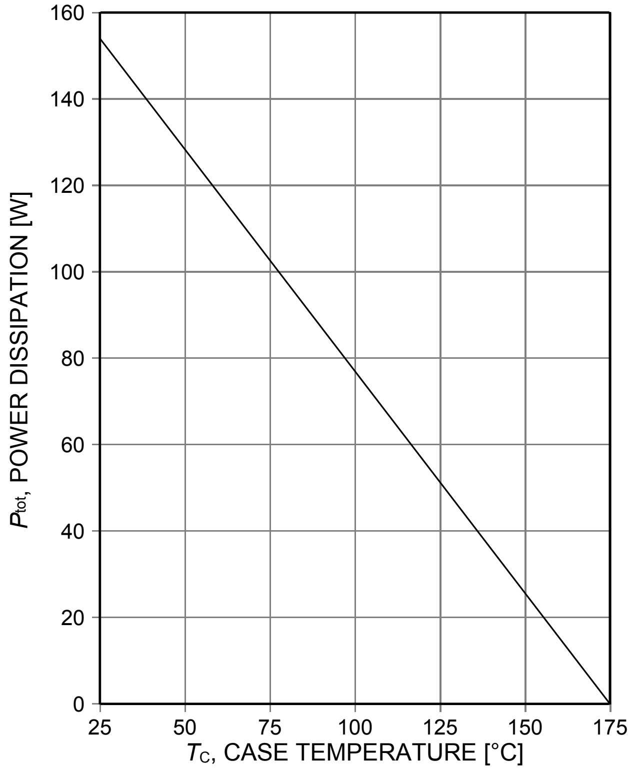


Figure 1. **Power dissipation as a function of case temperature**
(T_{vj}≤175°C)

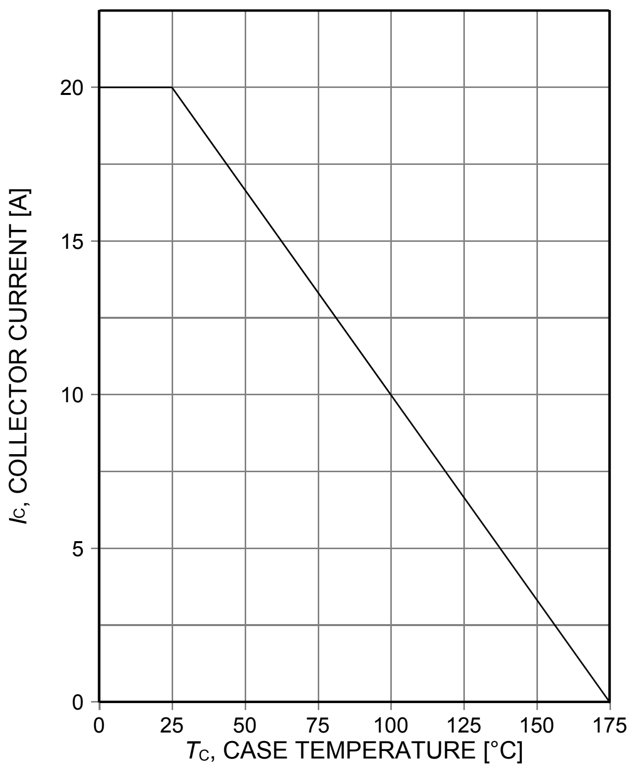


Figure 2. **Collector current as a function of case temperature**
(V_{GE}≥15V, T_{vj}≤175°C)

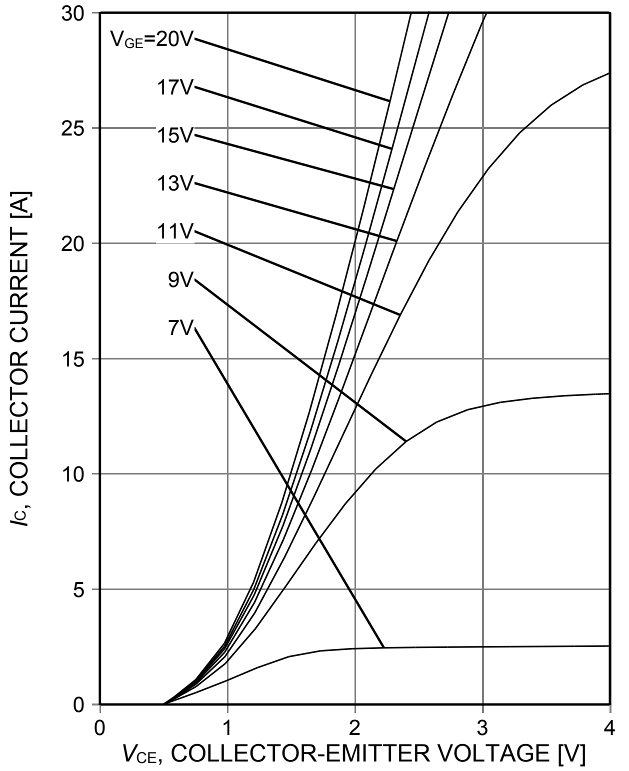


Figure 3. **Typical output characteristic**
(T_{vj}=25°C)

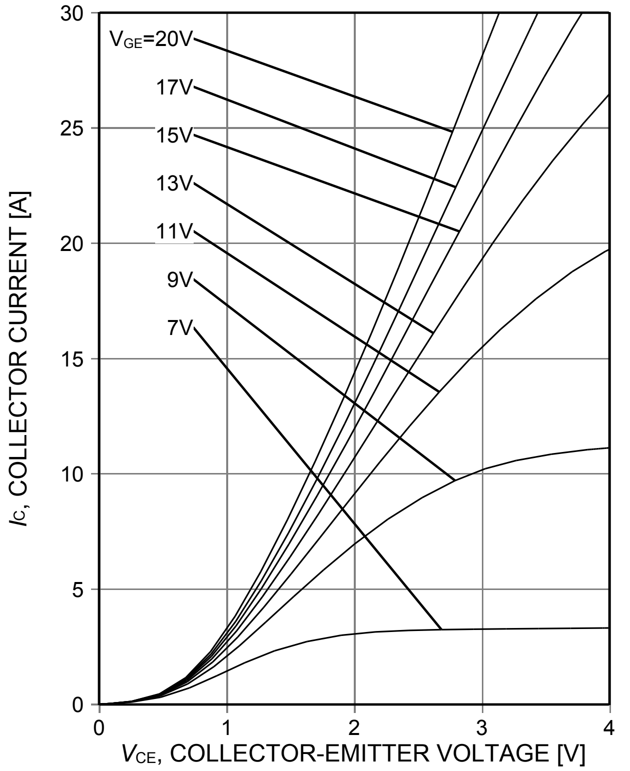


Figure 4. **Typical output characteristic**
(T_{vj}=175°C)

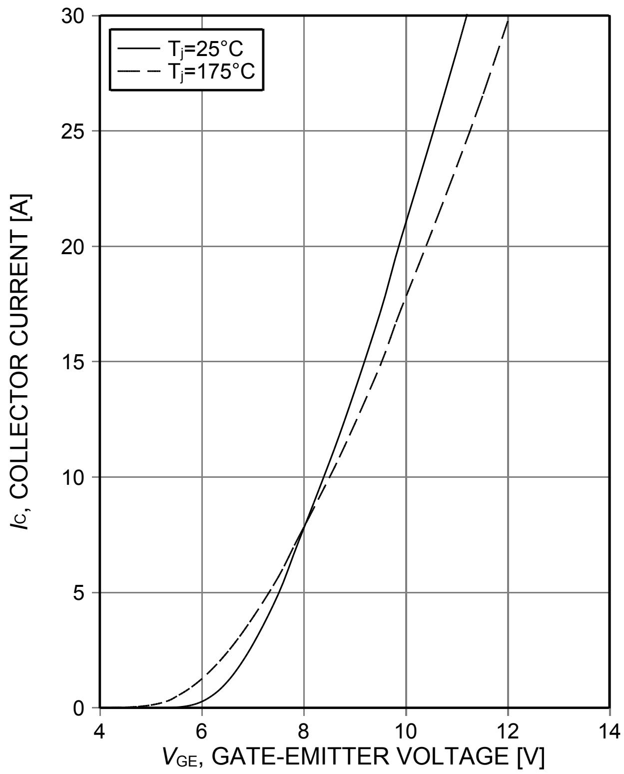


Figure 5. **Typical transfer characteristic**
(V_{CE}=10V)

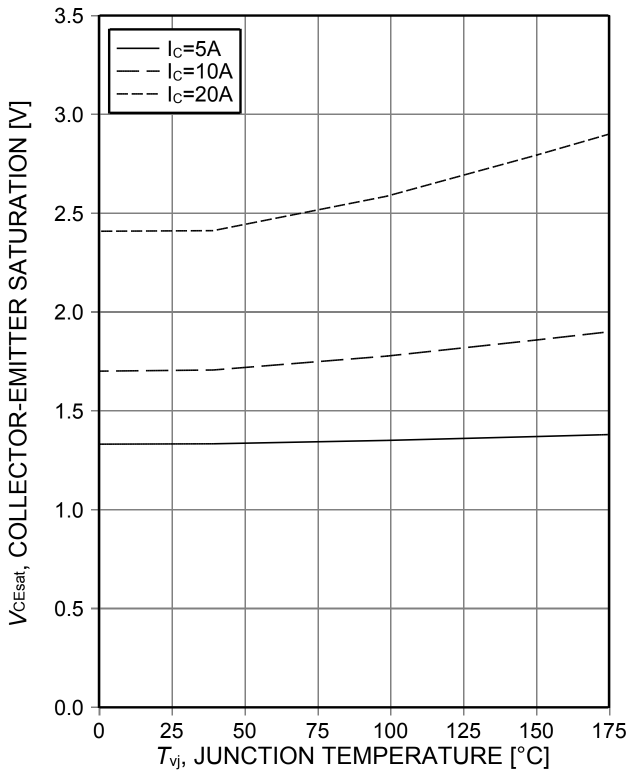


Figure 6. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

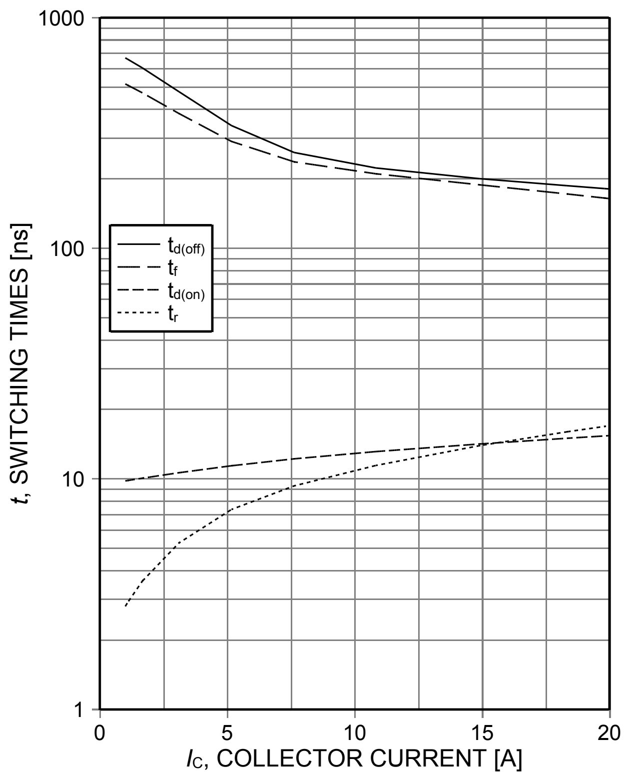


Figure 7. **Typical switching times as a function of collector current**
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=23Ω, Dynamic test circuit in Figure E)

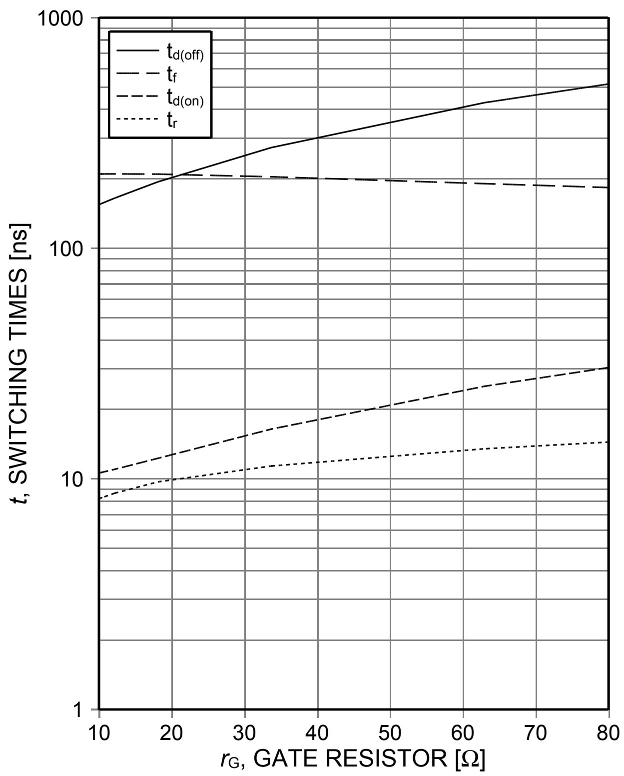


Figure 8. **Typical switching times as a function of gate resistor**
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=10A, Dynamic test circuit in Figure E)

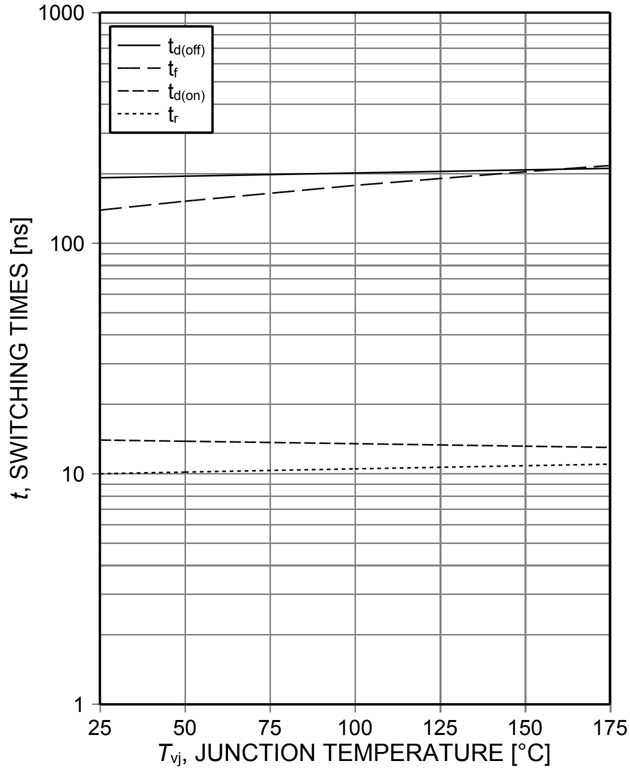


Figure 9. **Typical switching times as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=10A, r_G=23Ω, Dynamic test circuit in Figure E)

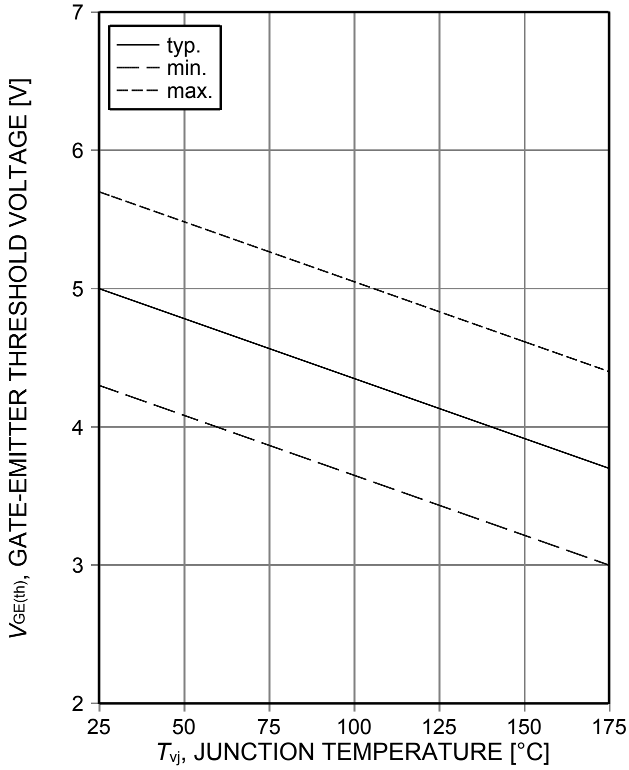


Figure 10. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=0.17mA)

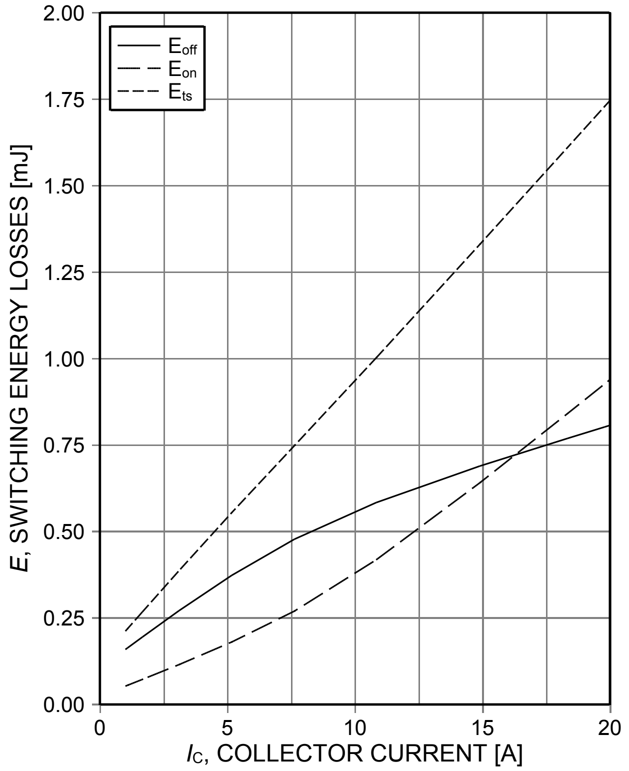


Figure 11. **Typical switching energy losses as a function of collector current**
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=23Ω, Dynamic test circuit in Figure E)

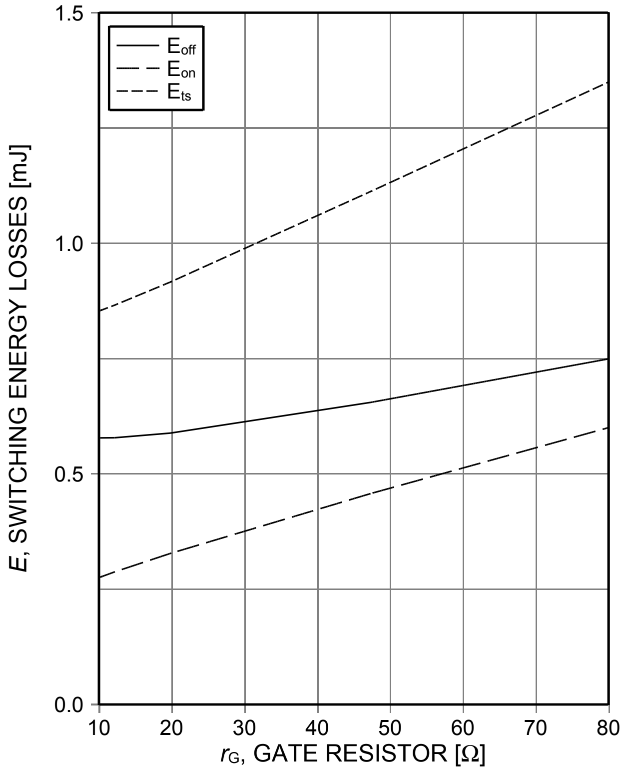


Figure 12. **Typical switching energy losses as a function of gate resistor**
(inductive load, T_{vj}=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=10A, Dynamic test circuit in Figure E)

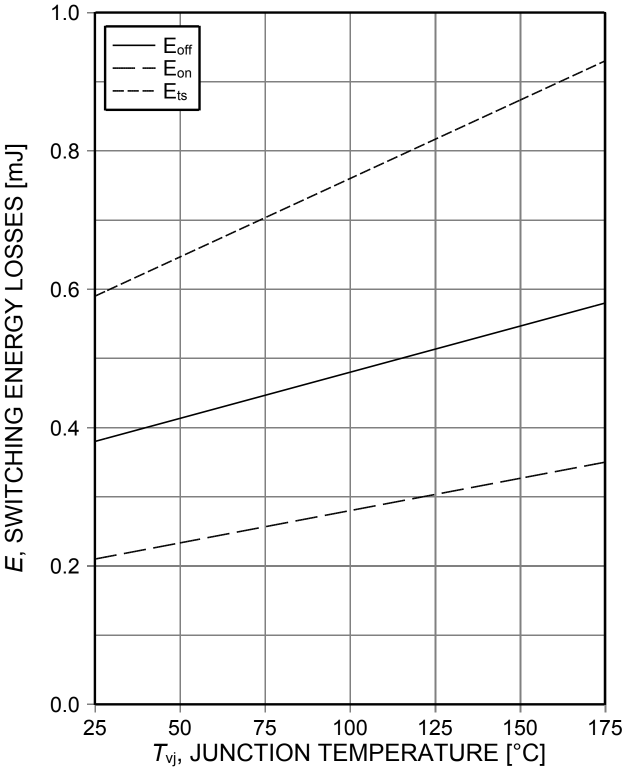


Figure 13. **Typical switching energy losses as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=10A, r_G=23Ω, Dynamic test circuit in Figure E)

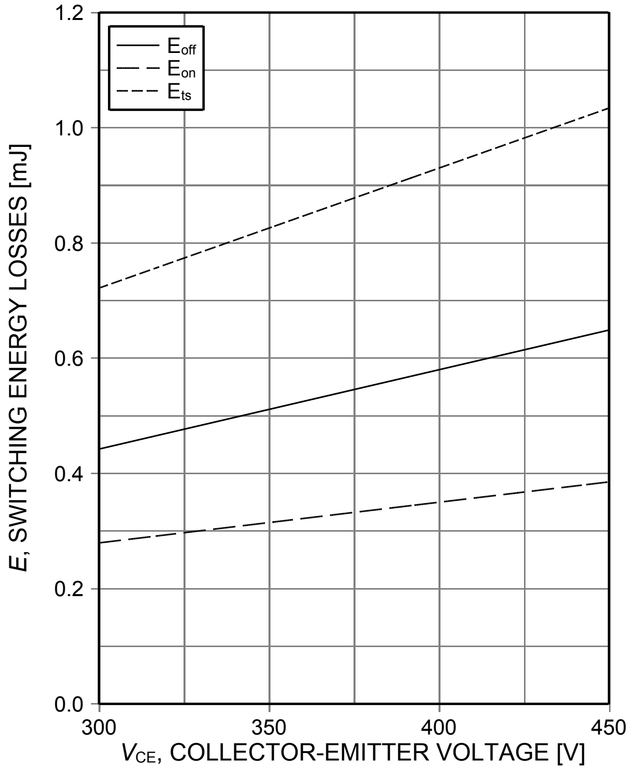


Figure 14. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, T_{vj}=175°C, V_{GE}=15/0V, I_C=10A, r_G=23Ω, Dynamic test circuit in Figure E)

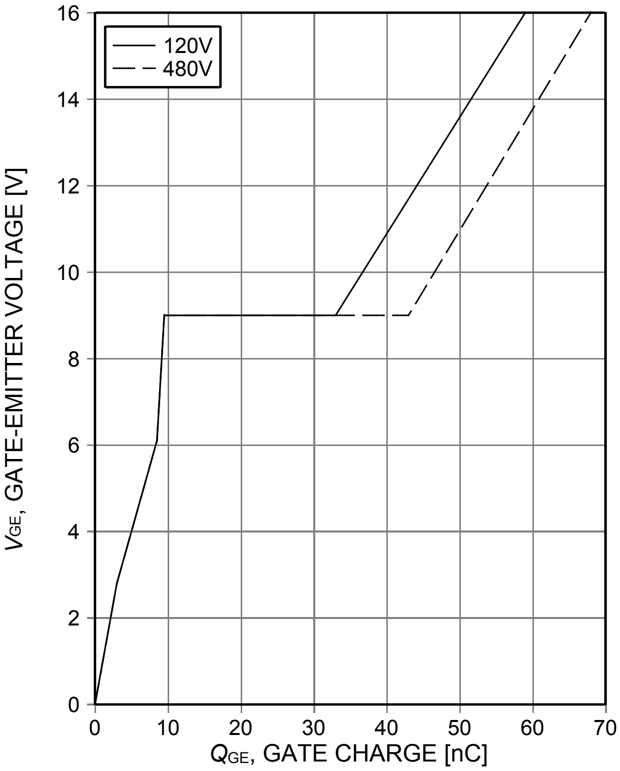


Figure 15. **Typical gate charge**
(I_C=10A)

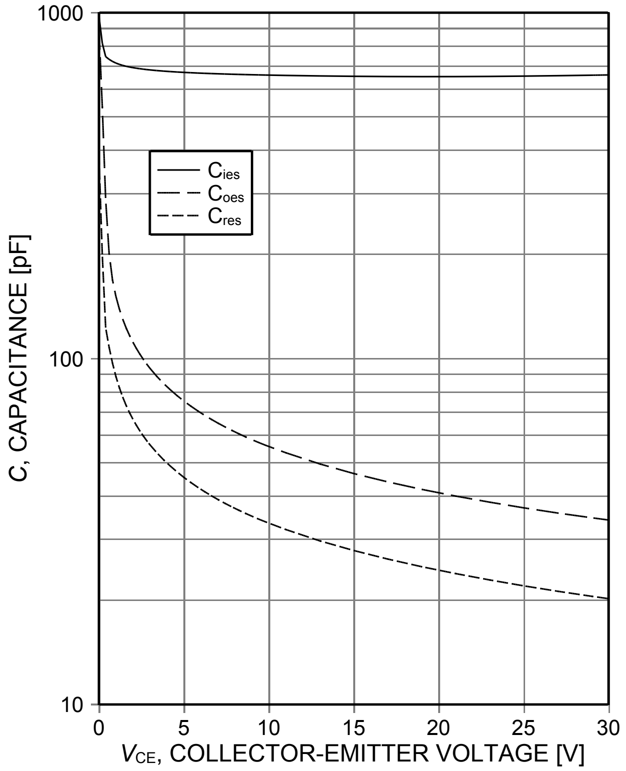


Figure 16. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)

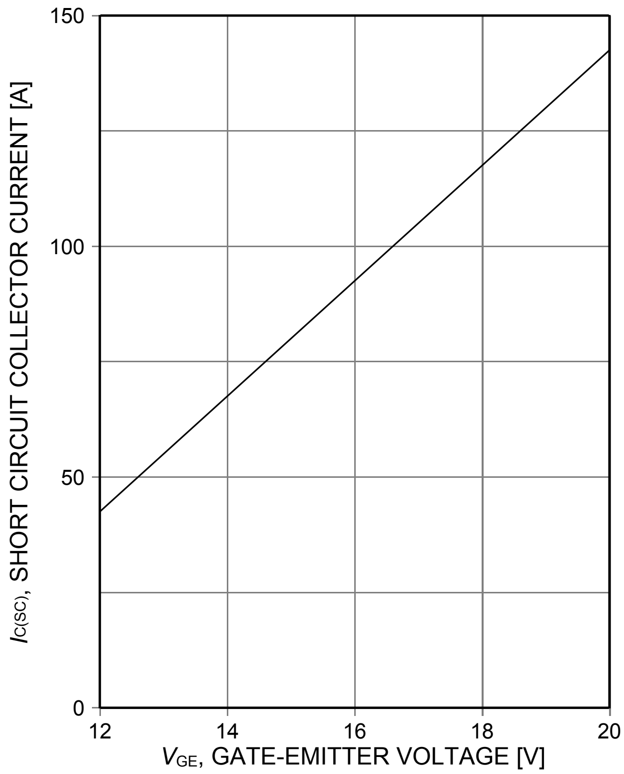


Figure 17. **Typical short circuit collector current as a function of gate-emitter voltage**
(V_{CE}≤400V, start at T_{vj}=25°C)

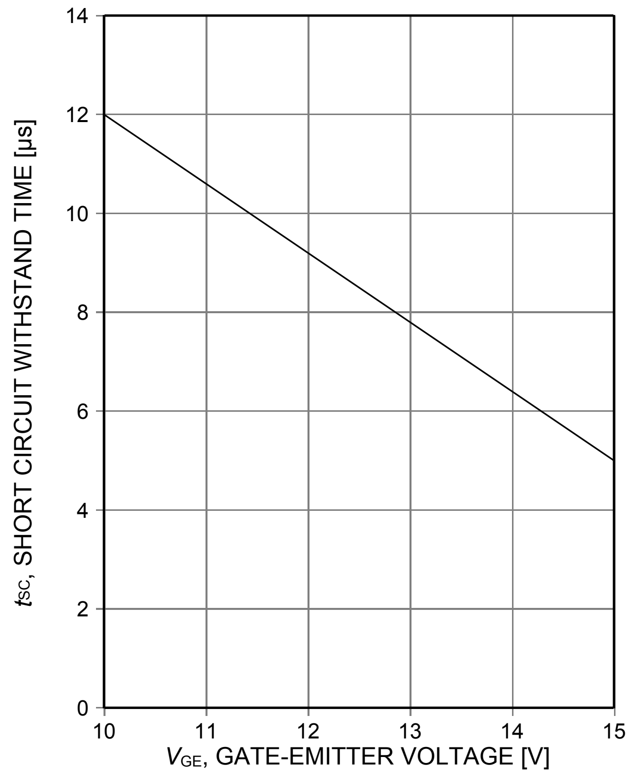


Figure 18. **Short circuit withstand time as a function of gate-emitter voltage**
(V_{CE}≤400V, start at T_{vj}≤150°C)

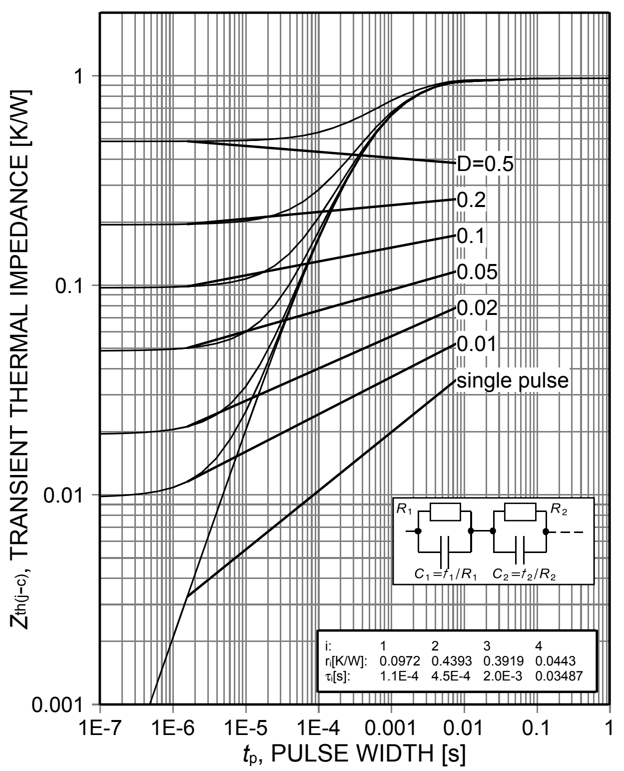


Figure 19. **IGBT transient thermal impedance as a function of pulse width** [1] **(see page 4)**
(D=t_p/T)

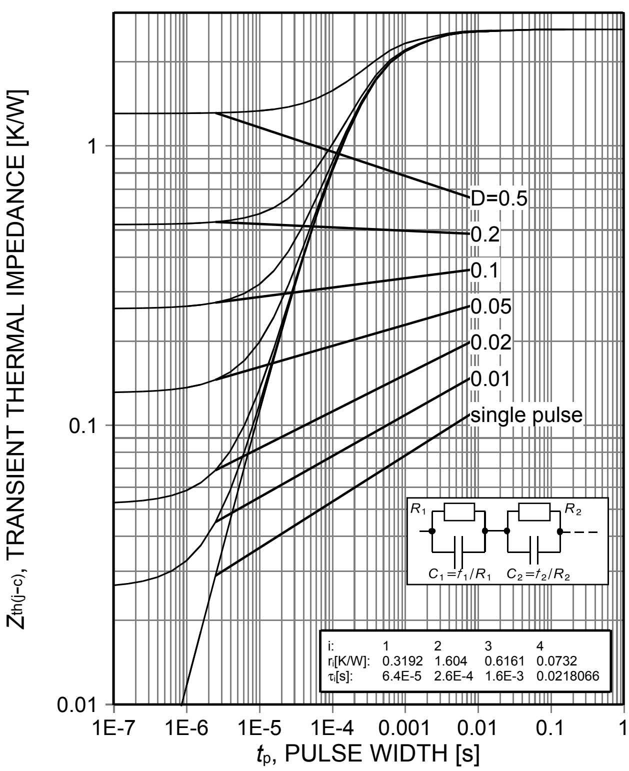


Figure 20. **Diode transient thermal impedance as a function of pulse width** [2] **(see page 4)**
(D=t_p/T)

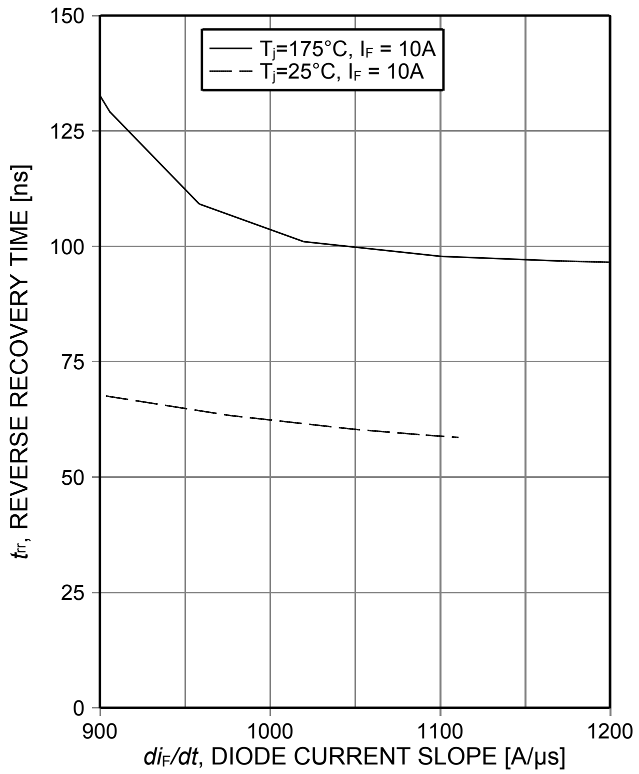


Figure 21. **Typical reverse recovery time as a function of diode current slope**
(V_R=400V)

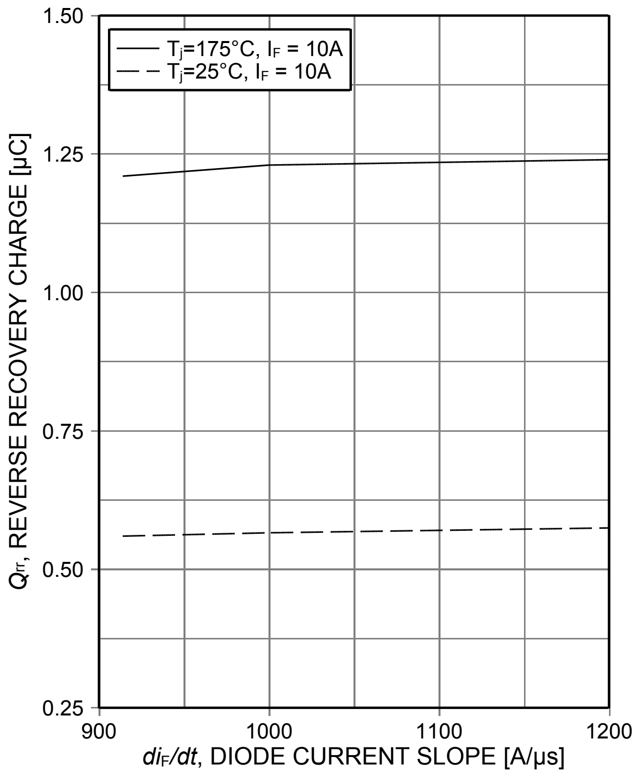


Figure 22. **Typical reverse recovery charge as a function of diode current slope**
(V_R=400V)

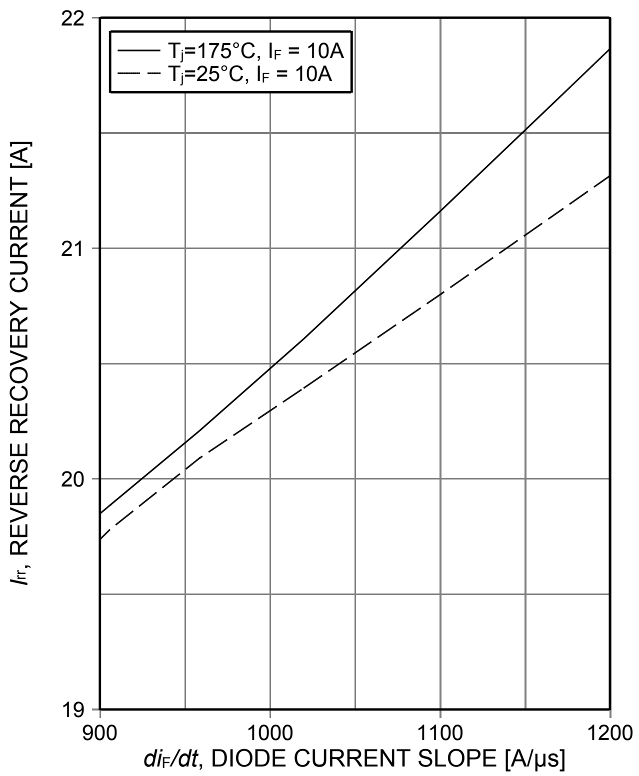


Figure 23. **Typical reverse recovery current as a function of diode current slope**
(V_R=400V)

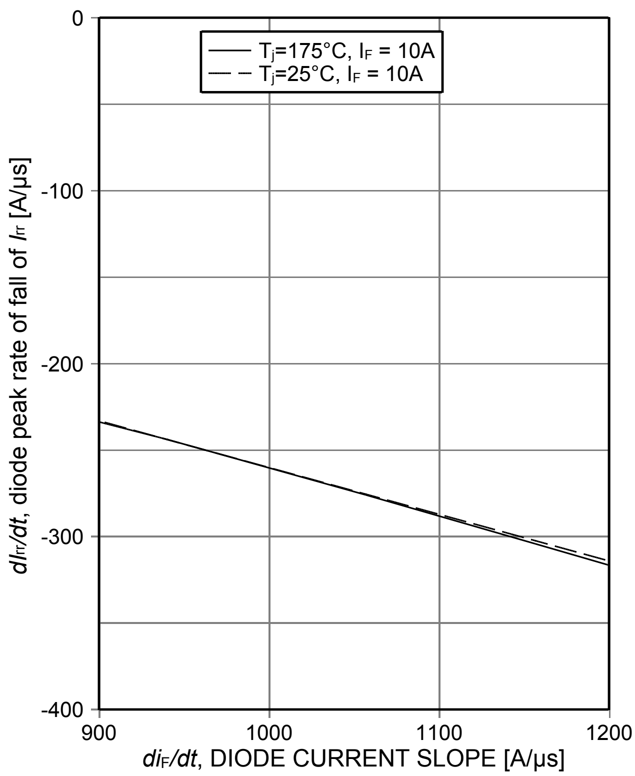


Figure 24. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
(V_R=400V)

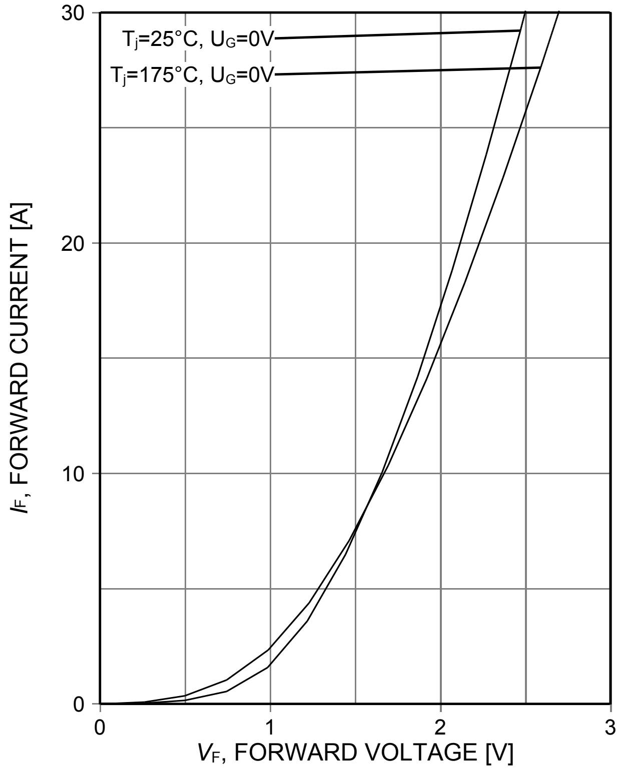


Figure 25. **Typical diode forward current as a function of forward voltage**

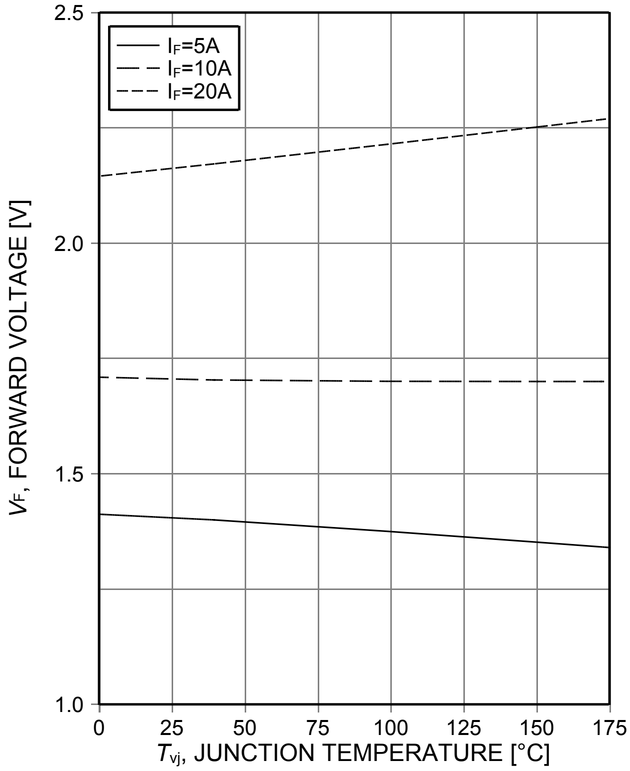
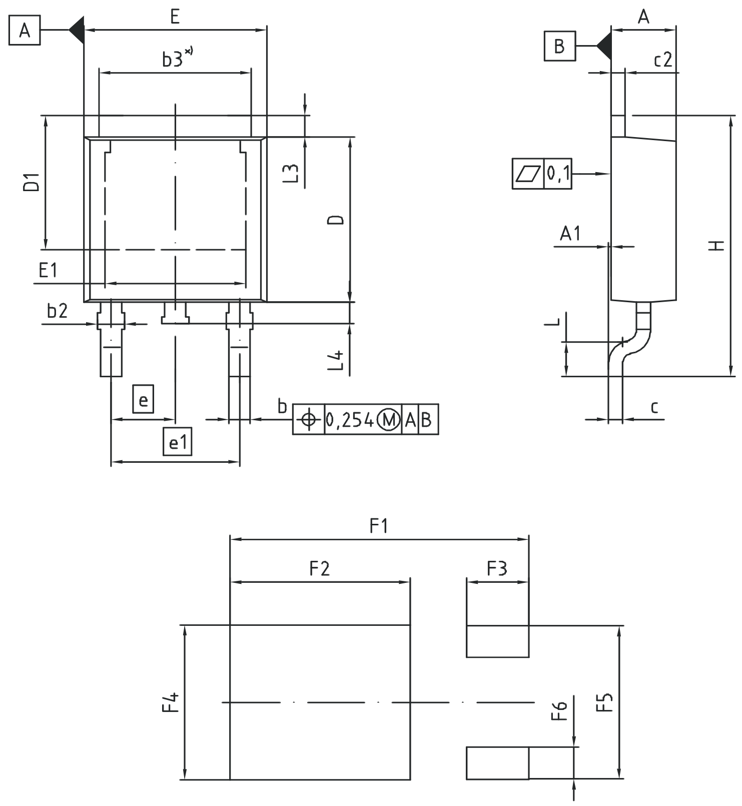


Figure 26. **Typical diode forward voltage as a function of junction temperature**

Package Drawing PG-TO252-3



*) mold flash not included

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.16	2.41	0.085	0.095
A1	0.00	0.15	0.000	0.006
b	0.64	0.89	0.025	0.035
b2	0.65	1.15	0.026	0.045
b3	5.00	5.50	0.197	0.217
c	0.46	0.60	0.018	0.024
c2	0.46	0.98	0.018	0.039
D	5.97	6.22	0.235	0.245
D1	5.02	5.84	0.198	0.230
E	6.40	6.73	0.252	0.265
E1	4.70	5.21	0.185	0.205
e	2.29 (BSC)		0.090 (BSC)	
e1	4.57		0.180	
N	3		3	
H	9.40	10.48	0.370	0.413
L	1.18	1.70	0.046	0.067
L3	0.90	1.25	0.035	0.049
L4	0.51	1.00	0.020	0.039
F1	10.60		0.417	
F2	6.40		0.252	
F3	2.20		0.087	
F4	5.80		0.228	
F5	5.76		0.227	
F6	1.20		0.047	

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ISSUE DATE 16-02-2011
REVISION 04

Testing Conditions

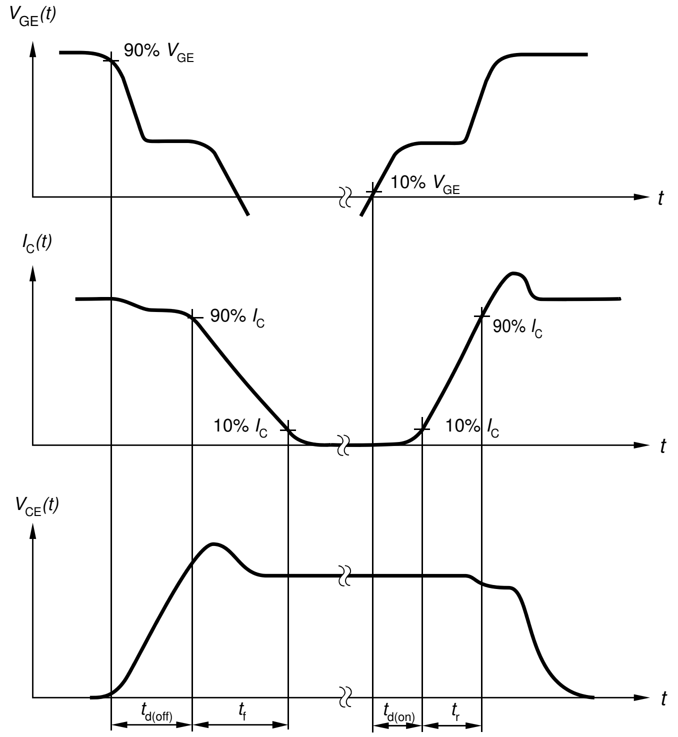

Figure A. **Definition of switching times**

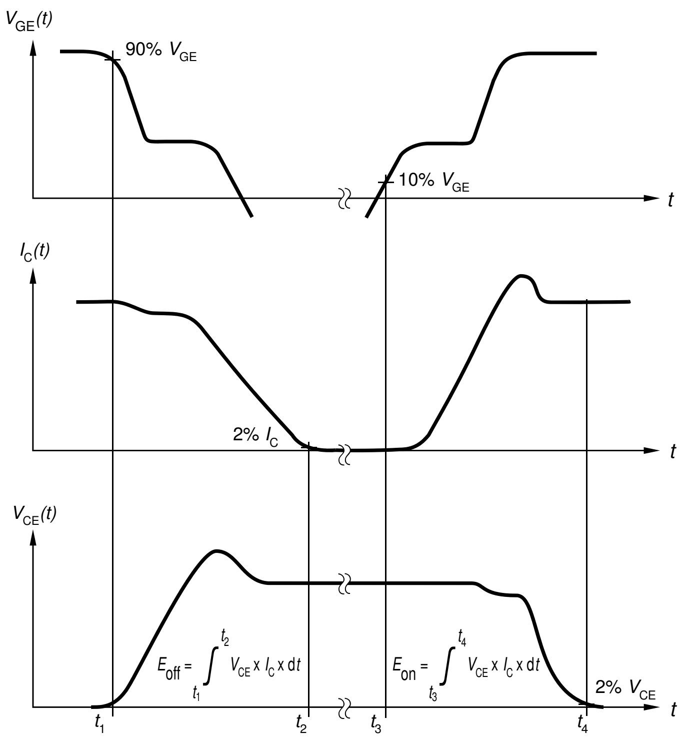

Figure B. **Definition of switching losses**

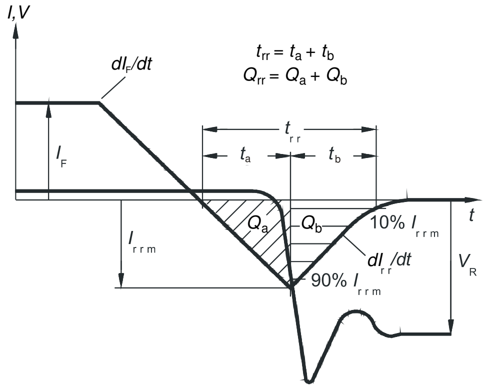

Figure C. **Definition of diode switching characteristics**

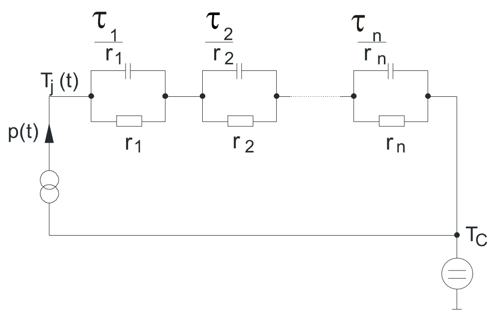

Figure D. **Thermal equivalent circuit**

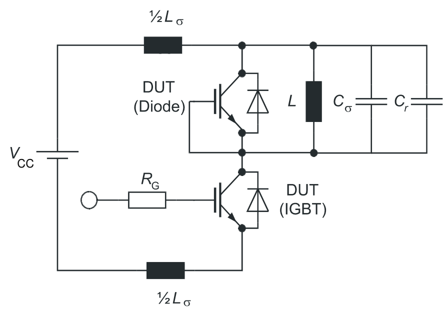

Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Revision History

AIHD10N60R

Revision: 2017-02-09, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2017-02-09	Data sheet created

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