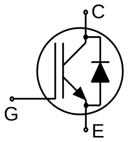
WINSOURCE ELECTRONICS

THE DATASHEET OF

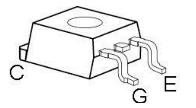
IKB10N60TATMA1

Low Loss DuoPack : IGBT in TRENCHSTOP™ and Fieldstop technology with soft, fast recovery anti-parallel Emitter Controlled HE diode



Features:

- Very low $V_{CE(sat)}$ 1.5V (typ.)
- Maximum Junction Temperature 175°C
- Short circuit withstand time 5µs
- Designed for frequency inverters for washing machines, fans, pumps and vacuum cleaners
- TRENCHSTOP™ technology for 600V applications offers :
  - very tight parameter distribution
  - high ruggedness, temperature stable behavior
- NPT technology offers easy parallel switching capability due to positive temperature coefficient in $V_{CE(sat)}$
- Low EMI
- Low Gate Charge
- Qualified according to JEDEC[1] for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models : http://www.infineon.com/igbt/



PG-TO263-3

Type	V_{CE}	I_C	$V_{CE(sat),Tj=25°C}$	$T_{j,max}$	Marking Code	Package
IKB10N60T	600V	10A	1.5V	175°C	K10T60	PG-TO263-3

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage, $T_j \geq 25°C$	V_{CE}	600	V
DC collector current, limited by T_{jmax} $T_C = 25°C$ $T_C = 100°C$	I_C	 24 18	A
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	30	
Turn off safe operating area, $V_{CE} = 600V$, $T_j = 175°C$, $t_p = 1µs$	-	30	
Diode forward current, limited by T_{jmax} $T_C = 25°C$ $T_C = 100°C$	I_F	 24 18	
Diode pulsed current, t_p limited by T_{jmax}	I_{Fpuls}	30	
Gate-emitter voltage	V_{GE}	±20	V
Short circuit withstand time[2)] $V_{GE} = 15V$, $V_{CC} \leq 400V$, $T_j \leq 150°C$	t_{SC}	5	µs
Power dissipation $T_C = 25°C$	P_{tot}	110	W
Operating junction temperature	T_j	-40...+175	°C
Storage temperature	T_{stg}	-55...+150	
Soldering temperature (reflow soldering, MSL1)		260	

[1] J-STD-020 and JESD-022
[2)] Allowed number of short circuits: <1000; time between short circuits: >1s.

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction – case	R_{thJC}		1.35	K/W
Diode thermal resistance, junction – case	R_{thJCD}		1.9	
Thermal resistance, junction – ambient	R_{thJA}	Footprint 6cm² Cu	65 40	

Electrical Characteristic, at T_j = 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=0.2mA	600	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE} = 15V, I_C=10A T_j=25°C T_j=175°C	 - -	 1.5 1.8	 2.05 -	
Diode forward voltage	V_F	V_{GE}=0V, I_F=10A T_j=25°C T_j=175°C	 - -	 1.6 1.6	 2.0 -	
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C=0.3mA, V_{CE}=V_{GE}	4.1	4.6	5.7	
Zero gate voltage collector current	I_{CES}	V_{CE}=600V, V_{GE}=0V T_j=25°C T_j=175°C	 - -	 - -	 40 1000	µA
Gate-emitter leakage current	I_{GES}	V_{CE}=0V, V_{GE}=20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE}=20V, I_C=10A	-	6	-	S
Integrated gate resistor	R_{Gint}			none		Ω

Dynamic Characteristic

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Input capacitance	C_{iss}	V_{CE}=25V,	-	551	-	pF
Output capacitance	C_{oss}	V_{GE}=0V,	-	40	-	
Reverse transfer capacitance	C_{rss}	f=1MHz	-	17	-	
Gate charge	Q_{Gate}	V_{CC}=480V, I_C=10A V_{GE}=15V	-	62	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	7	-	nH
Short circuit collector current[1)]	$I_{C(SC)}$	V_{GE}=15V, t_{SC}≤5µs V_{CC} = 400V, T_j = 25°C	-	100	-	A

[1)] Allowed number of short circuits: <1000; time between short circuits: >1s.

Switching Characteristic, Inductive Load, at T_j=25 °C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	T_j=25°C, V_{CC}=400V, I_C=10A, V_{GE}=0/15V, r_G=23Ω, L_σ=60nH, C_σ=40pF L_σ, C_σ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	12	-	ns
Rise time	t_r		-	8	-	
Turn-off delay time	$t_{d(off)}$		-	215	-	
Fall time	t_f		-	38	-	
Turn-on energy	E_{on}		-	0.16	-	mJ
Turn-off energy	E_{off}		-	0.27	-	
Total switching energy	E_{ts}		-	0.43	-	
Anti-Parallel Diode Characteristic						
Diode reverse recovery time	t_{rr}	T_j=25°C, V_R=400V, I_F=10A, di_F/dt=880A/µs	-	115	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.38	-	µC
Diode peak reverse recovery current	I_{rrm}		-	10	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	680	-	A/µs

Switching Characteristic, Inductive Load, at T_j=175 °C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	T_j=175°C, V_{CC}=400V, I_C=10A, V_{GE}=0/15V, r_G=23Ω, L_σ=60nH, C_σ=40pF L_σ, C_σ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	10	-	ns
Rise time	t_r		-	11	-	
Turn-off delay time	$t_{d(off)}$		-	233	-	
Fall time	t_f		-	63	-	
Turn-on energy	E_{on}		-	0.26	-	mJ
Turn-off energy	E_{off}		-	0.35	-	
Total switching energy	E_{ts}		-	0.61	-	
Anti-Parallel Diode Characteristic						
Diode reverse recovery time	t_{rr}	T_j=175°C V_R=400V, I_F=10A, di_F/dt=880A/µs	-	200	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.92	-	µC
Diode peak reverse recovery current	I_{rrm}		-	13	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	390	-	A/µs

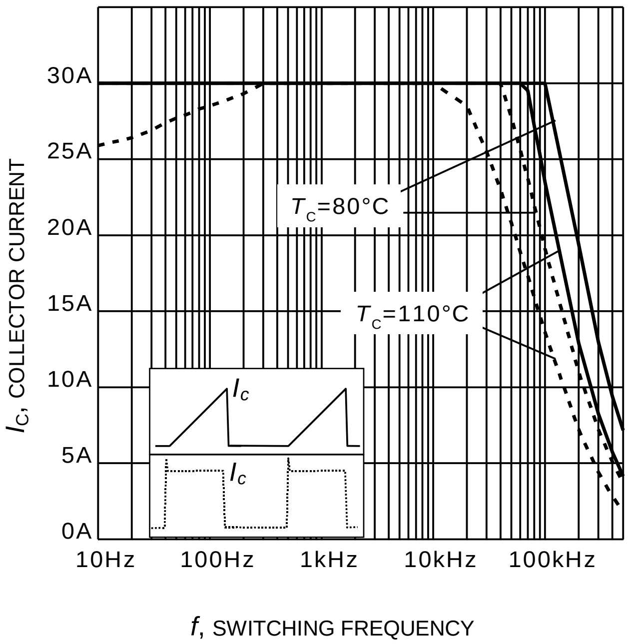


Figure 1. Collector current as a function of switching frequency
($T_j \leq 175°C$, $D = 0.5$, $V_{CE} = 400V$, $V_{GE} = 0/15V$, $r_G = 23\Omega$)

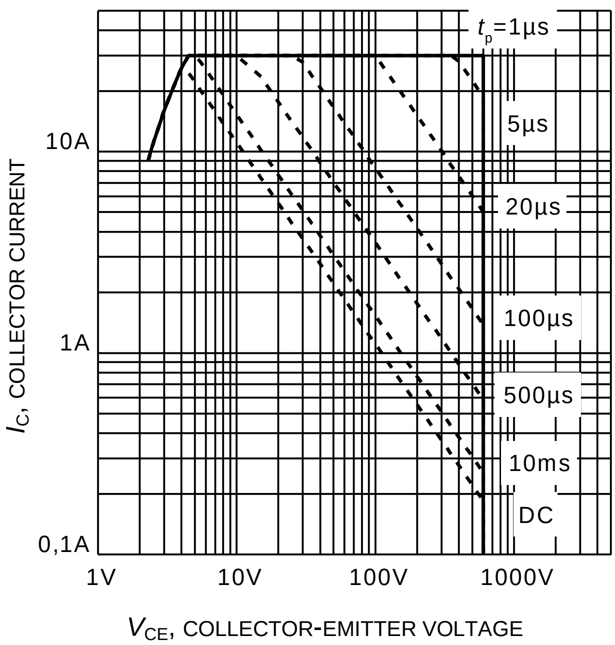


Figure 2. Safe operating area
($D = 0$, $T_C = 25°C$, $T_j \leq 175°C$; V_{GE}=0/15V)

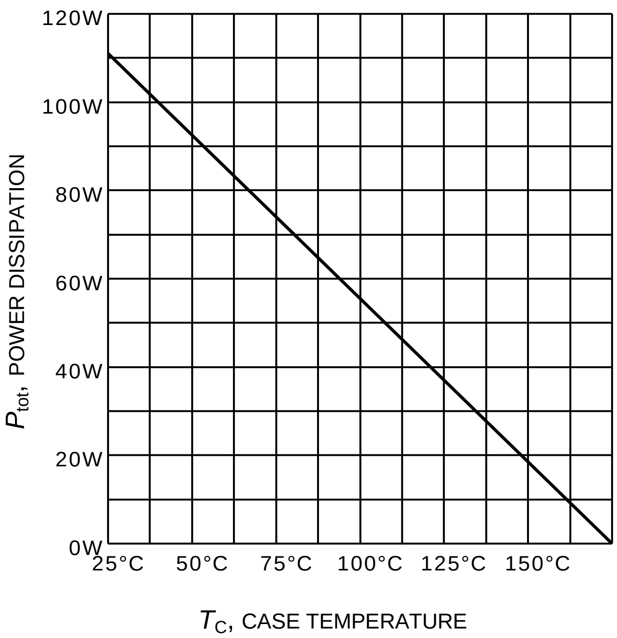


Figure 3. Power dissipation as a function of case temperature
($T_j \leq 175°C$)

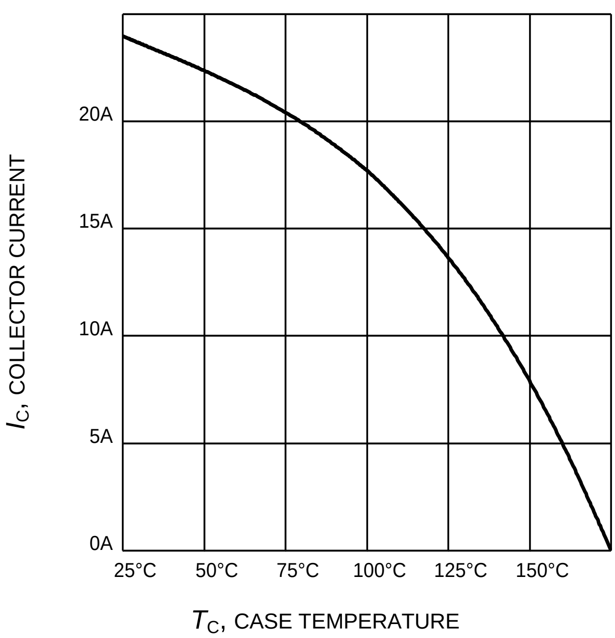


Figure 4. Collector current as a function of case temperature
($V_{GE} \geq 15V$, $T_j \leq 175°C$)

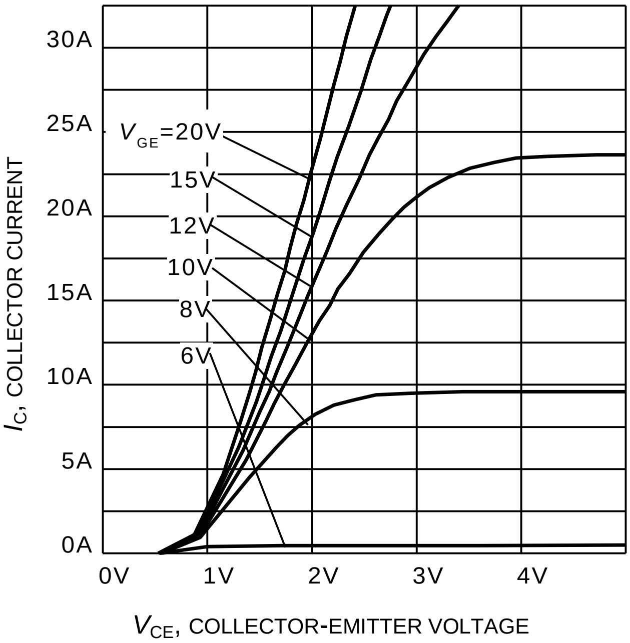


Figure 5. Typical output characteristic
(T_j = 25°C)

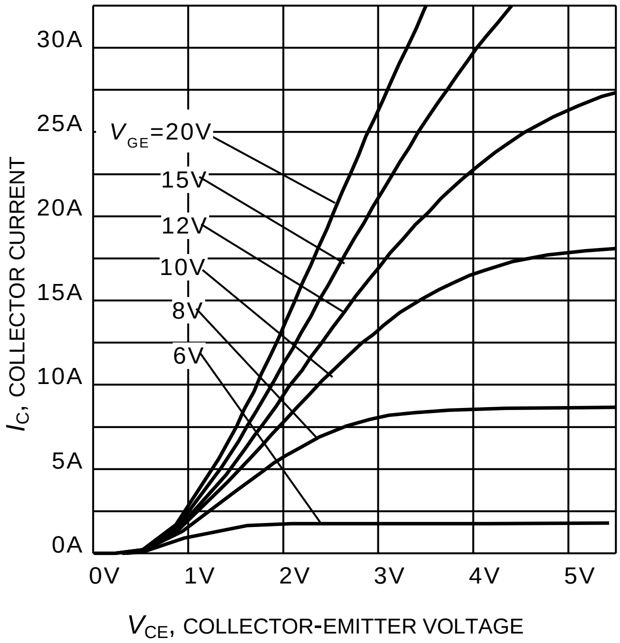


Figure 6. Typical output characteristic
(T_j = 175°C)

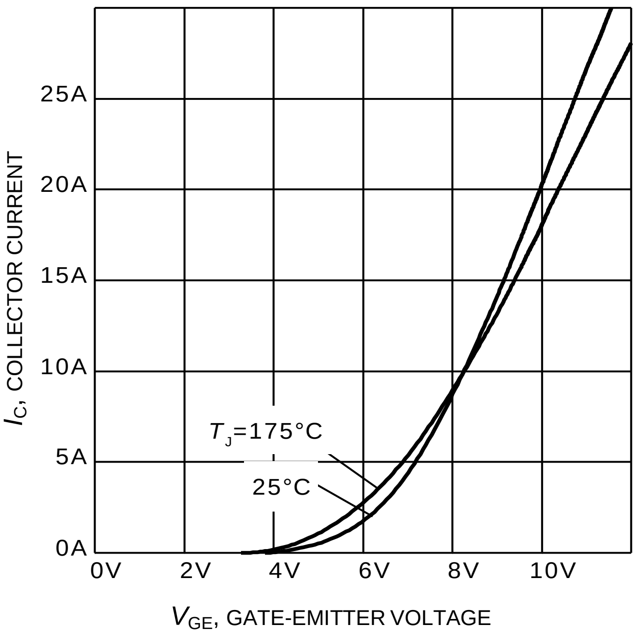


Figure 7. Typical transfer characteristic
(V_{CE}=20V)

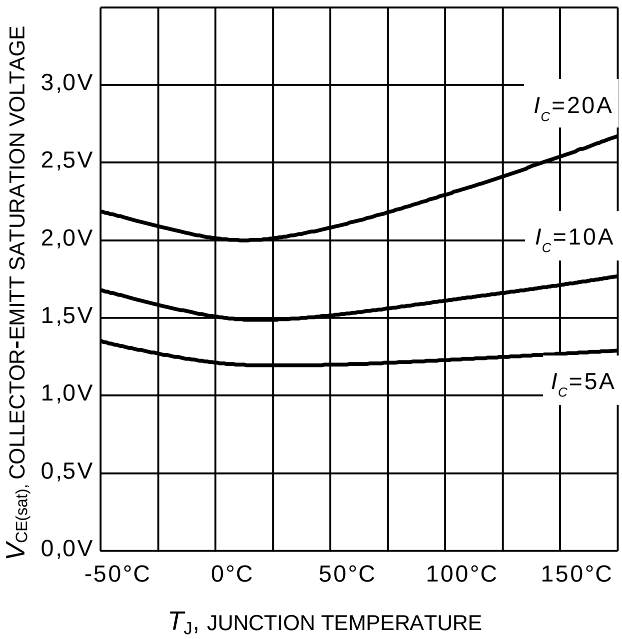
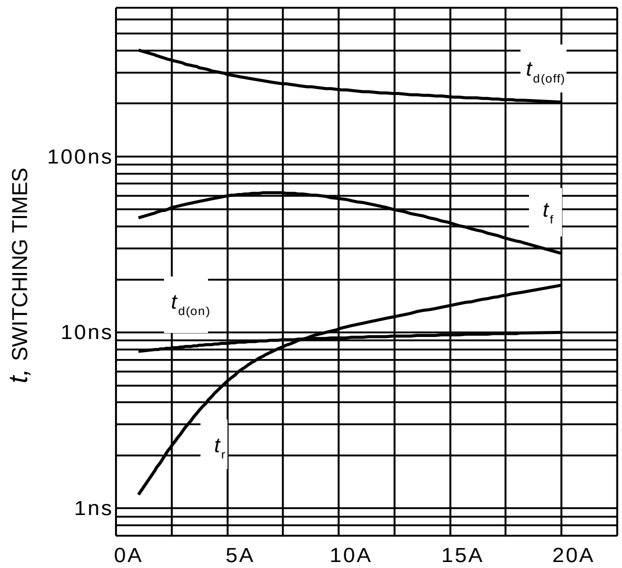
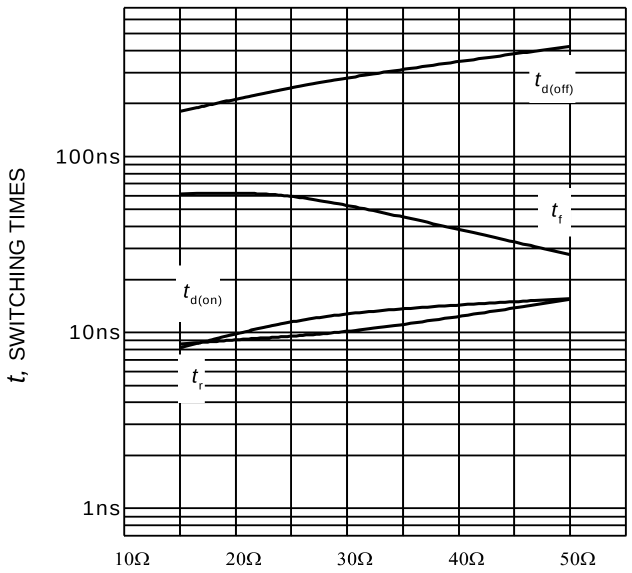


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE} = 15V)



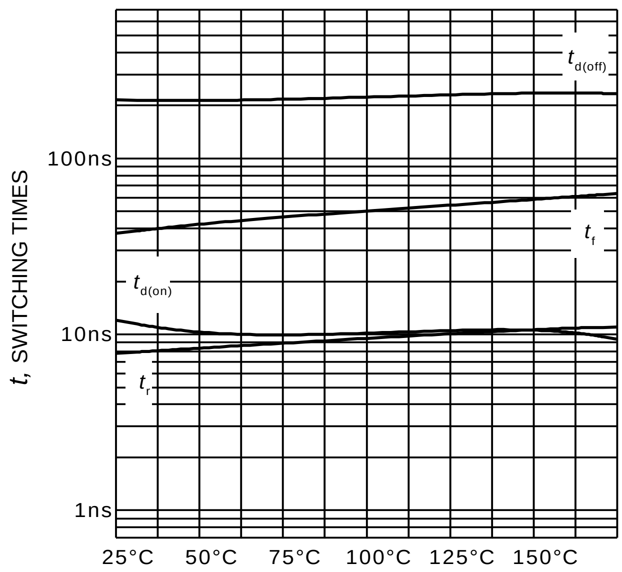
I_C, COLLECTOR CURRENT

Figure 9. Typical switching times as a function of collector current
(inductive load, T_J=175°C,
V_{CE} = 400V, V_{GE} = 0/15V, r_G = 23Ω,
Dynamic test circuit in Figure E)



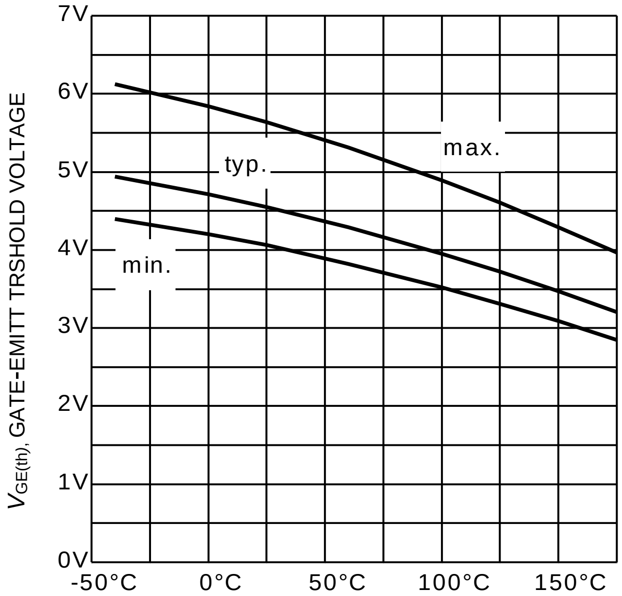
R_G, GATE RESISTOR

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



T_J, JUNCTION TEMPERATURE

Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE} = 400V,
V_{GE} = 0/15V, I_C = 10A, r_G=23Ω,
Dynamic test circuit in Figure E)



T_J, JUNCTION TEMPERATURE

Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C = 0.3mA)

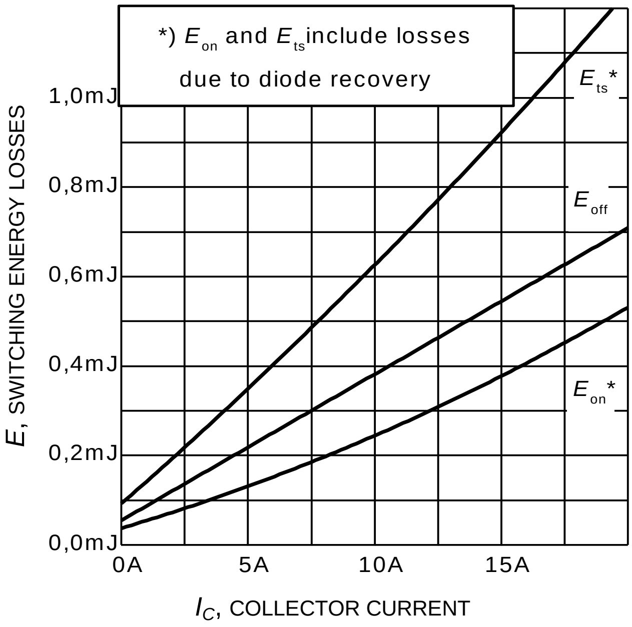


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_J = 175°C, V_{CE} = 400V, V_{GE} = 0/15V, r_G = 23Ω, Dynamic test circuit in Figure E)

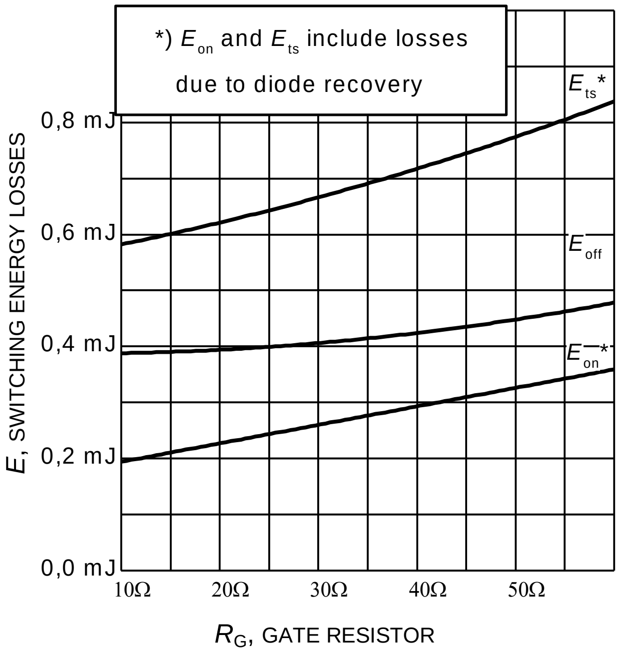


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_J = 175°C, V_{CE} = 400V, V_{GE} = 0/15V, I_C = 10A, Dynamic test circuit in Figure E)

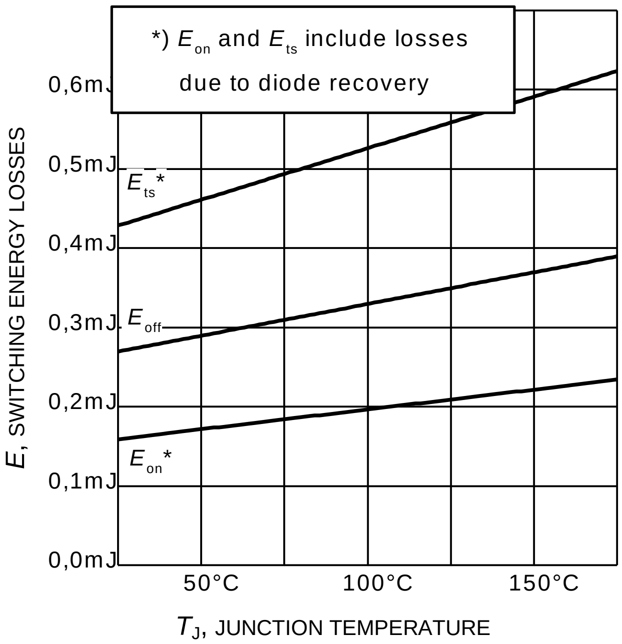


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE} = 400V, V_{GE} = 0/15V, I_C = 10A, r_G = 23Ω, Dynamic test circuit in Figure E)

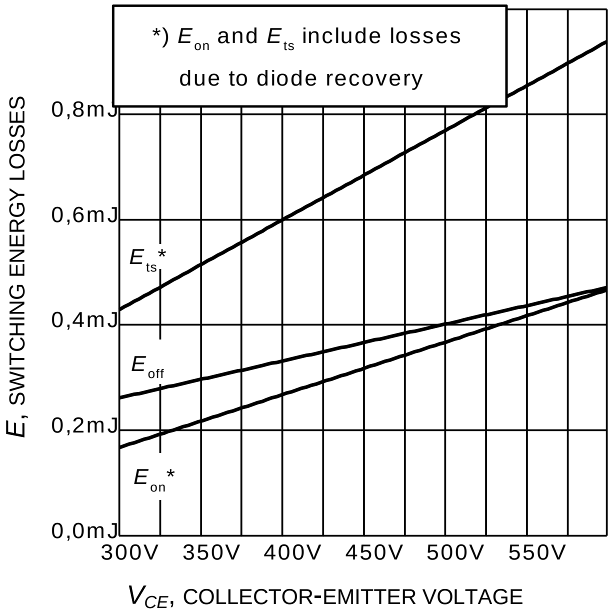


Figure 16. Typical switching energy losses as a function of collector emitter voltage
(inductive load, T_J = 175°C, V_{GE} = 0/15V, I_C = 10A, r_G = 23Ω, Dynamic test circuit in Figure E)

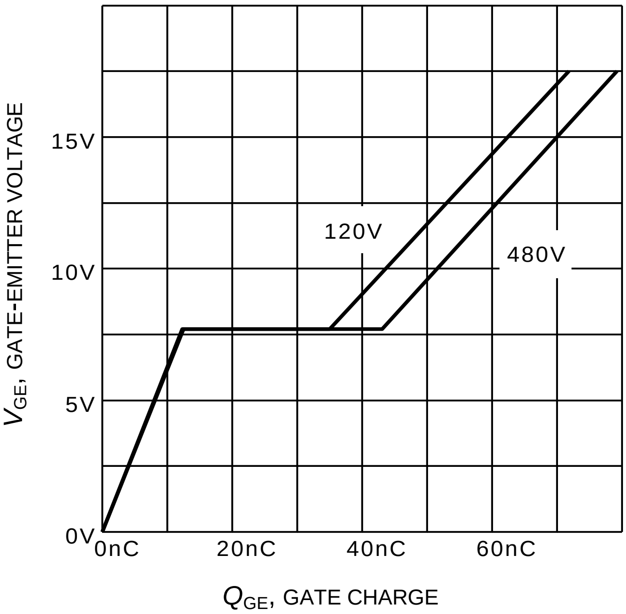


Figure 17. Typical gate charge
(I_C=10 A)

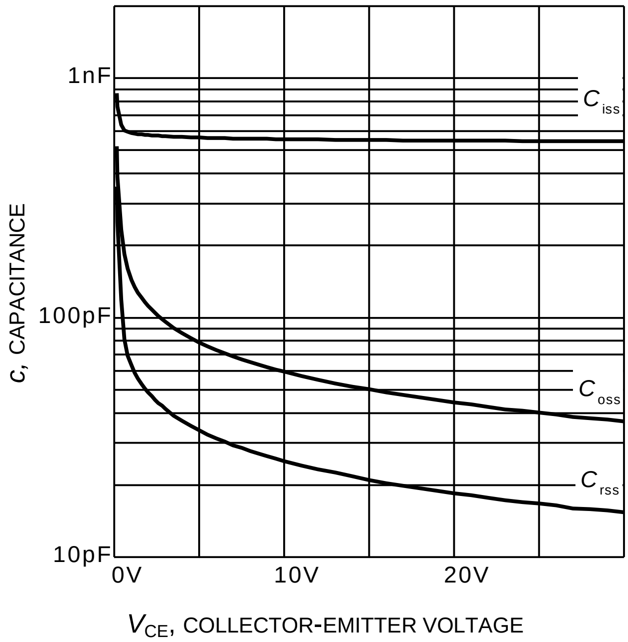


Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE}=0V, f = 1 MHz)

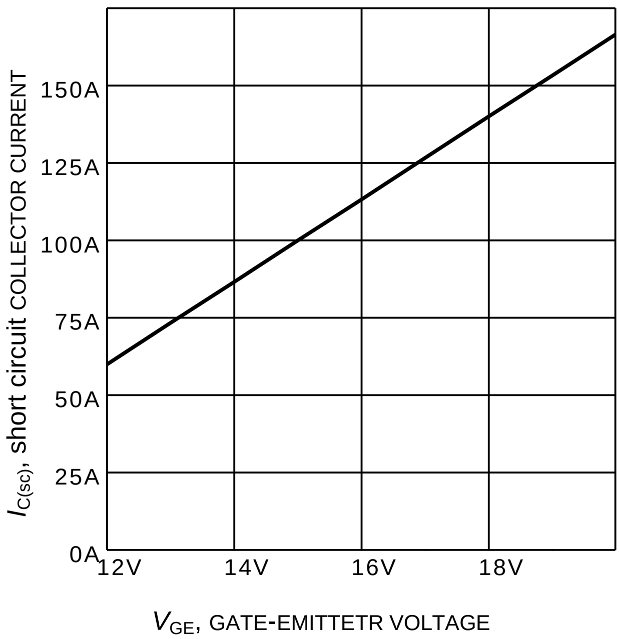


Figure 19. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \leq$ 400V, $T_j \leq$ 150°C)

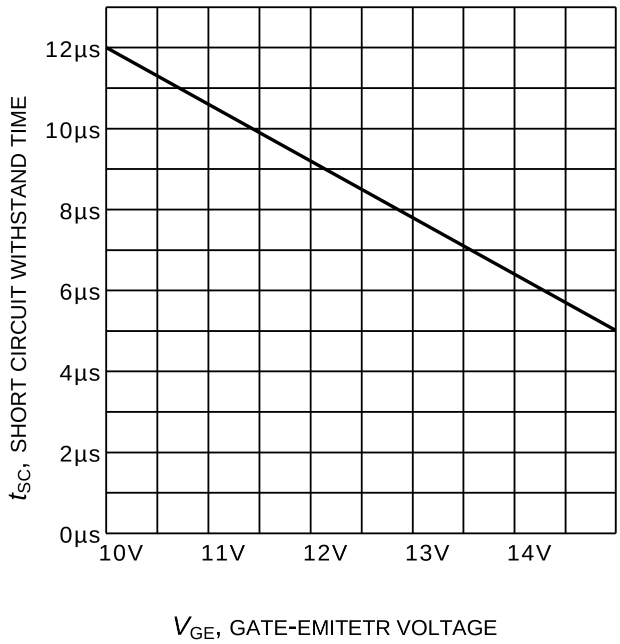


Figure 20. Short circuit withstand time as a function of gate-emitter voltage
(V_{CE}=400V, start at T_J=25°C, T_{Jmax}<150°C)

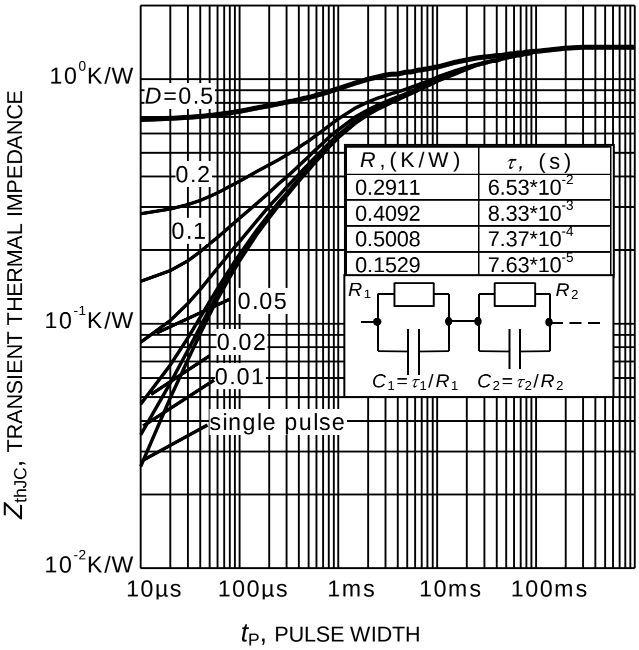


Figure 21. IGBT transient thermal impedance
($D = t_p / T$)

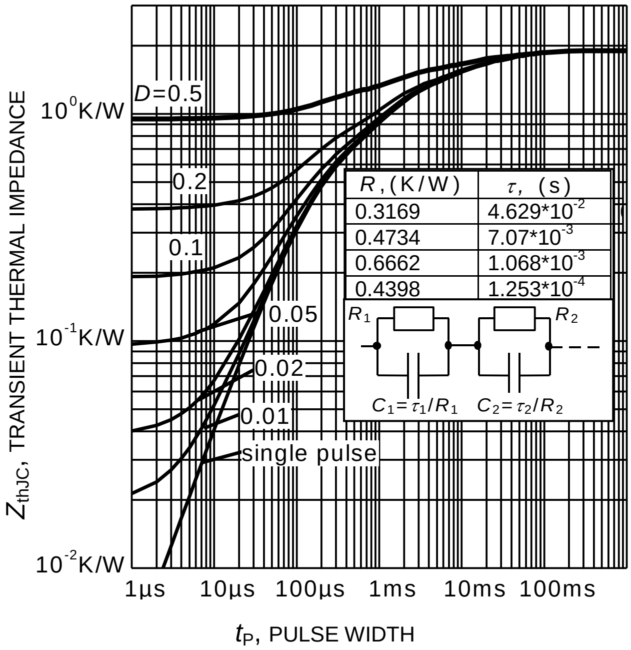


Figure 22. Diode transient thermal impedance as a function of pulse width
($D=t_P/T$)

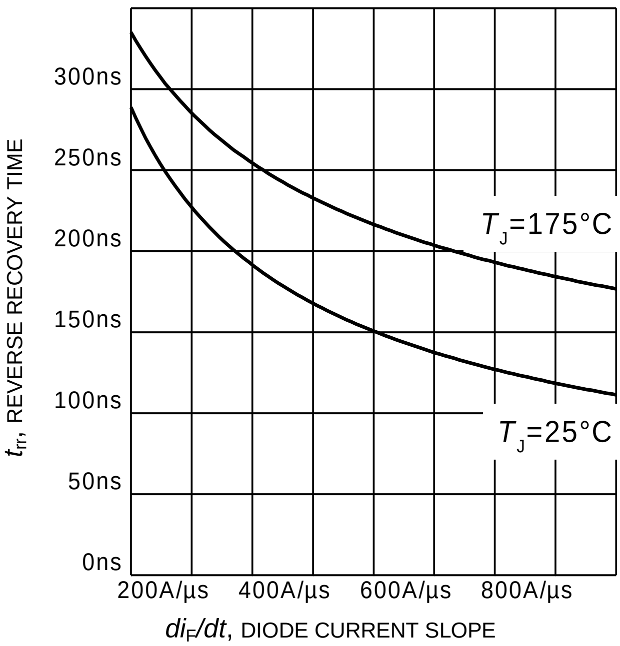


Figure 23. Typical reverse recovery time as a function of diode current slope
(V_R=400V, I_F=10A,
Dynamic test circuit in Figure E)

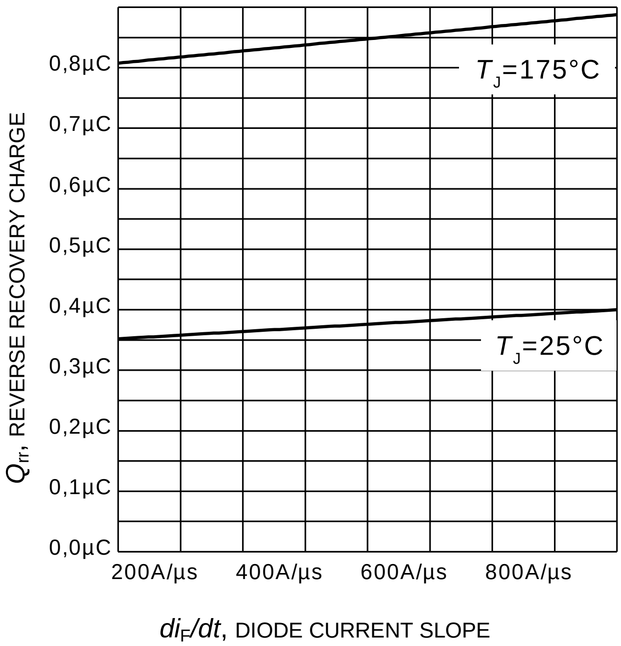


Figure 24. Typical reverse recovery charge as a function of diode current slope
(V_R = 400V, I_F = 10A,
Dynamic test circuit in Figure E)

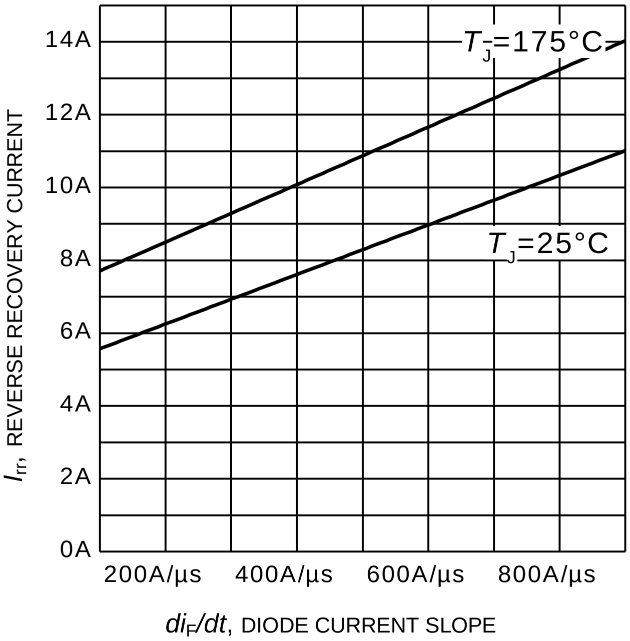


Figure 25. Typical reverse recovery current as a function of diode current slope
(V_R = 400V, I_F = 10A,
Dynamic test circuit in Figure E)

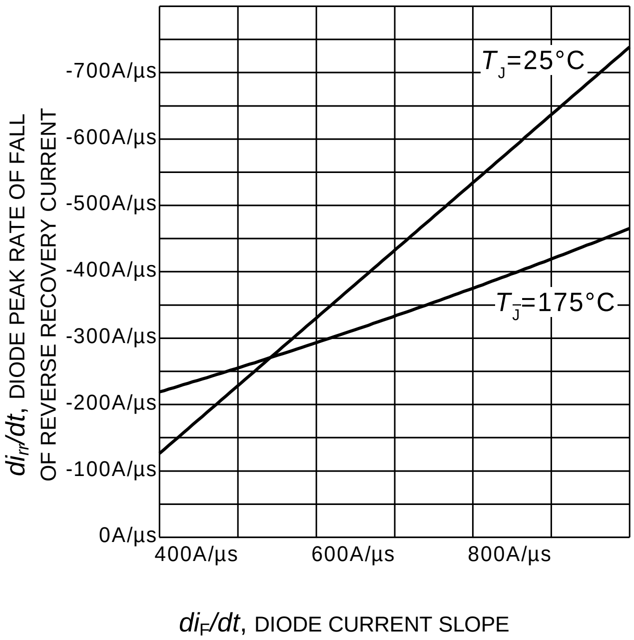


Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
(V_R=400V, I_F=10A,
Dynamic test circuit in Figure E)

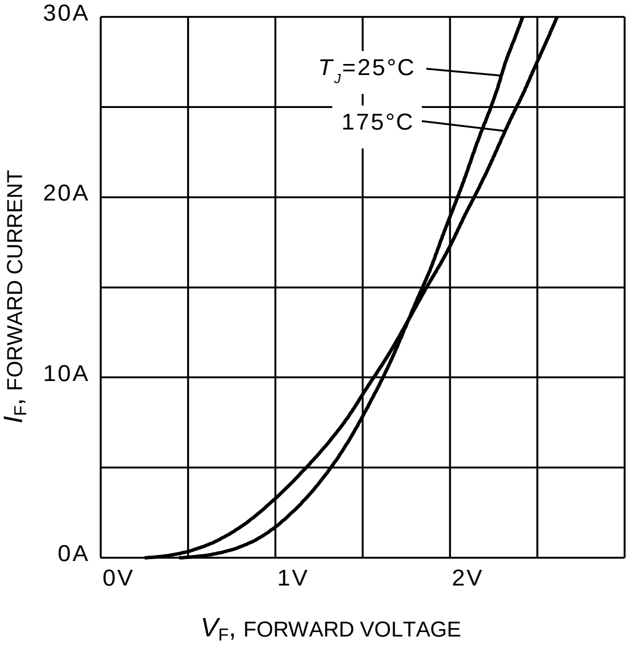


Figure 27. Typical diode forward current as a function of forward voltage

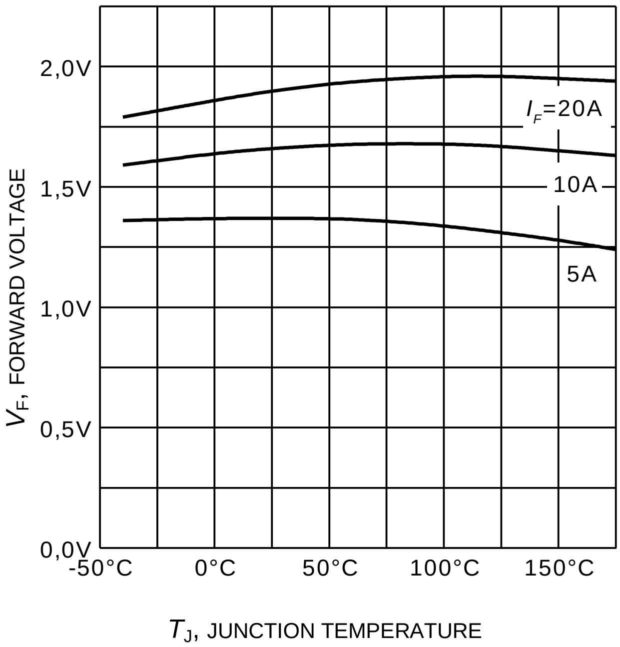


Figure 28. Typical diode forward voltage as a function of junction temperature

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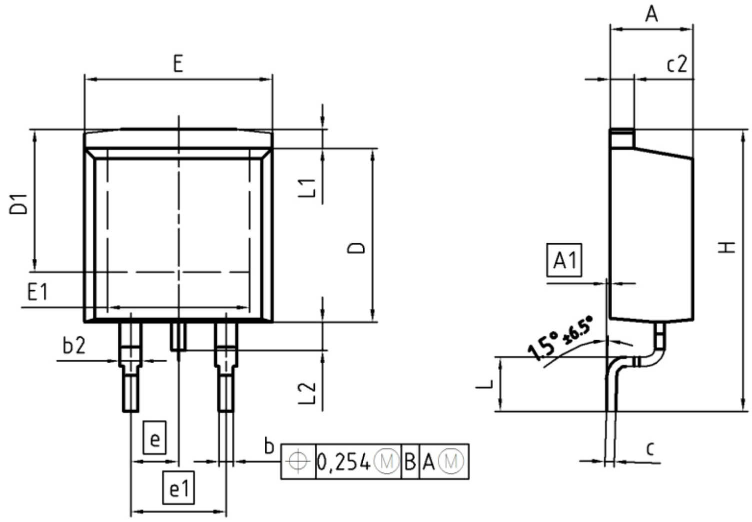
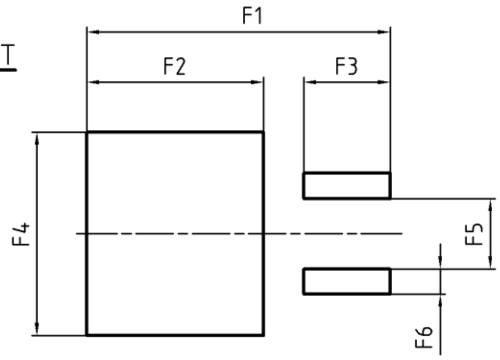


FOOTPRINT



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	0.00	0.25	0.000	0.010
b	0.65	0.85	0.026	0.033
b2	0.95	1.15	0.037	0.045
c	0.33	0.65	0.013	0.026
c2	1.17	1.40	0.046	0.055
D	8.51	9.45	0.335	0.372
D1	7.10	7.90	0.280	0.311
E	9.80	10.31	0.386	0.406
E1	6.50	8.60	0.256	0.339
e	2.54		0.100	
e1	5.08		0.200	
N	2		2	
H	14.61	15.88	0.575	0.625
L	2.29	3.00	0.090	0.118
L1	0.70	1.60	0.028	0.063
L2	1.00	1.78	0.039	0.070
F1	16.05	16.25	0.632	0.640
F2	9.30	9.50	0.366	0.374
F3	4.50	4.70	0.177	0.185
F4	10.70	10.90	0.421	0.429
F5	3.65	3.85	0.144	0.152
F6	1.25	1.45	0.049	0.057

DOCUMENT NO.
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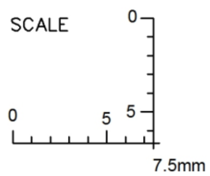
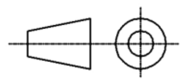
SCALE



EUROPEAN PROJECTION



ISSUE DATE
30-08-2007

REVISION
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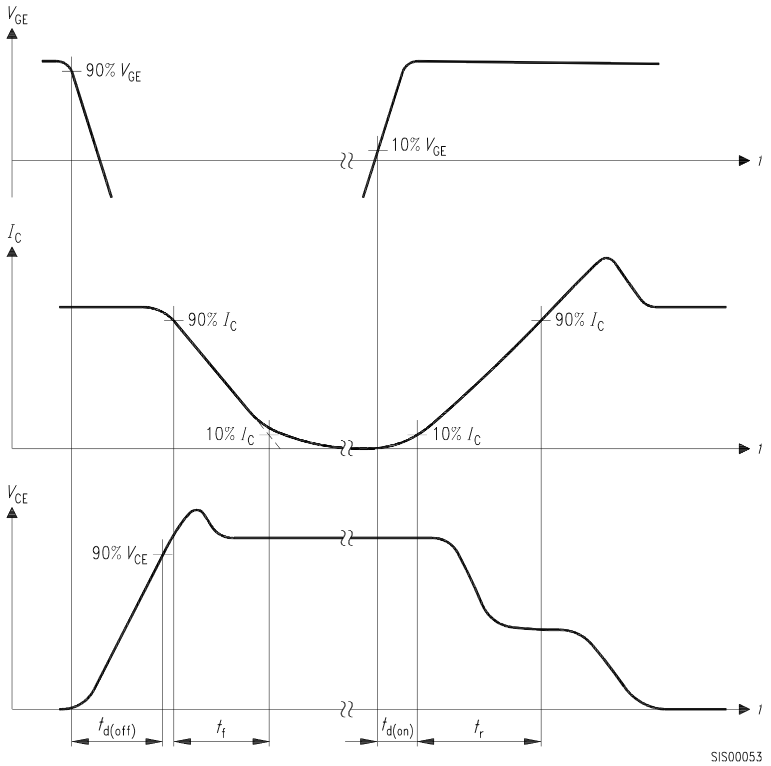

Figure A. Definition of switching times

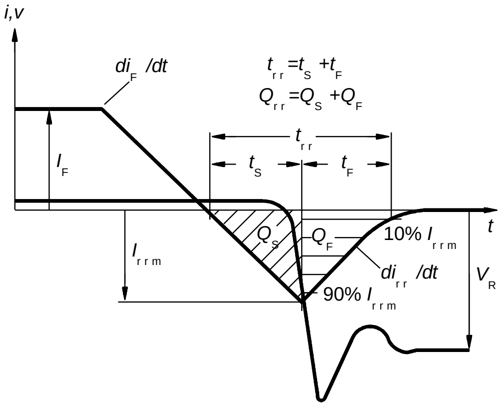

Figure C. Definition of diodes switching characteristics

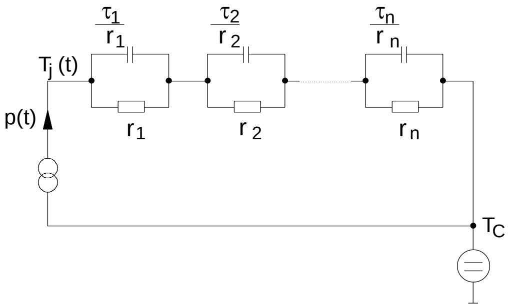

Figure D. Thermal equivalent circuit

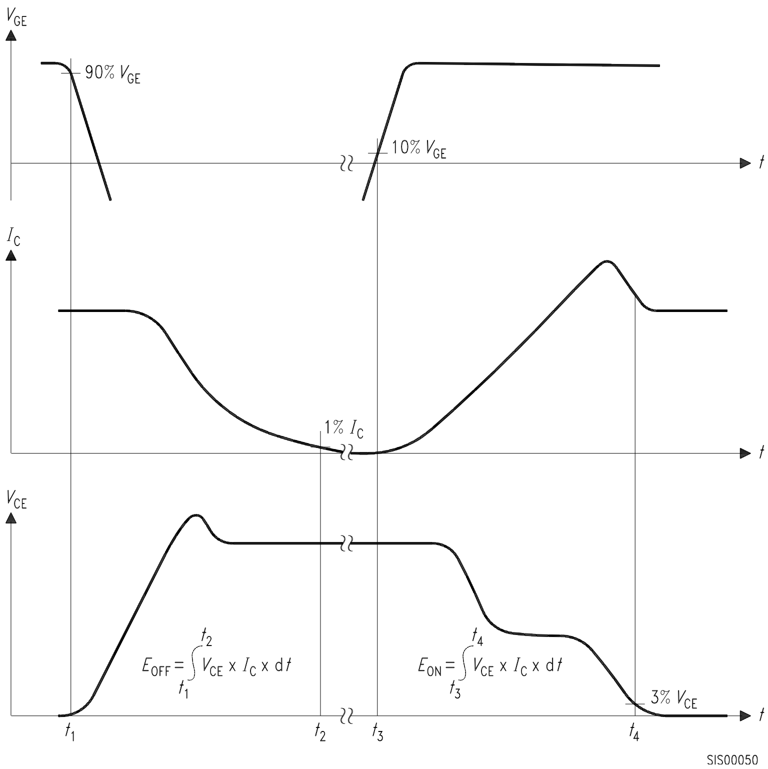

Figure B. Definition of switching losses

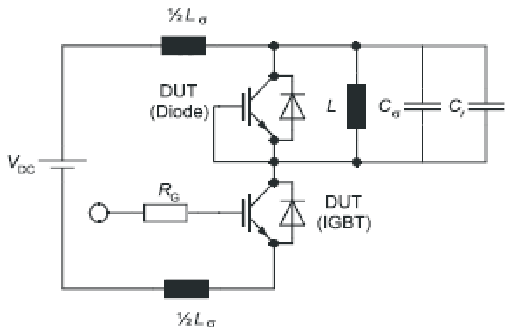

Figure E. Dynamic test circuit
Parasitic inductance L_σ,
Parasitic capacitor C_σ,
Relief capacitor C_r,
(only for ZVT switching)

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