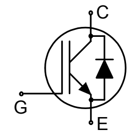
Soft Switching Series

Low Loss DuoPack : IGBT in **TrenchStop®** and Fieldstop technology with soft, fast recovery anti-parallel EmCon HE diode



- Short circuit withstand time – 10µs
- Designed for :
  - Soft Switching Applications
  - Induction Heating
- **TrenchStop®** and Fieldstop technology for 1200 V applications offers :
  - very tight parameter distribution
  - high ruggedness, temperature stable behavior
  - easy parallel switching capability due to positive temperature coefficient in $V_{CE(sat)}$
  - Very low $V_{ce(sat)}$
- Very soft, fast recovery anti-parallel EmCon™ HE diode
- Low EMI
- Qualified according to JEDEC[1] for target applications
- Application specific optimisation of inverse diode
- Pb-free lead plating; RoHS compliant

PG-TO-220-3-1

Type	V_{CE}	I_C	$V_{CE(sat),Tj=25°C}$	$T_{j,max}$	Marking	Package
IHP10T120	1200V	10A	1.7V	150°C	H10T120	PG-TO-220-3-1

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
DC collector current T_C = 25°C T_C = 100°C	I_C	 16 10	A
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	24	
Turn off safe operating area $V_{CE} \leq 1200V$, $T_j \leq 150°C$	-	24	
Diode forward current T_C = 25°C T_C = 100°C	I_F	 11 7	
Diode pulsed current, t_p limited by T_{jmax}, T_c = 25°C	I_{Fpuls}	16.5	
Diode surge non repetitive current, t_p limited by T_{jmax} T_C = 25°C, t_p = 10ms, sine halfwave T_C = 25°C, $t_p \leq 2.5$µs, sine halfwave T_C = 100°C, $t_p \leq 2.5$µs, sine halfwave	I_{FSM}	 28 50 40	A
Gate-emitter voltage	V_{GE}	±20	V
Short circuit withstand time[2)] V_{GE} = 15V, $V_{CC} \leq 1200V$, $T_j \leq 150°C$	t_{SC}	10	µs
Power dissipation, T_C = 25°C	P_{tot}	138	W
Operating junction temperature	T_j	-40...+150	°C
Storage temperature	T_{stg}	-55...+150	
Soldering temperature, 1.6mm (0.063 in.) from case for 10s	-	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}		0.9	K/W
Diode thermal resistance, junction – case	R_{thJCD}		2.6	
IGBT thermal resistance, junction – ambient	R_{thJA}		62	

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=0.5mA	1200	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE} = 15V, I_C=10A T_j=25°C T_j=125°C T_j=150°C	 - - -	 1.7 2.0 2.2	 2.2 - -	
Diode forward voltage	V_F	V_{GE}=0V, I_F=4A T_j=25°C T_j=150°C	 - -	 1.65 1.7	 2.15 -	
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C=0.6mA, V_{CE}=V_{GE}	5.0	5.8	6.5	
Zero gate voltage collector current	I_{CES}	V_{CE}=1200V, V_{GE}=0V T_j=25°C T_j=150°C	 - -	 - -	 0.2 2.0	mA
Gate-emitter leakage current	I_{GES}	V_{CE}=0V, V_{GE}=20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE}=20V, I_C=10A	-	10	-	S
Integrated gate resistor	R_{Gint}			none		Ω

Dynamic Characteristic

Input capacitance	C_{iss}	V_{CE}=25V, V_{GE}=0V, f=1MHz	-	606	-	pF
Output capacitance	C_{oss}		-	48	-	
Reverse transfer capacitance	C_{rss}		-	29	-	
Gate charge	Q_{Gate}	V_{CC}=960V, I_C=10A V_{GE}=15V	-	53	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13	-	nH
Short circuit collector current[1)]	$I_{C(SC)}$	V_{GE}=15V, $t_{SC}\leq$10µs V_{CC} = 600V, T_j = 25°C	-	48	-	A

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}=610V, I_C=10A, V_{GE}= 0/15V, R_G=81Ω, L_σ[2)]=180nH, C_σ[2)]=39pF Energy losses include "tail" and diode reverse recovery.	-	45	-	ns
Rise time	t_r		-	20	-	
Turn-off delay time	$t_{d(off)}$		-	520	-	
Fall time	t_f		-	82	-	
Turn-on energy	E_{on}		-	0.68	-	mJ
Turn-off energy	E_{off}		-	0.78	-	
Total switching energy	E_{ts}		-	1.46	-	
Anti-Parallel Diode Characteristic						
Diode reverse recovery time	t_{rr}	T_j=25°C, V_R=800V, I_F=4A, di_F/dt=750A/µs	-	115	-	ns
Diode reverse recovery charge	Q_{rr}		-	330		nC
Diode peak reverse recovery current	I_{rrm}		-	7.15		A

1) Allowed number of short circuits: <1000; time between short circuits: >1s.
2) Leakage inductance L_σ and Stray capacity C_σ due to dynamic test circuit in Figure E.

Switching Characteristic, Inductive Load, at T_j=150 °C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	T_j=150°C, V_{CC}=610V, I_C=10A, V_{GE}= 0 /15V, R_G= 81Ω, L_σ[1)]=180nH, C_σ[1)]=39pF Energy losses include “tail” and diode reverse recovery.	-	45	-	ns
Rise time	t_r		-	24	-	
Turn-off delay time	$t_{d(off)}$		-	592	-	
Fall time	t_f		-	177	-	
Turn-on energy	E_{on}		-	0.83	-	mJ
Turn-off energy	E_{off}		-	1.19	-	
Total switching energy	E_{ts}		-	2.02	-	
Anti-Parallel Diode Characteristic						
Diode reverse recovery time	t_{rr}	T_j=150°C V_R=800V, I_F=4A, di_F/dt=750A/µs	-	185	-	ns
Diode reverse recovery charge	Q_{rr}		-	630	-	nC
Diode peak reverse recovery current	I_{rrm}		-	8.1	-	A

[1)] Leakage inductance L_σ and Stray capacity C_σ due to dynamic test circuit in Figure E.

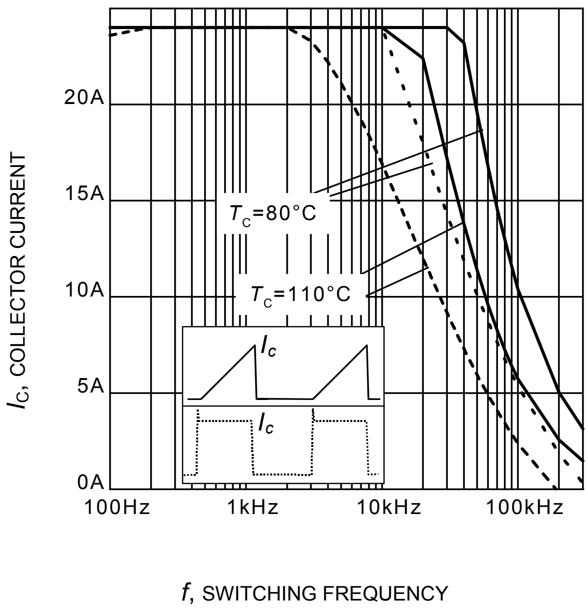


Figure 1. Collector current as a function of switching frequency
($T_j \leq 150°C$, $D = 0.5$, $V_{CE} = 600V$, $V_{GE} = 0/+15V$, $R_G = 81\Omega$)

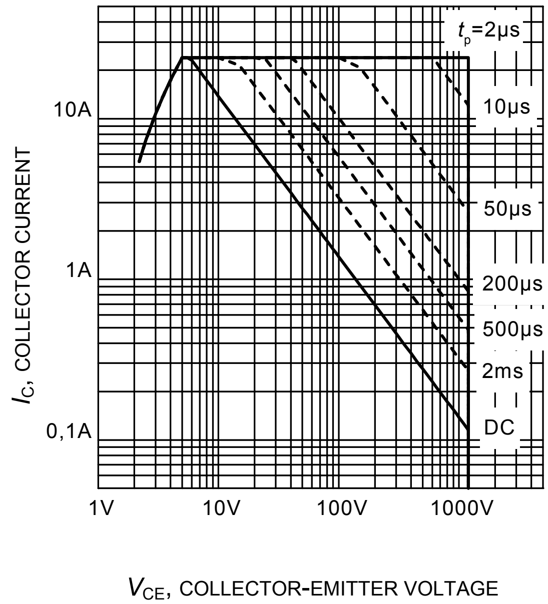


Figure 2. Safe operating area
($D = 0$, $T_C = 25°C$, $T_j \leq 150°C$; V_{GE}=15V)

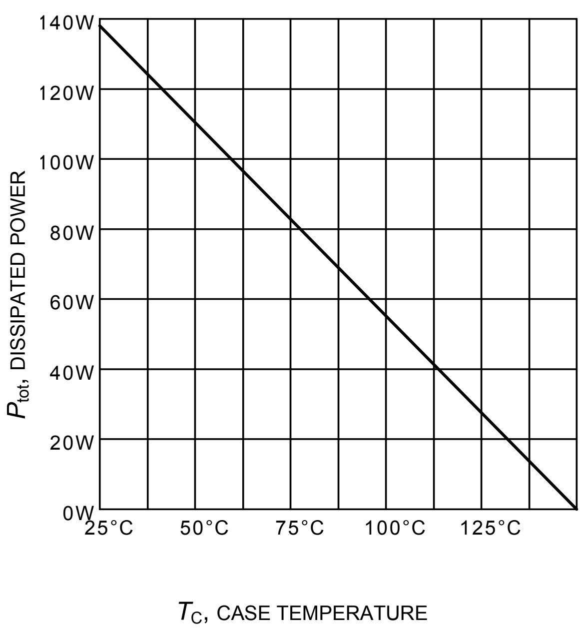


Figure 3. Power dissipation as a function of case temperature
($T_j \leq 150°C$)

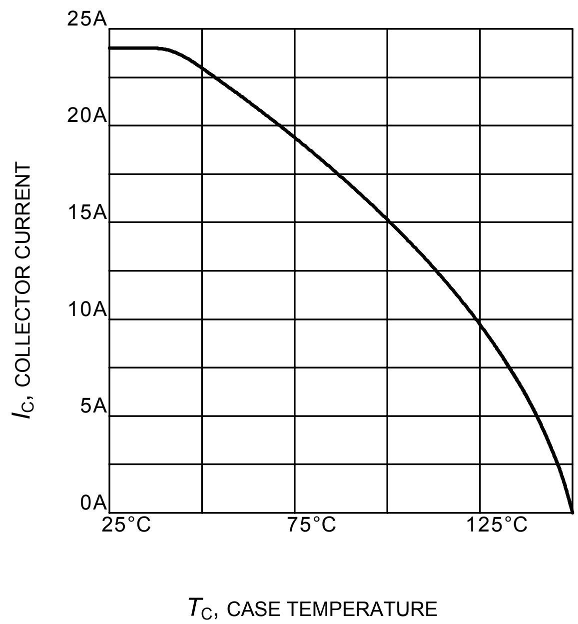


Figure 4. Collector current as a function of case temperature
($V_{GE} \geq 15V$, $T_j \leq 150°C$)

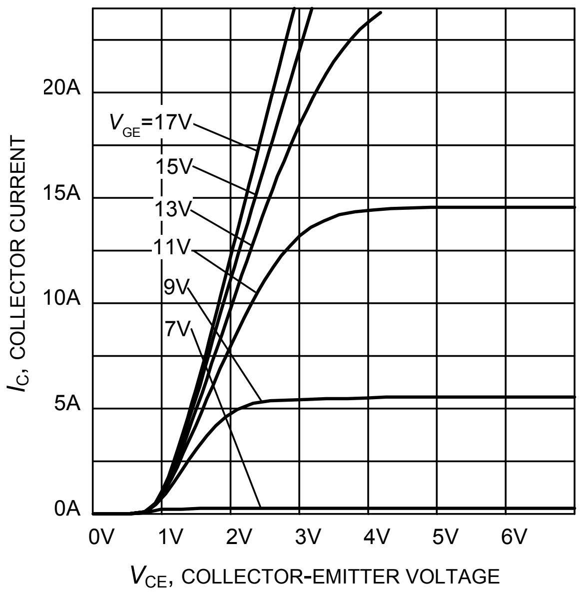


Figure 5. Typical output characteristic
(T_j = 25°C)

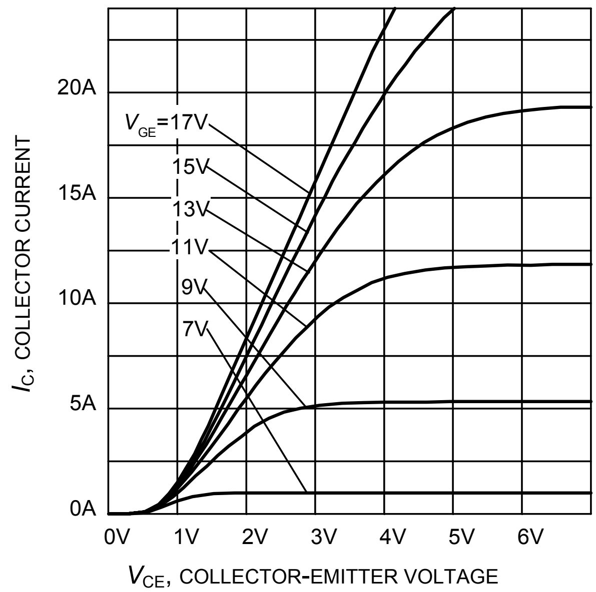


Figure 6. Typical output characteristic
(T_j = 150°C)

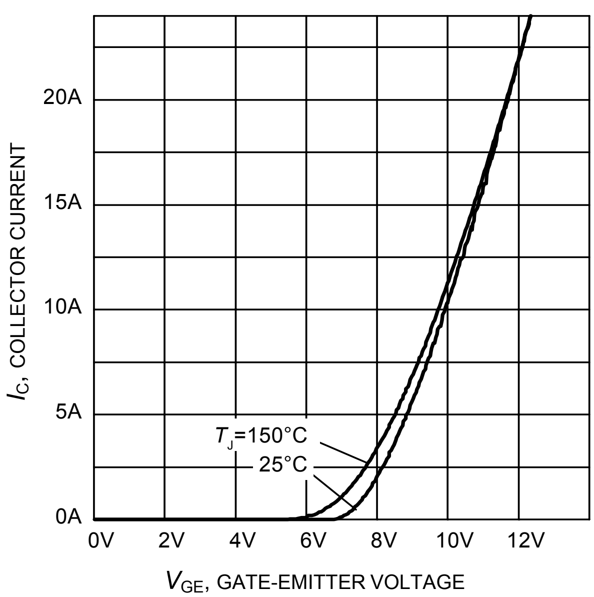


Figure 7. Typical transfer characteristic
(V_{CE}=20V)

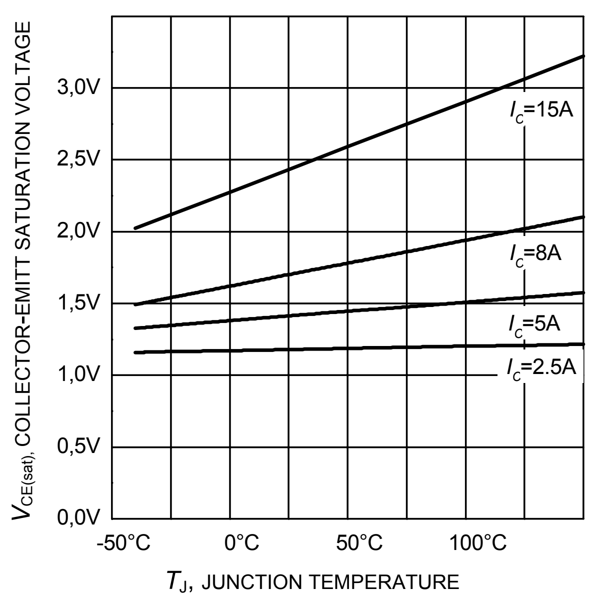


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE} = 15V)

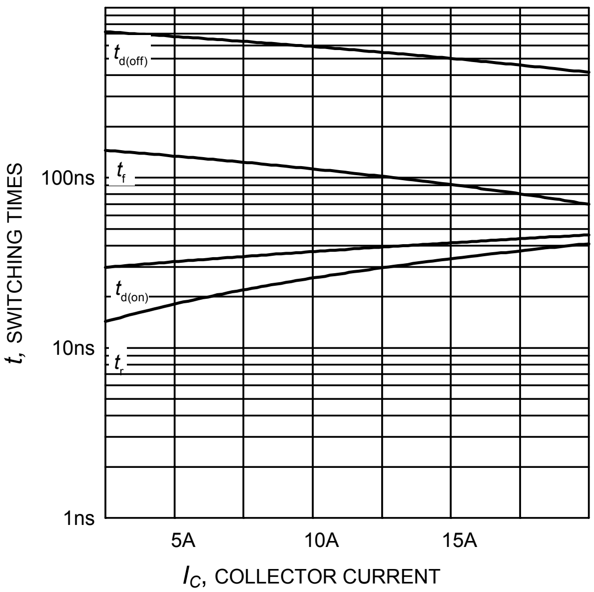


Figure 9. Typical switching times as a function of collector current
(inductive load, T_J=150°C, V_{CE}=600V, V_{GE}=0/15V, R_G=81Ω, Dynamic test circuit in Figure E)

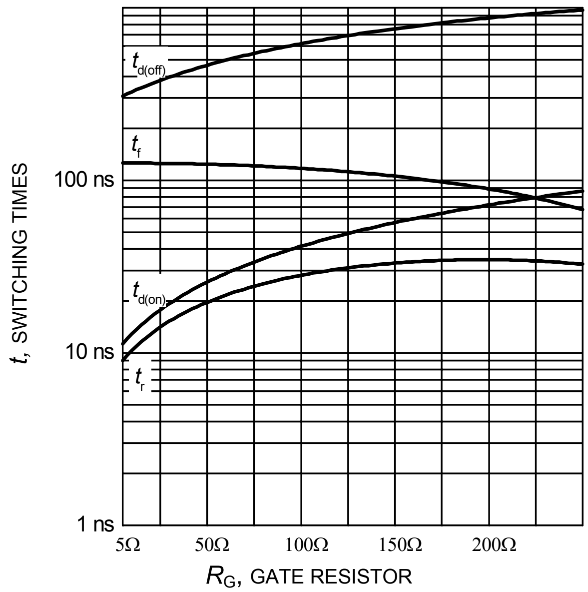


Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_J=150°C, V_{CE}=600V, V_{GE}=0/15V, I_C=8A, Dynamic test circuit in Figure E)

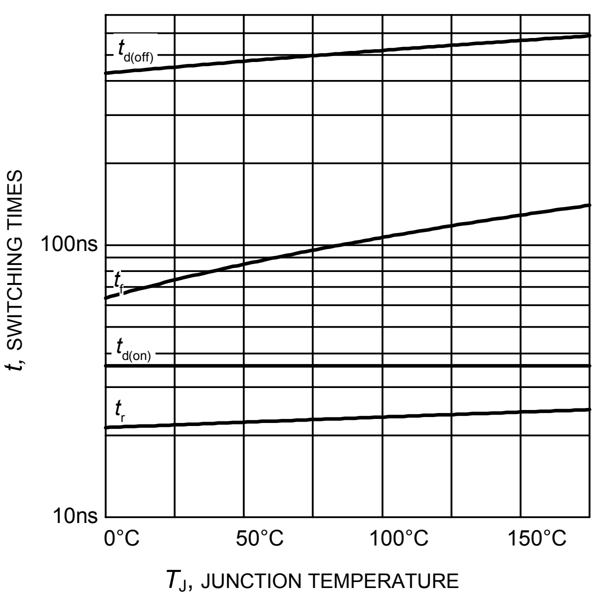


Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE}=600V, V_{GE}=0/15V, I_C=8A, R_G=81Ω, Dynamic test circuit in Figure E)

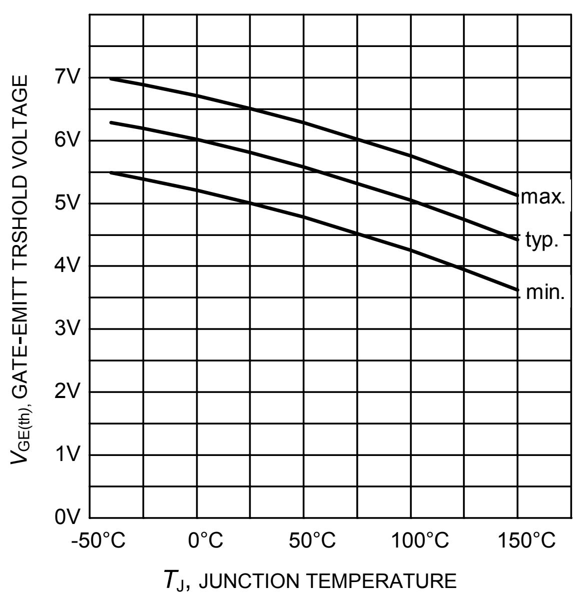


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C = 0.3mA)

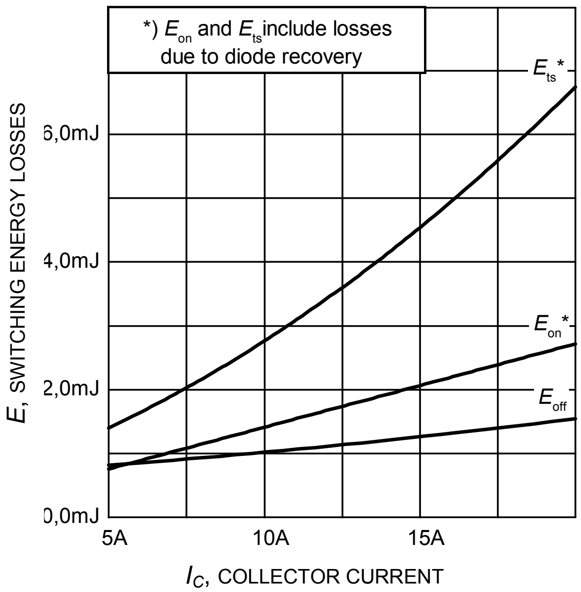


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_J=150°C, V_{CE}=600V, V_{GE}=0/15V, R_G=81Ω,
Dynamic test circuit in Figure E)

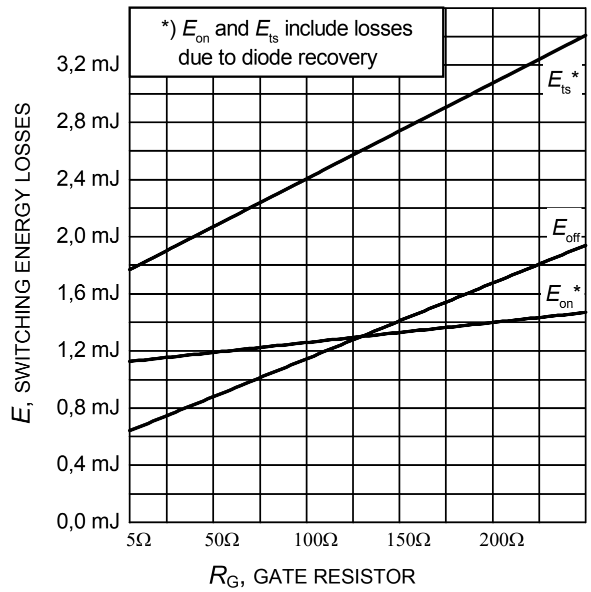


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_J=150°C, V_{CE}=600V, V_{GE}=0/15V, I_C=8A,
Dynamic test circuit in Figure E)

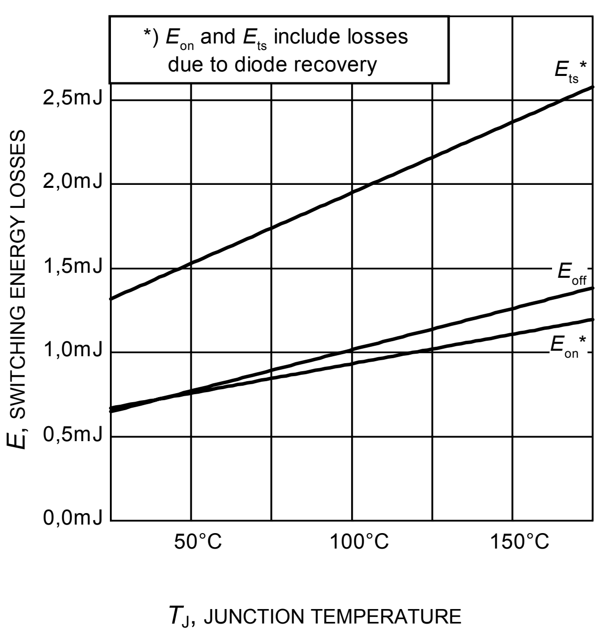


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE}=600V, V_{GE}=0/15V, I_C=8A, R_G=81Ω,
Dynamic test circuit in Figure E)

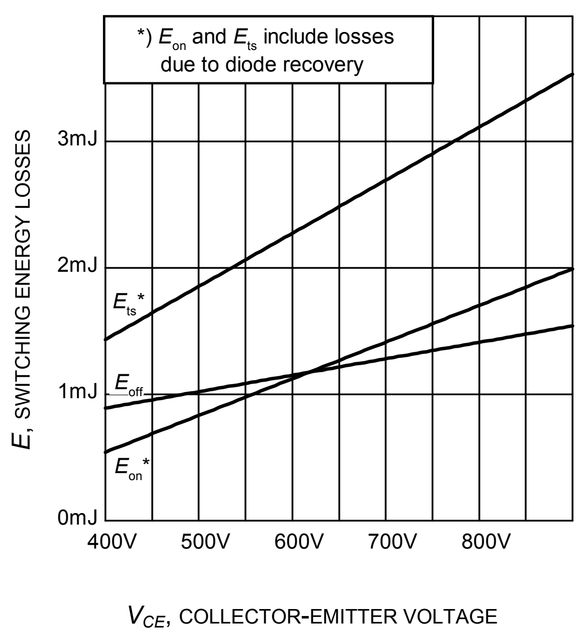


Figure 16. Typical switching energy losses as a function of collector emitter voltage
(inductive load, T_J=150°C, V_{GE}=0/15V, I_C=8A, R_G=81Ω,
Dynamic test circuit in Figure E)

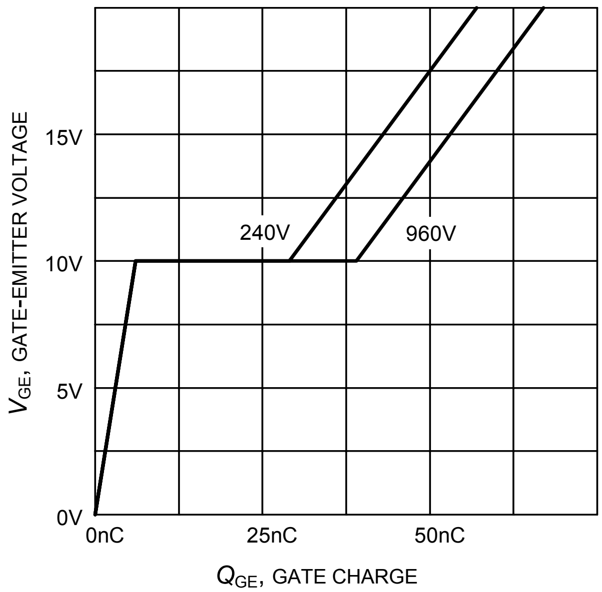


Figure 17. Typical gate charge
(I_C=8 A)

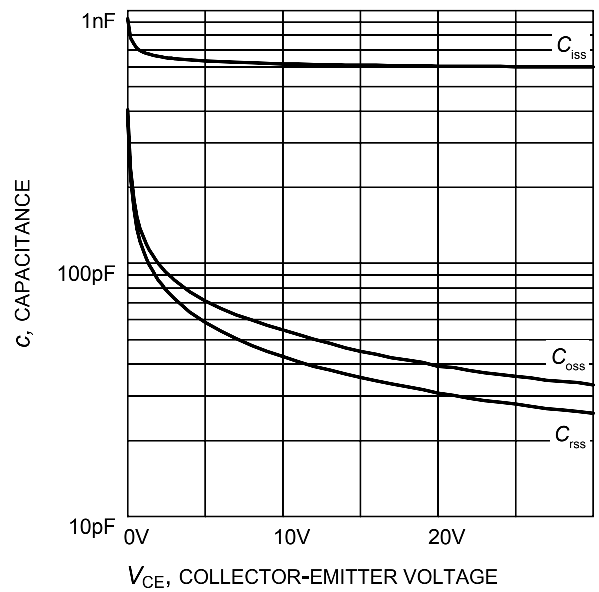


Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE}=0V, f = 1 MHz)

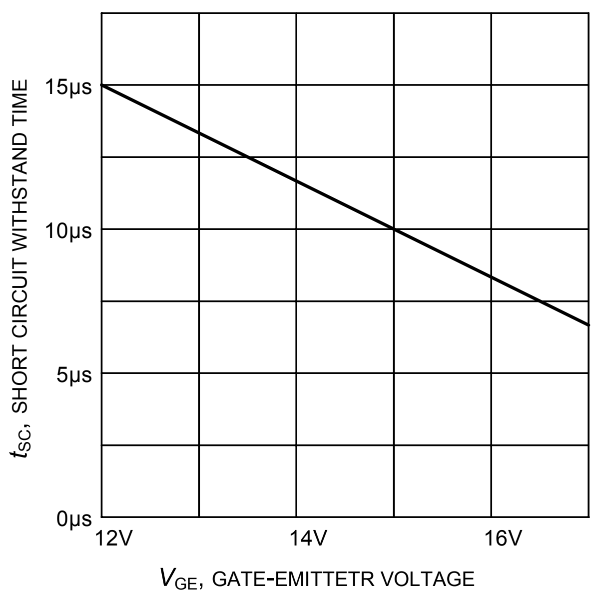


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
(V_{CE}=600V, start at T_J=25°C)

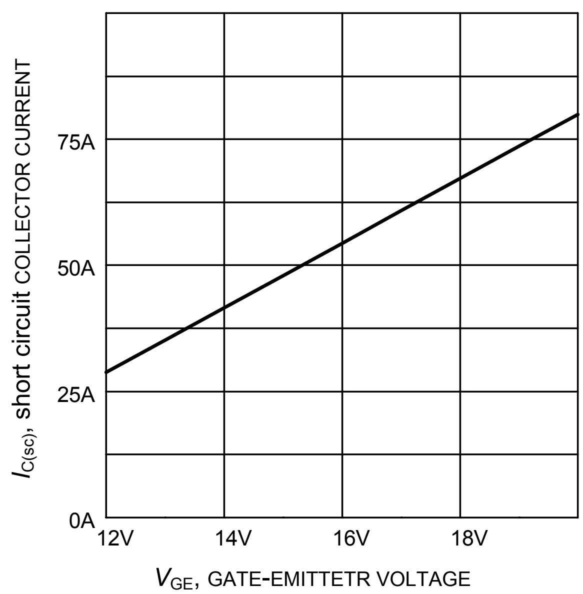


Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \leq$ 600V, $T_j \leq$ 150°C)

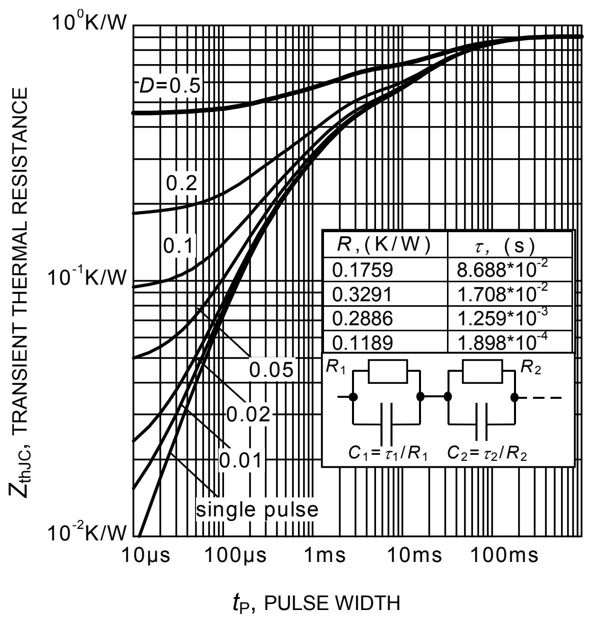


Figure 23. IGBT transient thermal resistance as a function of pulse width
($D = t_p / T$)

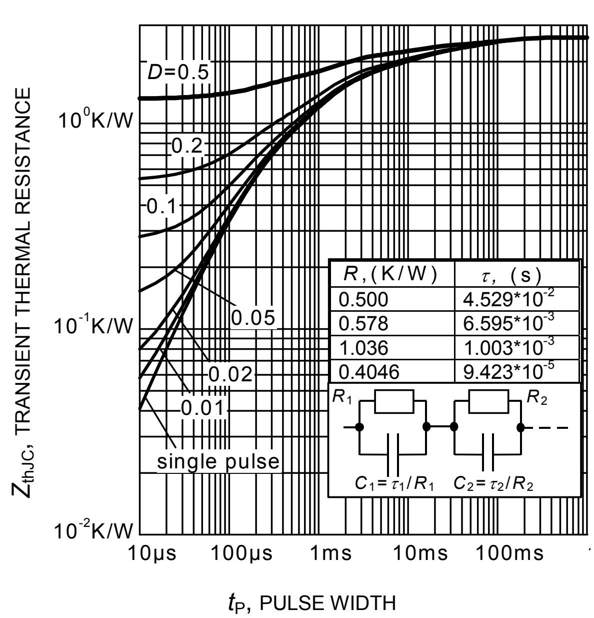


Figure 24. Diode transient thermal impedance as a function of pulse width
($D=t_P/T$)

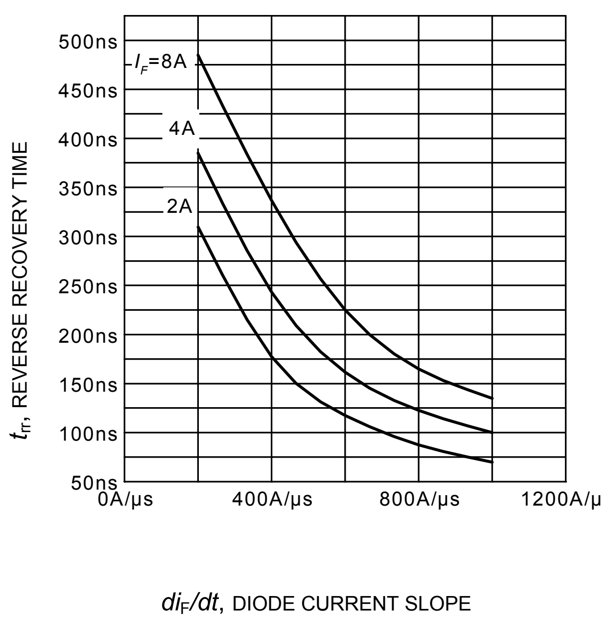


Figure 23. Typical reverse recovery time as a function of diode current slope
(V_R=600V, I_F=8A,
Dynamic test circuit in Figure E)

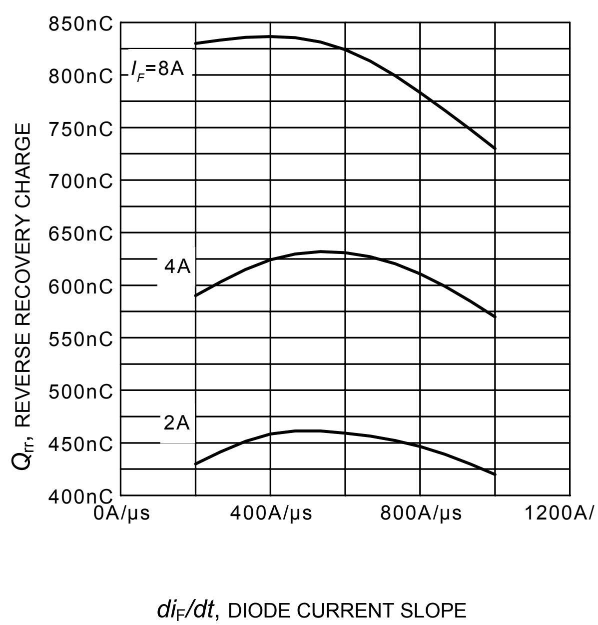


Figure 24. Typical reverse recovery charge as a function of diode current slope
(V_R=800V, T_J = 125°C,
Dynamic test circuit in Figure E)

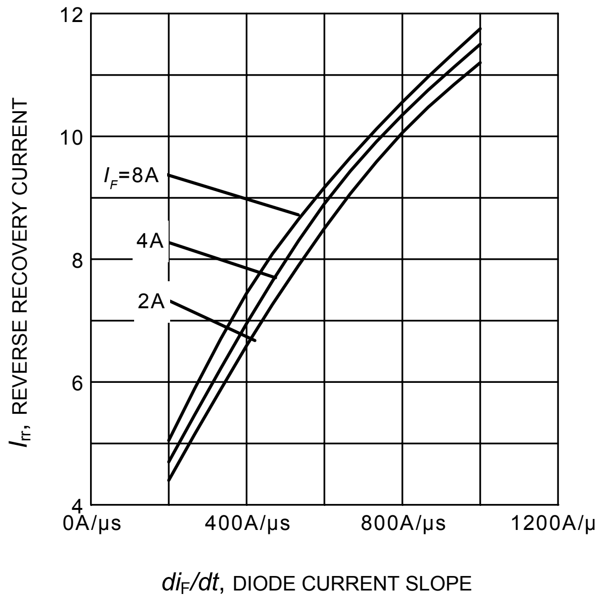


Figure 25. Typical reverse recovery current as a function of diode current slope
(V_R=800V, T_J = 125°C,
Dynamic test circuit in Figure E)

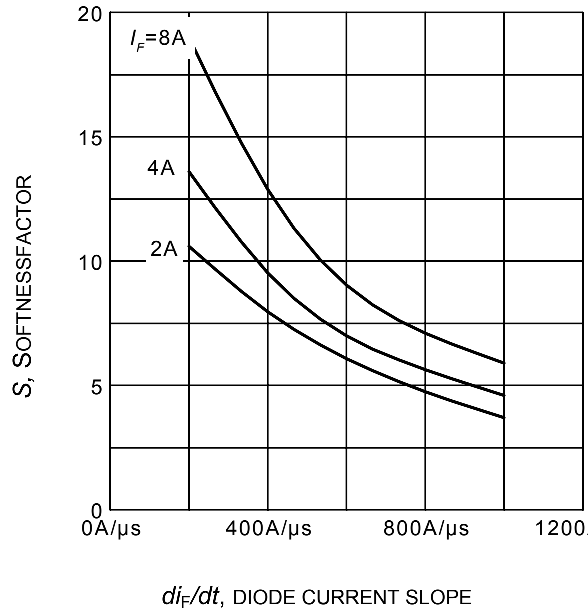


Figure 26. Typical reverse recovery softness factor as a function of diode current slope
(V_R=800V, T_J = 125°C,
Dynamic test circuit in Figure E)

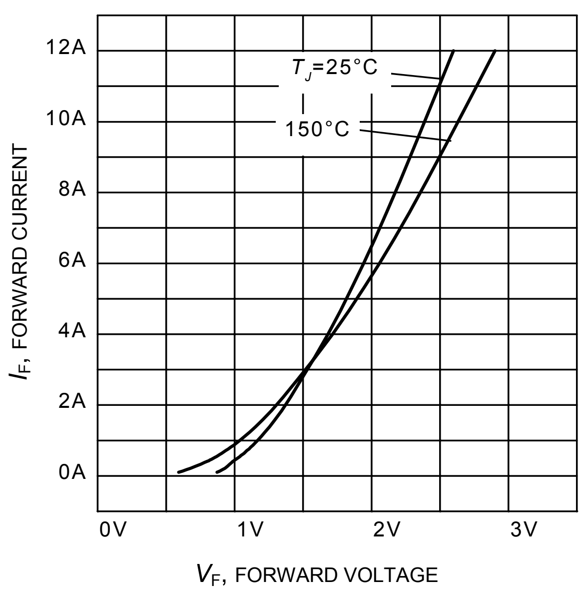


Figure 27. Typical diode forward current as a function of forward voltage

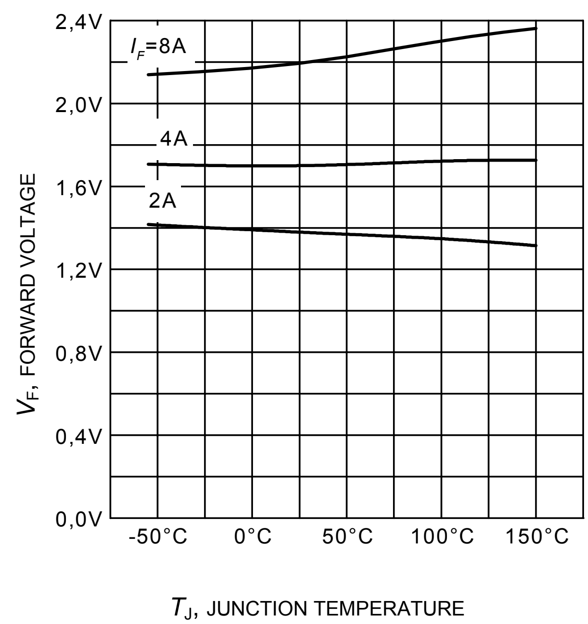


Figure 28. Typical diode forward voltage as a function of junction temperature

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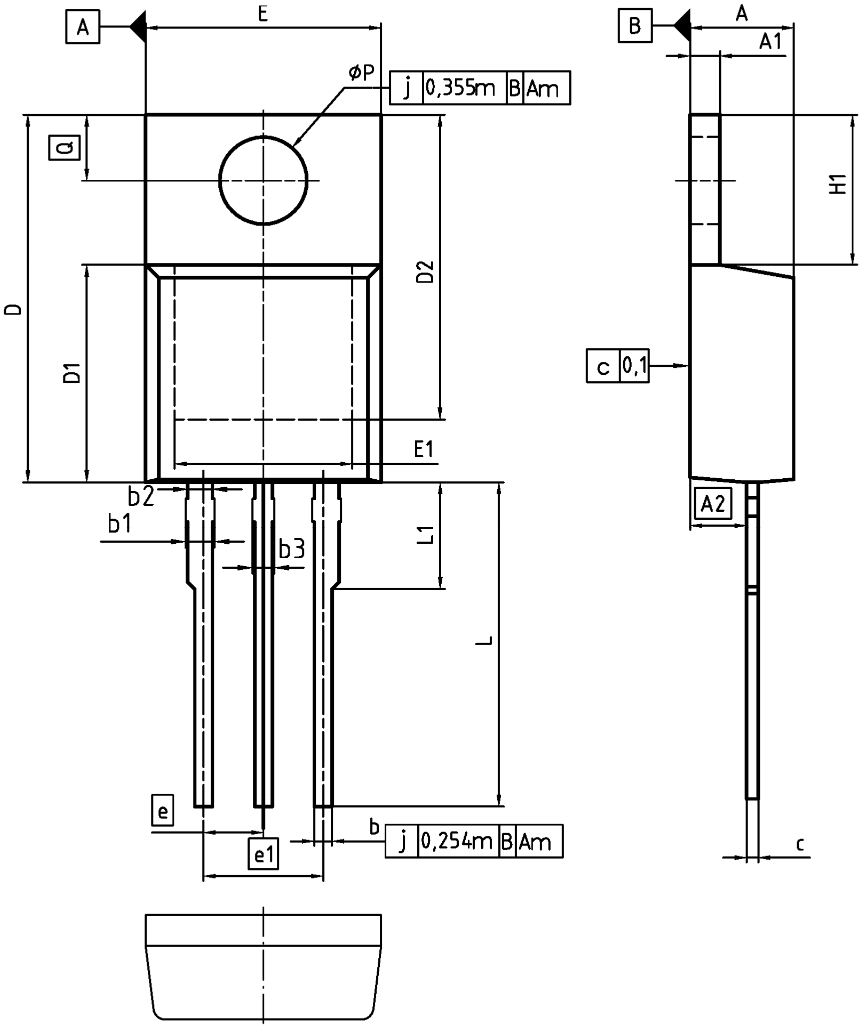

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	1.17	1.40	0.046	0.055
A2	2.15	2.72	0.085	0.107
b	0.65	0.86	0.026	0.034
b1	0.95	1.40	0.037	0.055
b2	0.95	1.15	0.037	0.045
b3	0.65	1.15	0.026	0.045
c	0.33	0.60	0.013	0.024
D	14.81	15.95	0.583	0.628
D1	8.51	9.45	0.335	0.372
D2	12.19	13.10	0.480	0.516
E	9.70	10.36	0.382	0.408
E1	6.50	8.60	0.256	0.339
e	2.54		0.100	
e1	5.08		0.200	
N	3		3	
H1	5.90	6.90	0.232	0.272
L	13.00	14.00	0.512	0.551
L1	-	4.80	-	0.189
øP	3.60	3.89	0.142	0.153
Q	2.60	3.00	0.102	0.118

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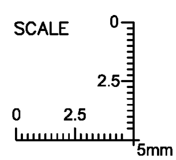
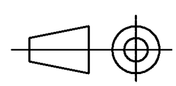
SCALE



EUROPEAN PROJECTION



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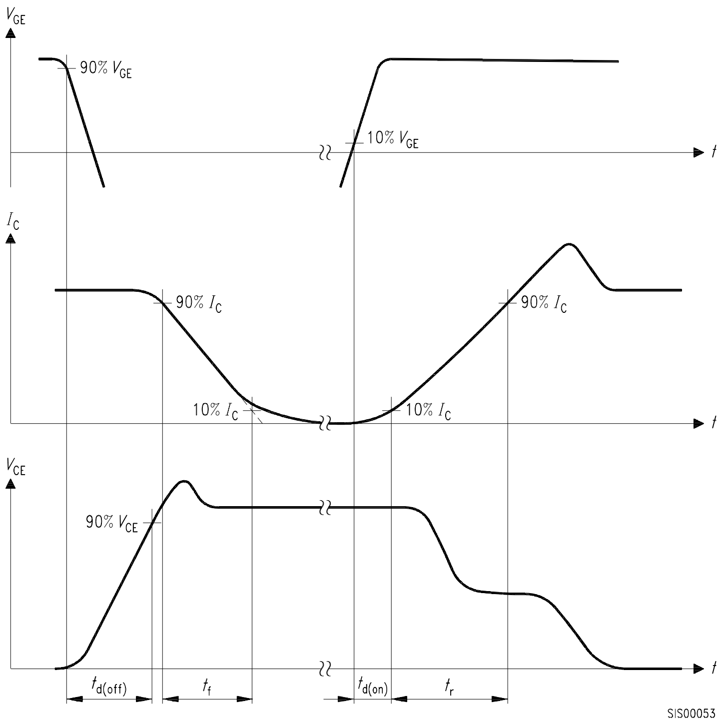

Figure A. Definition of switching times

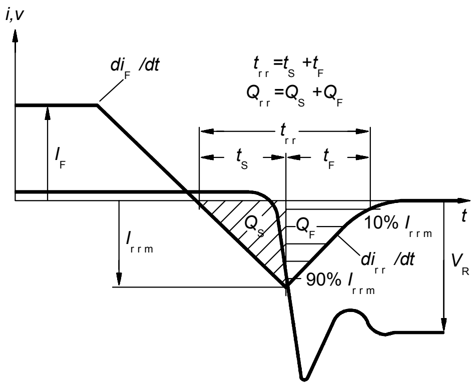

Figure C. Definition of diodes switching characteristics

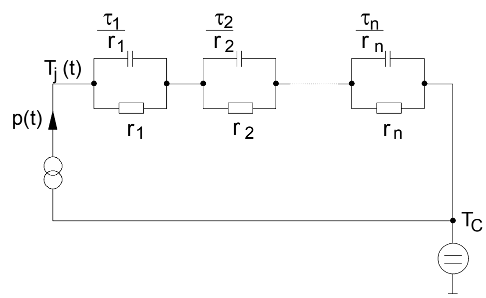

Figure D. Thermal equivalent circuit

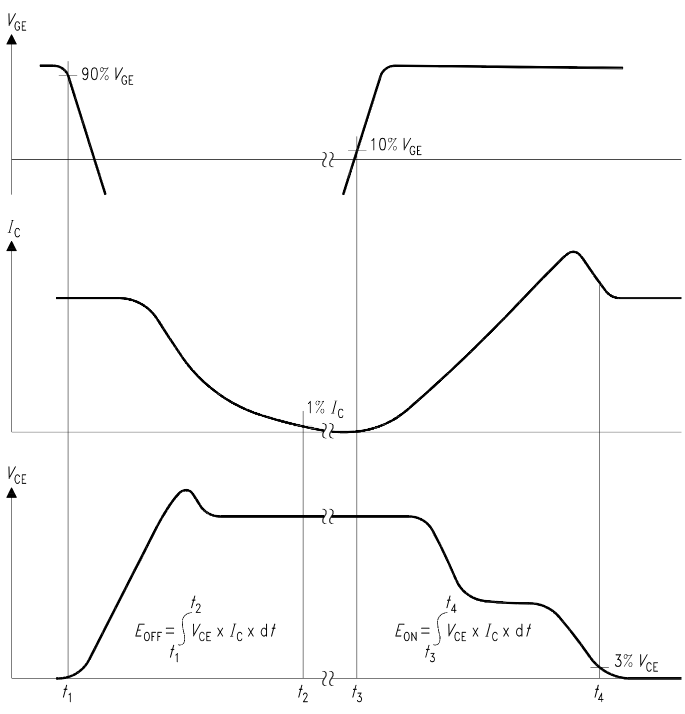

Figure B. Definition of switching losses

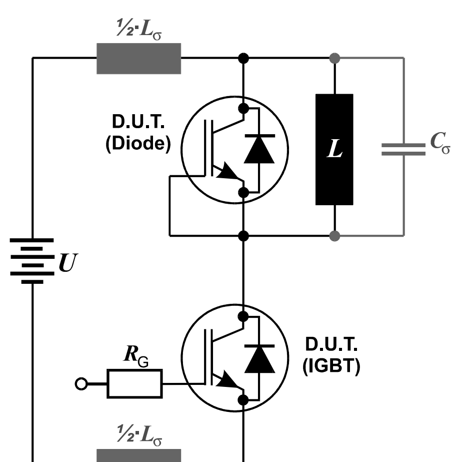

Figure E. Dynamic test circuit
Leakage inductance L_σ =180nH
and Stray capacity C_σ =39pF.

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