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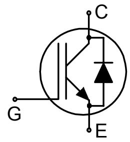
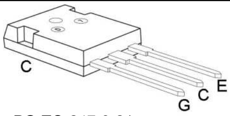
Soft Switching Series

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





PG-TO-247-3-21

- 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 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

Type	V_{CE}	I_C	$V_{CE(sat),Tj=25°C}$	$T_{j,max}$	**Marking**	**Package**
IHW20T120	1200V	20A	1.7V	150°C	H20T120	PG-TO-247-3-21

Maximum Ratings

Parameter	**Symbol**	**Value**	**Unit**
Collector-emitter voltage	V_{CE}	1200	V
DC collector current	I_C		A
T_C = 25°C		40	
T_C = 100°C		20	
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	60	
Turn off safe operating area $V_{CE} \leq$ 1200V, $T_j \leq$ 150°C	-	60	
Diode forward current	I_F		
T_C = 25°C		23	
T_C = 100°C		13	
Diode pulsed current, t_p limited by T_{jmax}	I_{Fpuls}	36	
Diode surge non repetitive current, t_p limited by T_{jmax}	I_{FSM}		A
T_C = 25°C, t_p = 10ms, sine halfwave		50	
T_C = 25°C, $t_p \leq$ 2.5µs, sine halfwave		130	
T_C = 100°C, $t_p \leq$ 2.5µs, sine halfwave		120	
Gate-emitter voltage	V_{GE}	±20	V
Short circuit withstand time[2)]	t_{SC}	10	µs
V_{GE} = 15V, $V_{CC} \leq$ 1200V, $T_j \leq$ 150°C			
Power dissipation, T_C = 25°C	P_{tot}	178	W
Operating junction temperature	T_j	-40...+150	°C
Storage temperature	T_{stg}	-55...+150	°C

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

Soldering temperature, 1.6mm (0.063 in.) from case for 10s	-	260	

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction – case	R_{thJC}		0.7	K/W
Diode thermal resistance, junction – case	R_{thJCD}		1.3	
Thermal resistance, junction – ambient	R_{thJA}		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=500µA	1200	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE} = 15V, I_C=20A 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=9A T_j=25°C T_j=125°C T_j=150°C	 - - -	 1.7 1.7 1.7	 2.2 - -	
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C=300µA, 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	 - -	 - -	 250 2500	µA
Gate-emitter leakage current	I_{GES}	V_{CE}=0V, V_{GE}=20V	-	-	600	nA
Transconductance	g_{fs}	V_{CE}=20V, I_C=20A	-	13	-	S

Dynamic Characteristic

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Input capacitance	C_{iss}	V_{CE}=25V,	-	1460	-	pF
Output capacitance	C_{oss}	V_{GE}=0V,	-	78	-	
Reverse transfer capacitance	C_{rss}	f=1MHz	-	65	-	
Gate charge	Q_{Gate}	V_{CC}=960V, I_C=20A V_{GE}=15V	-	120	-	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}≤10µs V_{CC} = 600V, T_j = 25°C	-	120	-	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}=600V, I_C=20A, V_{GE}=0/15V, R_G=28Ω, Energy losses include "tail" and diode reverse recovery.	-	50	-	ns
Rise time	t_r		-	30	-	
Turn-off delay time	$t_{d(off)}$		-	560	-	
Fall time	t_f		-	70	-	
Turn-on energy	E_{on}		-	1.8	-	mJ
Turn-off energy	E_{off}		-	1.5	-	
Total switching energy	E_{ts}		-	3.3	-	
Anti-Parallel Diode Characteristic						
Diode reverse recovery time	t_{rr}	T_j=25°C, V_R=800V, I_F=9A, di_F/dt=750A/µs	-	140	-	ns
Diode reverse recovery charge	Q_{rr}		-	950		nC
Diode peak reverse recovery current	I_{rrm}		-	13.3		A

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}=600V, I_C=20A, V_{GE}=0/15V, R_G= 28Ω Energy losses include "tail" and diode reverse recovery.	-	50	-	ns
Rise time	t_r		-	32	-	
Turn-off delay time	$t_{d(off)}$		-	660	-	
Fall time	t_f		-	130	-	
Turn-on energy	E_{on}		-	2.6	-	mJ
Turn-off energy	E_{off}		-	2.6	-	
Total switching energy	E_{ts}		-	5.2	-	
Anti-Parallel Diode Characteristic						
Diode reverse recovery time	t_{rr}	T_j=150°C V_R=800V, I_F=18A, di_F/dt=750A/µs	-	210	-	ns
Diode reverse recovery charge	Q_{rr}		-	1600	-	nC
Diode peak reverse recovery current	I_{rrm}		-	16.5	-	A

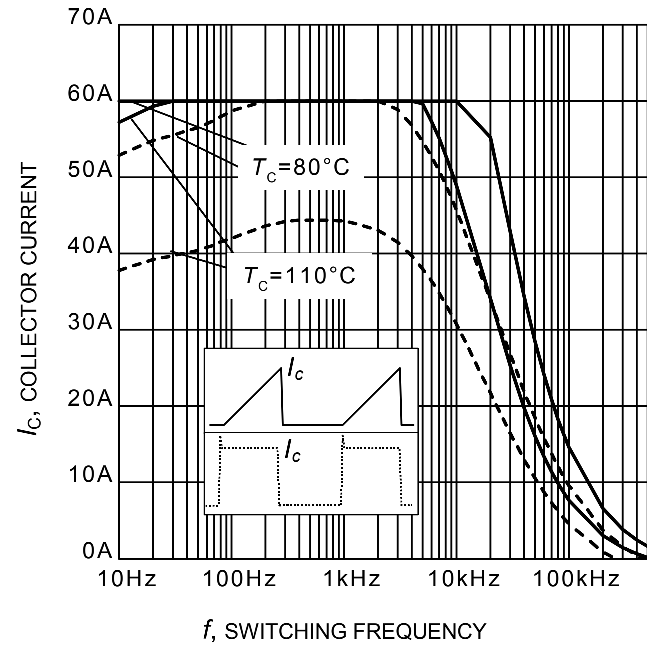


Figure 1. Collector current as a function of switching frequency
($T_j \leq 150°C$, $D = 0.5$, $V_{CE} = 600V$, $V_{GE} = 0/+15V$, $R_G = 28\Omega$)

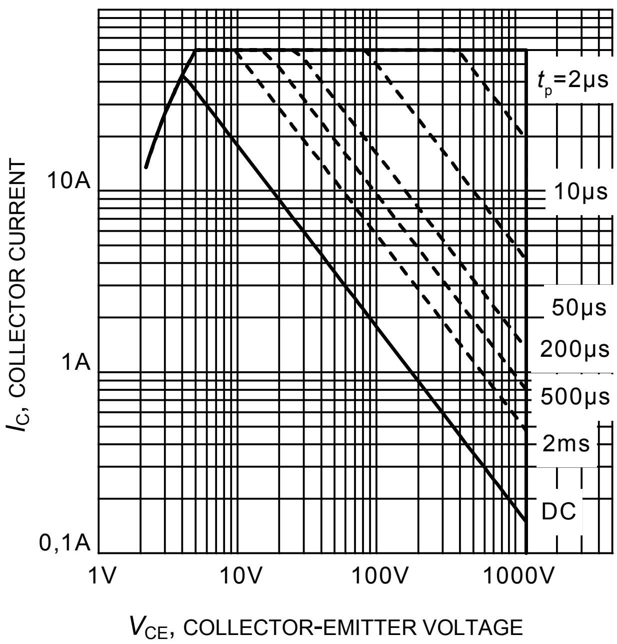


Figure 2. IGBT Safe operating area
($D = 0$, $T_C = 25°C$, $T_j \leq 150°C$; V_{GE}=15V)

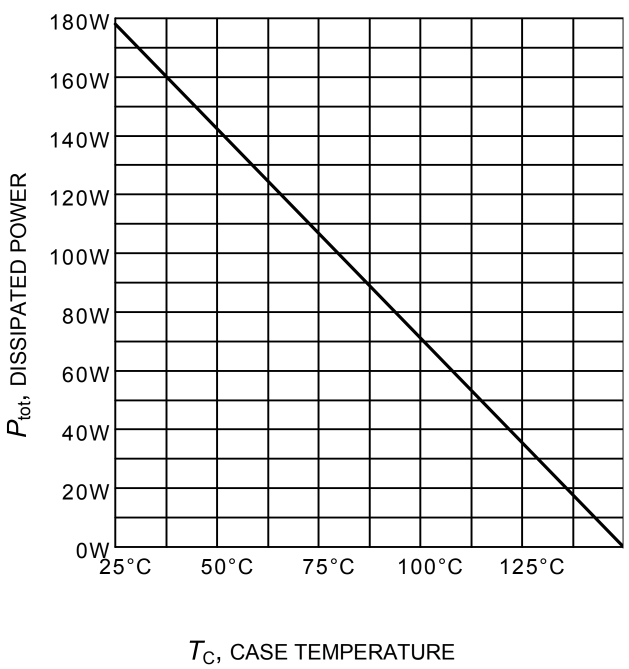


Figure 3. Power dissipation as a function of case temperature
($T_j \leq 150°C$)

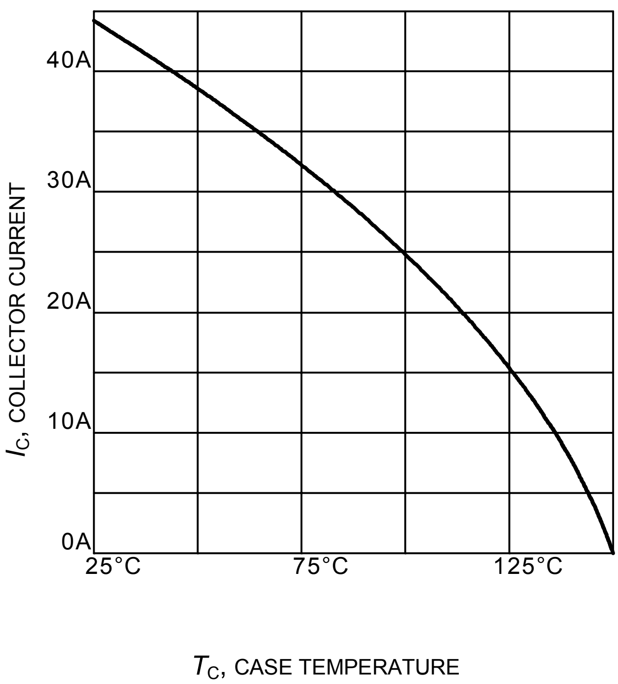


Figure 4. Collector current as a function of case temperature
($V_{GE} \geq 15V$, $T_j \leq 150°C$)

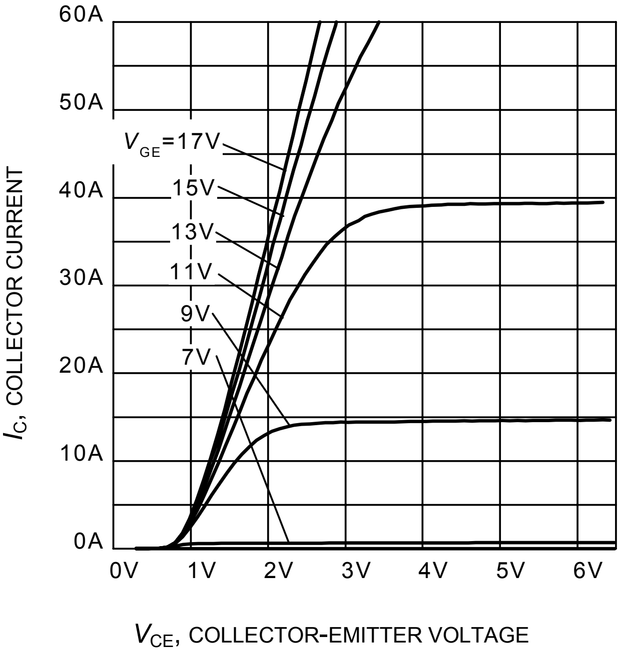


Figure 5. Typical output characteristic
(T_j = 25°C)

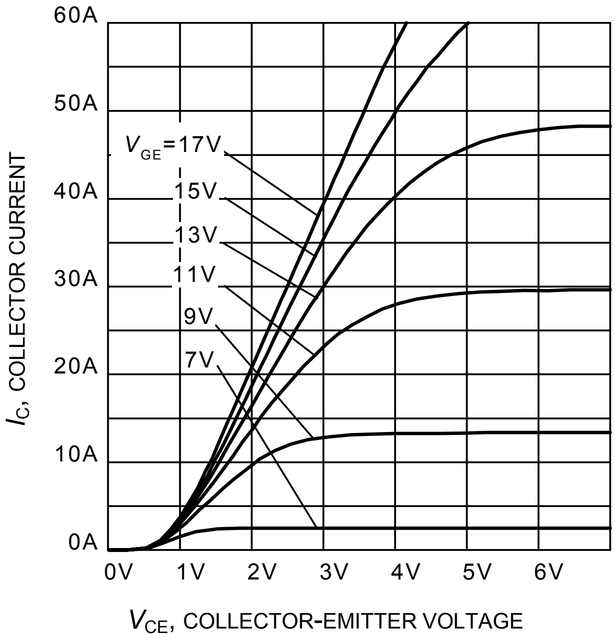


Figure 6. Typical output characteristic
(T_j = 150°C)

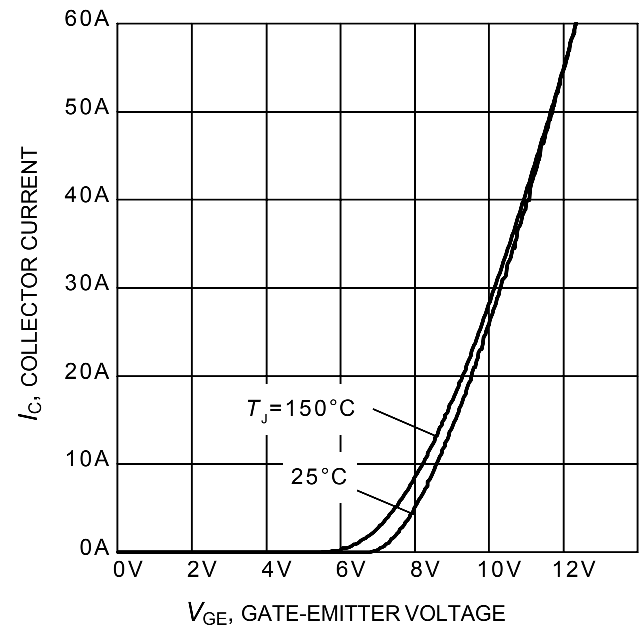


Figure 7. Typical transfer characteristic
(V_{CE}=20V)

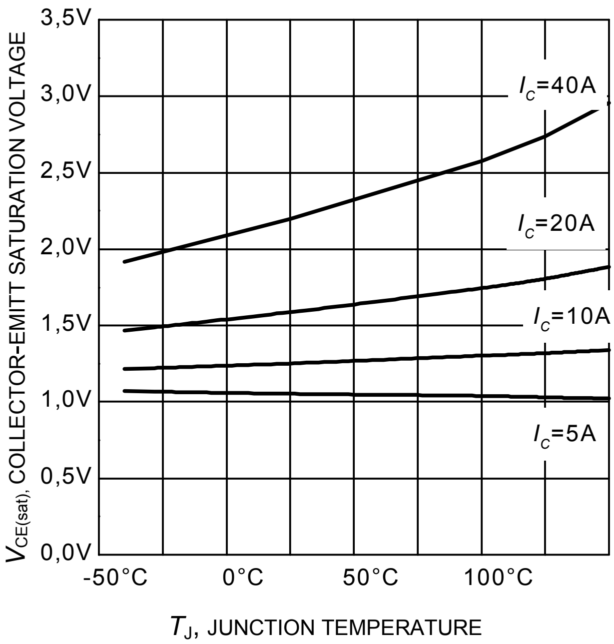


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE} = 15V)

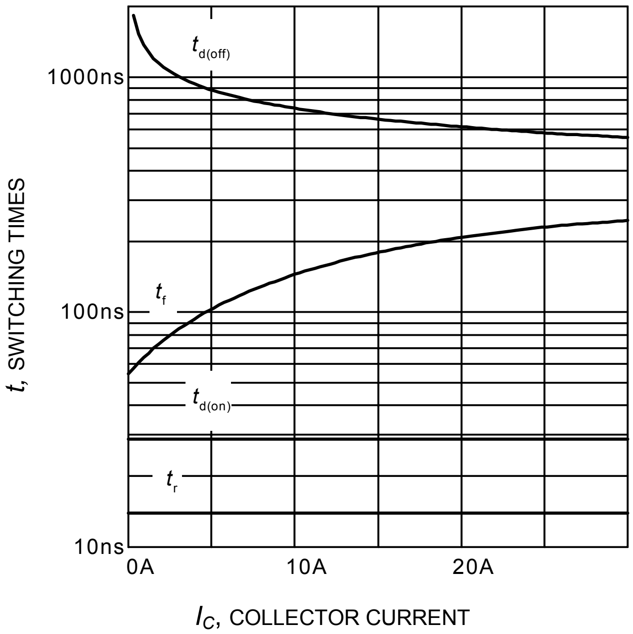


Figure 9. Typical switching times as a function of collector current
(inductive load, T_J=150°C, V_{CE}=600V, V_{GE}=0/15V, R_G=35Ω, Dynamic test circuit in Figure E)

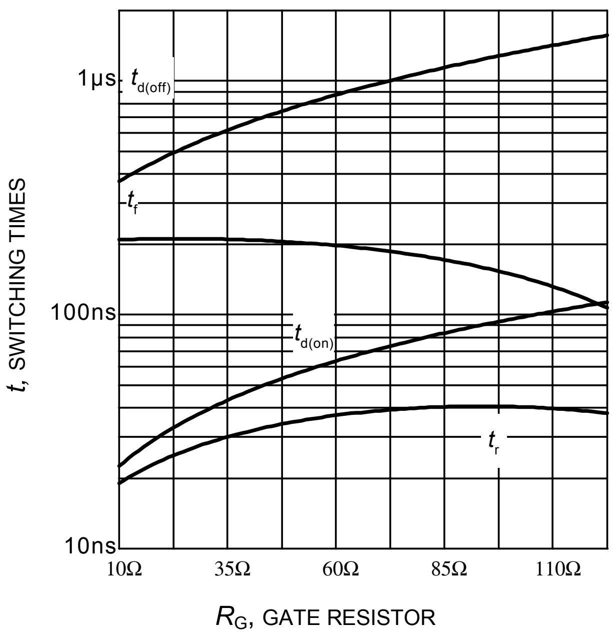


Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_J=150°C, V_{CE}=600V, V_{GE}=0/15V, I_C=20A, Dynamic test circuit in Figure E)

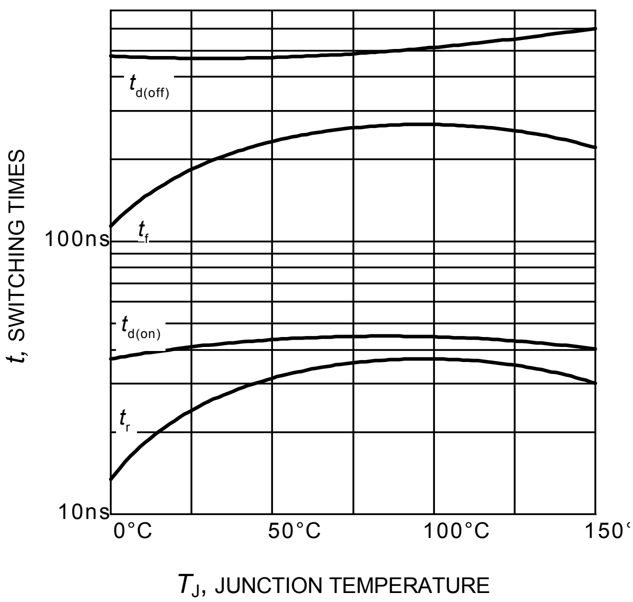


Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE}=600V, V_{GE}=0/15V, I_C=20A, R_G=35Ω, Dynamic test circuit in Figure E)

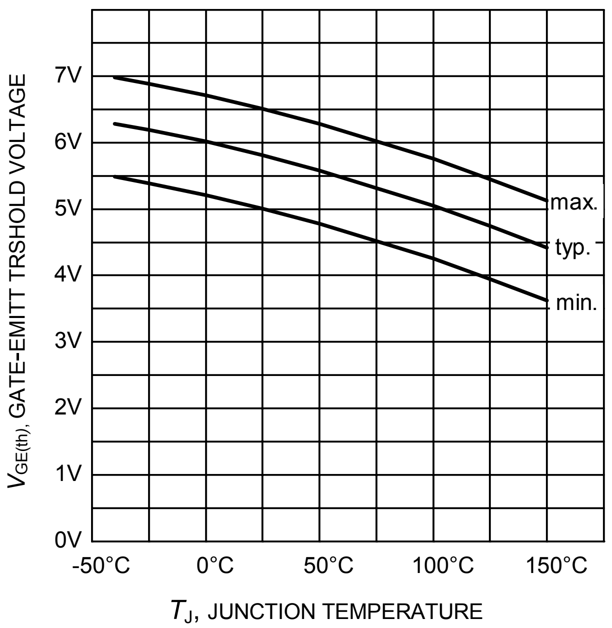


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C = 0.3mA)

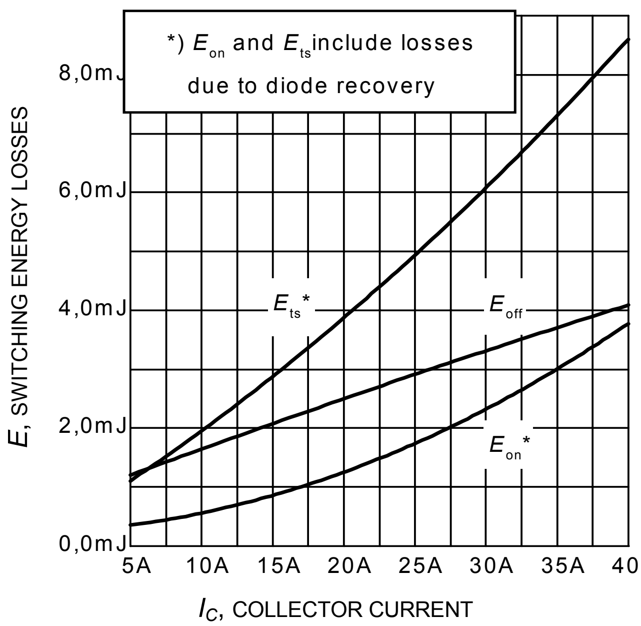


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_J=150°C, V_{CE}=600V, V_{GE}=0/15V, R_G=35Ω, Dynamic test circuit in Figure E)

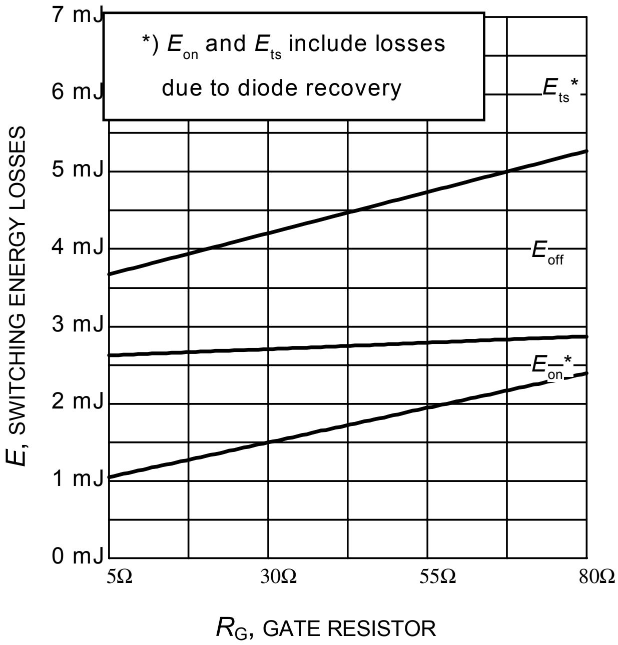


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_J=150°C, V_{CE}=600V, V_{GE}=0/15V, I_C=20A, Dynamic test circuit in Figure E)

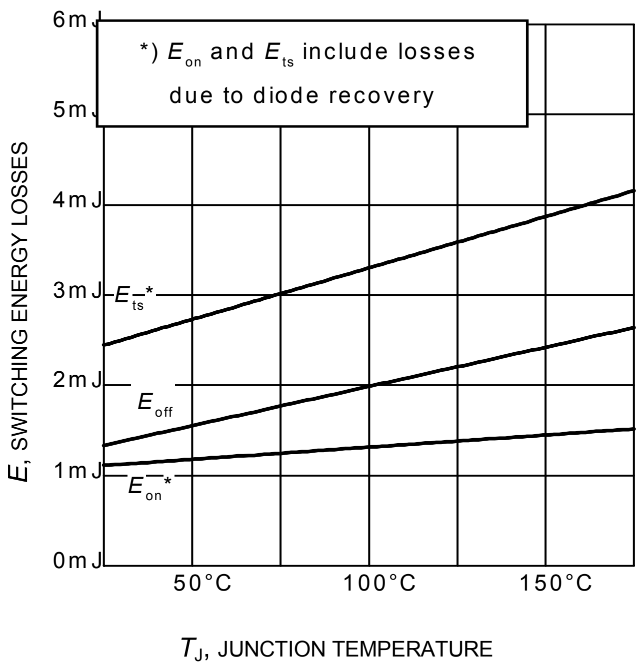


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE}=600V, V_{GE}=0/15V, I_C=20A, R_G=35Ω, Dynamic test circuit in Figure E)

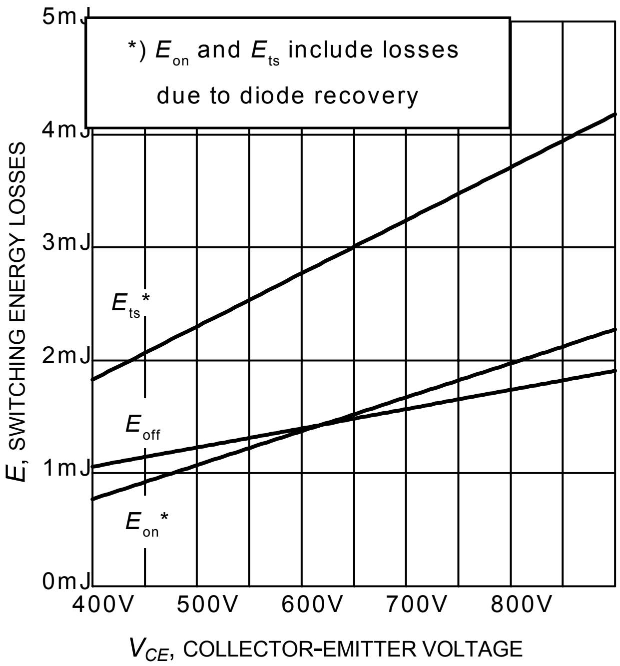


Figure 16. Typical switching energy losses as a function of collector emitter voltage
(inductive load, T_J=150°C, V_{GE}=0/15V, I_C=20A, R_G=35Ω, Dynamic test circuit in Figure E)

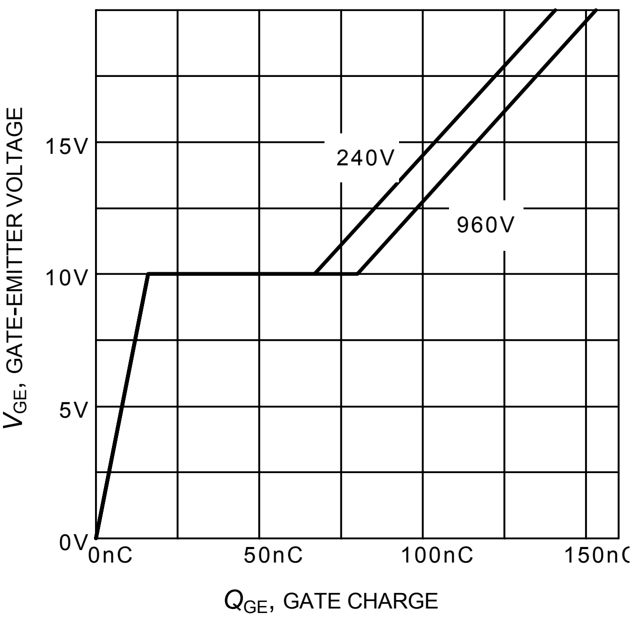


Figure 17. Typical gate charge
(I_C=20 A)

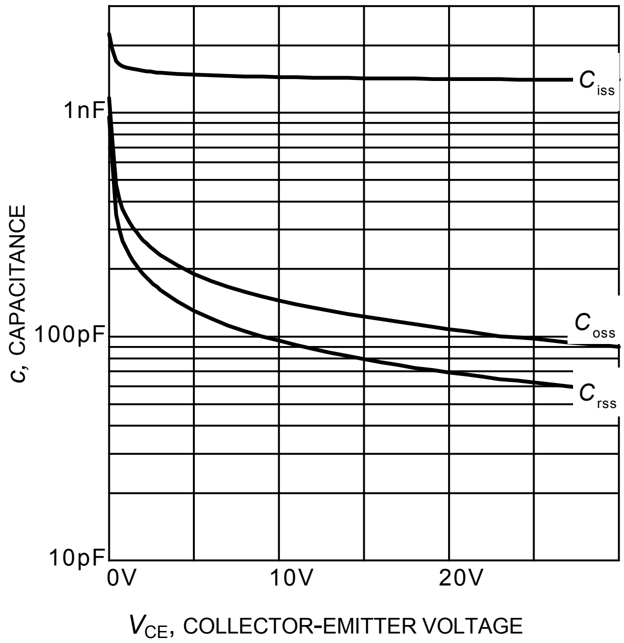


Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE}=0V, f = 1 MHz)

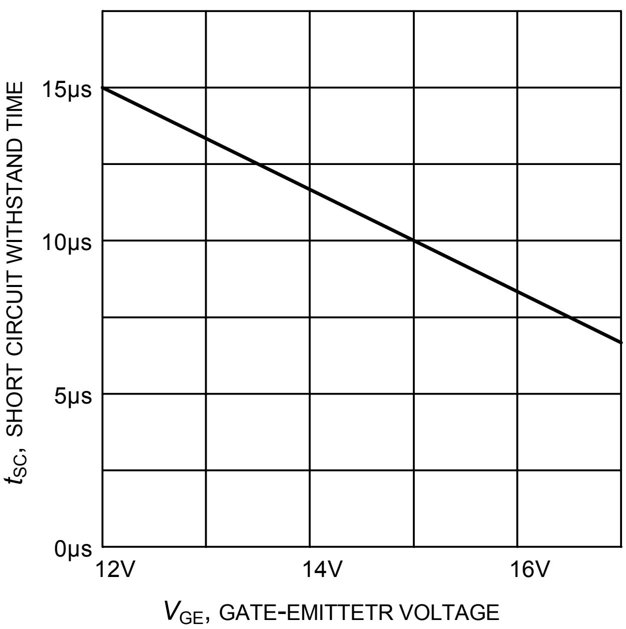


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
(V_{CE}=600V, start at T_J=25°C)

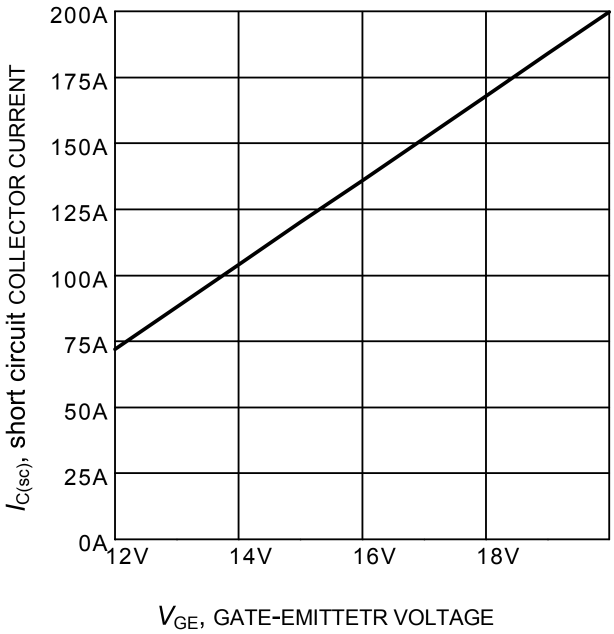


Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \leq 600V$, $T_j \leq 150°C$)

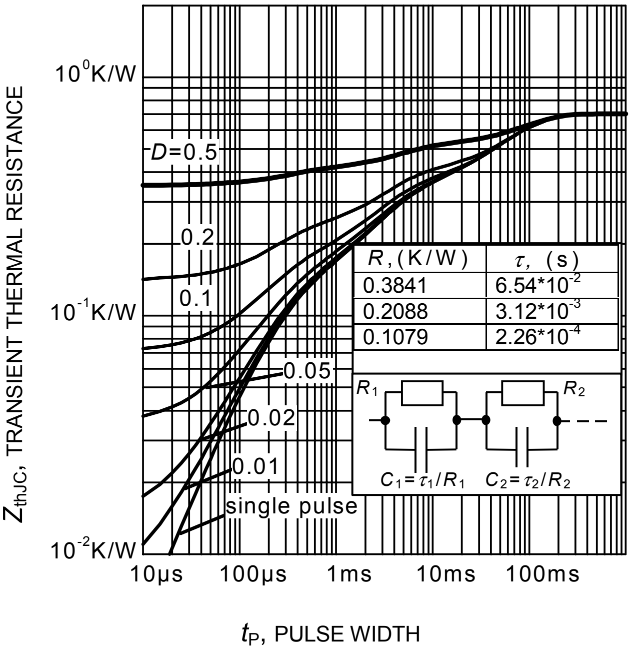


Figure 23. IGBT transient thermal resistance
($D = t_p / T$)

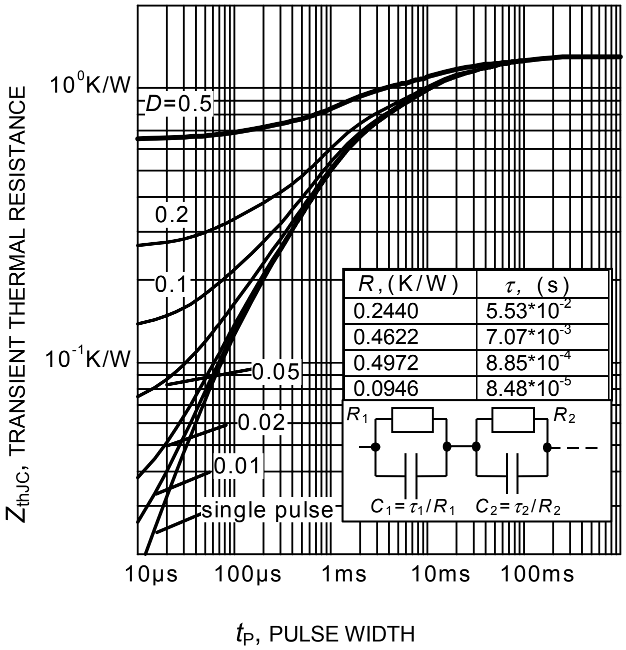


Figure 24. Typical Diode transient thermal impedance as a function of pulse width
($D=t_P/T$)

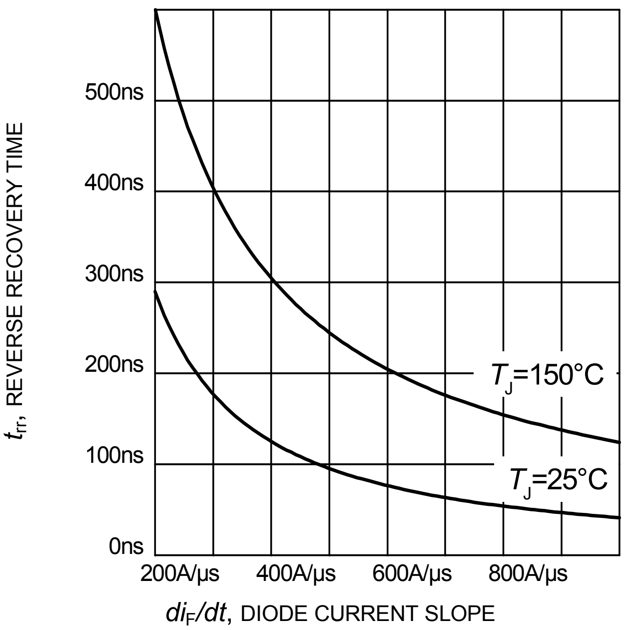


Figure 23. Typical reverse recovery time as a function of diode current slope
(V_R=600V, I_F=8A,
Dynamic test circuit in Figure E)

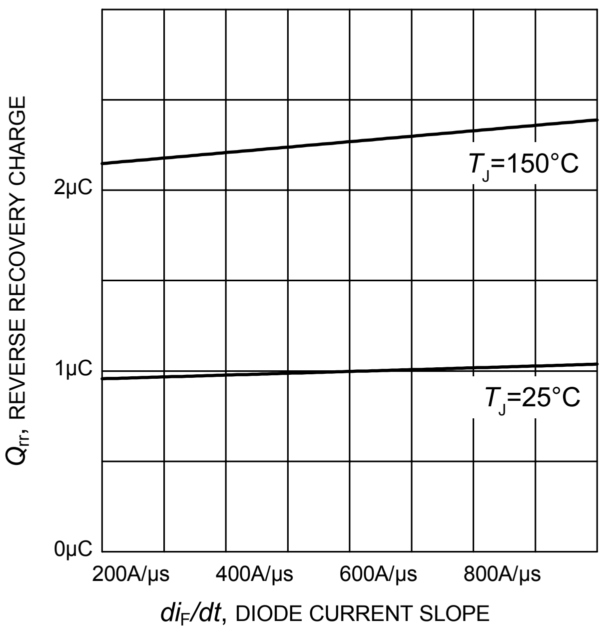


Figure 24. Typical reverse recovery charge as a function of diode current slope
(V_R=600V, I_F=8A,
Dynamic test circuit in Figure E)

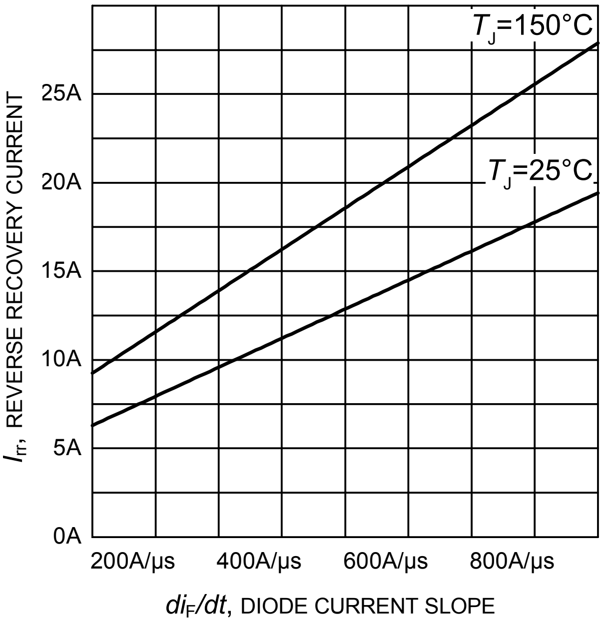


Figure 25. Typical reverse recovery current as a function of diode current slope
(V_R=600V, I_F=8A,
Dynamic test circuit in Figure E)

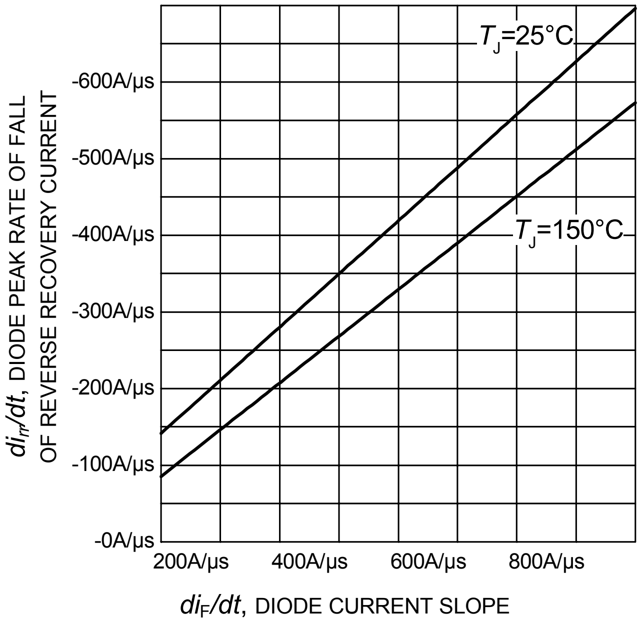


Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
(V_R=600V, I_F=8A,
Dynamic test circuit in Figure E)

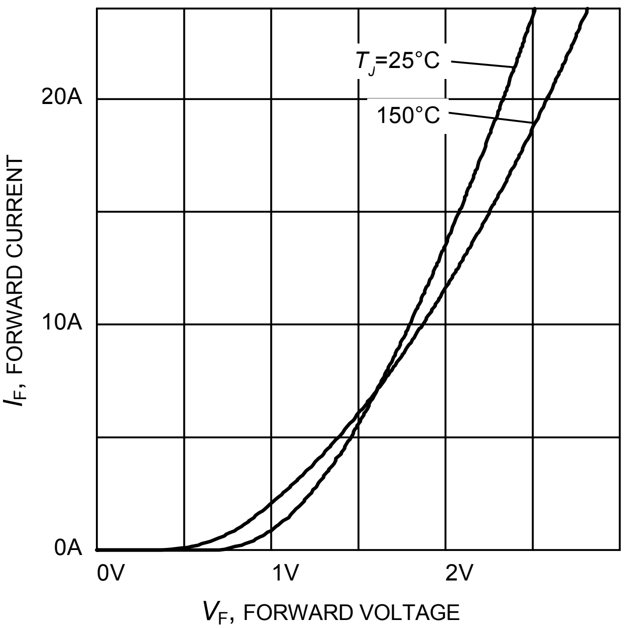


Figure 27. Typical diode forward current as a function of forward voltage

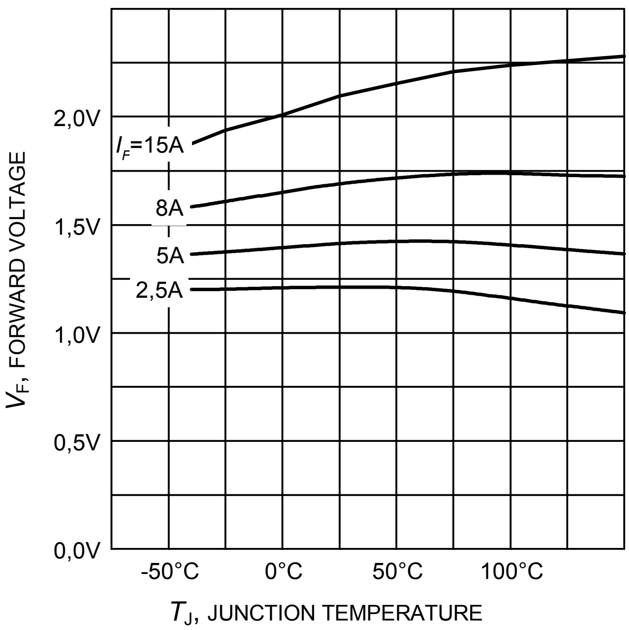


Figure 28. Typical diode forward voltage as a function of junction temperature

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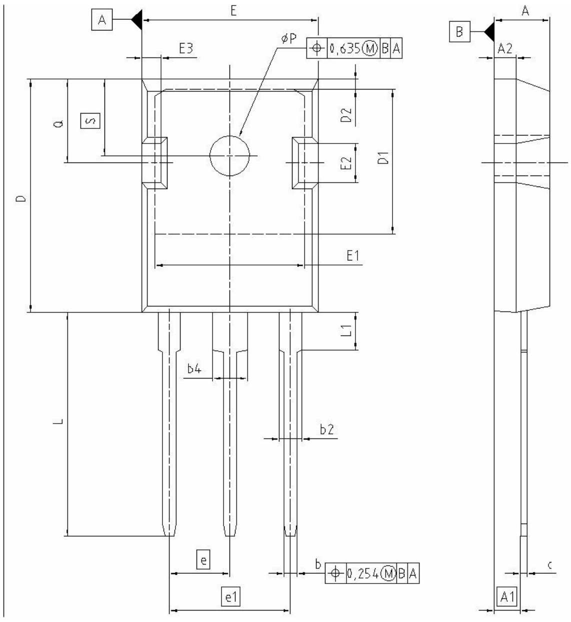

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.903	5.157	0.193	0.203
A1	2.273	2.527	0.092	0.096
A2	1.853	2.107	0.075	0.081
b	1.073	1.327	0.047	0.052
b2	1.903	2.386	0.075	0.094
b4	2.870	3.454	0.113	0.136
c	0.549	0.752	0.024	0.030
D	20.823	21.077	0.820	0.830
D1	17.323	17.831	0.682	0.702
D2	1.063	1.317	0.042	0.052
E	15.773	16.027	0.621	0.631
E1	13.893	14.147	0.547	0.557
E2	3.683	3.937	0.145	0.155
E3	1.683	1.937	0.066	0.076
e	5.450		0.215	
e1	10.900		0.430	
N	3		3	
L	20.053	20.307	0.789	0.799
L1	4.168	4.472	0.164	0.176
øP	3.559	3.661	0.140	0.144
Q	5.493	5.747	0.216	0.226
S	6.043	6.297	0.238	0.248

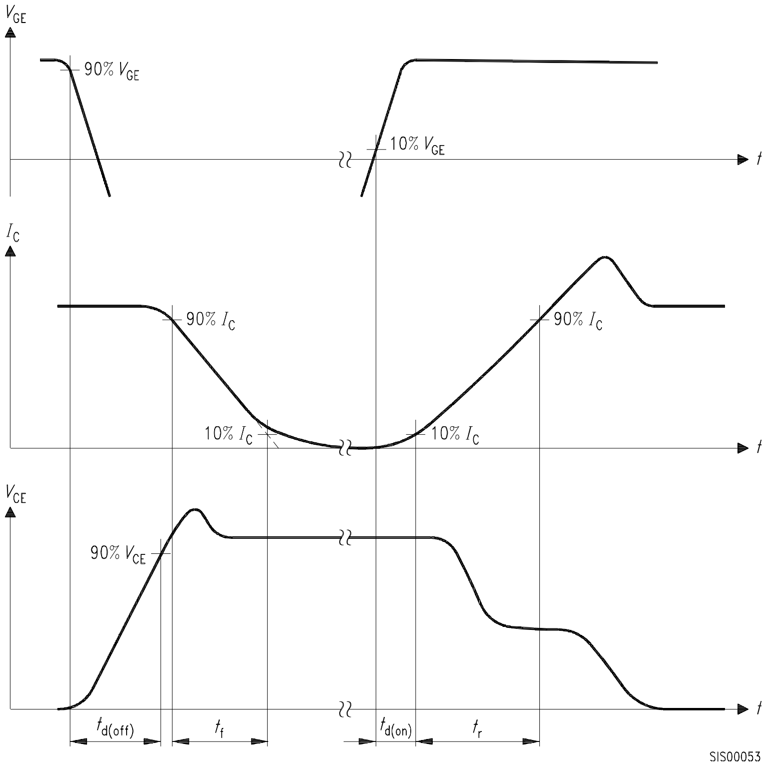

Figure A. Definition of switching times

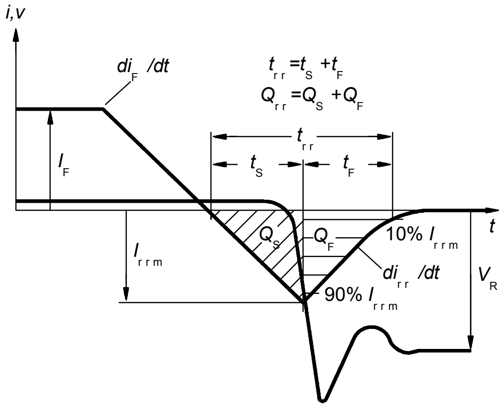

Figure C. Definition of diodes switching characteristics

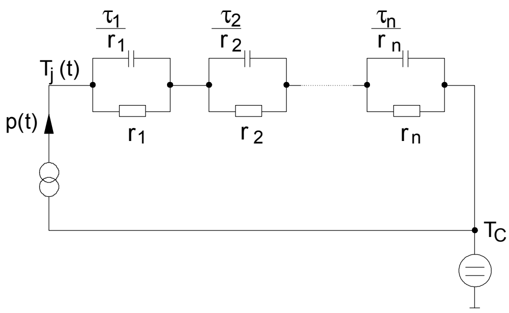

Figure D. Thermal equivalent circuit

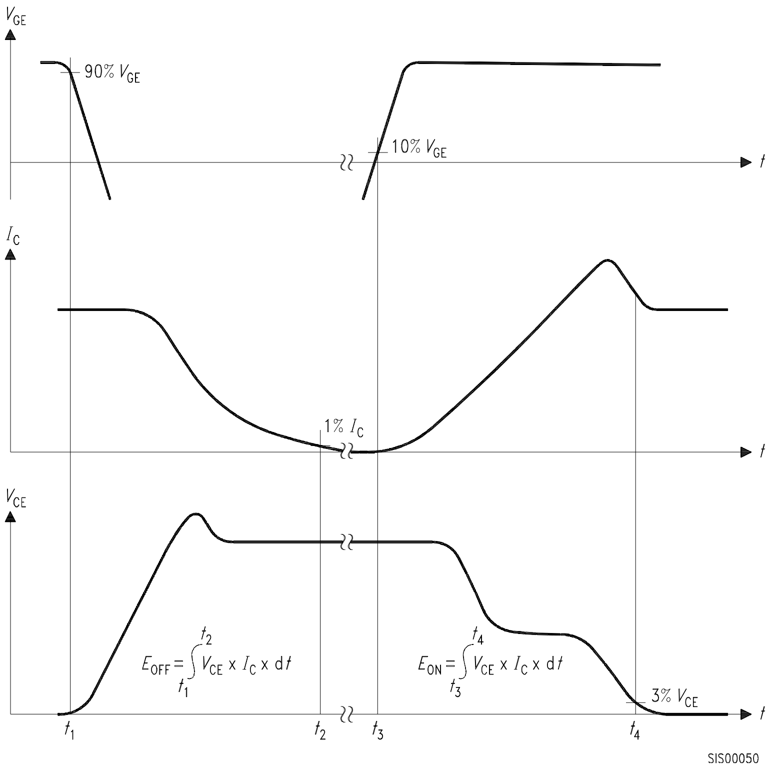

Figure B. Definition of switching losses

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