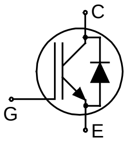
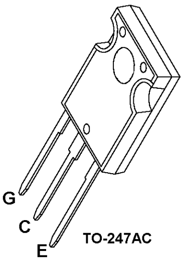
SKW25N120

Fast IGBT in NPT-technology with soft, fast recovery anti-parallel EmCon diode



- 40% lower E_{off} compared to previous generation
- Short circuit withstand time – 10 µs
- Designed for:
    - Motor controls
    - Inverter
    - SMPS
- NPT-Technology offers:
    - very tight parameter distribution
    - high ruggedness, temperature stable behaviour
    - parallel switching capability



Type	V_{CE}	I_C	E_{off}	T_j	Package	Ordering Code
SKW25N120	1200V	25A	2.9mJ	150°C	TO-247AC	Q67040-S4282

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
DC collector current	I_C		A
T_C = 25°C		46	
T_C = 100°C		25	
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	84	
Turn off safe operating area $V_{CE} \leq$ 1200V, $T_j \leq$ 150°C	-	84	
Diode forward current	I_F		
T_C = 25°C		42	
T_C = 100°C		25	
Diode pulsed current, t_p limited by T_{jmax}	I_{Fpuls}	80	
Gate-emitter voltage	V_{GE}	±20	V
Short circuit withstand time[1] V_{GE} = 15V, 100V$\leq V_{CC} \leq$1200V, $T_j \leq$ 150°C	t_{SC}	10	µs
Power dissipation T_C = 25°C	P_{tot}	313	W
Operating junction and storage temperature	T_j , T_{stg}	-55...+150	°C
Soldering temperature, 1.6mm (0.063 in.) from case for 10s	-	260	

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[1] 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}		0.4	K/W
Diode thermal resistance, junction – case	R_{thJCD}		1.15	
Thermal resistance, junction – ambient	R_{thJA}	TO-247AC	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=1500µA	1200	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE} = 15V, I_C=25A T_j=25°C T_j=150°C	 2.5 -	 3.1 3.7	 3.6 4.3	
Diode forward voltage	V_F	V_{GE}=0V, I_F=25A T_j=25°C T_j=150°C	 -	 2.0 1.75	 2.5	
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C=1000µA, V_{CE}=V_{GE}	3	4	5	
Zero gate voltage collector current .	I_{CES}	V_{CE}=1200V,V_{GE}=0V T_j=25°C T_j=150°C	 - -	 - -	 350 1400	µA
Gate-emitter leakage current	I_{GES}	V_{CE}=0V,V_{GE}=20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE}=20V, I_C=25A		20	-	S
Dynamic Characteristic						
Input capacitance	C_{iss}	V_{CE}=25V, V_{GE}=0V, f=1MHz	-	2150	2600	pF
Output capacitance	C_{oss}		-	260	310	
Reverse transfer capacitance	C_{rss}		-	110	130	
Gate charge	Q_{Gate}	V_{CC}=960V, I_C=25A V_{GE}=15V	-	225	300	nC
Internal emitter inductance Measured 5mm (0.197 in.) from case	L_E	TO-247AC	-	13	-	NH
Short circuit collector current[1)]	$I_{C(SC)}$	V_{GE}=15V,t_{SC}≤10µs 100V≤V_{CC}≤1200V, T_j ≤ 150°C	-	240	-	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}=800V,I_C=25A, V_{GE}=15/0V, R_G=22Ω, L_σ[1]=180nH, C_σ[1]=40pF Energy losses include "tail" and diode reverse recovery.	-	45	60	ns
Rise time	t_r		-	40	52	
Turn-off delay time	$t_{d(off)}$		-	730	950	
Fall time	t_f		-	30	39	
Turn-on energy	E_{on}		-	2.2	2.9	mJ
Turn-off energy	E_{off}		-	1.5	2.0	
Total switching energy	E_{ts}		-	3.7	4.9	
Anti-Parallel Diode Characteristic						
Diode reverse recovery time	t_{rr} t_S t_F	T_j=25°C, V_R=800V, I_F=25A, di_F/dt=650A/µs	- - -	90		ns
Diode reverse recovery charge	Q_{rr}		-	1.0		µC
Diode peak reverse recovery current	I_{rrm}		-	20		A
Diode peak rate of fall of reverse recovery current during t_F	di_{rr}/dt		-	470		A/µs

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}=800V,I_C=25A, V_{GE}=15/0V, R_G=22Ω, L_σ[1]=180nH, C_σ[1]=40pF Energy losses include "tail" and diode reverse recovery.	-	50	60	ns
Rise time	t_r		-	36	43	
Turn-off delay time	$t_{d(off)}$		-	820	990	
Fall time	t_f		-	42	50	
Turn-on energy	E_{on}		-	3.8	4.6	mJ
Turn-off energy	E_{off}		-	2.9	3.8	
Total switching energy	E_{ts}		-	6.7	8.4	
Anti-Parallel Diode Characteristic						
Diode reverse recovery time	t_{rr} t_S t_F	T_j=150°C V_R=800V, I_F=25A, di_F/dt=750A/µs	- - -	280		ns
Diode reverse recovery charge	Q_{rr}		-	4.3		µC
Diode peak reverse recovery current	I_{rrm}		-	32		A
Diode peak rate of fall of reverse recovery current during t_F	di_{rr}/dt		-	130		A/µs

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[1] Leakage inductance L_σ and stray capacity C_σ due to dynamic test circuit in figure E.

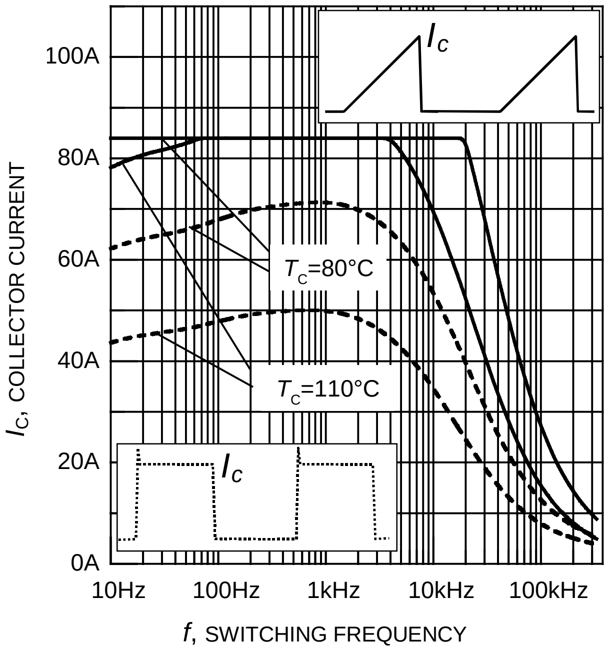


Figure 1. Collector current as a function of switching frequency
($T_j \le 150°C$, $D = 0.5$, $V_{CE} = 800V$, $V_{GE} = +15V/0V$, $R_G = 22\Omega$)

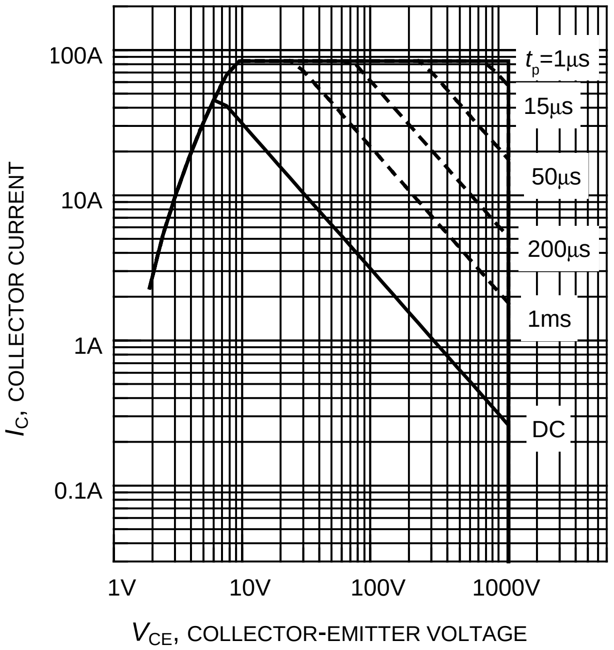


Figure 2. Safe operating area
($D = 0$, $T_C = 25°C$, $T_j \le 150°C$)

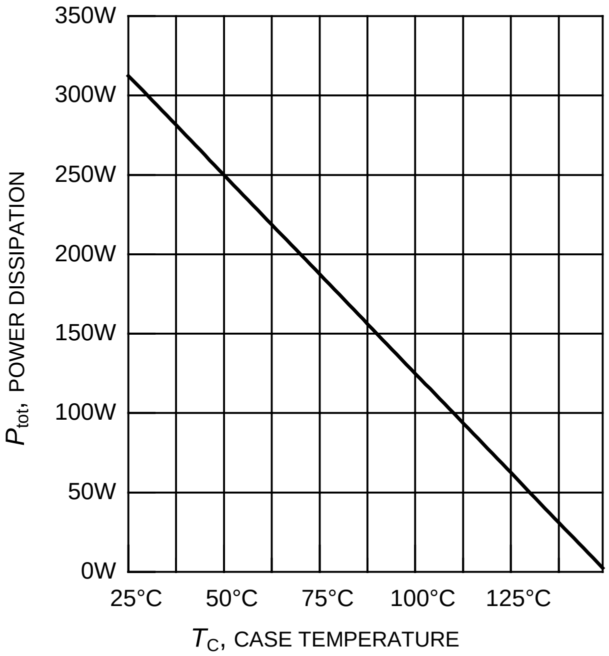


Figure 3. Power dissipation as a function of case temperature
($T_j \le 150°C$)

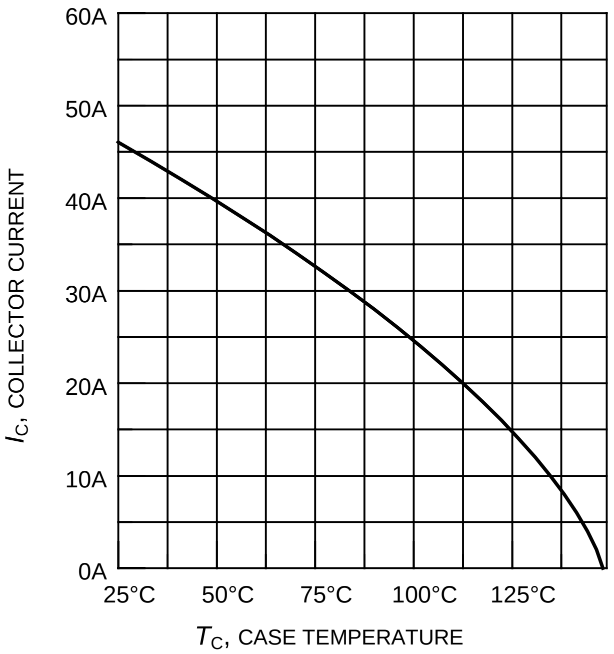


Figure 4. Collector current as a function of case temperature
($V_{GE} \le 15V$, $T_j \le 150°C$)

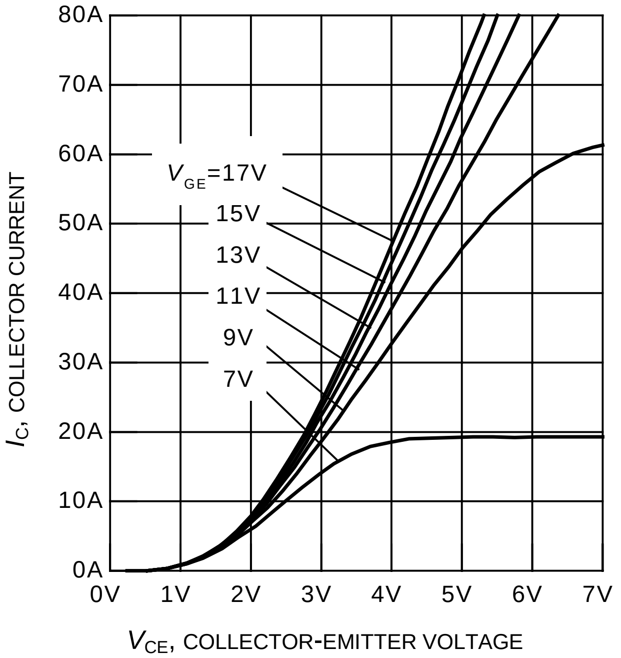


Figure 5. Typical output characteristics
(T_j = 25°C)

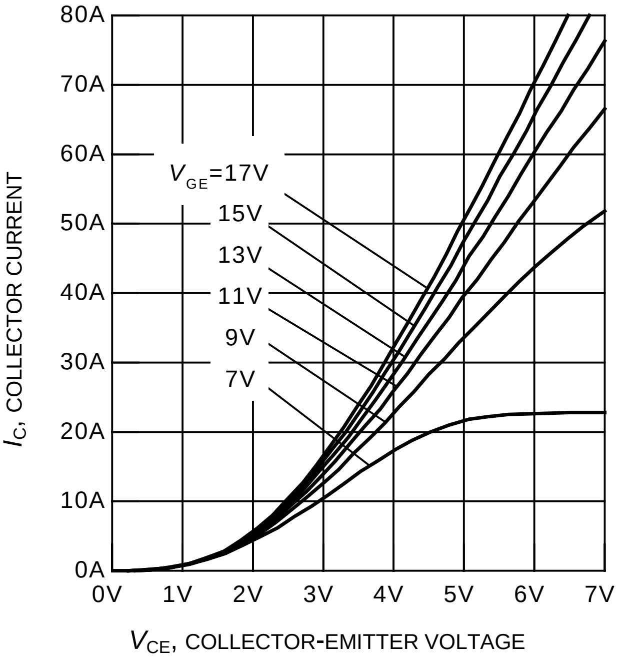


Figure 6. Typical output characteristics
(T_j = 150°C)

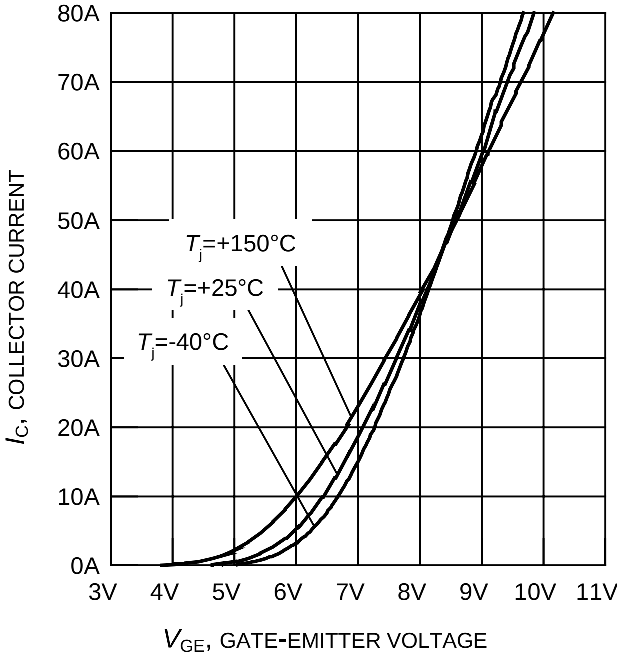


Figure 7. Typical transfer characteristics
(V_{CE} = 20V)

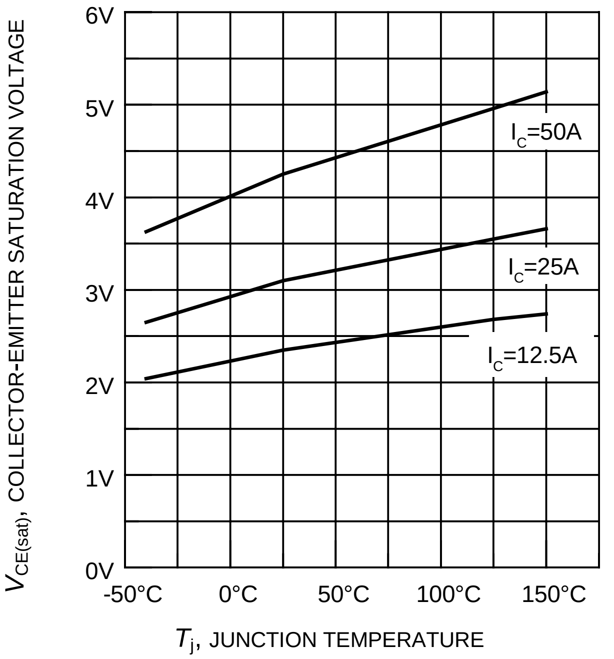


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE} = 15V)

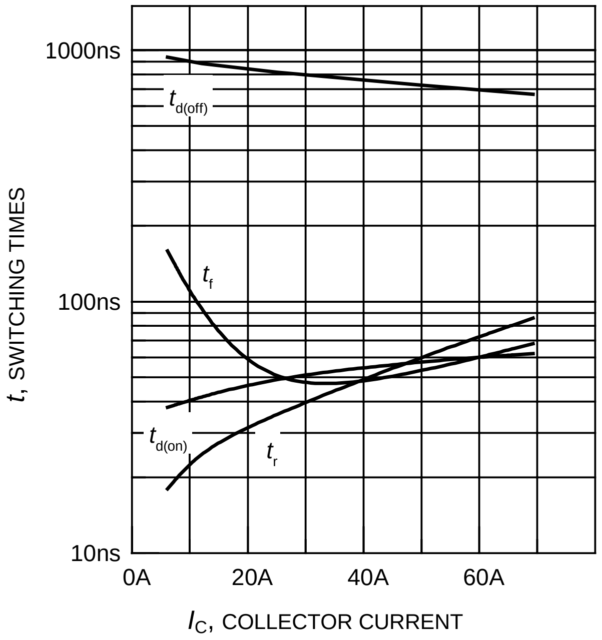


Figure 9. Typical switching times as a function of collector current
(inductive load, T_j = 150°C,
V_{CE} = 800V, V_{GE} = +15V/0V, R_G = 22Ω,
dynamic test circuit in Fig.E)

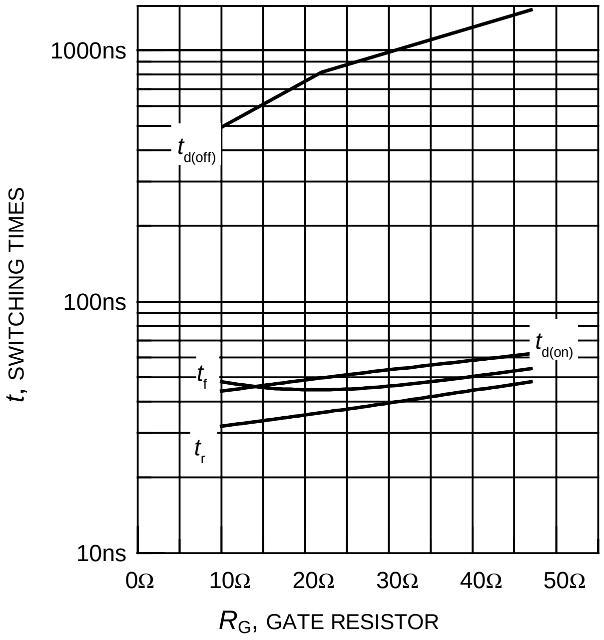


Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_j = 150°C,
V_{CE} = 800V, V_{GE} = +15V/0V, I_C = 25A,
dynamic test circuit in Fig.E)

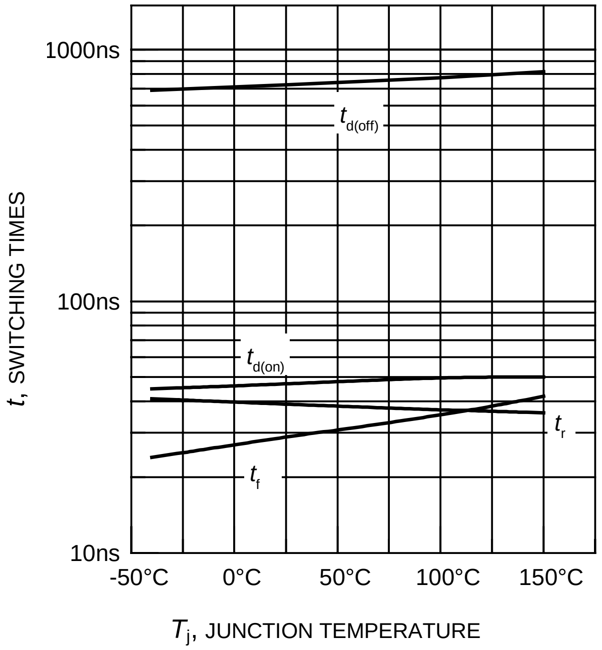


Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE} = 800V,
V_{GE} = +15V/0V, I_C = 25A, R_G = 22Ω,
dynamic test circuit in Fig.E)

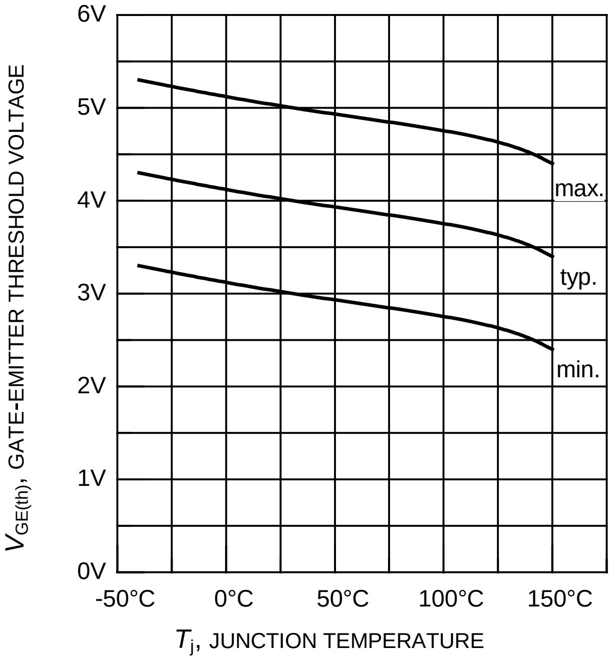


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C = 0.3mA)

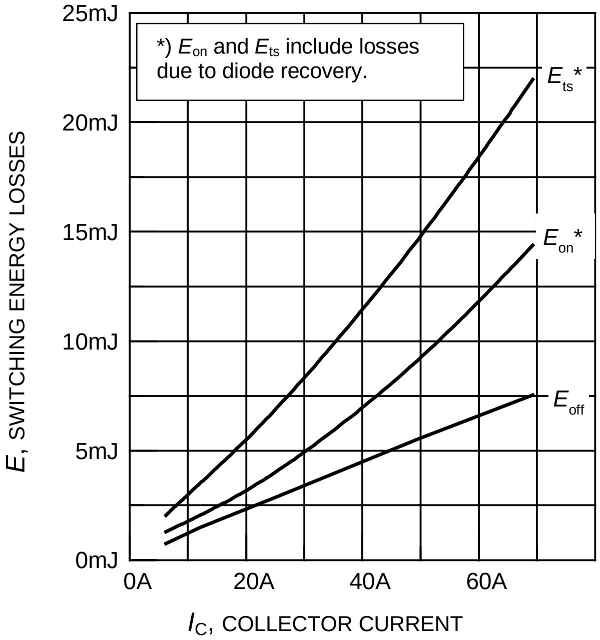


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_j = 150°C,
V_{CE} = 800V, V_{GE} = +15V/0V, R_G = 22Ω,
dynamic test circuit in Fig.E)

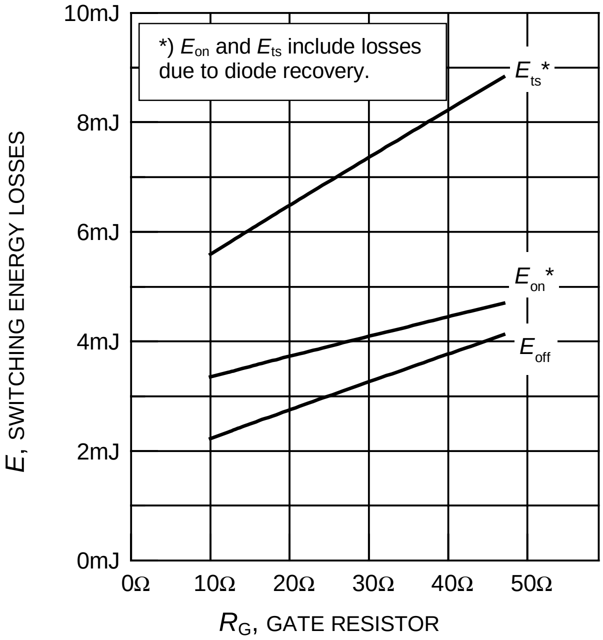


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_j = 150°C,
V_{CE} = 800V, V_{GE} = +15V/0V, I_C = 25A,
dynamic test circuit in Fig.E)

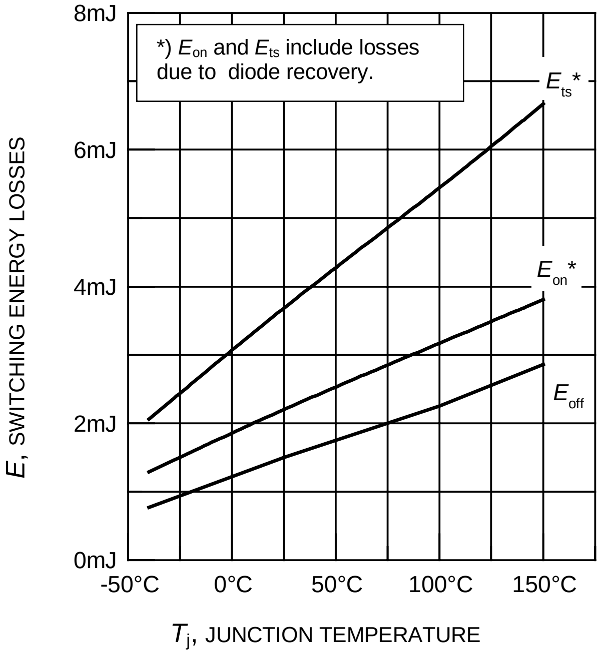
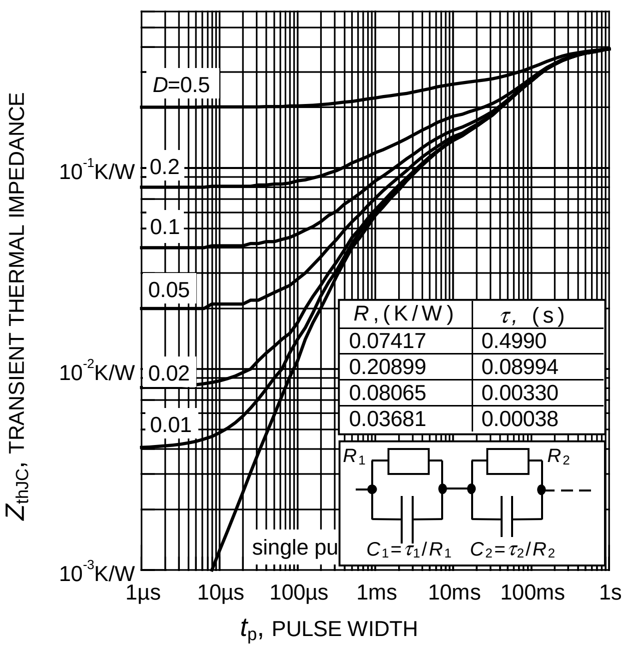


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE} = 800V,
V_{GE} = +15V/0V, I_C = 25A, R_G = 22Ω,
dynamic test circuit in Fig.E)



R,(K/W)	τ, (s)
0.07417	0.4990
0.20899	0.08994
0.08065	0.00330
0.03681	0.00038

Figure 16. IGBT transient thermal impedance as a function of pulse width
($D = t_p / T$)

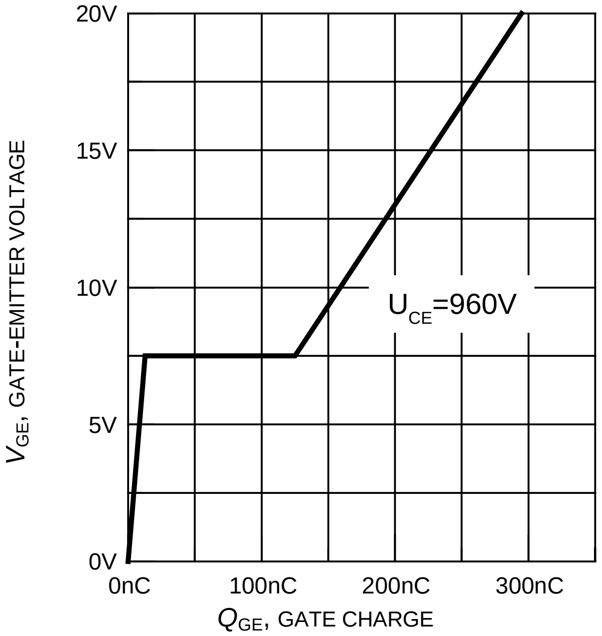


Figure 17. Typical gate charge
(I_C = 25A)

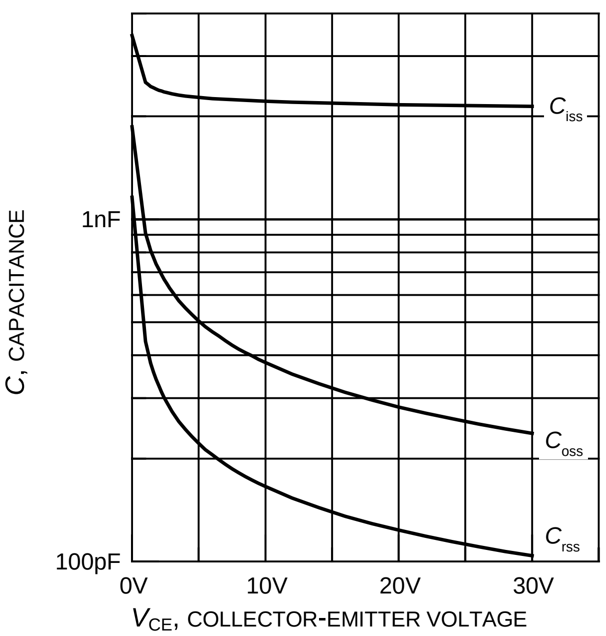


Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE} = 0V, f = 1MHz)

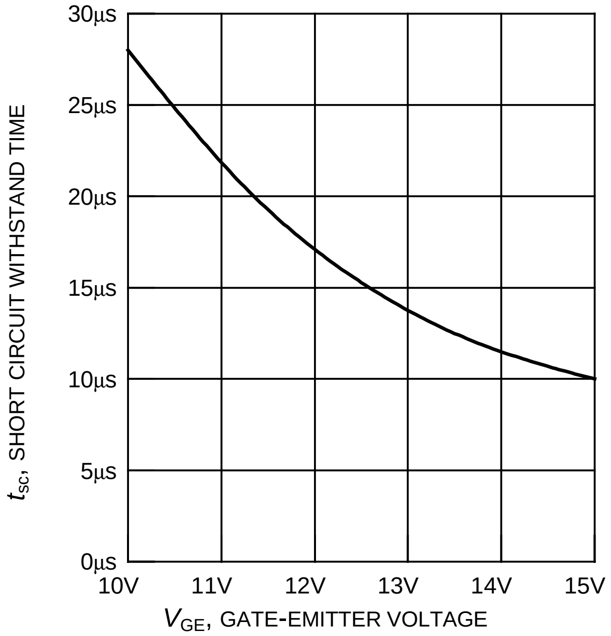


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
(V_{CE} = 1200V, start at T_j = 25°C)

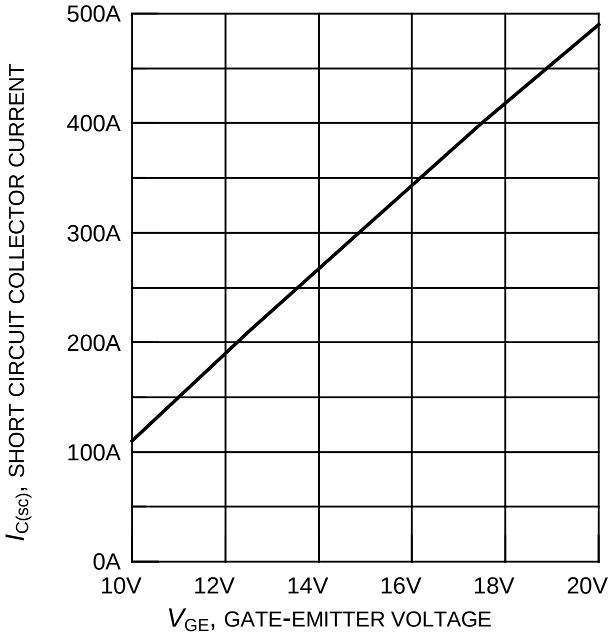


Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
(100V≤V_{CE} ≤1200V, T_C = 25°C, T_j ≤ 150°C)

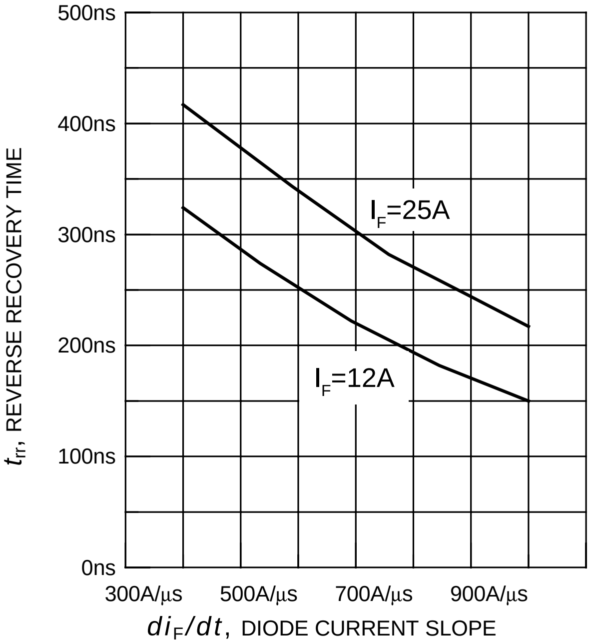


Figure 21. Typical reverse recovery time as a function of diode current slope
(V_R = 800V, T_j = 150°C,
dynamic test circuit in Fig.E)

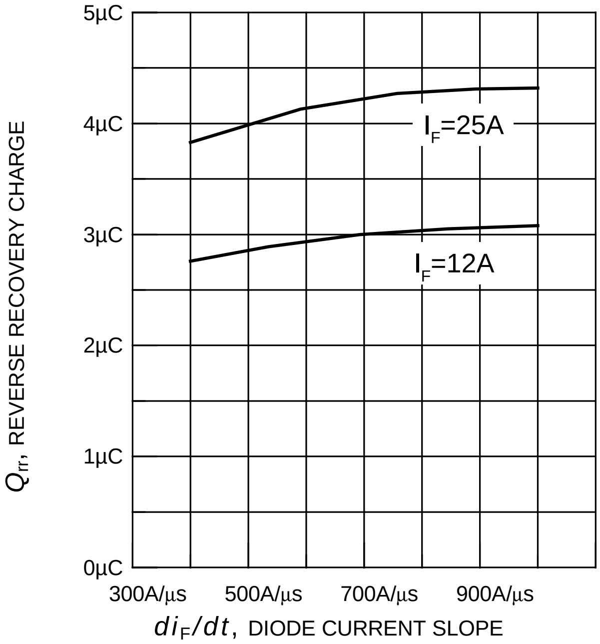


Figure 22. Typical reverse recovery charge as a function of diode current slope
(V_R = 800V, T_j = 150°C,
dynamic test circuit in Fig.E)

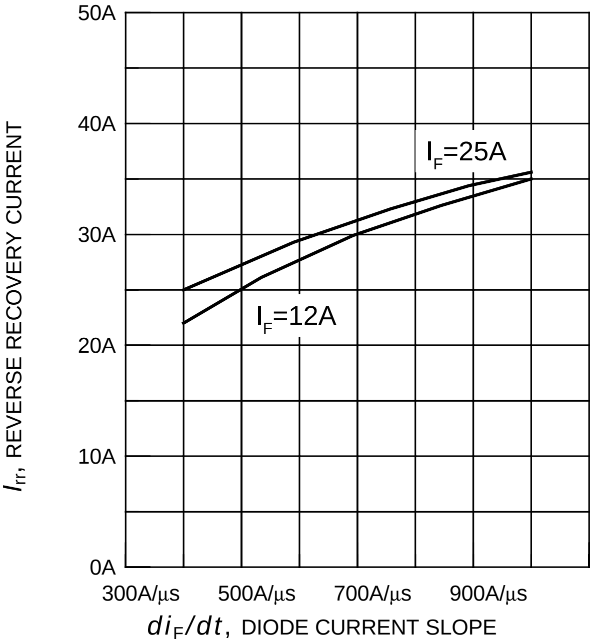


Figure 23. Typical reverse recovery current as a function of diode current slope
(V_R = 800V, T_j = 150°C,
dynamic test circuit in Fig.E)

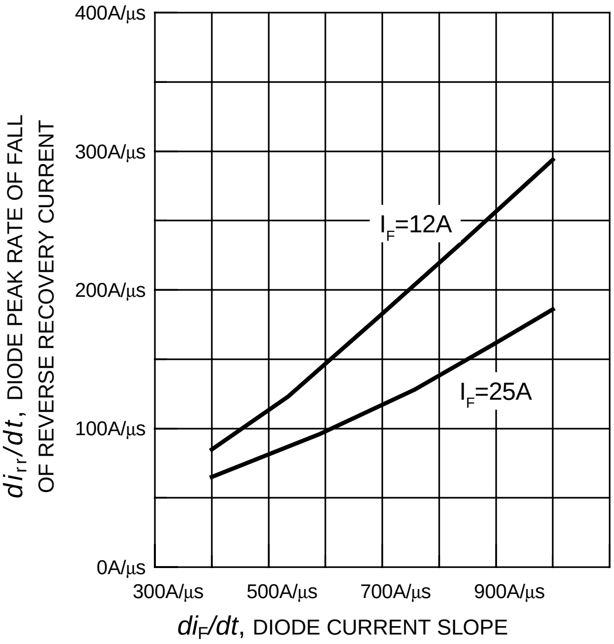


Figure 24. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
(V_R = 800V, T_j = 150°C,
dynamic test circuit in Fig.E)

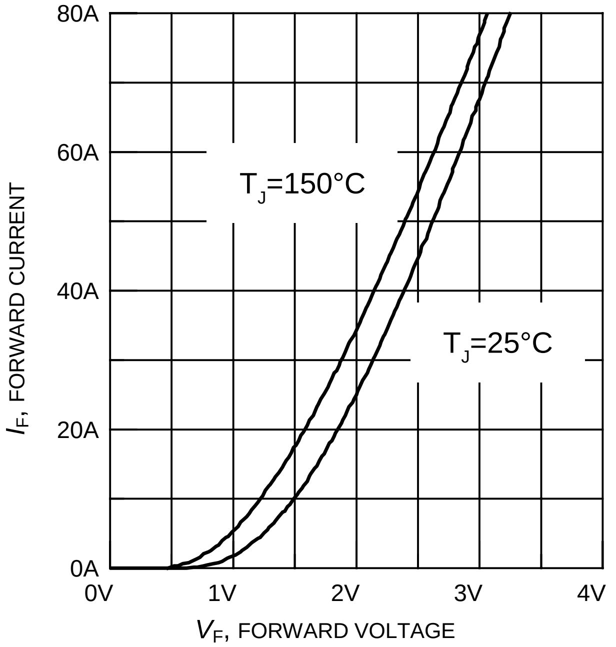


Figure 25. Typical diode forward current as a function of forward voltage

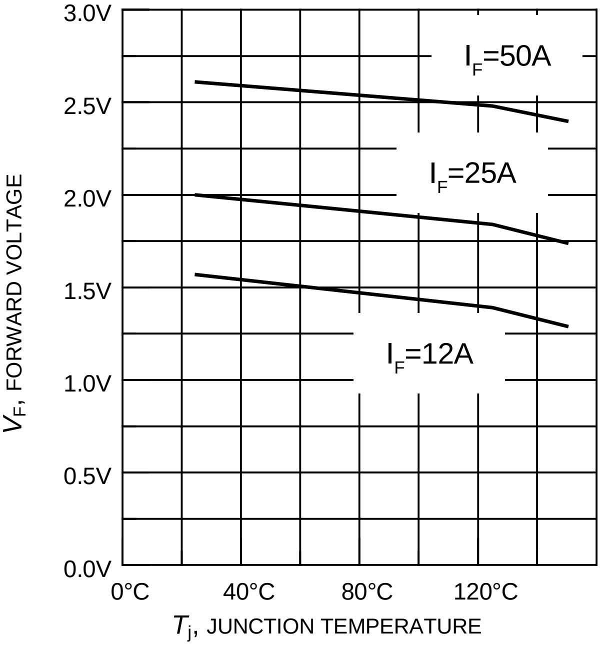
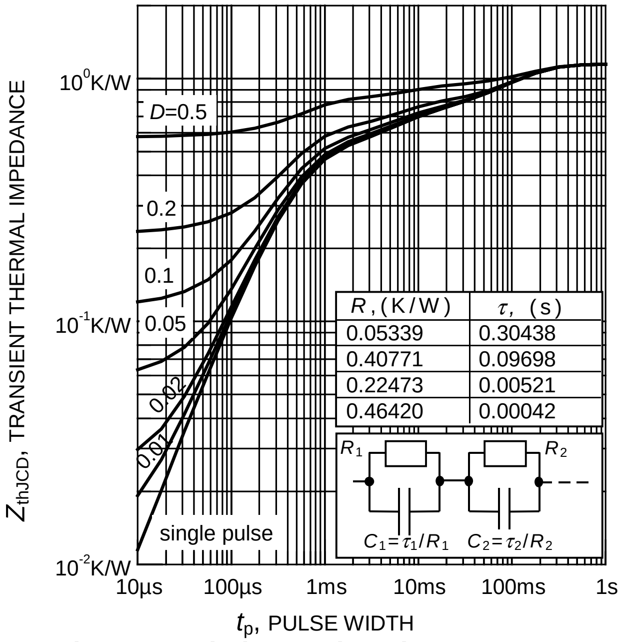


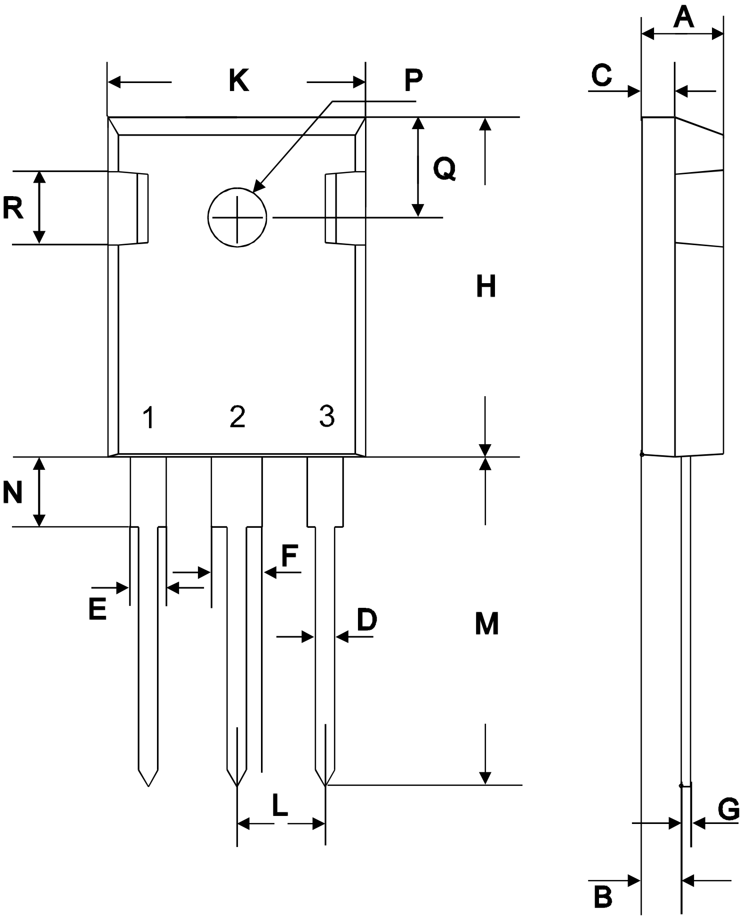
Figure 26. Typical diode forward voltage as a function of junction temperature



R,(K/W)	τ, (s)
0.05339	0.30438
0.40771	0.09698
0.22473	0.00521
0.46420	0.00042

Figure 27. Diode transient thermal impedance as a function of pulse width
($D = t_p / T$)

TO-247AC



symbol	dimensions			
	[mm]		[inch]	
	min	max	min	max
A	4.78	5.28	0.1882	0.2079
B	2.29	2.51	0.0902	0.0988
C	1.78	2.29	0.0701	0.0902
D	1.09	1.32	0.0429	0.0520
E	1.73	2.06	0.0681	0.0811
F	2.67	3.18	0.1051	0.1252
G	0.76 max		0.0299 max	
H	20.80	21.16	0.8189	0.8331
K	15.65	16.15	0.6161	0.6358
L	5.21	5.72	0.2051	0.2252
M	19.81	20.68	0.7799	0.8142
N	3.560	4.930	0.1402	0.1941
∅P	3.61		0.1421	
Q	6.12	6.22	0.2409	0.2449

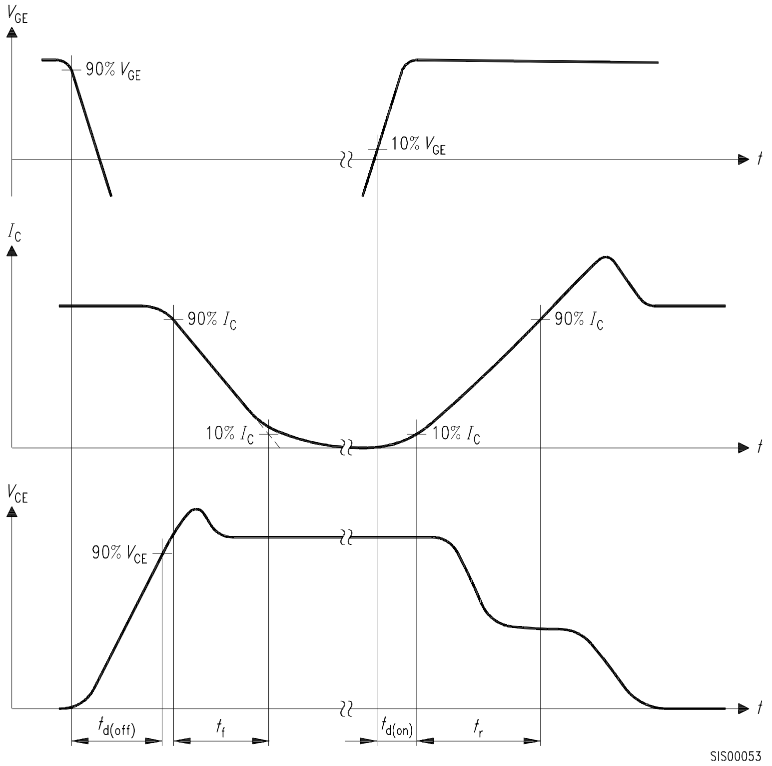


Figure A. Definition of switching times

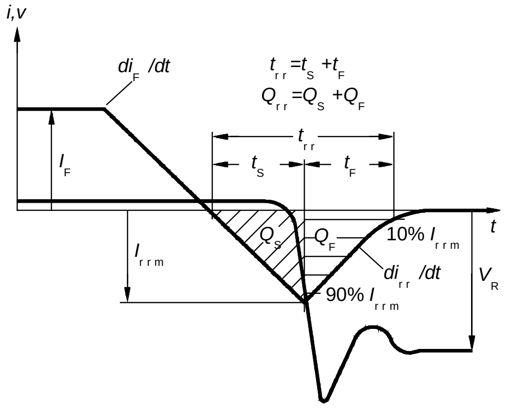


Figure C. Definition of diodes switching characteristics

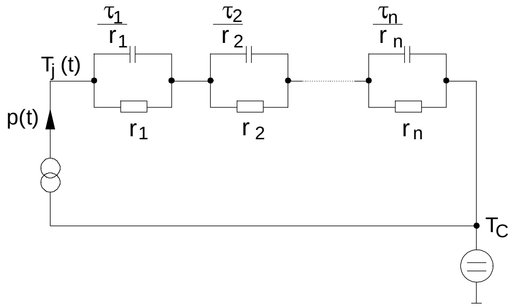


Figure D. Thermal equivalent circuit

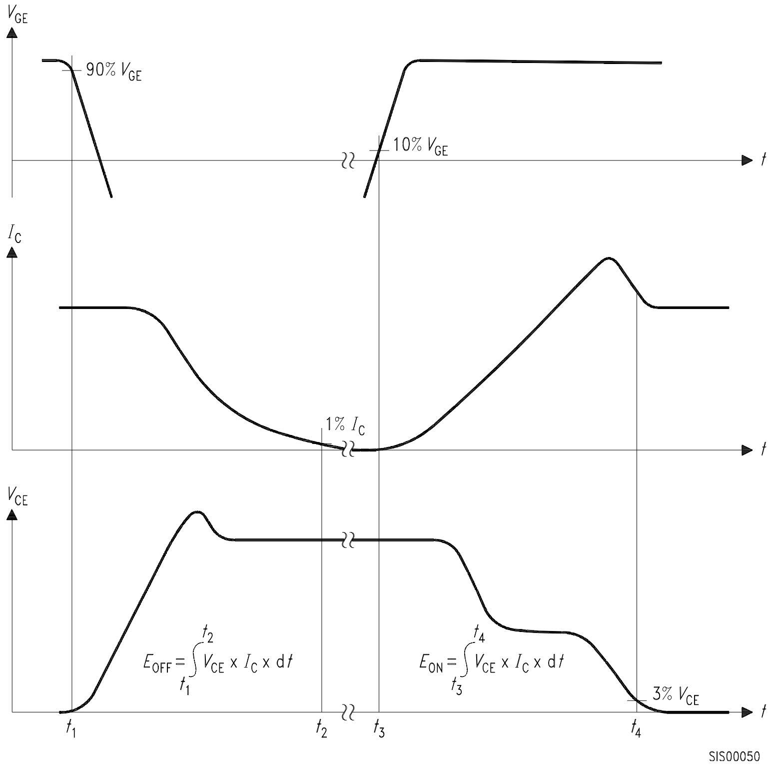


Figure B. Definition of switching losses

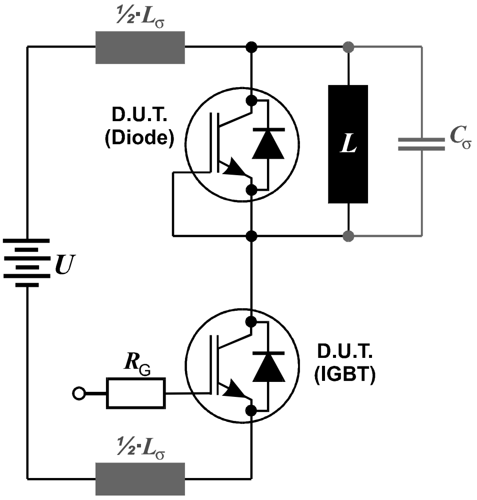


Figure E. Dynamic test circuit Leakage inductance L_σ=180nH, and stray capacity C_σ =40pF.

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