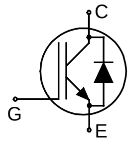
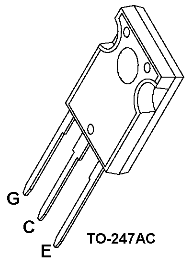
SKW15N120

Fast S-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
SKW15N120	1200V	15A	1.5mJ	150°C	TO-247AC	Q67040-S4281

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	 30 15	A
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	52	
Turn off safe operating area $V_{CE} \leq$ 1200V, $T_j \leq$ 150°C	-	52	
Diode forward current T_C = 25°C T_C = 100°C	I_F	 32 15	
Diode pulsed current, t_p limited by T_{jmax}	I_{Fpuls}	50	
Gate-emitter voltage	V_{GE}	±20	V
Short circuit withstand time[1)] V_{GE} = 15V, 100V≤ V_{CC} ≤1200V, $T_j \leq$ 150°C	t_{SC}	10	µs
Power dissipation T_C = 25°C	P_{tot}	198	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	

[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}		0.63	K/W
Diode thermal resistance, junction – case	R_{thJCD}		1.5	
Thermal resistance, junction – ambient	R_{thJA}	TO-247AC	40	

Electrical Characteristic, at T_j = 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=1000µA	1200	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE} = 15V, I_C=15A 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=15A T_j=25°C T_j=150°C	 -	 2.0 1.75	 2.5 	
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C=600µA,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	 - -	 - -	 200 800	µA
Gate-emitter leakage current	I_{GES}	V_{CE}=1200V,V_{GE}=0V	-	-	100	nA
Transconductance	g_{fs}	V_{CE}=20V, I_C=15A		11	-	S
Dynamic Characteristic						
Input capacitance	C_{iss}	V_{CE}=25V,	-	1290	1550	pF
Output capacitance	C_{oss}	V_{GE}=0V,	-	155	185	
Reverse transfer capacitance	C_{rss}	f=1MHz	-	90	110	
Gate charge	Q_{Gate}	V_{CC}=960V, I_C=15A V_{GE}=15V	-	130	175	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	-	145	-	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,	-	18	24	ns
Rise time	t_r	V_{CC}=800V, I_C=15A,	-	23	30	
Turn-off delay time	$t_{d(off)}$	V_{GE}=15V/0V,	-	580	750	
Fall time	t_f	R_G=33Ω,	-	22	29	
Turn-on energy	E_{on}	Energy losses include	-	1.1	1.5	mJ
Turn-off energy	E_{off}	“tail” and diode	-	0.8	1.1	
Total switching energy	E_{ts}	reverse recovery.	-	1.9	2.6	
Anti-Parallel Diode Characteristic						
Diode reverse recovery time	t_{rr} t_S t_F	T_j=25°C, V_R=800V, I_F=15A, di_F/dt=650A/µs	- - -	65		ns
Diode reverse recovery charge	Q_{rr}		-	0.5		µC
Diode peak reverse recovery current	I_{rrm}		-	15		A
Diode peak rate of fall of reverse recovery current during t_F	di_{rr}/dt		-	500		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	-	38	46	ns
Rise time	t_r	V_{CC}=800V,	-	30	36	
Turn-off delay time	$t_{d(off)}$	I_C=15A,	-	652	780	
Fall time	t_f	V_{GE}=15V/0V,	-	31	37	
Turn-on energy	E_{on}	R_G=33Ω	-	1.9	2.3	mJ
Turn-off energy	E_{off}	Energy losses include	-	1.5	2.0	
Total switching energy	E_{ts}	“tail” and diode reverse recovery.	-	3.4	4.3	
Anti-Parallel Diode Characteristic						
Diode reverse recovery time	t_{rr} t_S t_F	T_j=150°C V_R=800V, I_F=15A, di_F/dt=650A/µs	- - -	200		ns
Diode reverse recovery charge	Q_{rr}		-	2.0		µC
Diode peak reverse recovery current	I_{rrm}		-	23		A
Diode peak rate of fall of reverse recovery current during t_F	di_{rr}/dt		-	140		A/µs

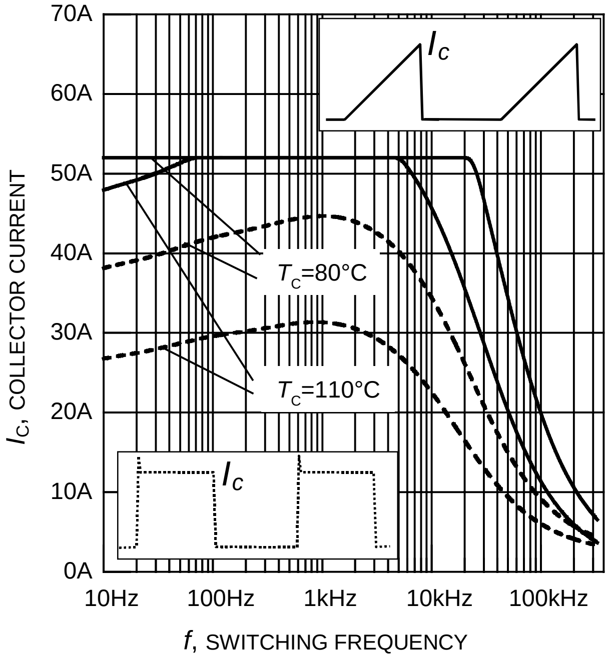


Figure 1. Collector current as a function of switching frequency
($T_j \leq 150°C$, $D = 0.5$, $V_{CE} = 800V$, $V_{GE} = +15V/0V$, $R_G = 33\Omega$)

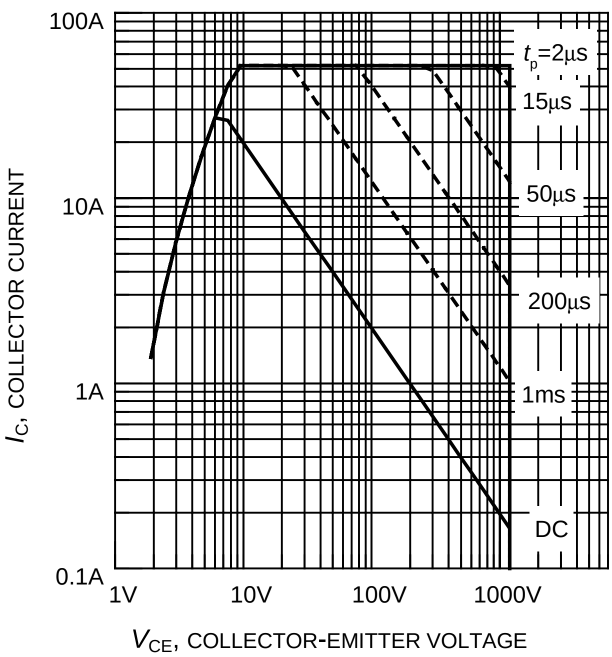


Figure 2. Safe operating area
($D = 0$, $T_C = 25°C$, $T_j \leq 150°C$)

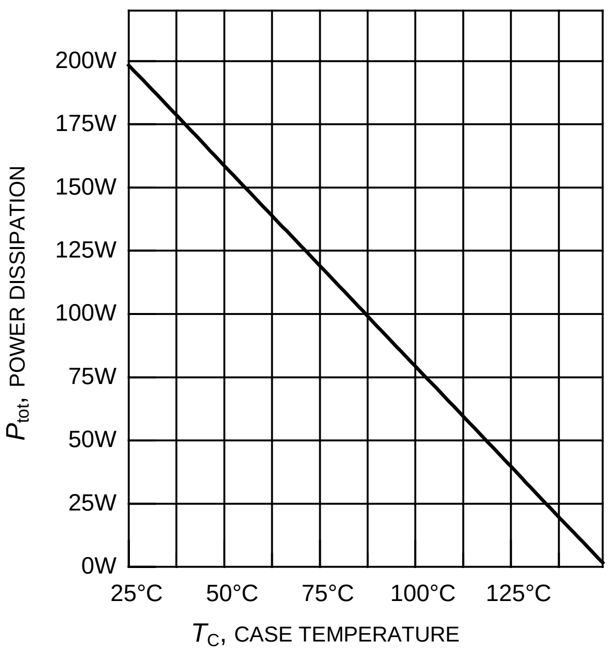


Figure 3. Power dissipation as a function of case temperature
($T_j \leq 150°C$)

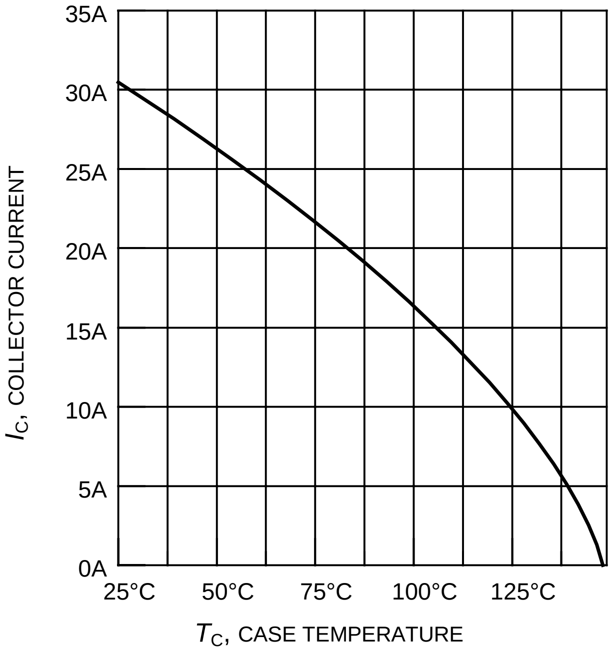


Figure 4. Collector current as a function of case temperature
($V_{GE} \leq 15V$, $T_j \leq 150°C$)

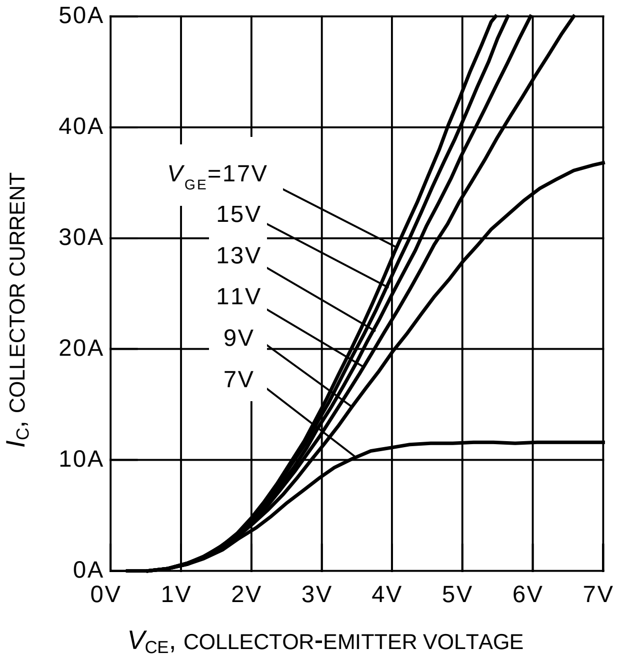


Figure 5. Typical output characteristics
(T_j = 25°C)

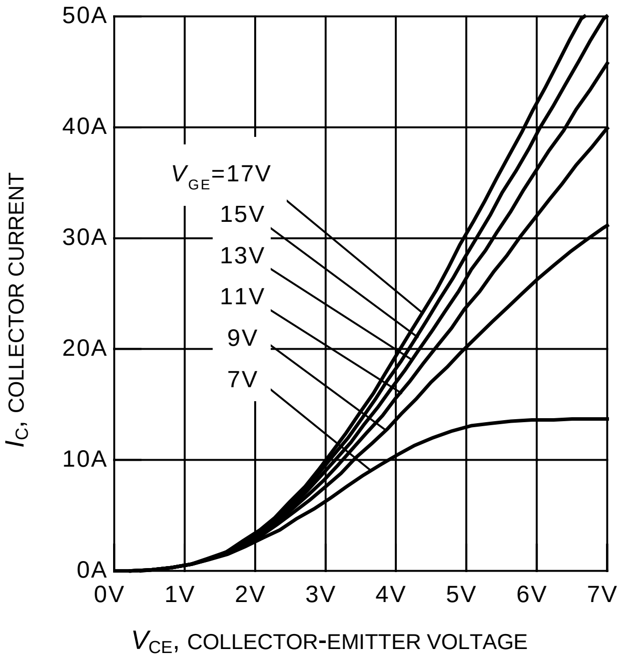


Figure 6. Typical output characteristics
(T_j = 150°C)

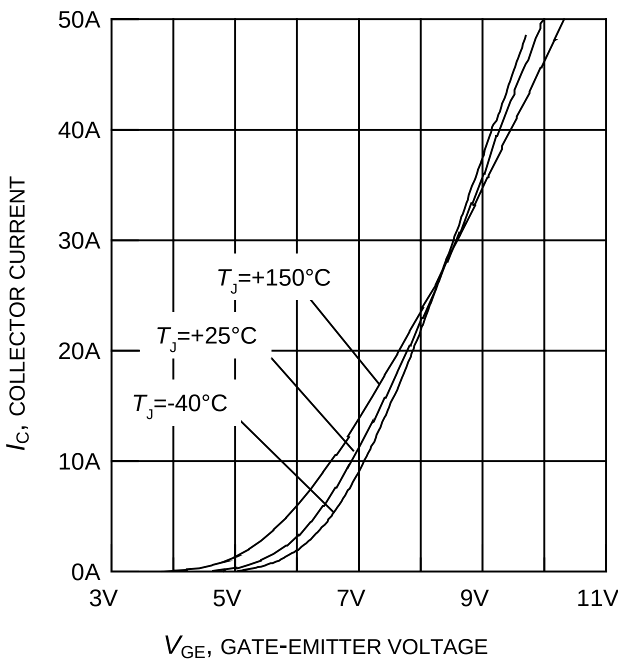


Figure 7. Typical transfer characteristics
(V_{CE} = 20V)

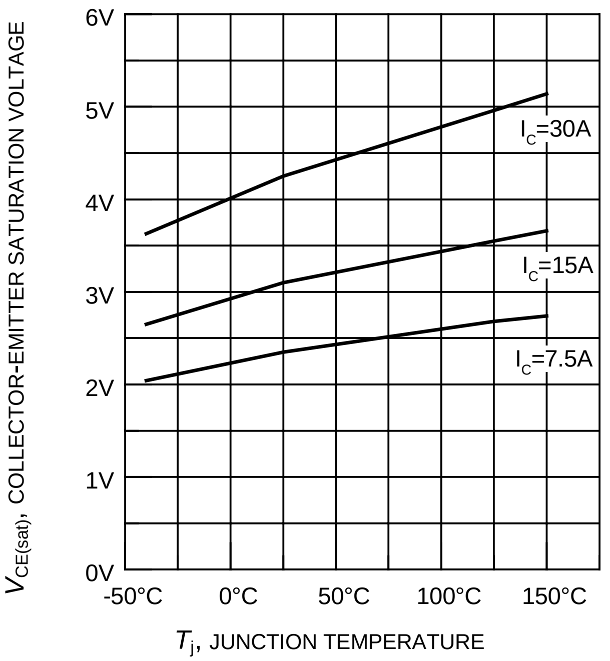


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE} = 15V)

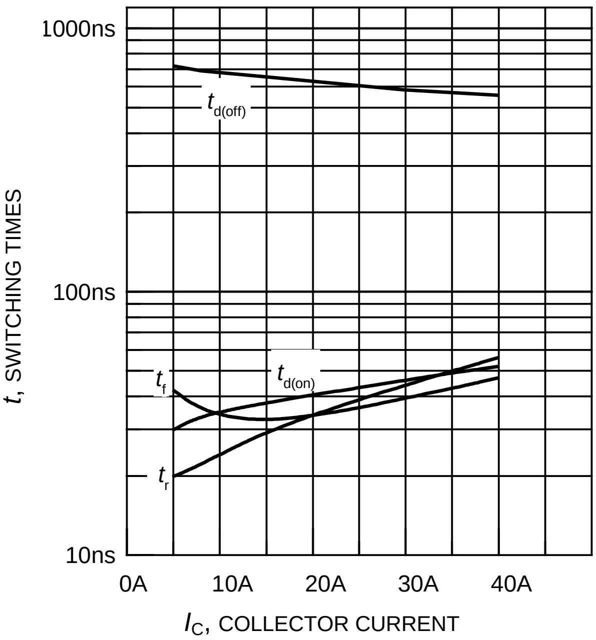


Figure 9. Typical switching times as a function of collector current
(inductive load, T_j = 150°C, V_{CE} = 8600V, V_{GE} = +15V/0V, R_G = 33Ω)

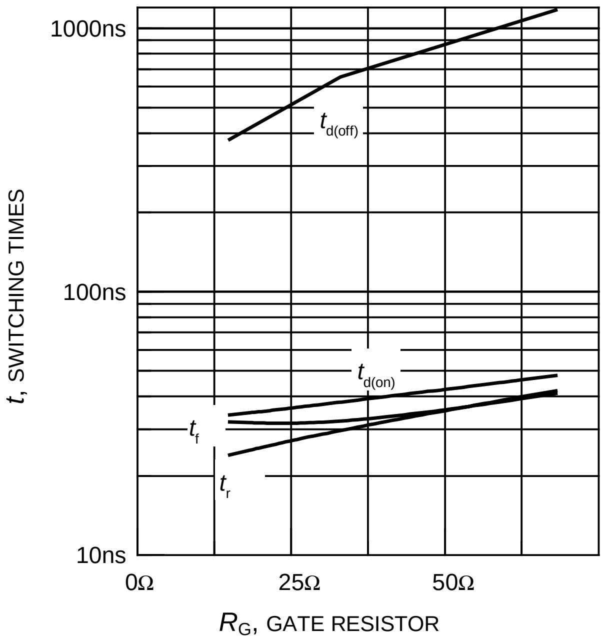


Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_j = 150°C, V_{CE} = 800V, V_{GE} = +15V/0V, I_C = 15A)

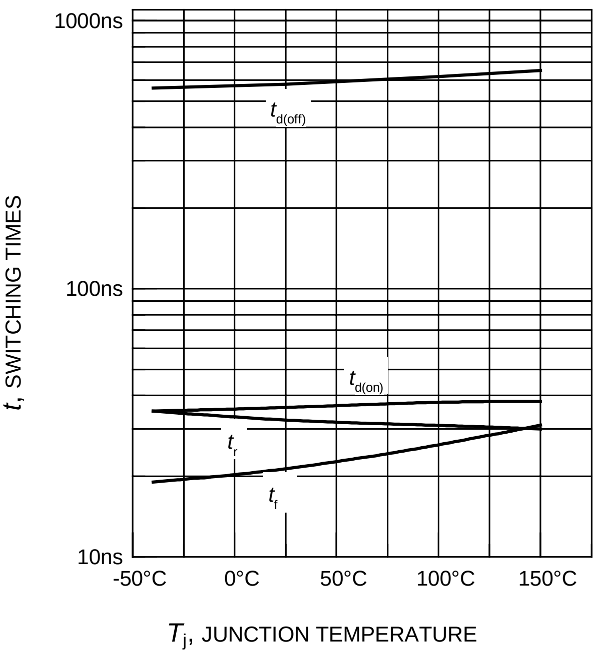


Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE} = 800V, V_{GE} = +15V/0V, I_C = 15A, R_G = 33Ω)

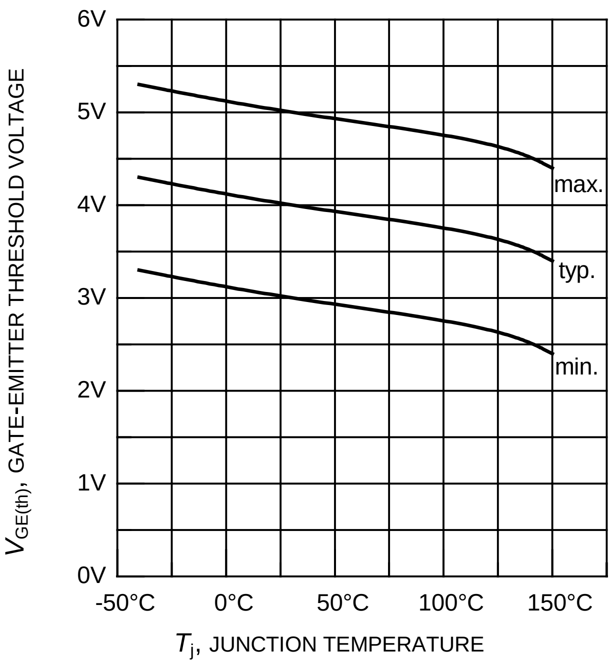


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C = 0.3mA)

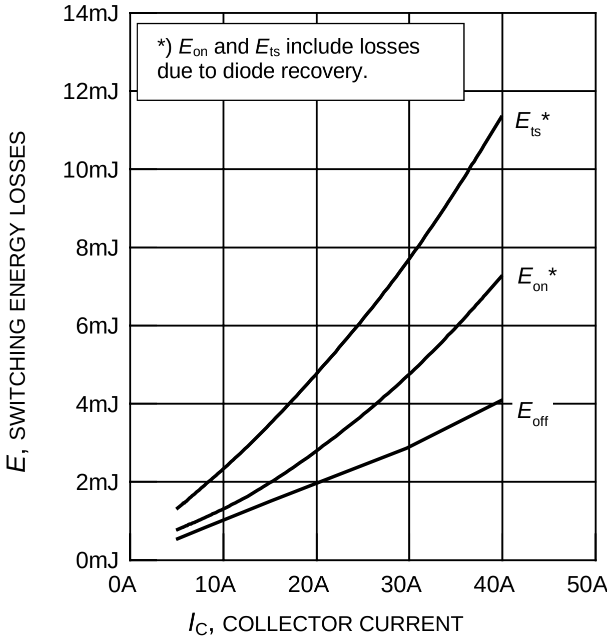


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_j = 150°C, V_{CE} = 800V, V_{GE} = +15V/0V, R_G = 33Ω)

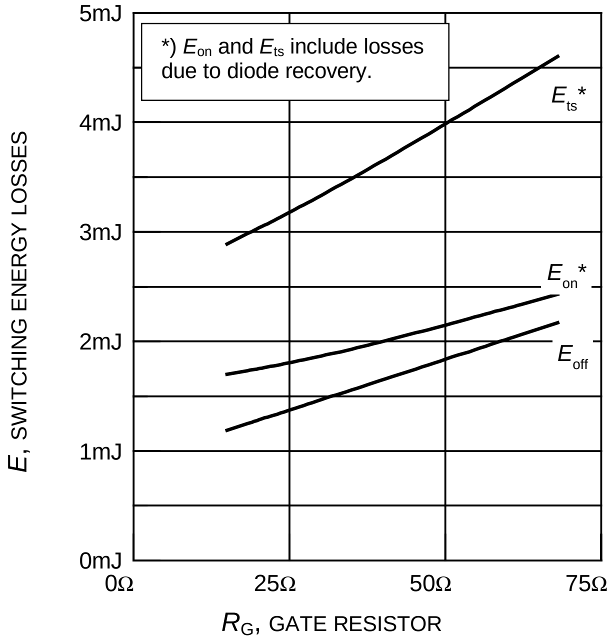


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_j = 150°C, V_{CE} = 800V, V_{GE} = +15V/0V, I_C = 15A)

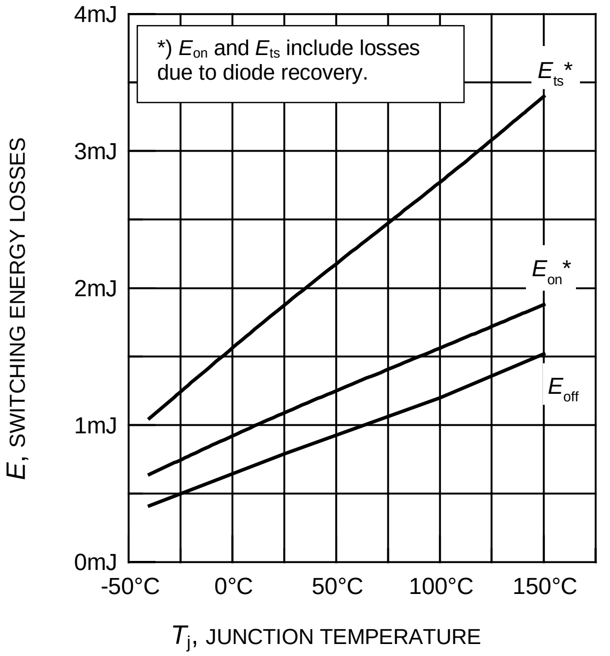


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE} = 800V, V_{GE} = +15V/0V, I_C = 15A, R_G = 33Ω)

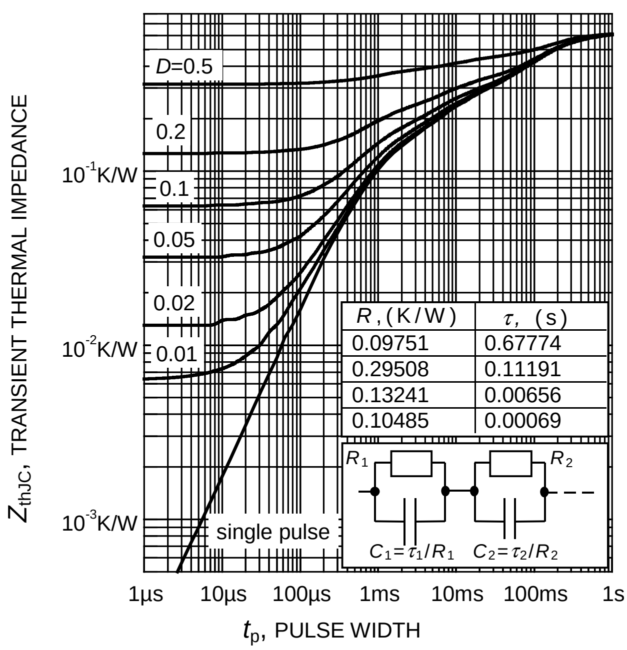


Figure 16. IGBT transient thermal impedance as a function of pulse width
($D = t_p / T$)

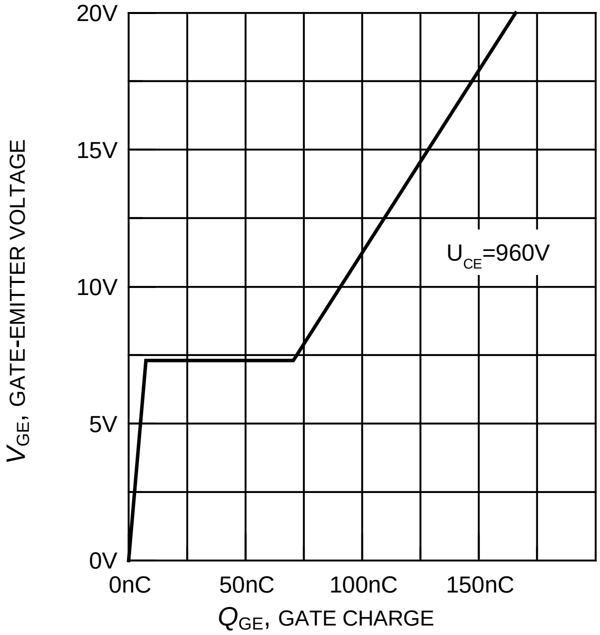


Figure 17. Typical gate charge
(I_C = 15A)

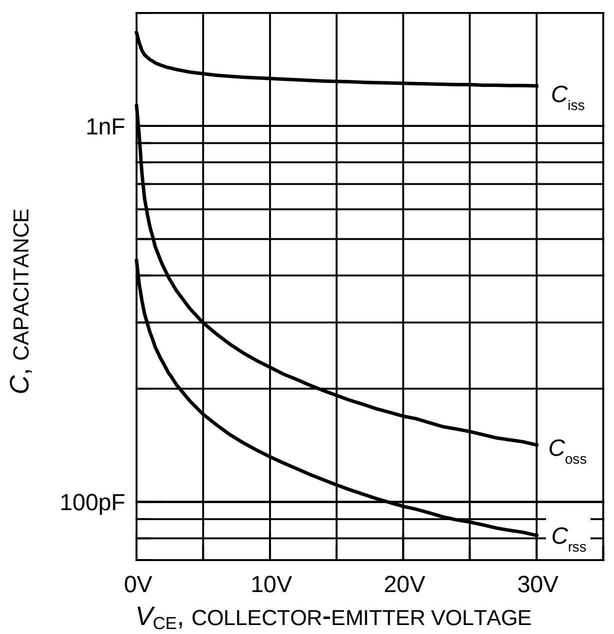


Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE} = 0V, f = 1MHz)

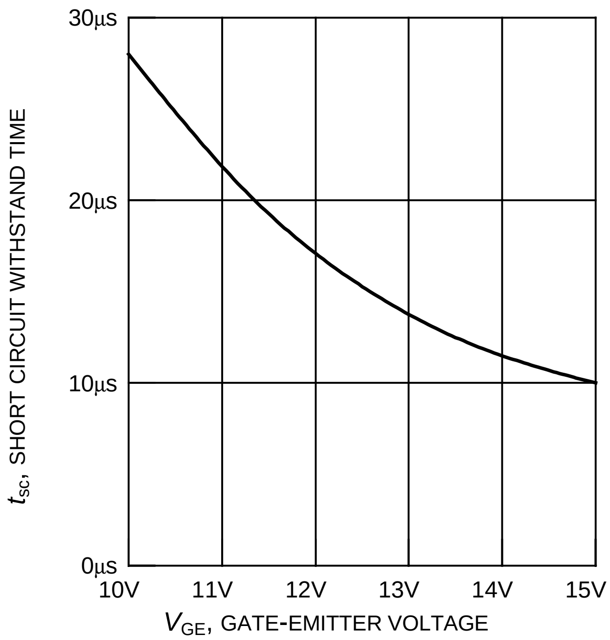


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
(V_{CE} = 1200V, start at T_j = 25°C)

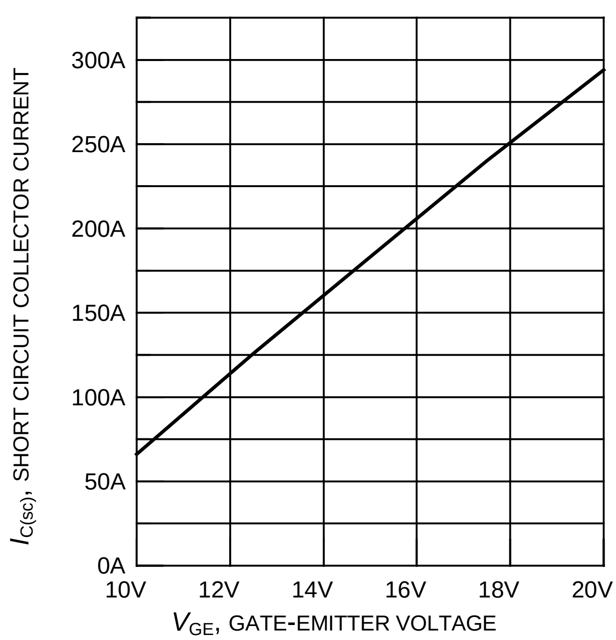


Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
(100V $\leq V_{CE} \leq$1200V, T_C = 25°C, $T_j \leq$ 150°C)

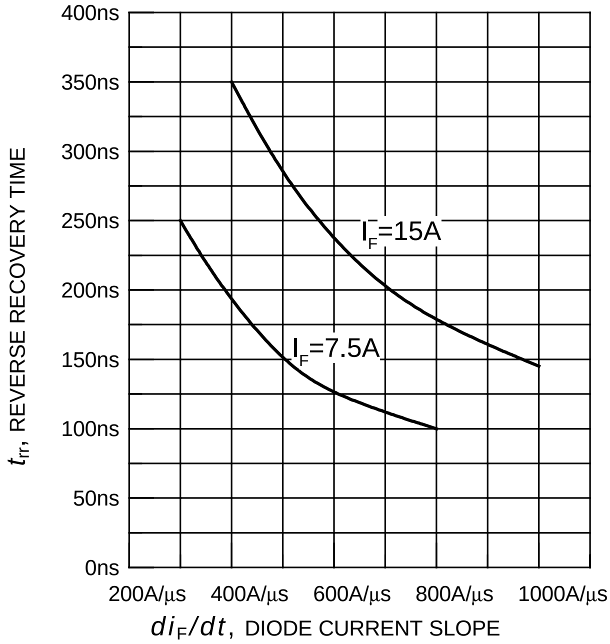


Figure 21. Typical reverse recovery time as a function of diode current slope
(V_R = 800V, T_j = 150°C)

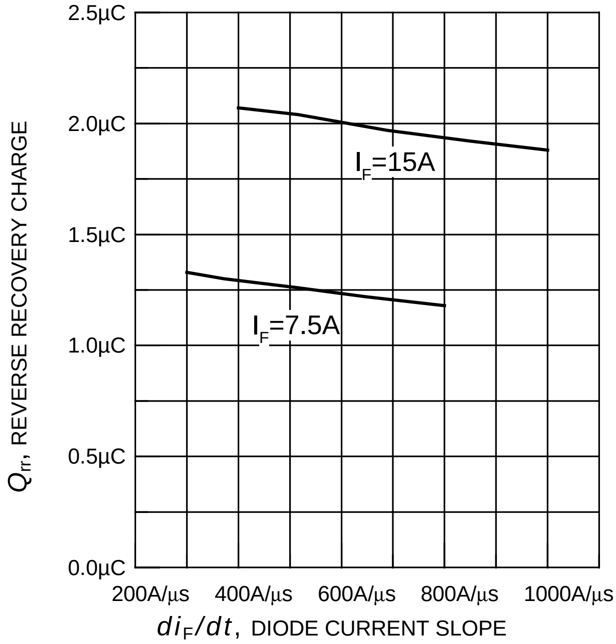


Figure 22. Typical reverse recovery charge as a function of diode current slope
(V_R = 800V, T_j = 150°C)

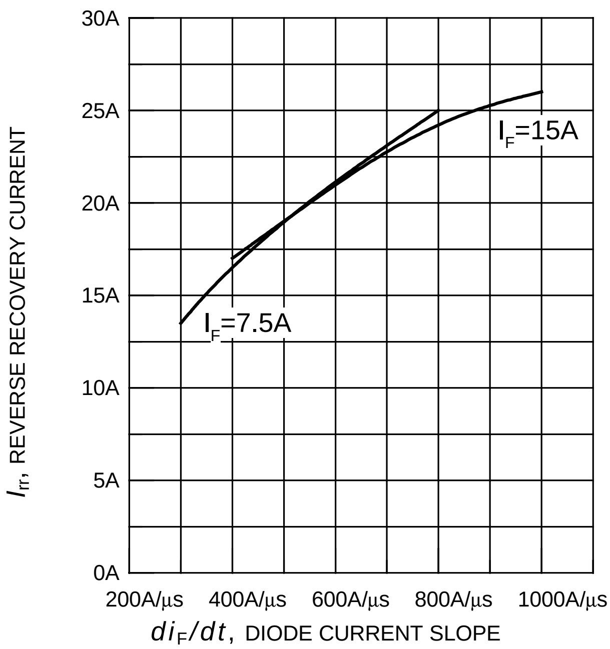


Figure 23. Typical reverse recovery current as a function of diode current slope
(V_R = 800V, T_j = 150°C)

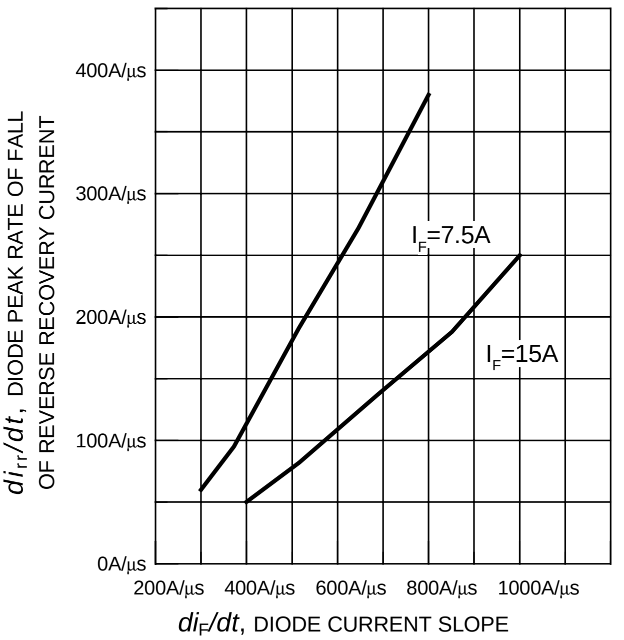


Figure 24. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
(V_R = 800V, T_j = 150°C)

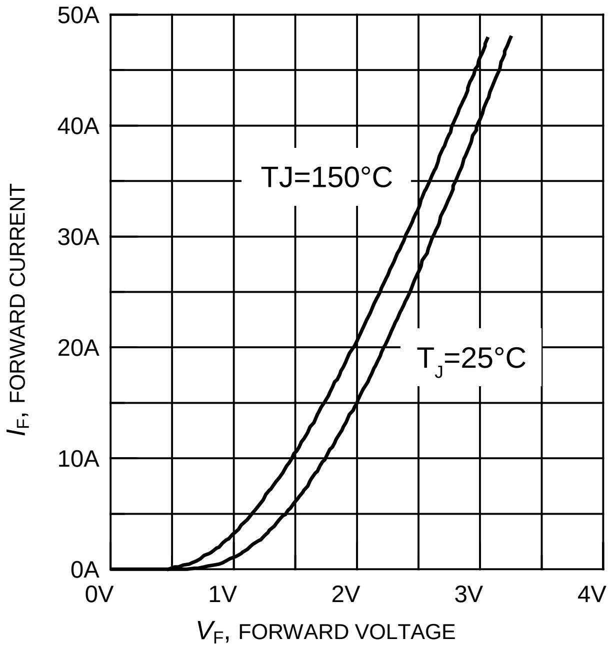


Figure 25. Typical diode forward current as a function of forward voltage

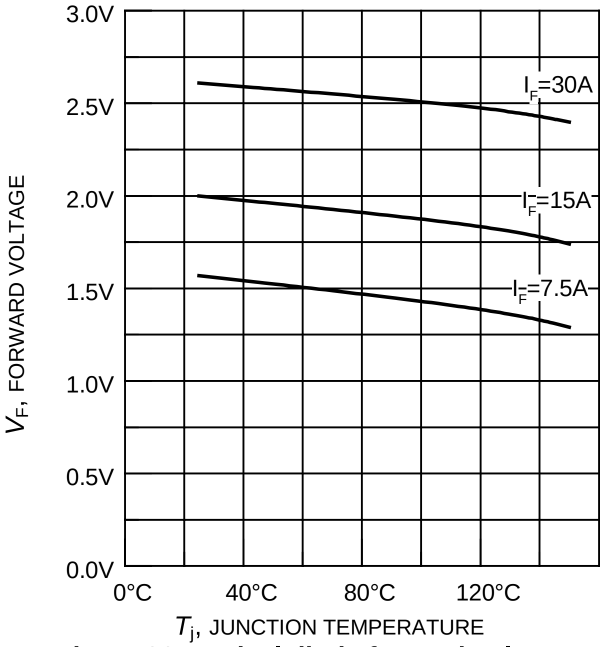
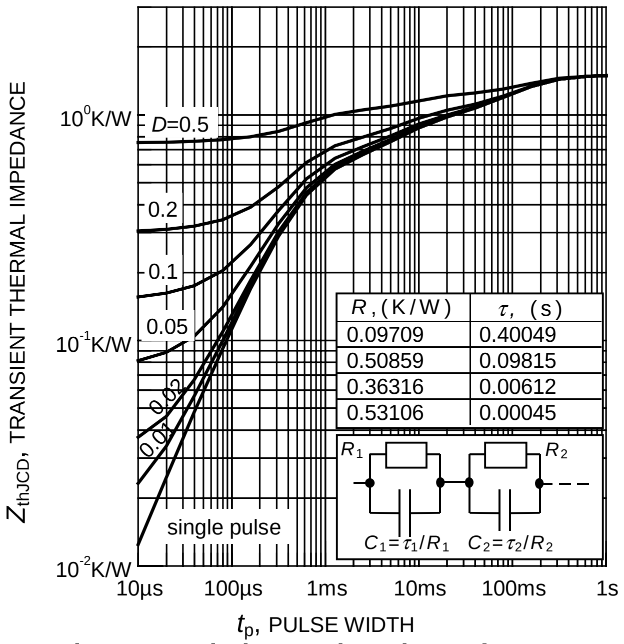


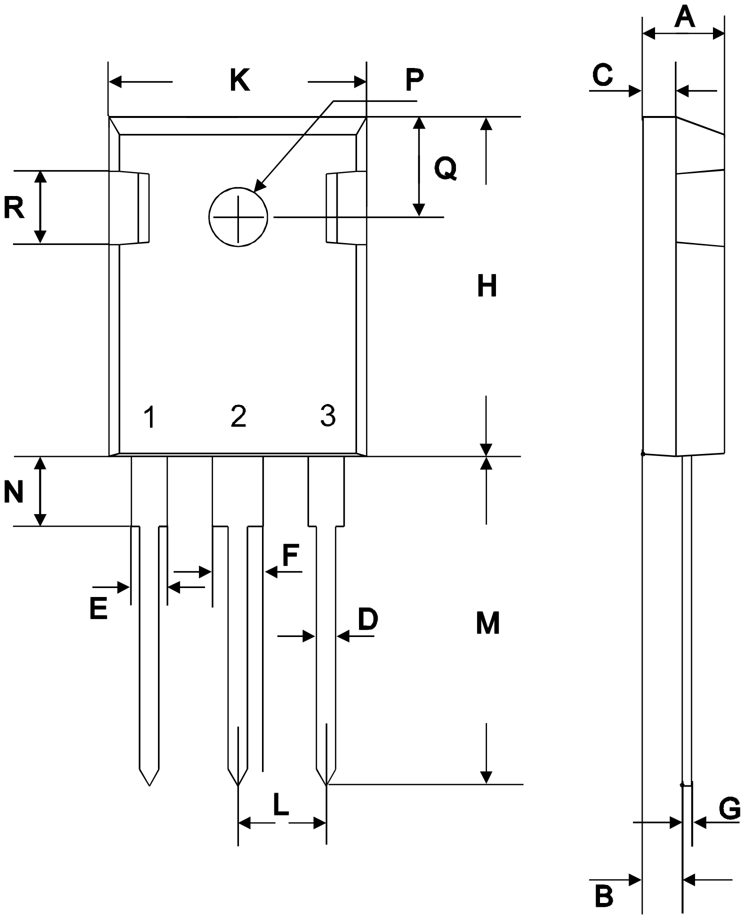
Figure 26. Typical diode forward voltage as a function of junction temperature



R, (K/W)	τ, (s)
0.09709	0.40049
0.50859	0.09815
0.36316	0.00612
0.53106	0.00045

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

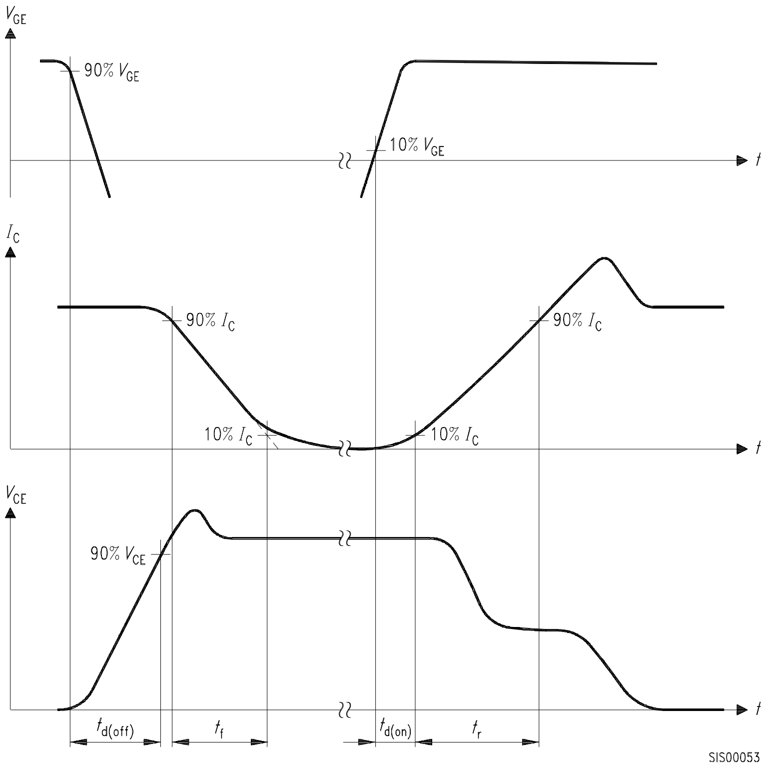


Figure A. Definition of switching times

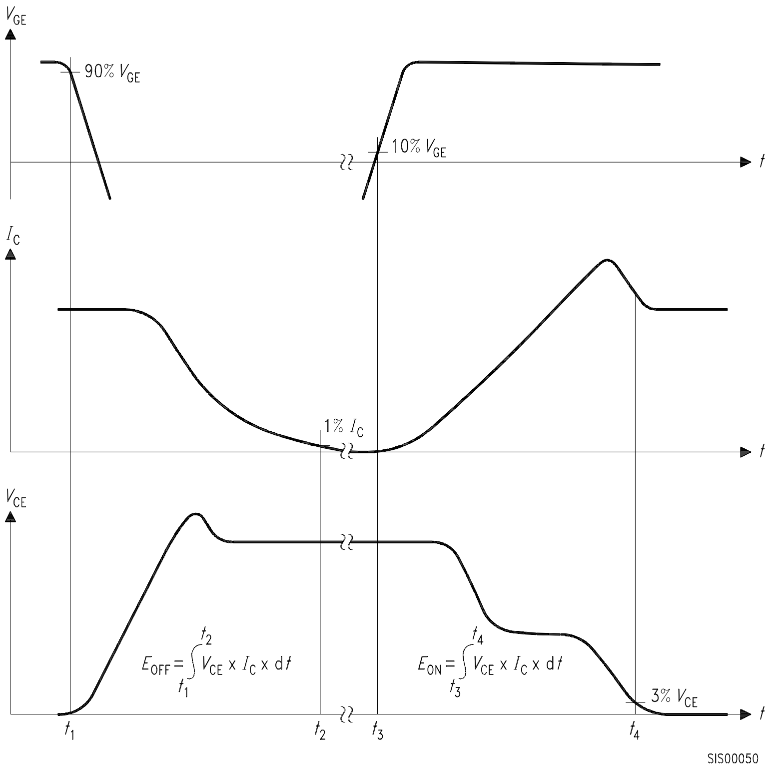


Figure B. Definition of switching losses

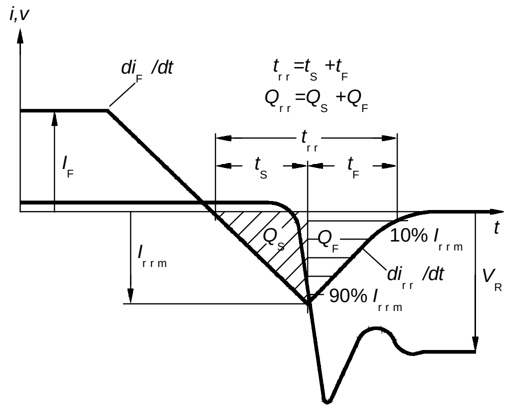


Figure C. Definition of diodes switching characteristics

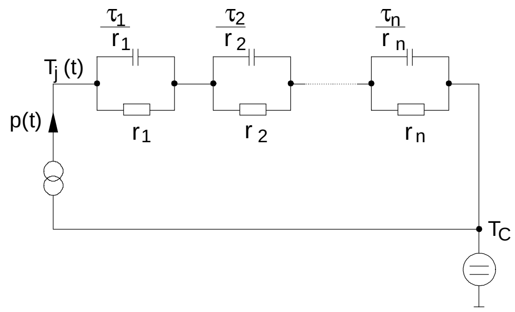


Figure D. Thermal equivalent circuit

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