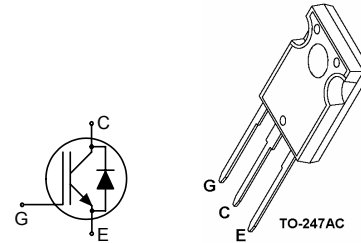


Low Loss DuoPack : IGBT in Trench and Fieldstop technology
with soft, fast recovery anti-parallel EmCon HE diode

- Short circuit withstand time – 10 μ s
- Designed for :
 - Soft Switching Applications
 - Induction Heating
- Trench 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
- Application specific optimisation of inverse diode



Type	V_{CE}	I_C	$V_{CE(sat), T_j=25^\circ C}$	$T_{j,max}$	Marking	Package	Ordering Code
IHW20T120	1200V	20A	1.7V	150°C	H20T120	TO-247AC	Q67040-S4652

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
DC collector current	I_C	40	A
$T_C = 25^\circ C$		20	
$T_C = 100^\circ C$		20	
Pulsed collector current, t_p limited by $T_{j,max}$	$I_{C,puls}$	60	
Turn off safe operating area	-	60	
$V_{CE} \leq 1200V, T_j \leq 150^\circ C$			
Diode forward current	I_F	23	
$T_C = 25^\circ C$		13	
$T_C = 100^\circ C$		13	
Diode pulsed current, t_p limited by $T_{j,max}$	$I_{F,puls}$	36	
Diode surge non repetitive current, t_p limited by $T_{j,max}$	I_{FSM}	50	A
$T_C = 25^\circ C, t_p = 10ms$, sine halfwave		130	
$T_C = 25^\circ C, t_p \leq 2.5\mu s$, sine halfwave		120	
$T_C = 100^\circ C, t_p \leq 2.5\mu s$, sine halfwave			
Gate-emitter voltage	V_{GE}	± 20	V
Short circuit withstand time ¹⁾	t_{SC}	10	μs
$V_{GE} = 15V, V_{CC} \leq 1200V, T_j \leq 150^\circ C$			
Power dissipation, $T_C = 25^\circ C$	P_{tot}	178	W
Operating junction temperature	T_j	-40...+150	°C
Storage temperature	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}		0.7	K/W
Diode thermal resistance, junction – case	R_{thJCD}		1.3	
Thermal resistance, junction – ambient	R_{thJA}	TO-247AC	40	

Electrical Characteristic, at $T_j = 25\text{ }^\circ\text{C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Static Characteristic						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE}=0V, I_C=500\mu A$	1200	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE} = 15V, I_C=20A$ $T_j=25\text{ }^\circ\text{C}$ $T_j=125\text{ }^\circ\text{C}$ $T_j=150\text{ }^\circ\text{C}$	- - -	1.7 2.0 2.2	2.2 - -	V
Diode forward voltage	V_F	$V_{GE}=0V, I_F=9A$ $T_j=25\text{ }^\circ\text{C}$ $T_j=125\text{ }^\circ\text{C}$ $T_j=150\text{ }^\circ\text{C}$	- - -	1.7 1.7 1.7	2.2 - -	
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C=300\mu A, V_{CE}=V_{GE}$	5.0	5.8	6.5	
Zero gate voltage collector current	I_{CES}	$V_{CE}=1200V, V_{GE}=0V$ $T_j=25\text{ }^\circ\text{C}$ $T_j=150\text{ }^\circ\text{C}$	- -	- -	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

Input capacitance	C_{iss}	$V_{CE}=25V,$	-	1460	-	pF
Output capacitance	C_{oss}	$V_{GE}=0V,$	-	78	-	
Reverse transfer capacitance	C_{riss}	$f=1MHz$	-	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	TO-247AC	-	-	13	nH
Short circuit collector current ¹⁾	$I_{C(SC)}$	$V_{GE}=15V, t_{SC} \leq 10\mu s$ $V_{CC} = 600V,$ $T_j = 25^\circ C$	-	120	-	A

Switching Characteristic, Inductive Load, at $T_j=25^\circ C$

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	$T_j=25^\circ C,$	-	50	-	ns
Rise time	t_r	$V_{CC}=600V, I_C=20A,$	-	30	-	
Turn-off delay time	$t_{d(off)}$	$V_{GE}=-15/15V,$	-	560	-	
Fall time	t_f	$R_G=28\Omega,$	-	70	-	
Turn-on energy	E_{on}	Energy losses include "tail" and diode reverse recovery.	-	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}	$T_j=25^\circ C,$	-	140	-	ns
Diode reverse recovery charge	Q_{rr}	$V_R=800V, I_F=9A,$	-	950	-	
Diode peak reverse recovery current	I_{rrm}	$di_F/dt=750A/\mu s$	-	13.3	-	A

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

Switching Characteristic, Inductive Load, at $T_j=150^\circ\text{C}$

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	$T_j=150^\circ\text{C}$	-	50	-	ns
Rise time	t_r	$V_{CC}=600\text{V},$	-	32	-	
Turn-off delay time	$t_{d(off)}$	$I_C=20\text{A},$	-	660	-	
Fall time	t_f	$V_{GE}=-15/15\text{V},$	-	130	-	
Turn-on energy	E_{on}	$R_G=28\Omega$	-	2.6	-	mJ
Turn-off energy	E_{off}	Energy losses include "tail" and diode reverse recovery.	-	2.6	-	
Total switching energy	E_{ts}		-	5.2	-	
Anti-Parallel Diode Characteristic						
Diode reverse recovery time	t_{rr}	$T_j=150^\circ\text{C}$	-	210	-	ns
Diode reverse recovery charge	Q_{rr}	$V_R=800\text{V}, I_F=18\text{A},$	-	1600	-	nC
Diode peak reverse recovery current	I_{rrm}	$di_F/dt=750\text{A}/\mu\text{s}$	-	16.5	-	A

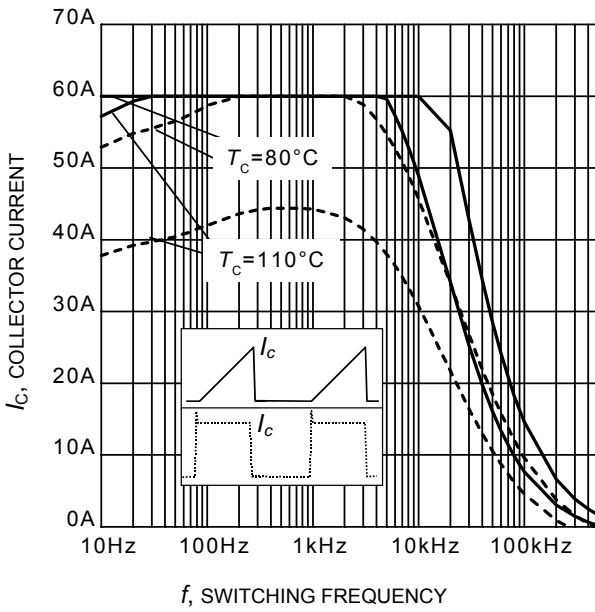


Figure 1. Collector current as a function of switching frequency
 ($T_j \leq 150^\circ\text{C}$, $D = 0.5$, $V_{CE} = 600\text{V}$,
 $V_{GE} = 0/+15\text{V}$, $R_G = 28\Omega$)

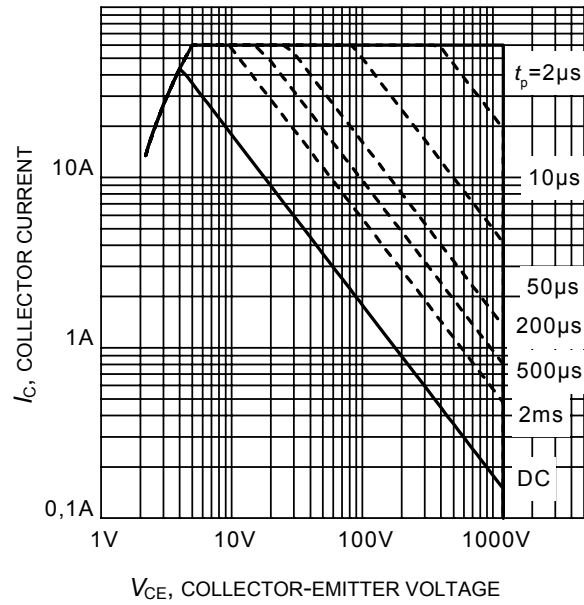


Figure 2. IGBT Safe operating area
 ($D = 0$, $T_C = 25^\circ\text{C}$,
 $T_j \leq 150^\circ\text{C}$; $V_{GE} = 15\text{V}$)

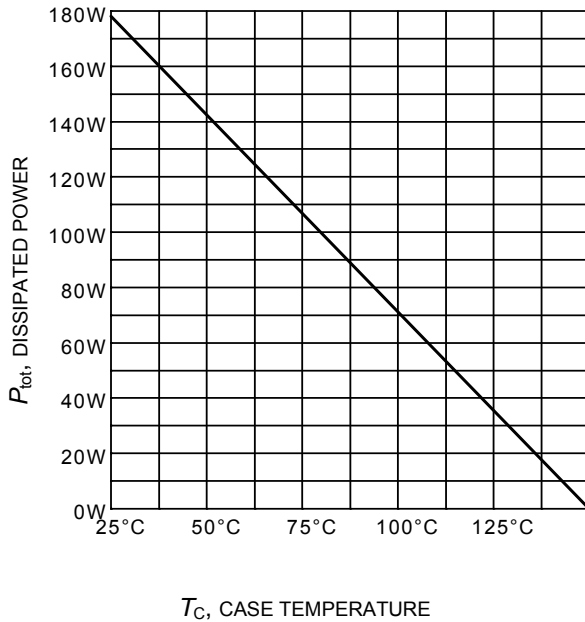


Figure 3. Power dissipation as a function of case temperature
 ($T_j \leq 150^\circ\text{C}$)

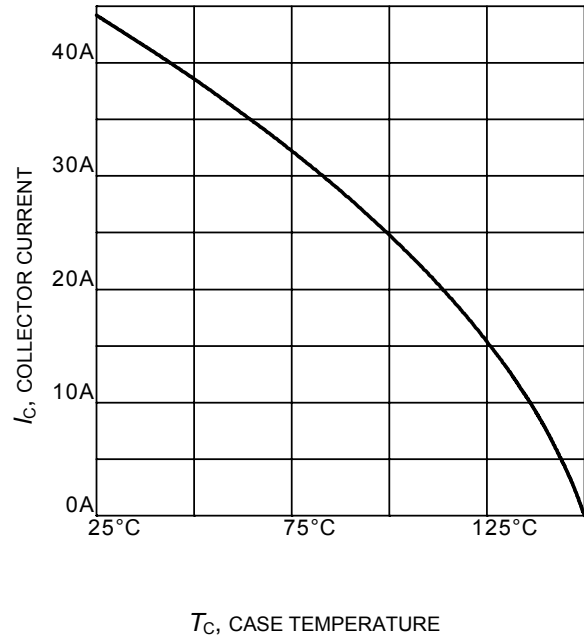


Figure 4. Collector current as a function of case temperature
 ($V_{GE} \geq 15\text{V}$, $T_j \leq 150^\circ\text{C}$)

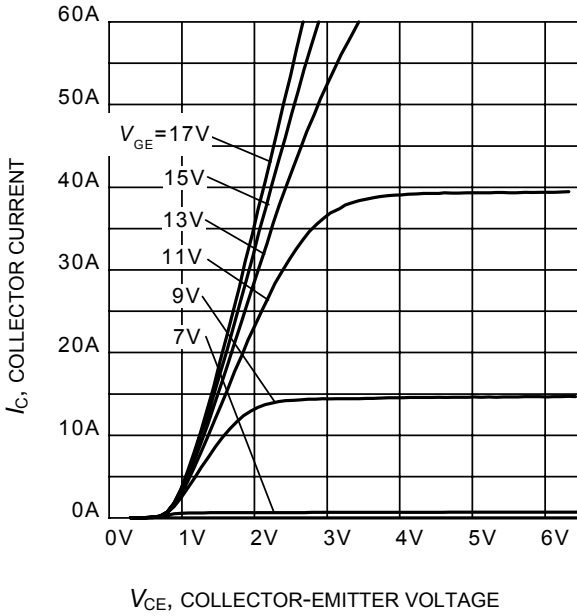


Figure 5. Typical output characteristic
($T_j = 25^\circ\text{C}$)

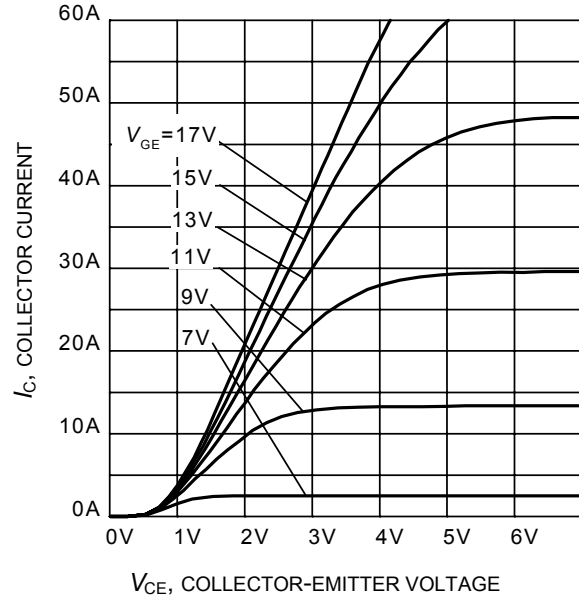


Figure 6. Typical output characteristic
($T_j = 150^\circ\text{C}$)

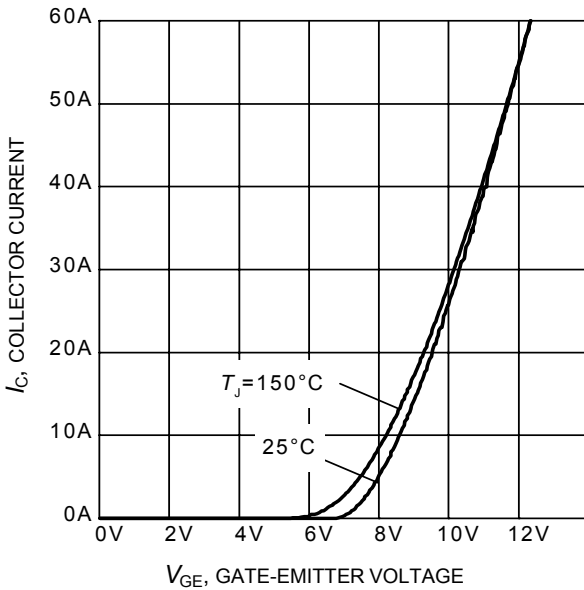


Figure 7. Typical transfer characteristic
($V_{CE} = 20\text{V}$)

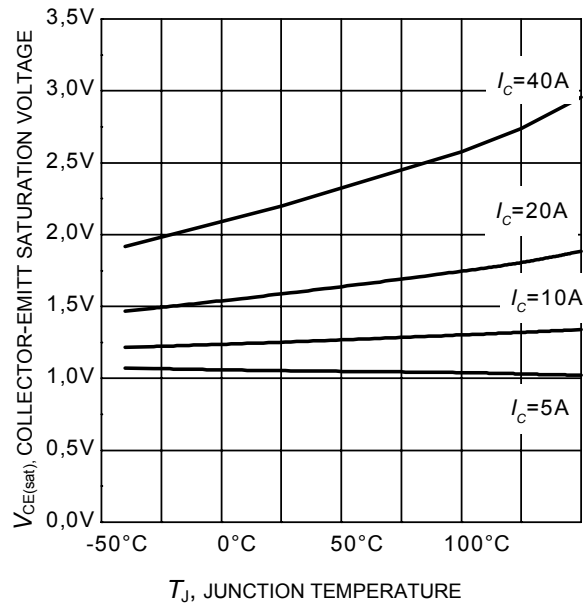


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
($V_{GE} = 15\text{V}$)

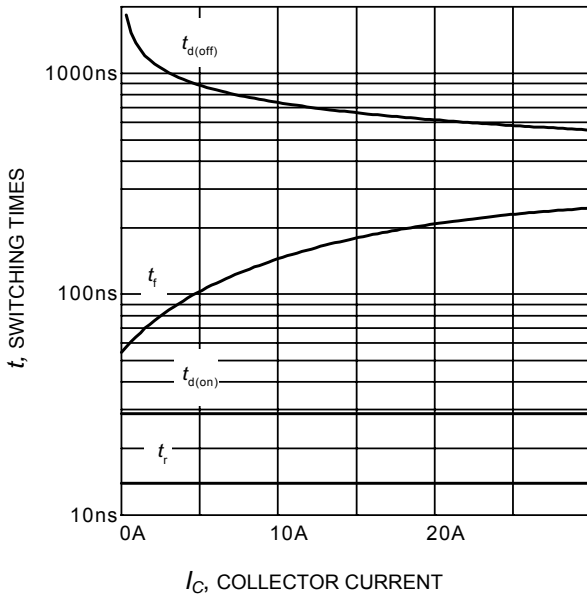


Figure 9. Typical switching times as a function of collector current
(inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=35\Omega$, Dynamic test circuit in Figure E)

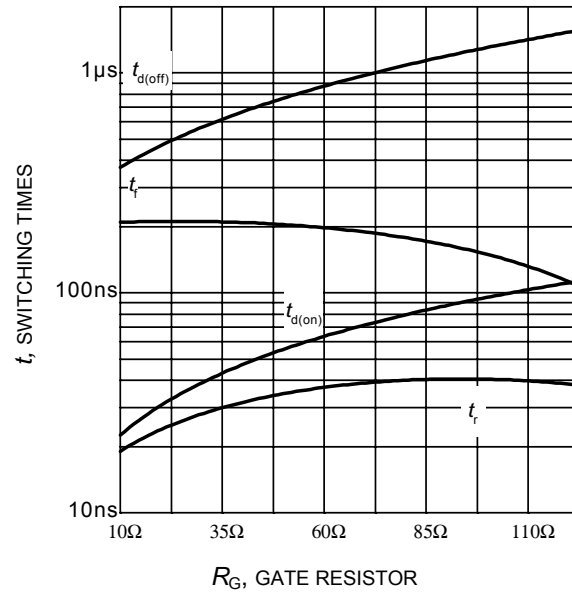


Figure 10. Typical switching times as a function of gate resistor
(inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, Dynamic test circuit in Figure E)

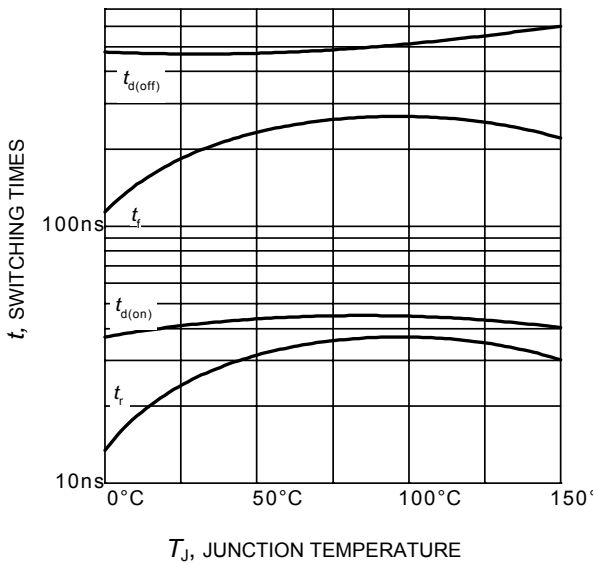


Figure 11. Typical switching times as a function of junction temperature
(inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, $R_G=35\Omega$, Dynamic test circuit in Figure E)

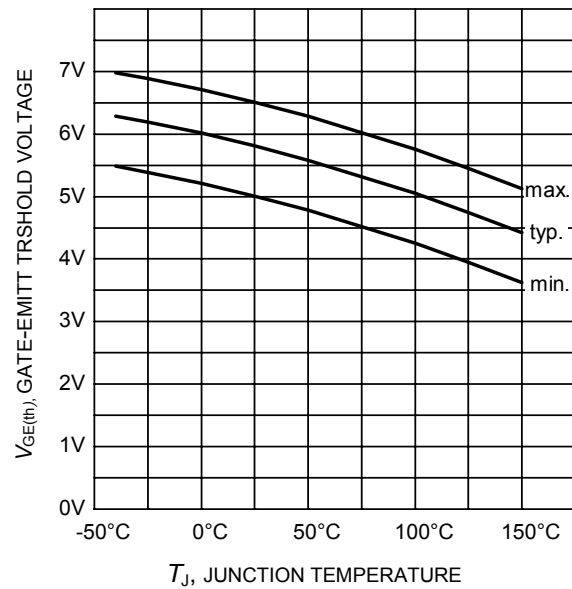


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
($I_C = 0.3\text{mA}$)

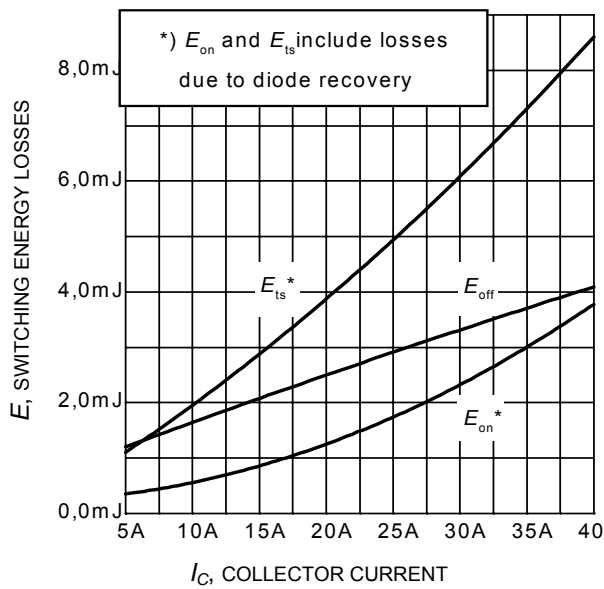


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=35\Omega$, Dynamic test circuit in Figure E)

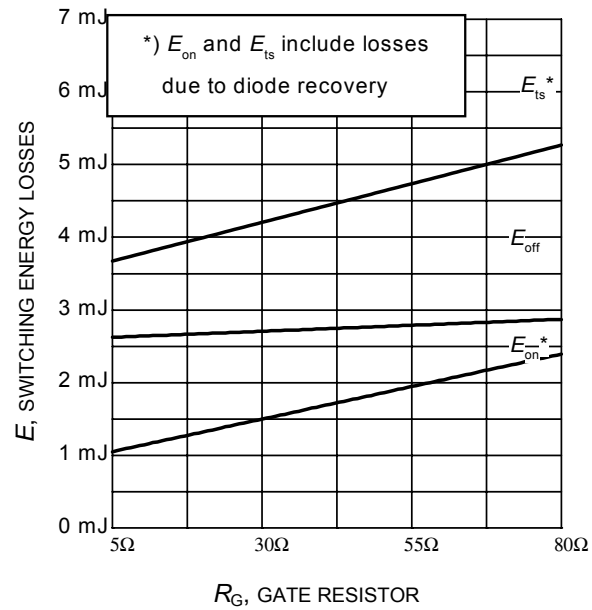


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, Dynamic test circuit in Figure E)

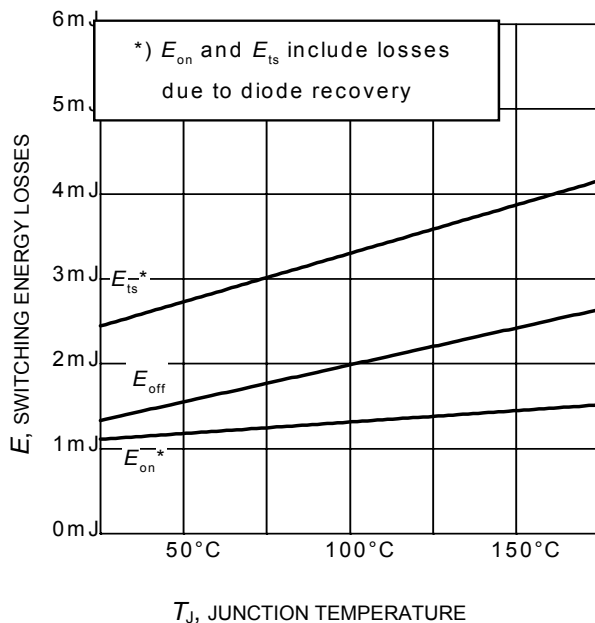


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, $R_G=35\Omega$, Dynamic test circuit in Figure E)

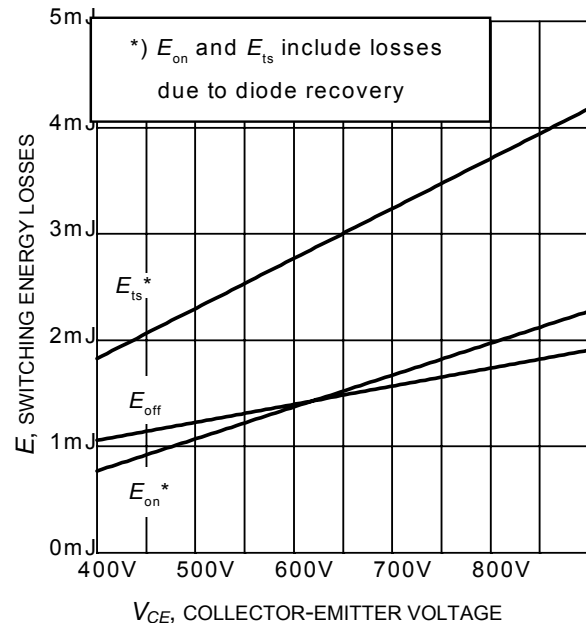


Figure 16. Typical switching energy losses as a function of collector emitter voltage
(inductive load, $T_J=150^\circ\text{C}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, $R_G=35\Omega$, Dynamic test circuit in Figure E)

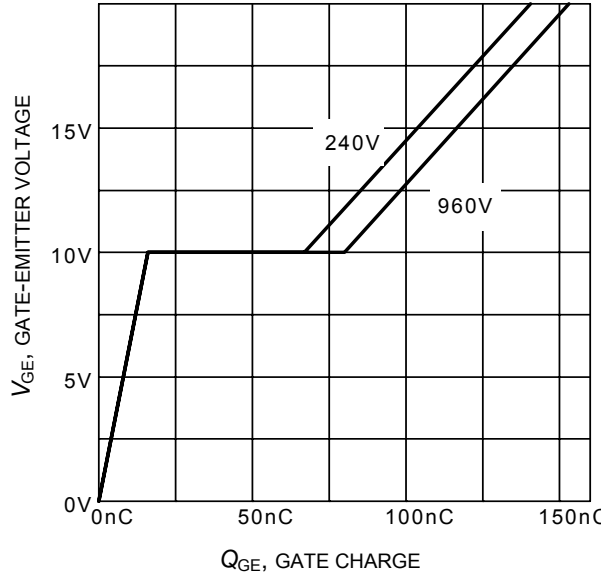


Figure 17. Typical gate charge
($I_C=20\text{ A}$)

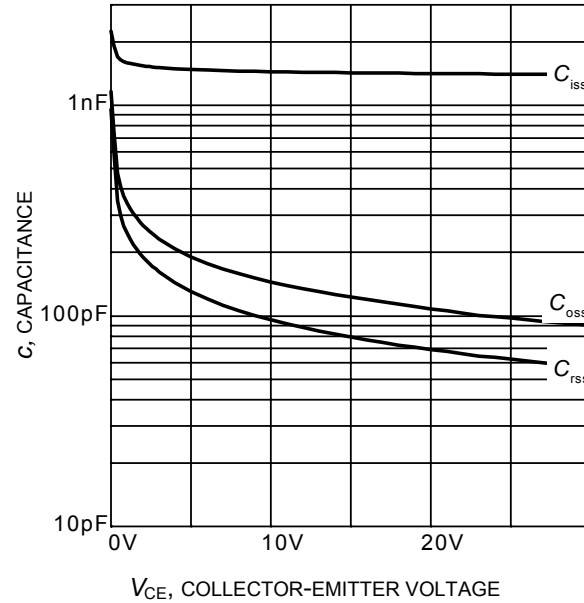


Figure 18. Typical capacitance as a function of collector-emitter voltage
($V_{GE}=0\text{V}$, $f=1\text{ MHz}$)

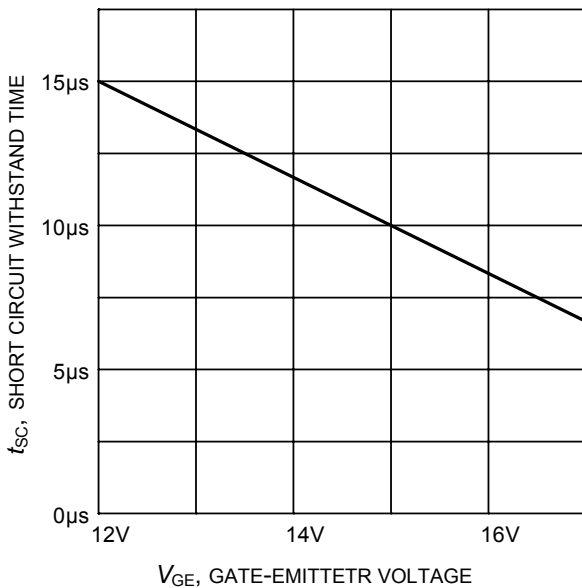


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
($V_{CE}=600\text{V}$, start at $T_J=25^\circ\text{C}$)

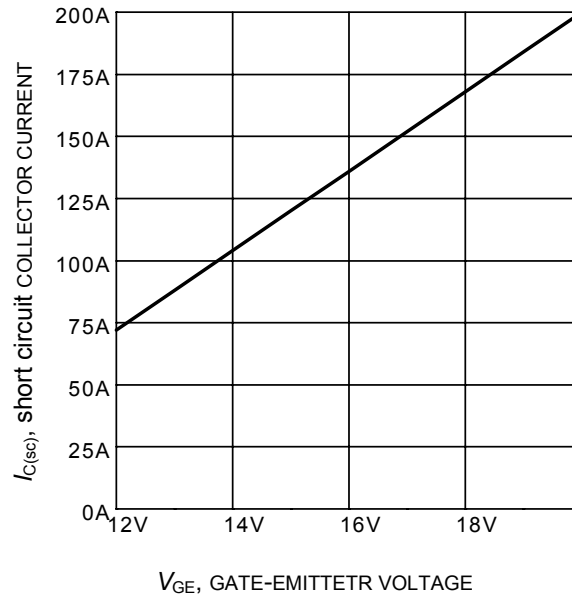


Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \leq 600\text{V}$, $T_J \leq 150^\circ\text{C}$)

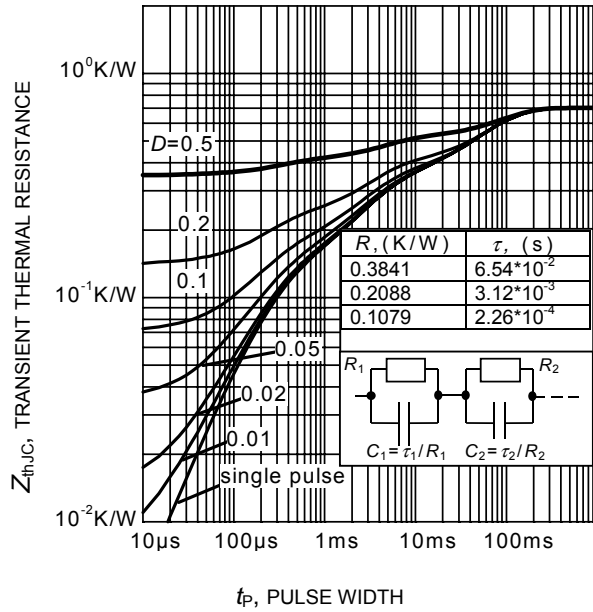


Figure 23. IGBT transient thermal resistance
($D = t_p / T$)

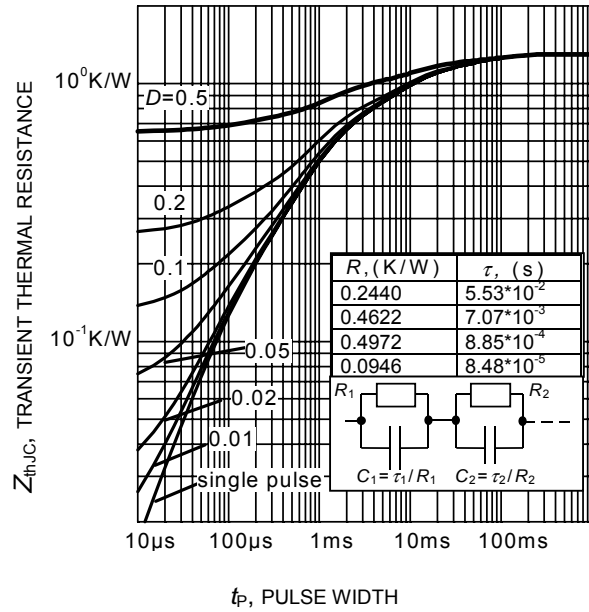


Figure 24. Typical Diode transient thermal impedance as a function of pulse width
($D = t_p / T$)

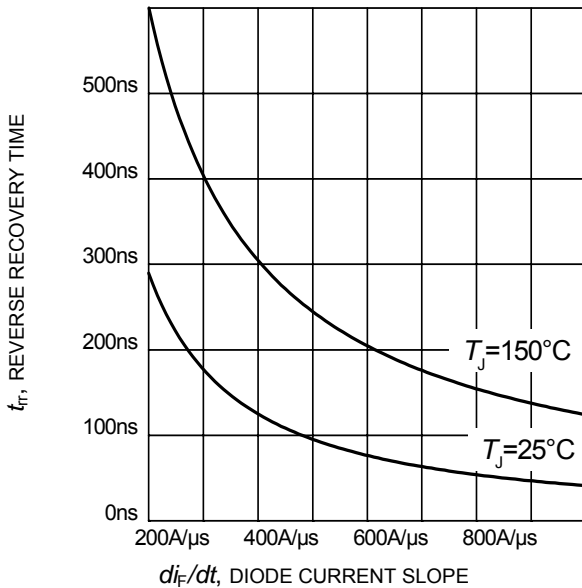


Figure 23. Typical reverse recovery time as a function of diode current slope
($V_R=600V$, $I_F=8A$,
Dynamic test circuit in Figure E)

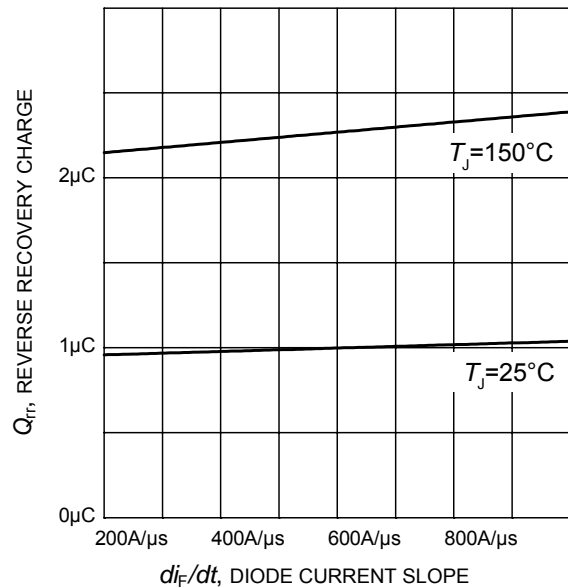


Figure 24. Typical reverse recovery charge as a function of diode current slope
($V_R=600V$, $I_F=8A$,
Dynamic test circuit in Figure E)

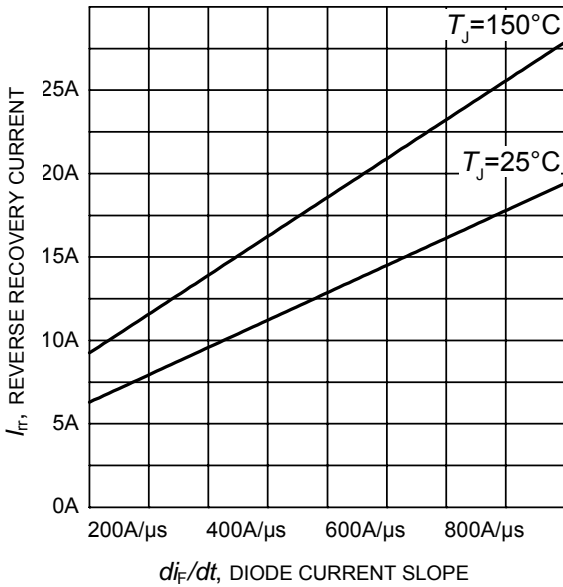


Figure 25. Typical reverse recovery current as a function of diode current slope
 ($V_R=600V$, $I_F=8A$,
 Dynamic test circuit in Figure E)

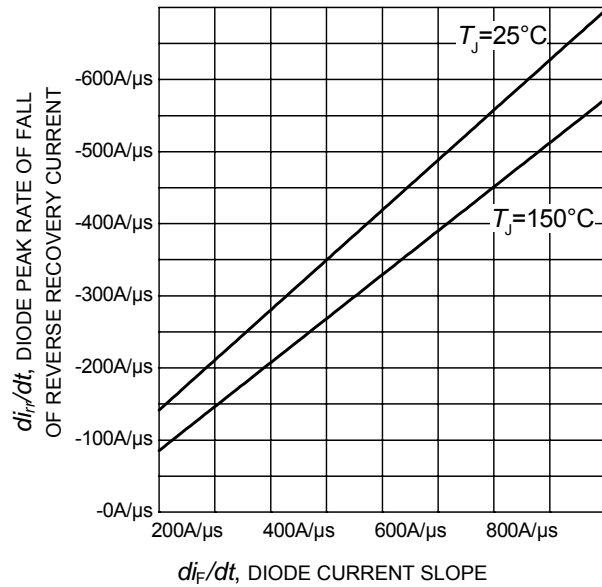


Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
 ($V_R=600V$, $I_F=8A$,
 Dynamic test circuit in Figure E)

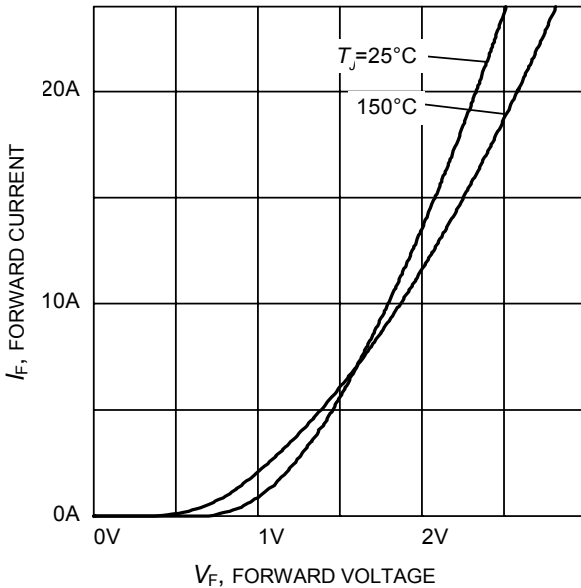


Figure 27. Typical diode forward current as a function of forward voltage

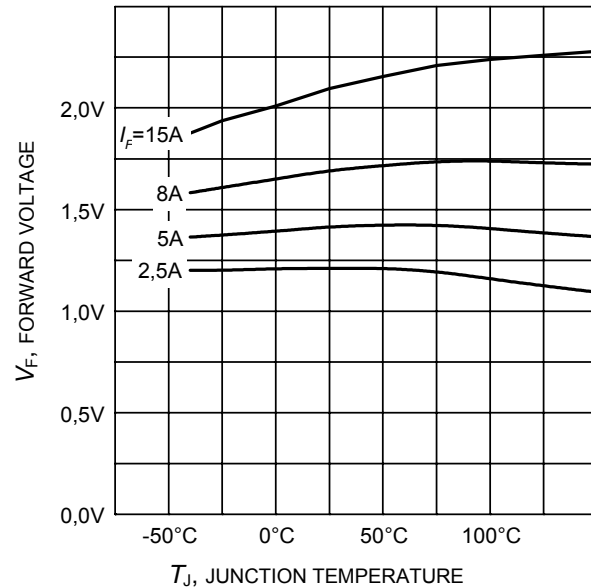
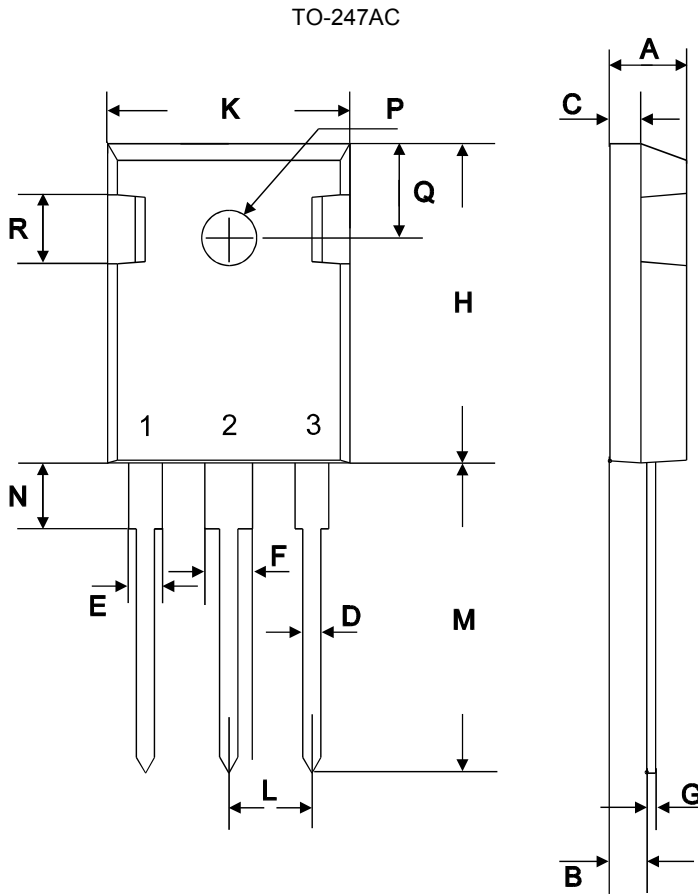


Figure 28. Typical diode forward voltage as a function of junction temperature



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

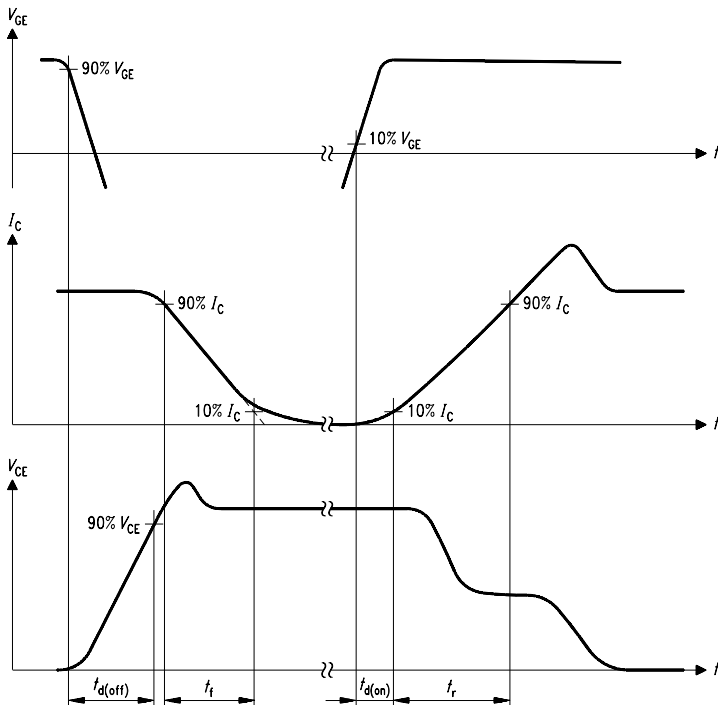


Figure A. Definition of switching times

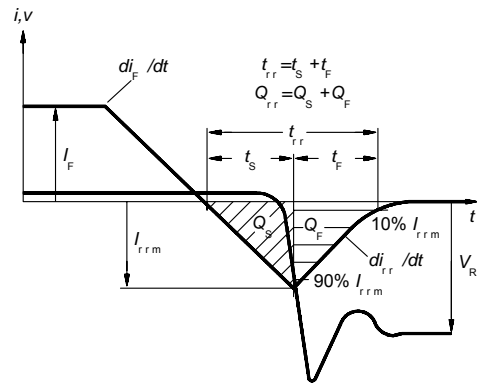


Figure C. Definition of diodes switching characteristics

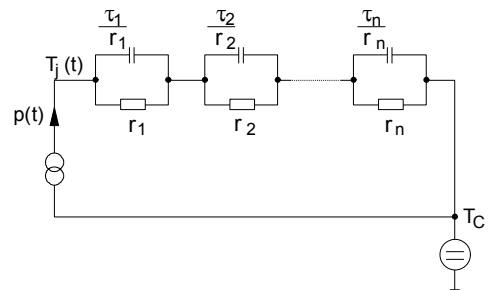


Figure D. Thermal equivalent circuit

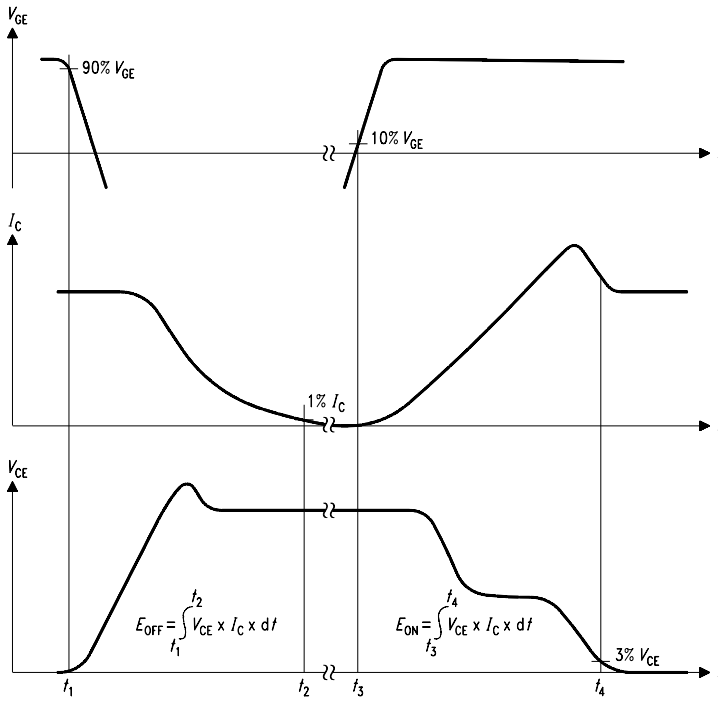


Figure B. Definition of switching losses

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