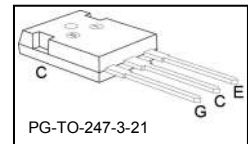
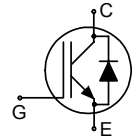


Low Loss DuoPack : IGBT in **TrenchStop®** and Fieldstop technology  
with soft, fast recovery anti-parallel EmCon HE diode

- Short circuit withstand time – 10 $\mu$ s
- 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<sup>1</sup> for target applications
- Application specific optimisation of inverse diode
- Pb-free lead plating; RoHS compliant



Type	$V_{CE}$	$I_C$	$V_{CE(sat), T_j=25^\circ C}$	$T_{j,max}$	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
$T_C = 25^\circ C$		40	
$T_C = 100^\circ C$		20	
Pulsed collector current, $t_p$ limited by $T_{jmax}$	$I_{C,puls}$	60	
Turn off safe operating area $V_{CE} \leq 1200V, T_j \leq 150^\circ C$	-	60	
Diode forward current	$I_F$		
$T_C = 25^\circ C$		23	
$T_C = 100^\circ C$		13	
Diode pulsed current, $t_p$ limited by $T_{jmax}$	$I_{F,puls}$	36	
Diode surge non repetitive current, $t_p$ limited by $T_{jmax}$	$I_{FSM}$		A
$T_C = 25^\circ C, t_p = 10ms$ , sine halfwave		50	
$T_C = 25^\circ C, t_p \leq 2.5\mu s$ , sine halfwave		130	
$T_C = 100^\circ C, t_p \leq 2.5\mu s$ , sine halfwave		120	
Gate-emitter voltage	$V_{GE}$	$\pm 20$	V
Short circuit withstand time <sup>2)</sup>	$t_{SC}$	10	$\mu s$
$V_{GE} = 15V, V_{CC} \leq 1200V, T_j \leq 150^\circ C$			
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

<sup>1</sup> J-STD-020 and JESD-022

<sup>2)</sup> Allowed number of short circuits: <1000; time between short circuits: >1s.



Soft Switching Series

IHW20T120

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

Parameter	Symbol	Conditions	Max. Value	Unit
<b>Characteristic</b>				
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  $T_j = 25^\circ\text{C}$ , unless otherwise specified**

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>Static Characteristic</b>						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE}=0V, I_C=500\mu A$	1200	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE} = 15V, I_C=20A$ $T_j=25^\circ\text{C}$ $T_j=125^\circ\text{C}$ $T_j=150^\circ\text{C}$	-	1.7	2.2	
Diode forward voltage	$V_F$	$V_{GE}=0V, I_F=9A$ $T_j=25^\circ\text{C}$ $T_j=125^\circ\text{C}$ $T_j=150^\circ\text{C}$	-	1.7	2.2	μA
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	$I_{CES}$	$V_{CE}=1200V,$ $V_{GE}=0V$ $T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$	-	-	250 2500	
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	$C_{iss}$	$V_{CE}=25V,$ $V_{GE}=0V,$ $f=1\text{MHz}$	-	1460	-	pF
Output capacitance	$C_{oss}$		-	78	-	
Reverse transfer capacitance	$C_{rss}$		-	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 <sup>1)</sup>	$I_{C(SC)}$	$V_{GE}=15V, t_{SC}\leq 10\mu s$ $V_{CC} = 600V,$ $T_j = 25^\circ\text{C}$	-	120	-	A

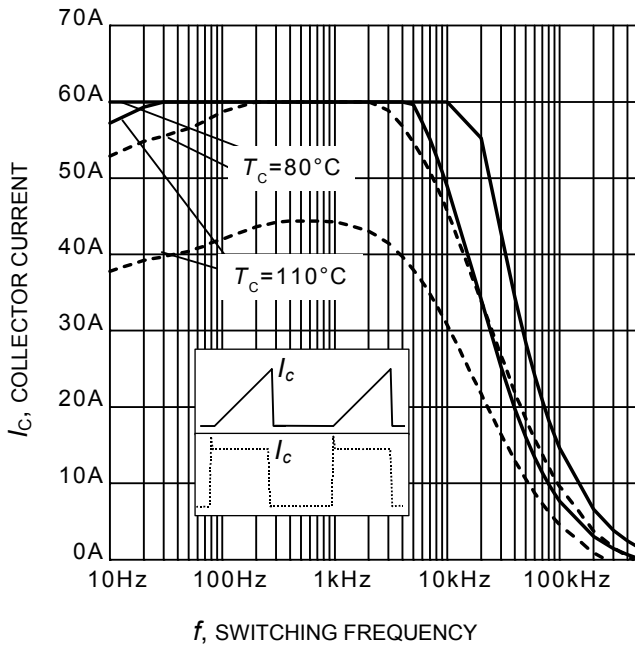
<sup>1)</sup> Allowed number of short circuits: <1000; time between short circuits: >1s.

**Switching Characteristic, Inductive Load, at  $T_j=25\text{ }^\circ\text{C}$** 

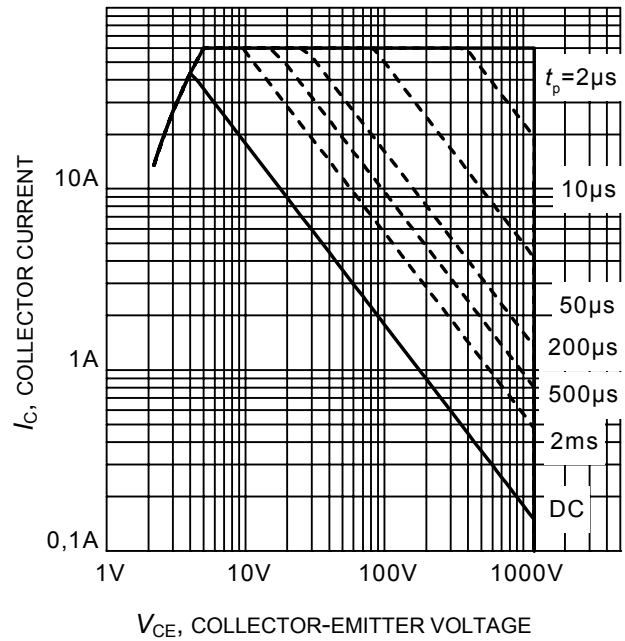
Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>IGBT Characteristic</b>						
Turn-on delay time	$t_{d(on)}$	$T_j=25\text{ }^\circ\text{C}$ , $V_{CC}=600\text{V}$ , $I_C=20\text{A}$ , $V_{GE}=0/15\text{V}$ , $R_G=28\Omega$ ,	-	50	-	ns
Rise time	$t_r$		-	30	-	
Turn-off delay time	$t_{d(off)}$		-	560	-	
Fall time	$t_f$		-	70	-	
Turn-on energy	$E_{on}$	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	-	
<b>Anti-Parallel Diode Characteristic</b>						
Diode reverse recovery time	$t_{rr}$	$T_j=25\text{ }^\circ\text{C}$ , $V_R=800\text{V}$ , $I_F=9\text{A}$ , $di_F/dt=750\text{A}/\mu\text{s}$	-	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  $T_j=150\text{ }^\circ\text{C}$** 

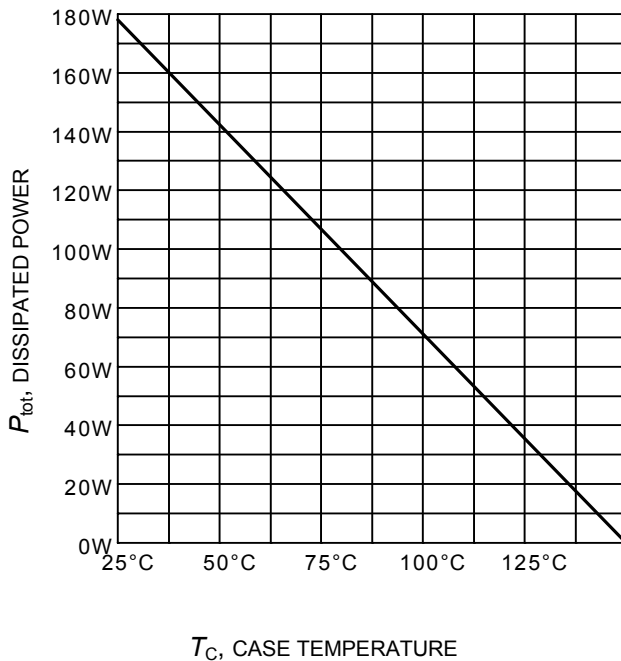
Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>IGBT Characteristic</b>						
Turn-on delay time	$t_{d(on)}$	$T_j=150\text{ }^\circ\text{C}$ $V_{CC}=600\text{V}$ , $I_C=20\text{A}$ , $V_{GE}=0/15\text{V}$ , $R_G=28\Omega$	-	50	-	ns
Rise time	$t_r$		-	32	-	
Turn-off delay time	$t_{d(off)}$		-	660	-	
Fall time	$t_f$		-	130	-	
Turn-on energy	$E_{on}$	Energy losses include "tail" and diode reverse recovery.	-	2.6	-	mJ
Turn-off energy	$E_{off}$		-	2.6	-	
Total switching energy	$E_{ts}$		-	5.2	-	
<b>Anti-Parallel Diode Characteristic</b>						
Diode reverse recovery time	$t_{rr}$	$T_j=150\text{ }^\circ\text{C}$ $V_R=800\text{V}$ , $I_F=18\text{A}$ , $di_F/dt=750\text{A}/\mu\text{s}$	-	210	-	ns
Diode reverse recovery charge	$Q_{rr}$		-	1600	-	nC
Diode peak reverse recovery current	$I_{rrm}$		-	16.5	-	A



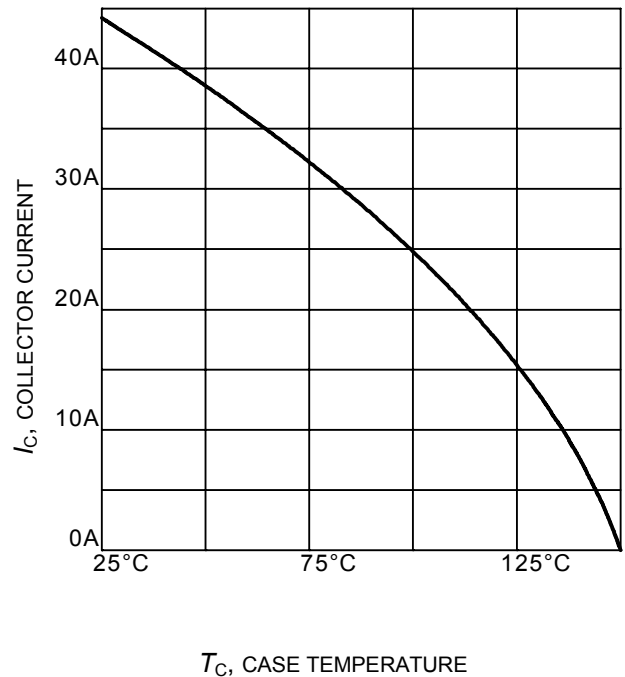
**Figure 1. Collector current as a function of switching frequency**  
 ( $T_j \leq 150^\circ\text{C}$ ,  $D = 0.5$ ,  $V_{CE} = 600\text{V}$ ,  
 $V_{GE} = 0/+15\text{V}$ ,  $R_G = 28\Omega$ )



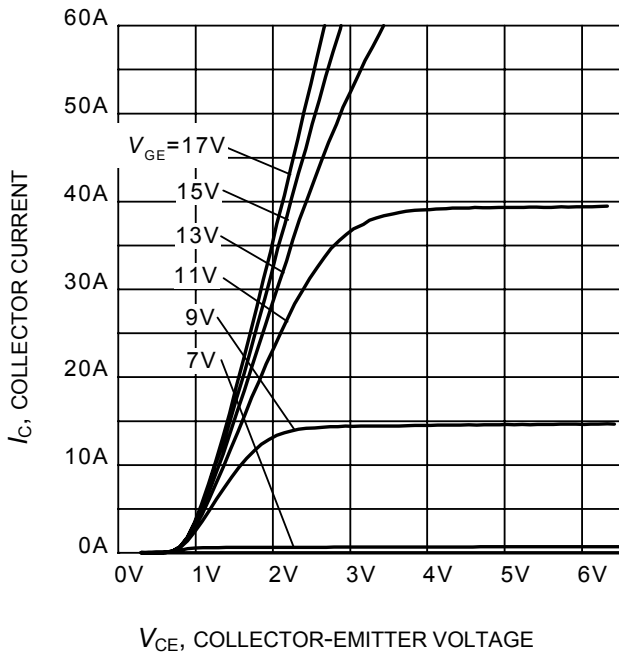
**Figure 2. IGBT Safe operating area**  
 ( $D = 0$ ,  $T_C = 25^\circ\text{C}$ ,  
 $T_j \leq 150^\circ\text{C}$ ;  $V_{GE} = 15\text{V}$ )



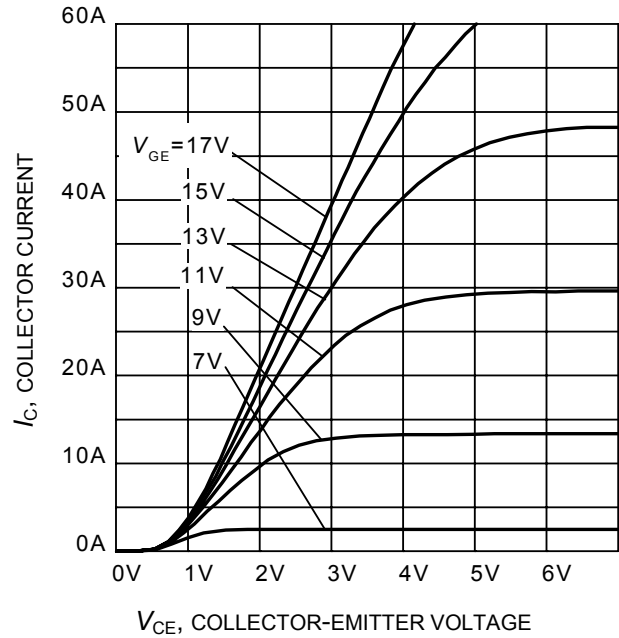
**Figure 3. Power dissipation as a function of case temperature**  
 ( $T_j \leq 150^\circ\text{C}$ )



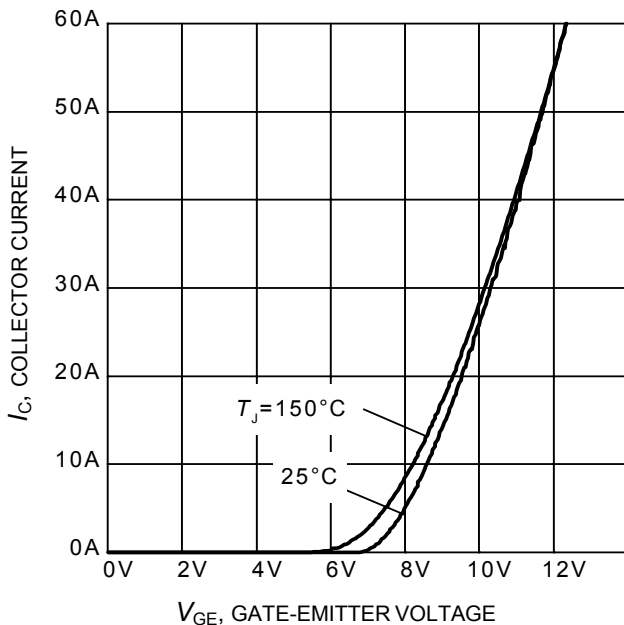
**Figure 4. Collector current as a function of case temperature**  
 ( $V_{GE} \geq 15\text{V}$ ,  $T_j \leq 150^\circ\text{C}$ )



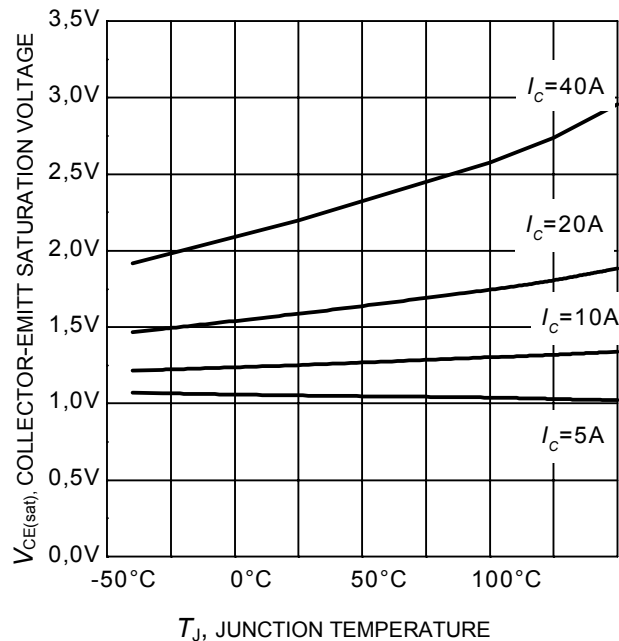
**Figure 5. Typical output characteristic**  
( $T_j = 25^\circ\text{C}$ )



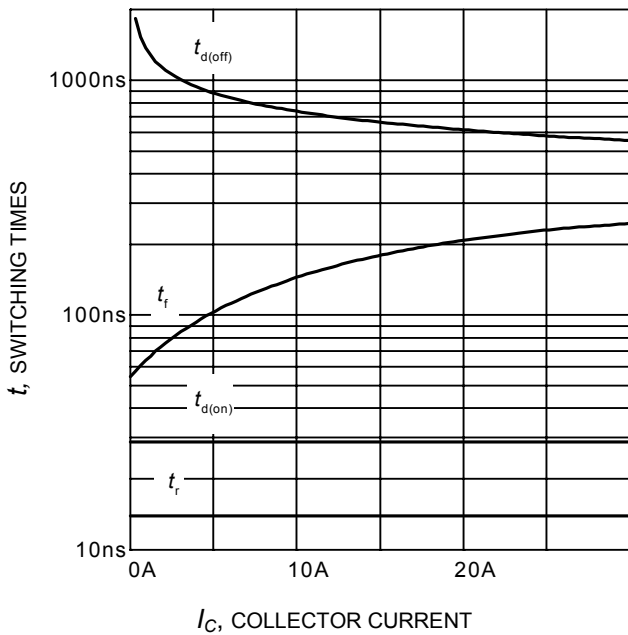
**Figure 6. Typical output characteristic**  
( $T_j = 150^\circ\text{C}$ )



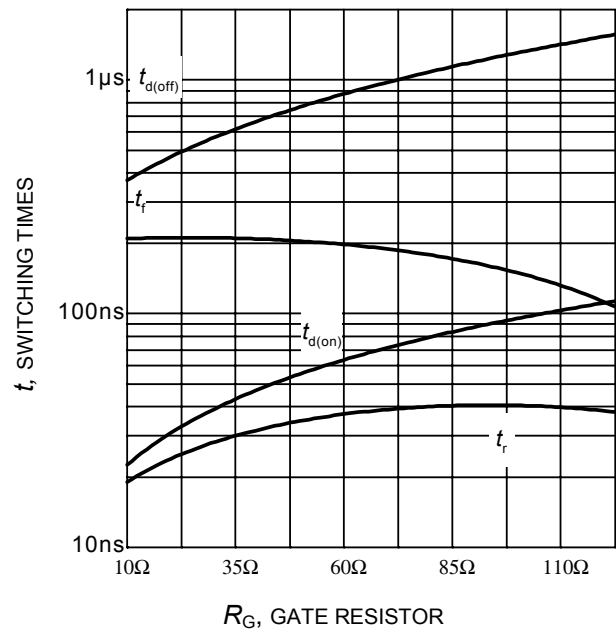
**Figure 7. Typical transfer characteristic**  
( $V_{CE} = 20\text{V}$ )



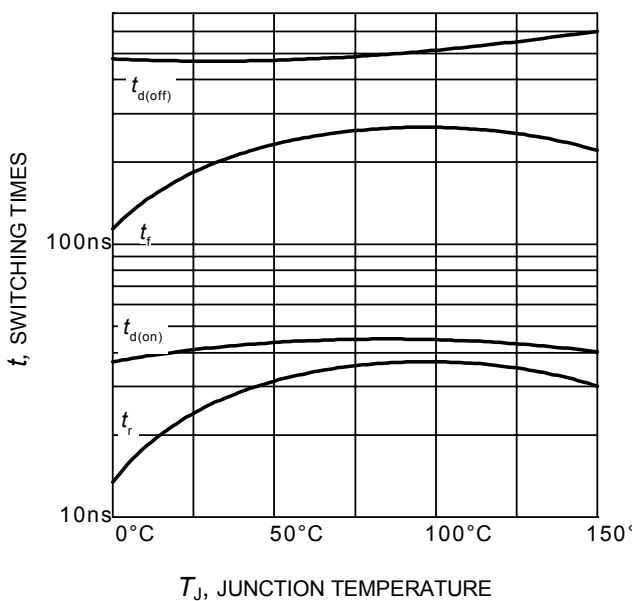
**Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature**  
( $V_{GE} = 15\text{V}$ )



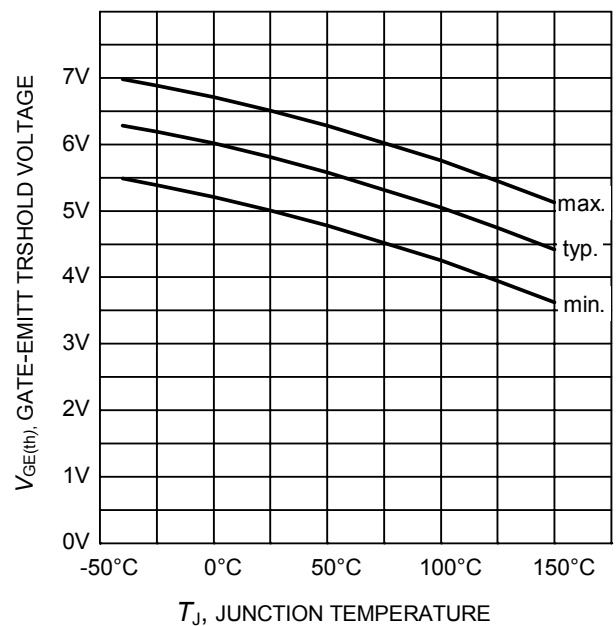
**Figure 9. Typical switching times as a function of collector current**  
(inductive load,  $T_J=150^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $R_G=35\Omega$ , Dynamic test circuit in Figure E)



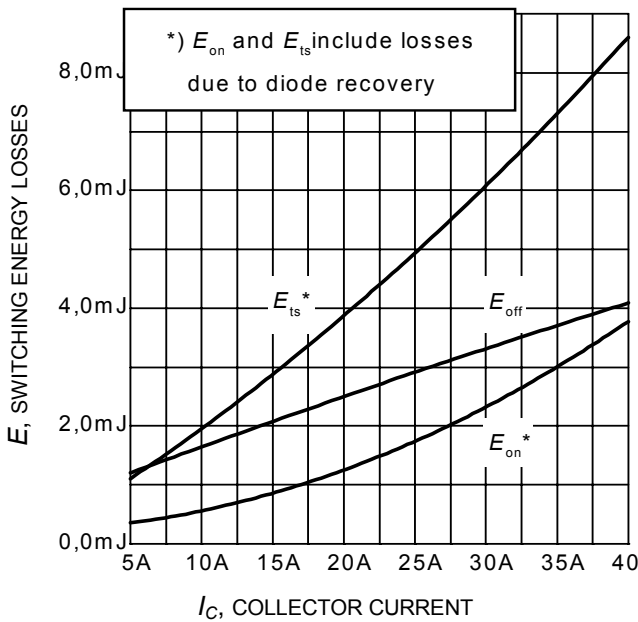
**Figure 10. Typical switching times as a function of gate resistor**  
(inductive load,  $T_J=150^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=20\text{A}$ , Dynamic test circuit in Figure E)



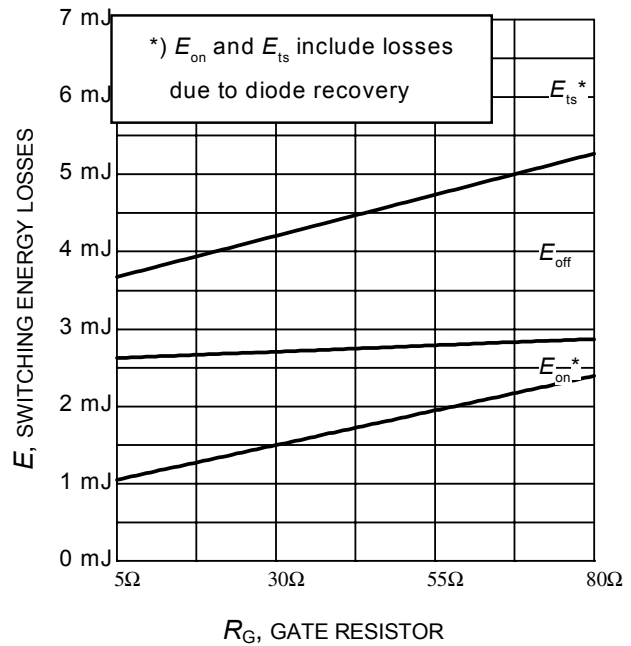
**Figure 11. Typical switching times as a function of junction temperature**  
(inductive load,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=20\text{A}$ ,  $R_G=35\Omega$ , Dynamic test circuit in Figure E)



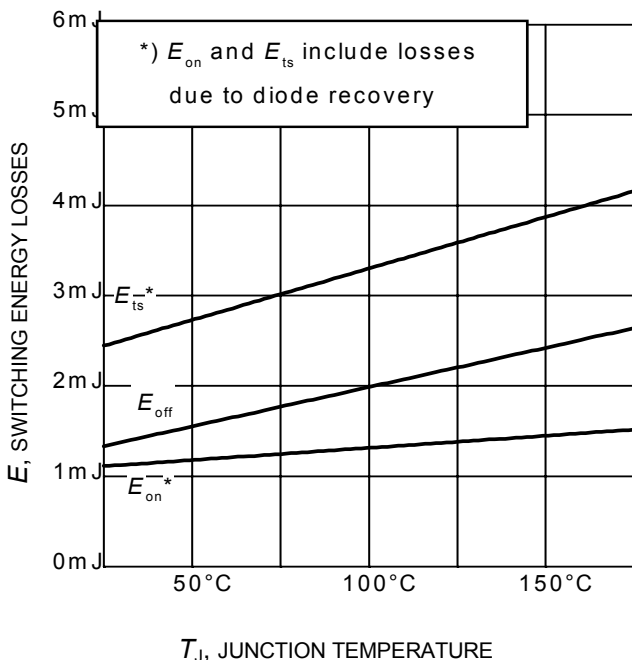
**Figure 12. Gate-emitter threshold voltage as a function of junction temperature**  
( $I_C = 0.3\text{mA}$ )



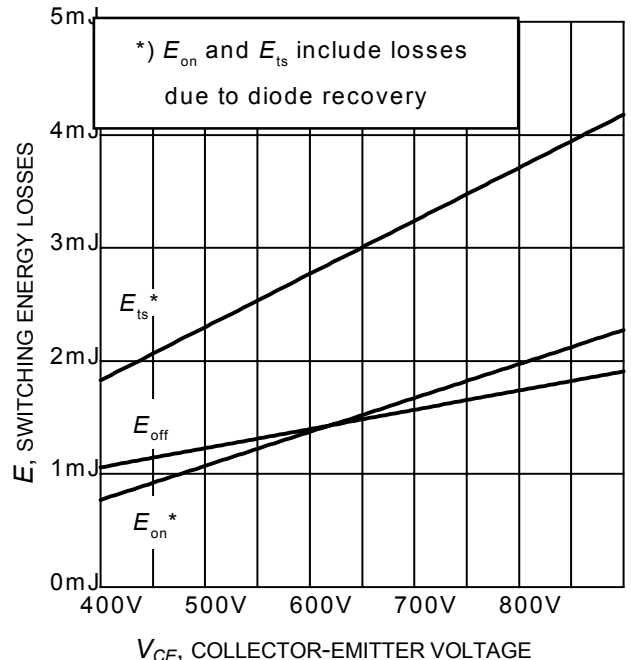
**Figure 13. Typical switching energy losses as a function of collector current**  
 (inductive load,  $T_J=150^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $R_G=35\Omega$ , Dynamic test circuit in Figure E)



**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)

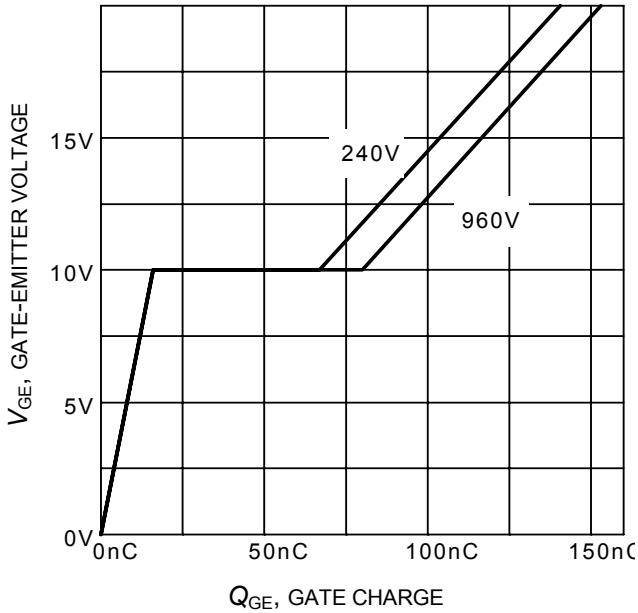


**Figure 15. Typical switching energy losses as a function of junction temperature**  
 (inductive load,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=20\text{A}$ ,  $R_G=35\Omega$ , Dynamic test circuit in Figure E)

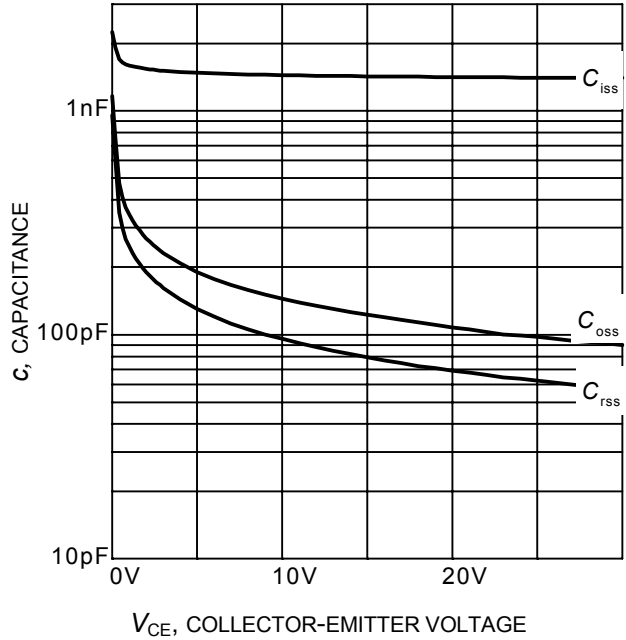


**Figure 16. Typical switching energy losses as a function of collector emitter voltage**  
 (inductive load,  $T_J=150^\circ\text{C}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=20\text{A}$ ,  $R_G=35\Omega$ , Dynamic test circuit in Figure E)

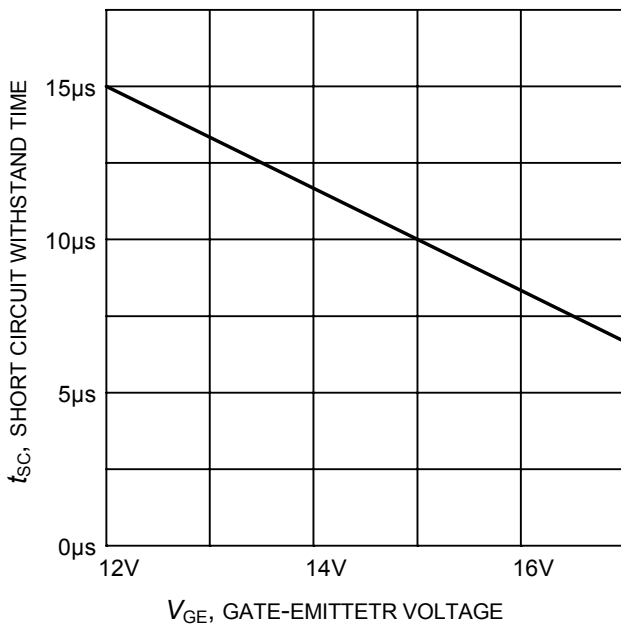




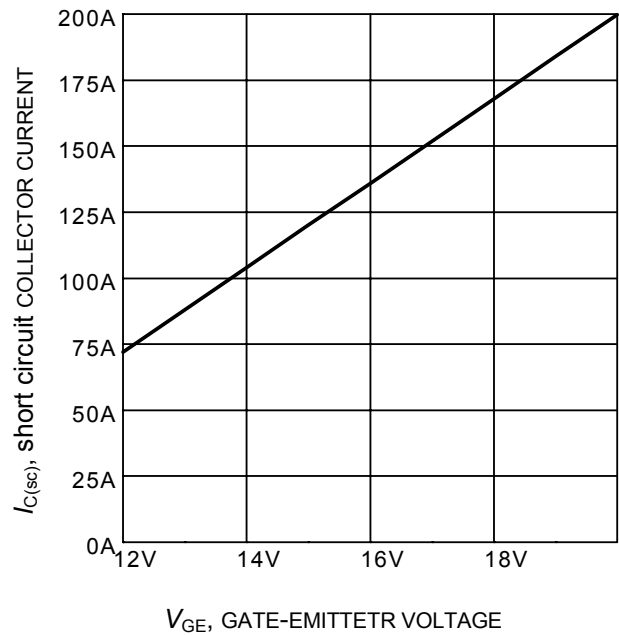
**Figure 17. Typical gate charge**  
( $I_C=20\text{ A}$ )



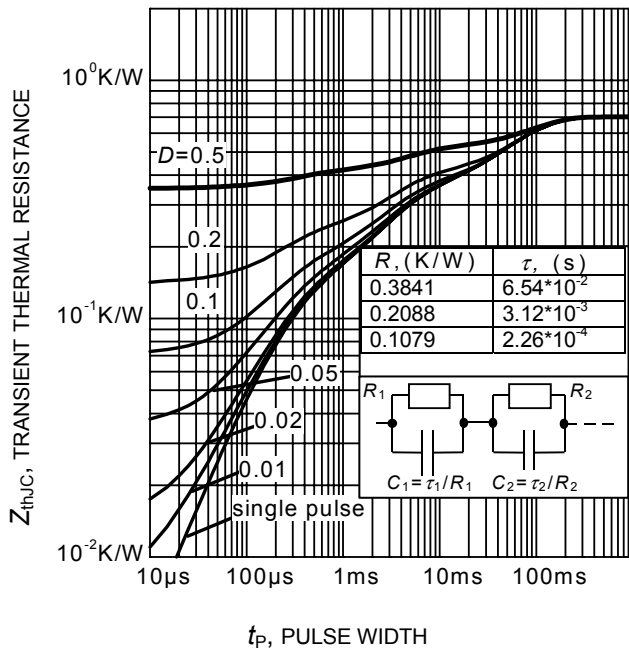
**Figure 18. Typical capacitance as a function of collector-emitter voltage**  
( $V_{GE}=0\text{V}$ ,  $f=1\text{ MHz}$ )



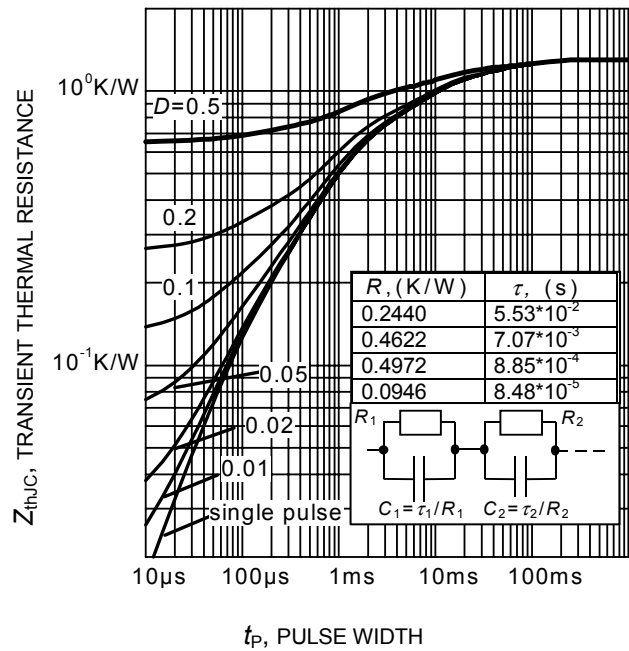
**Figure 19. Short circuit withstand time as a function of gate-emitter voltage**  
( $V_{CE}=600\text{V}$ , start at  $T_J=25^\circ\text{C}$ )



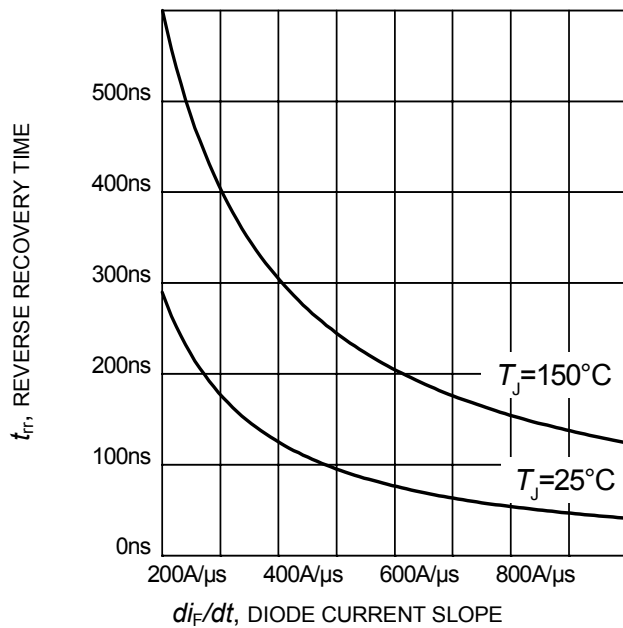
**Figure 20. Typical short circuit collector current as a function of gate-emitter voltage**  
( $V_{CE} \leq 600\text{V}$ ,  $T_J \leq 150^\circ\text{C}$ )



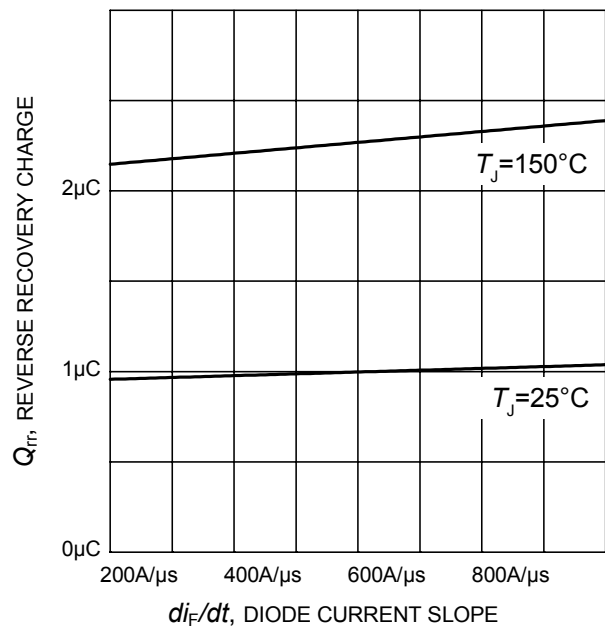
**Figure 23. IGBT transient thermal resistance**  
 $(D = t_p / T)$



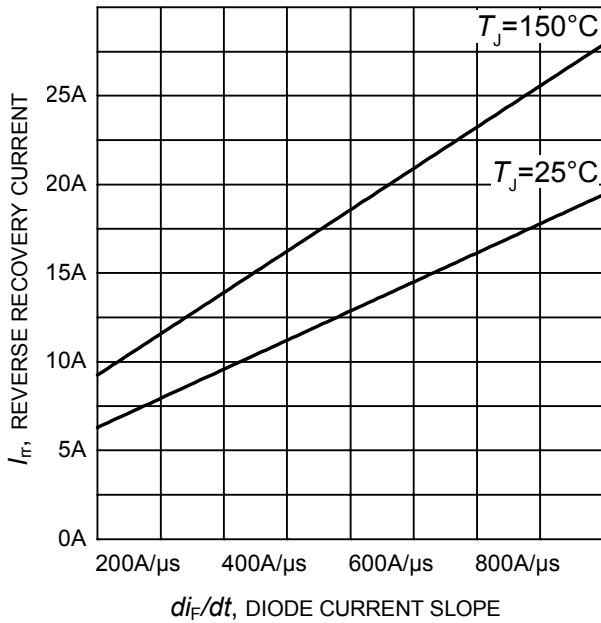
**Figure 24. Typical Diode transient thermal impedance as a function of pulse width**  
 $(D = t_p / T)$



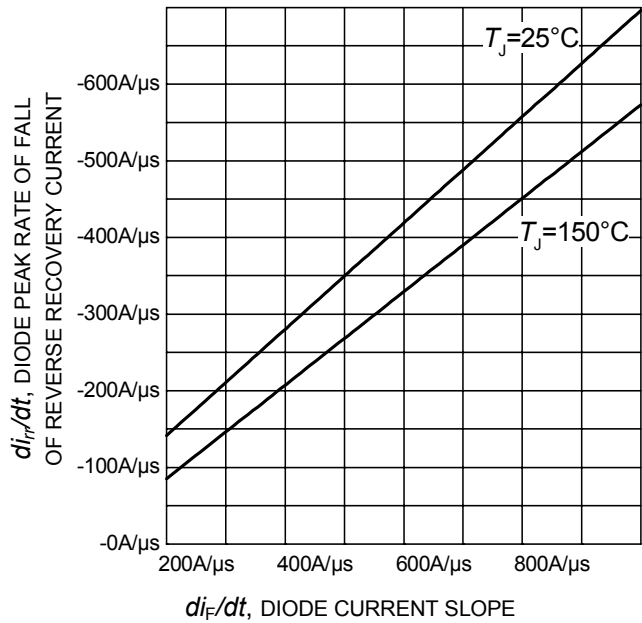
**Figure 23. Typical reverse recovery time as a function of diode current slope**  
 $(V_R=600V, I_F=8A,$   
 Dynamic test circuit in Figure E)



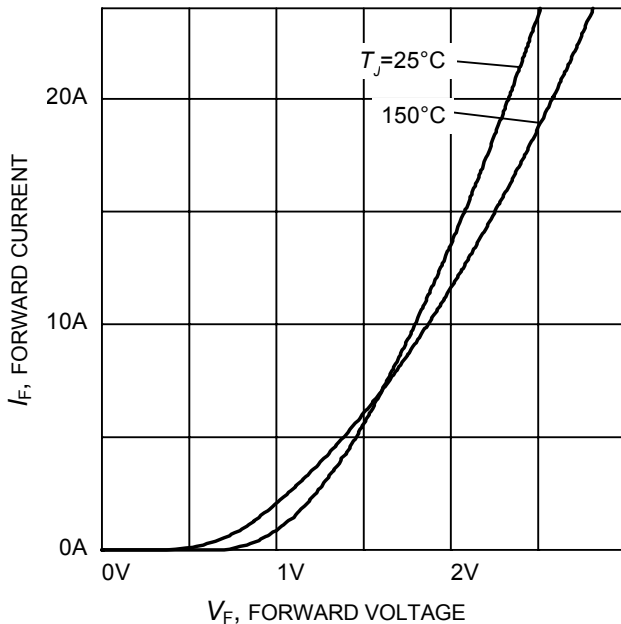
**Figure 24. Typical reverse recovery charge as a function of diode current slope**  
 $(V_R=600V, I_F=8A,$   
 Dynamic test circuit in Figure E)



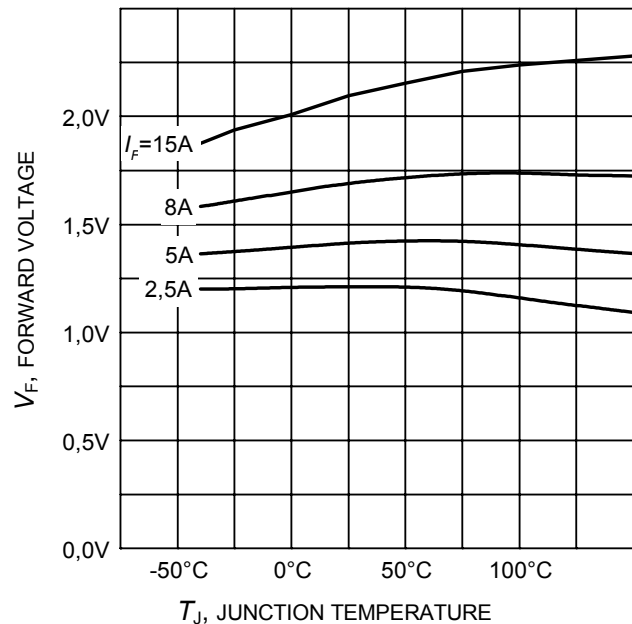
**Figure 25. Typical reverse recovery current as a function of diode current slope**  
 ( $V_R=600V$ ,  $I_F=8A$ ,  
 Dynamic test circuit in Figure E)



**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)

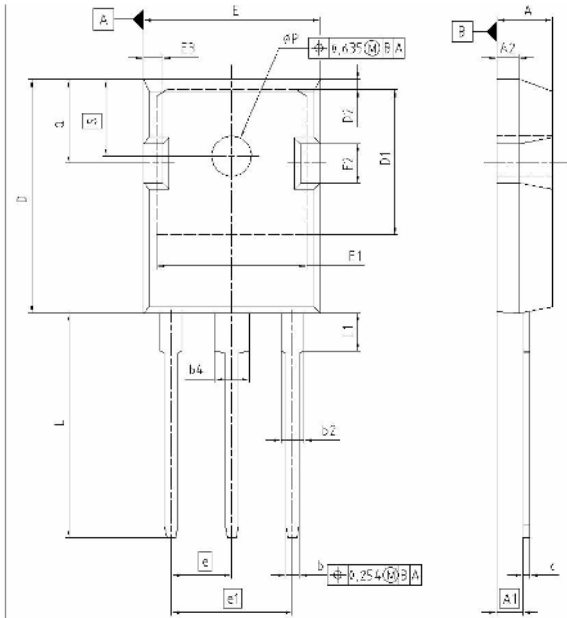


**Figure 27. Typical diode forward current as a function of forward voltage**



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

PG-TO247-3-21



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
b1	1.903	2.386	0.075	0.094
b2	2.870	3.454	0.113	0.136
b3	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

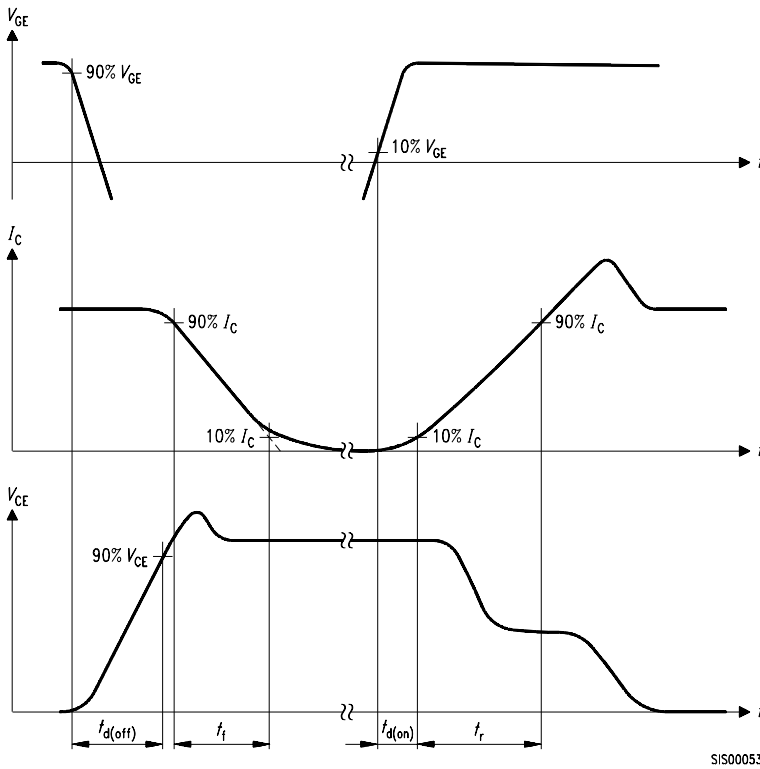


Figure A. Definition of switching times

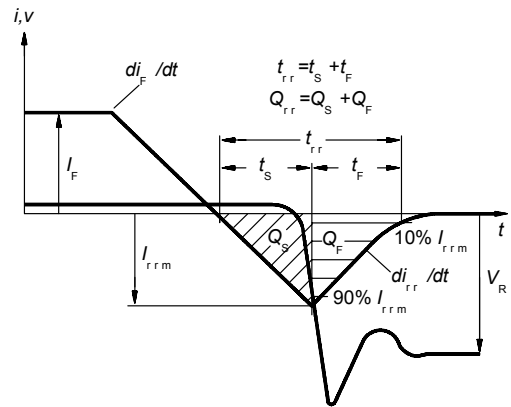


Figure C. Definition of diodes switching characteristics

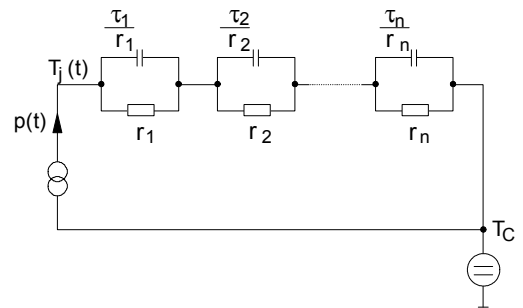


Figure D. Thermal equivalent circuit

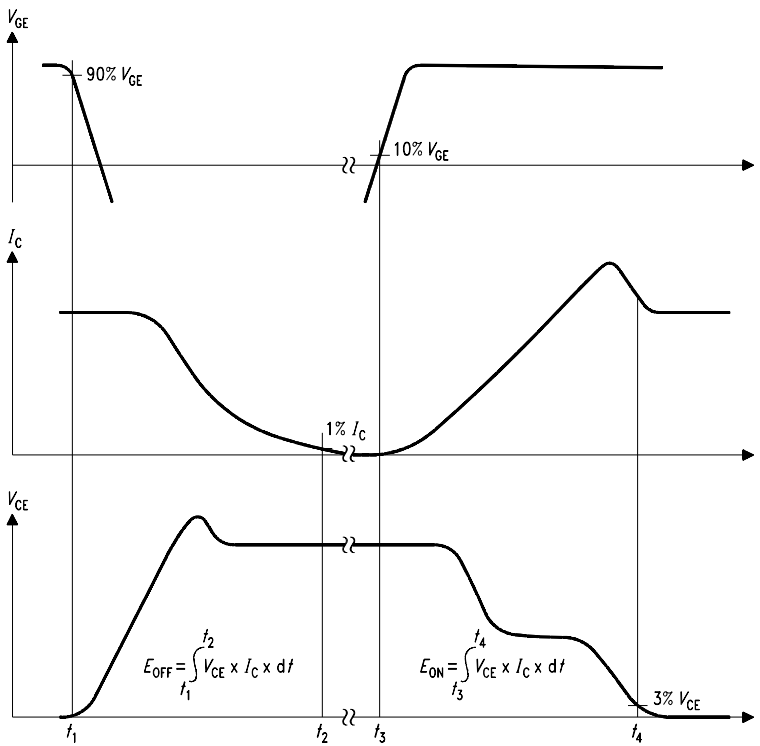


Figure B. Definition of switching losses

**Edition 2006-01**

**Published by  
Infineon Technologies AG  
81726 München, Germany**

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