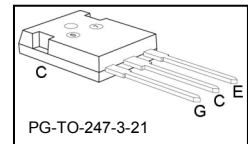
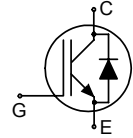


Low Loss DuoPack : IGBT in **TrenchStop®** and Fieldstop technology
with soft, fast recovery anti-parallel EmCon HE diode

- 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 JEDEC¹ 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	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 $V_{CE} \leq 1200V, T_j \leq 150^\circ C$	-	60	
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		120	
Gate-emitter voltage	V_{GE}	± 20	V
Short circuit withstand time ²⁾	t_{SC}	10	µs
$V_{GE} = 15V, V_{CC} \leq 1200V, T_j \leq 150^\circ C$			
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

¹ J-STD-020 and JESD-022

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



Soft Switching Series

IHW20T120

Soldering temperature, 1.6mm (0.063 in.) from case for 10s	-	260	
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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 $T_j = 25^\circ\text{C}$, 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	$V_{CE(sat)}$	$V_{GE} = 15V, I_C=20A$				
		$T_j=25^{\circ}C$	-	1.7	2.2	
		$T_j=125^{\circ}C$	-	2.0	-	
		$T_j=150^{\circ}C$	-	2.2	-	
Diode forward voltage	V_F	$V_{GE}=0V, I_F=9A$				
		$T_j=25^{\circ}C$	-	1.7	2.2	
		$T_j=125^{\circ}C$	-	1.7	-	
		$T_j=150^{\circ}C$	-	1.7	-	
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}	$V_{CE}=1200V,$ $V_{GE}=0V$				μA
		$T_j=25^{\circ}C$ $T_j=150^{\circ}C$	- -	- -	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 ¹⁾	$I_{C(SC)}$	$V_{GE}=15V, t_{SC}\leq 10\mu s$ $V_{CC} = 600V,$ $T_j = 25^\circ\text{C}$	-	120	-	A

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

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

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	$T_j=25^{\circ}\text{C}$, $V_{CC}=600\text{V}$, $I_C=20\text{A}$, $V_{GE}=0/15\text{V}$, $R_G=28\Omega$,	-	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	-	
Anti-Parallel Diode Characteristic						
Diode reverse recovery time	t_{rr}	$T_j=25^{\circ}\text{C}$, $V_R=800\text{V}$, $I_F=9\text{A}$, $di_F/dt=750\text{A}/\mu\text{s}$	-	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 $T_j=150^\circ\text{C}$

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	$T_j=150^{\circ}\text{C}$ $V_{CC}=600\text{V}$, $I_C=20\text{A}$, $V_{GE}=0/15\text{V}$, $R_G=28\Omega$	-	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	-	
Anti-Parallel Diode Characteristic						
Diode reverse recovery time	t_{rr}	$T_j=150^{\circ}\text{C}$ $V_R=800\text{V}$, $I_F=18\text{A}$, $di_F/dt=750\text{A}/\mu\text{s}$	-	210	-	ns
Diode reverse recovery charge	Q_{rr}		-	1600	-	nC
Diode peak reverse recovery current	I_{rrm}		-	16.5	-	A

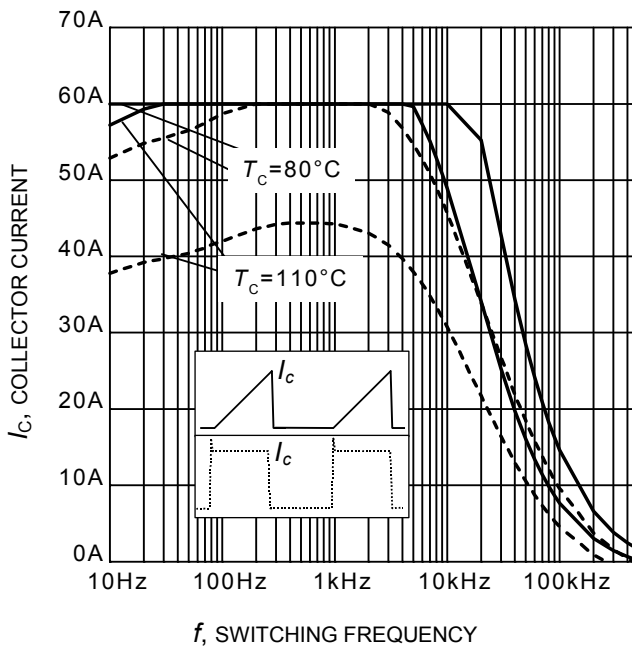


Figure 1. Collector current as a function of switching frequency
 $(T_j \leq 150^\circ\text{C}, D = 0.5, V_{CE} = 600\text{V}, V_{GE} = 0/+15\text{V}, R_G = 28\Omega)$

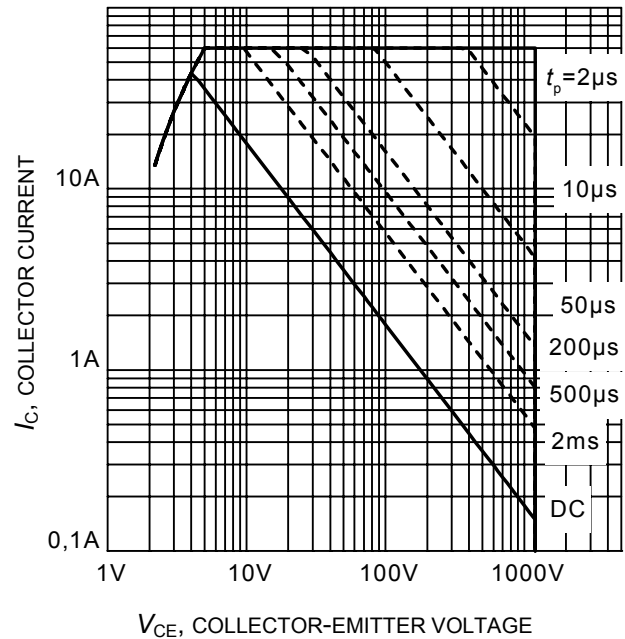


Figure 2. IGBT Safe operating area
 $(D = 0, T_C = 25^\circ\text{C}, T_j \leq 150^\circ\text{C}; V_{GE} = 15\text{V})$

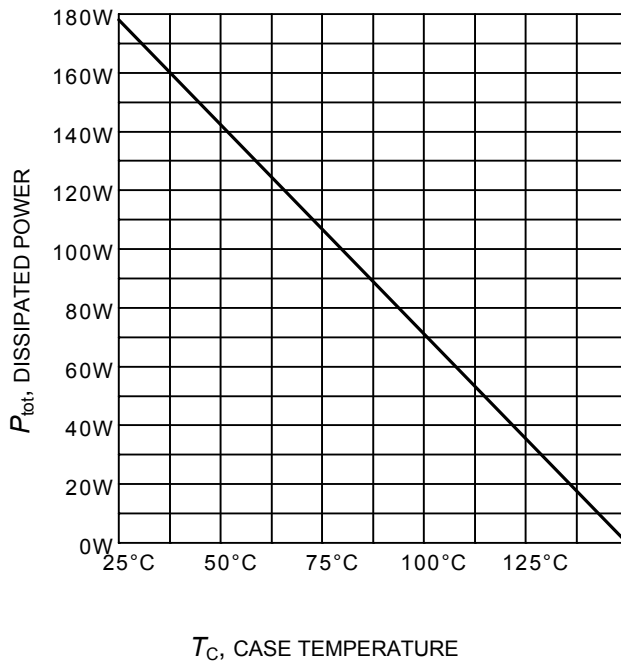


Figure 3. Power dissipation as a function of case temperature
 $(T_j \leq 150^\circ\text{C})$

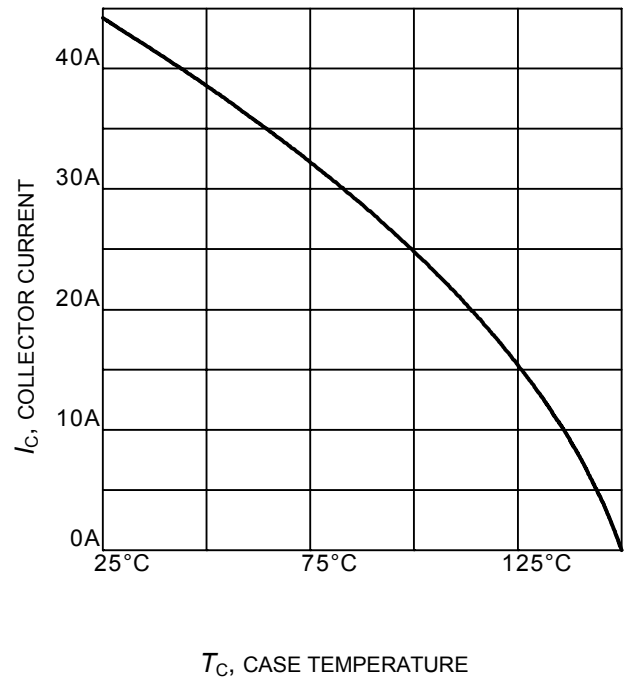


Figure 4. Collector current as a function of case temperature
 $(V_{GE} \geq 15\text{V}, T_j \leq 150^\circ\text{C})$

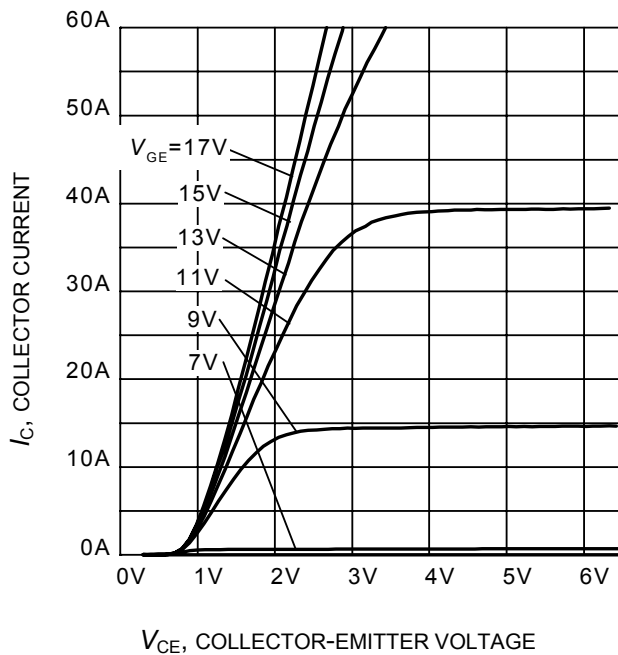


Figure 5. Typical output characteristic
($T_J = 25^\circ C$)

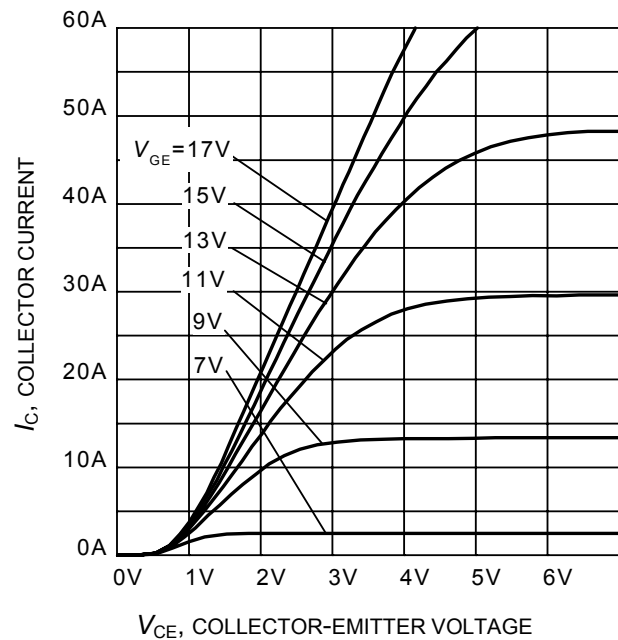


Figure 6. Typical output characteristic
($T_J = 150^\circ C$)

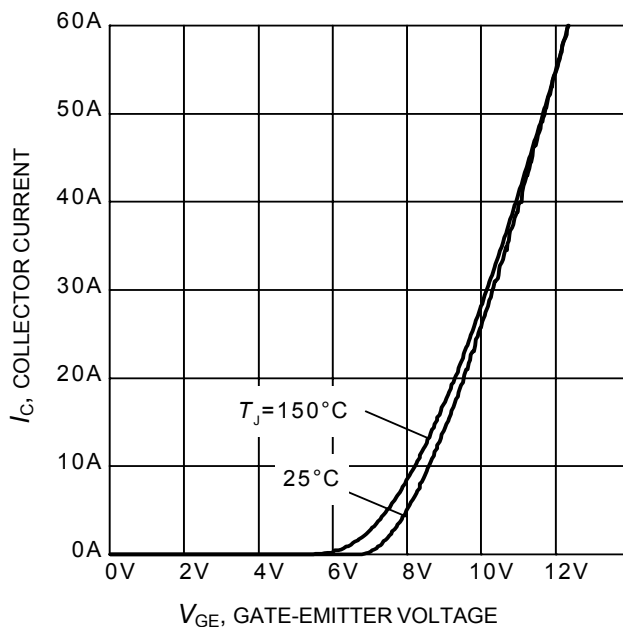


Figure 7. Typical transfer characteristic
($V_{CE} = 20V$)

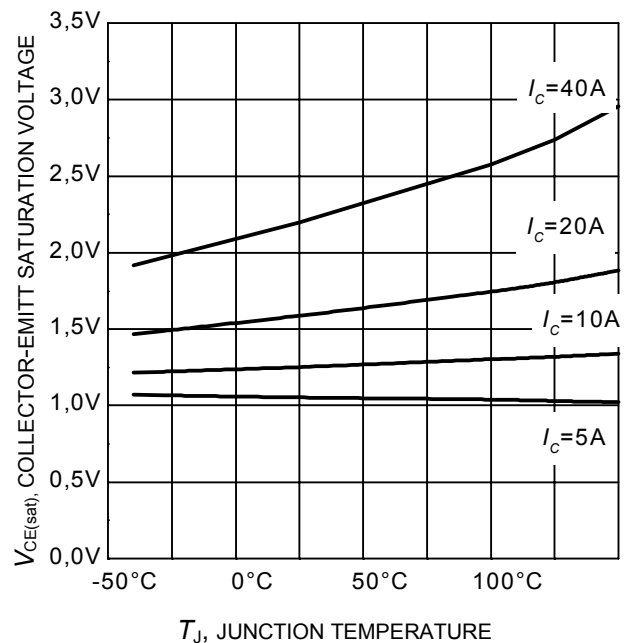


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
($V_{GE} = 15V$)

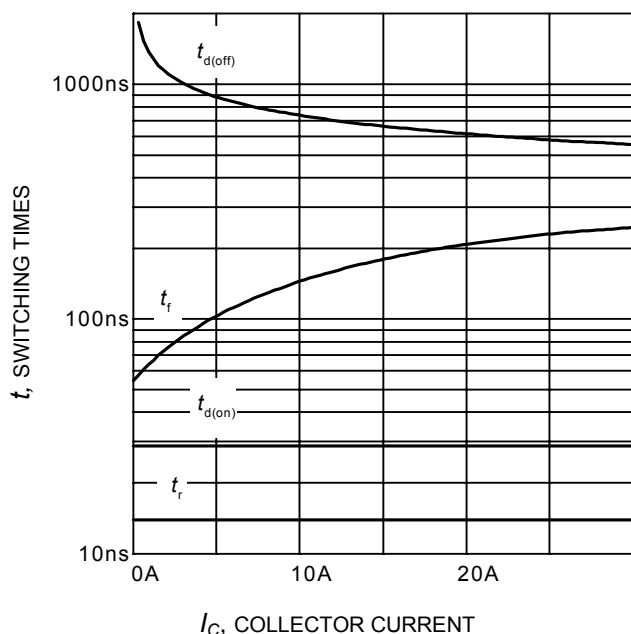


Figure 9. Typical switching times as a function of collector current
(inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=35\Omega$, Dynamic test circuit in Figure E)

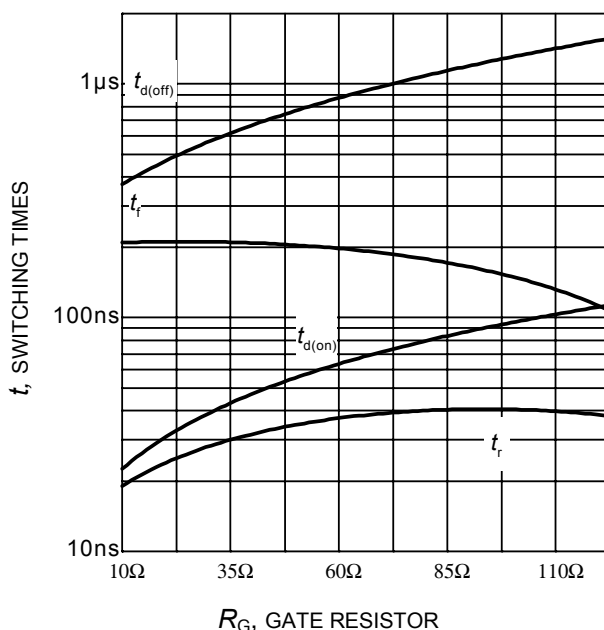


Figure 10. Typical switching times as a function of gate resistor
(inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, Dynamic test circuit in Figure E)

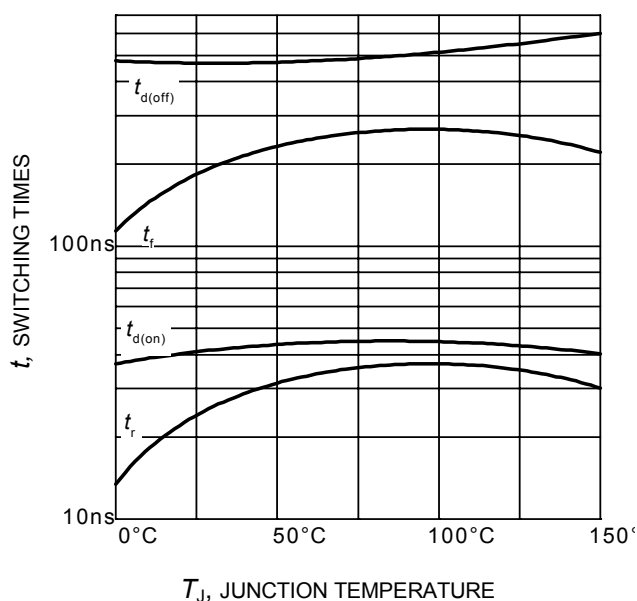


Figure 11. Typical switching times as a function of junction temperature
(inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, $R_G=35\Omega$, Dynamic test circuit in Figure E)

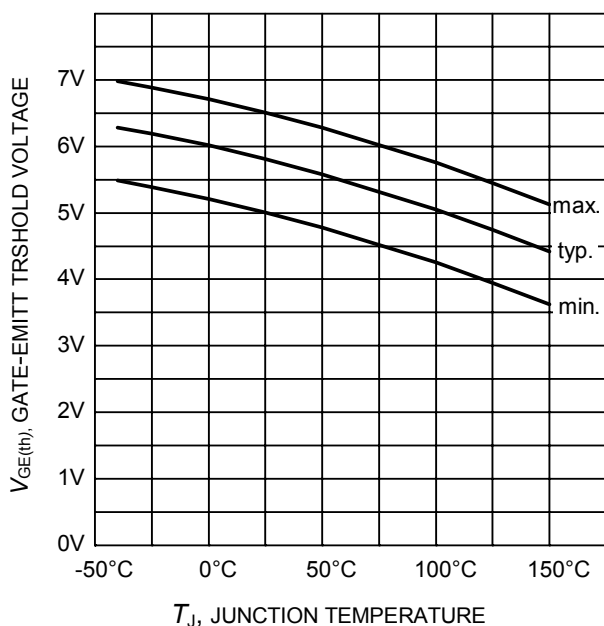


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
($I_C = 0.3\text{mA}$)

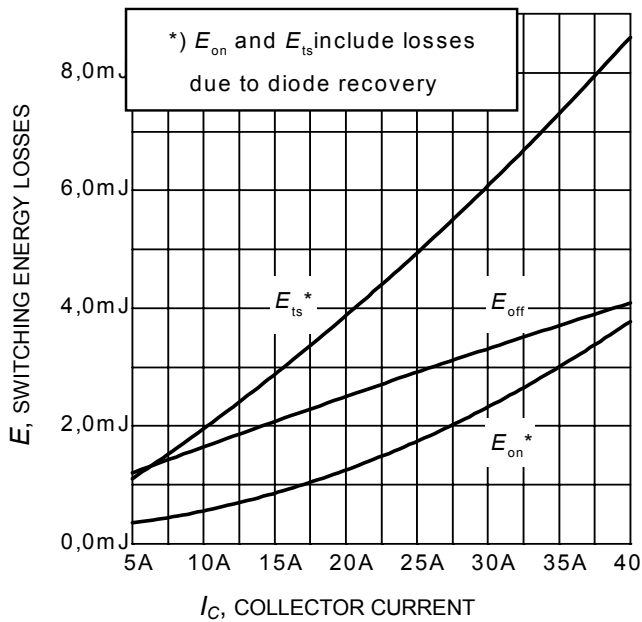


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=35\Omega$, Dynamic test circuit in Figure E)

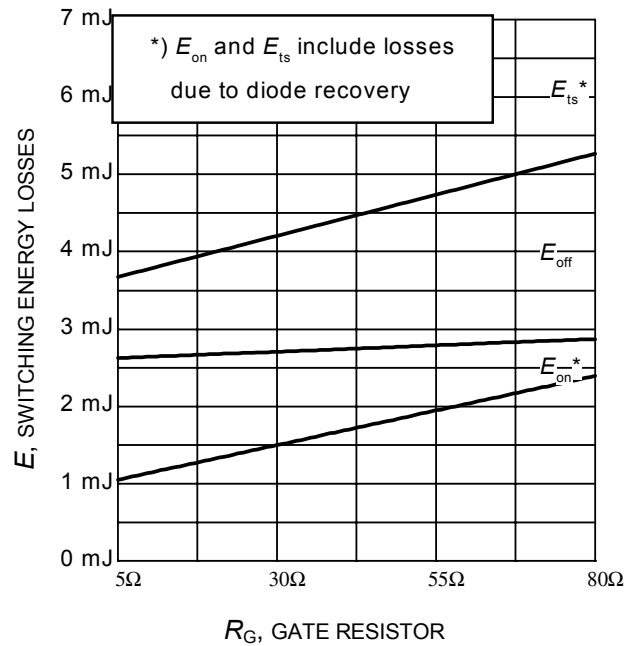


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, Dynamic test circuit in Figure E)

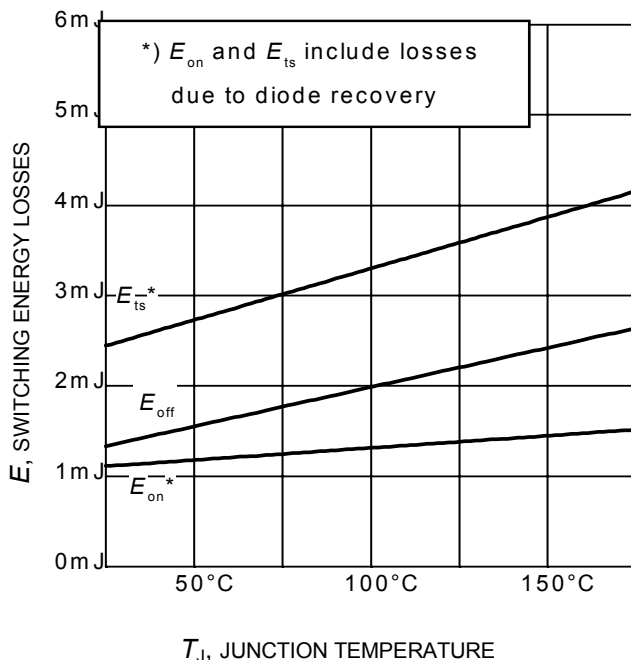


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, $R_G=35\Omega$, Dynamic test circuit in Figure E)

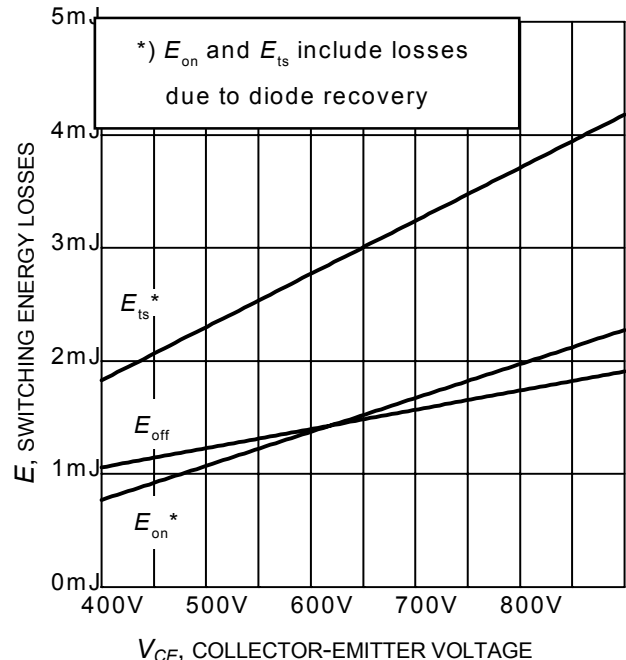


Figure 16. Typical switching energy losses as a function of collector emitter voltage
(inductive load, $T_J=150^\circ\text{C}$, $V_{GE}=0/15\text{V}$, $I_C=20\text{A}$, $R_G=35\Omega$, Dynamic test circuit in Figure E)

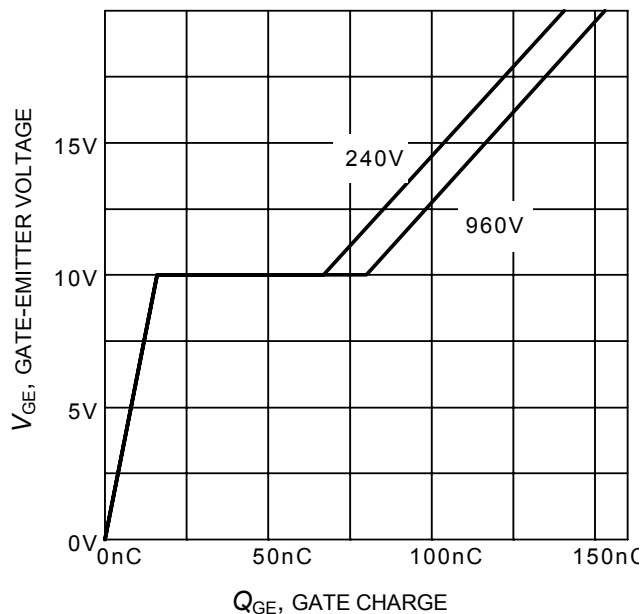


Figure 17. Typical gate charge
($I_C = 20\text{ A}$)

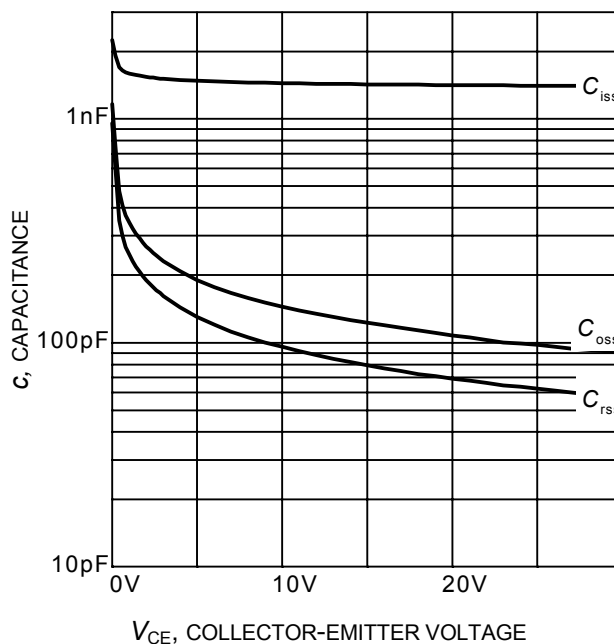


Figure 18. Typical capacitance as a function of collector-emitter voltage
($V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$)

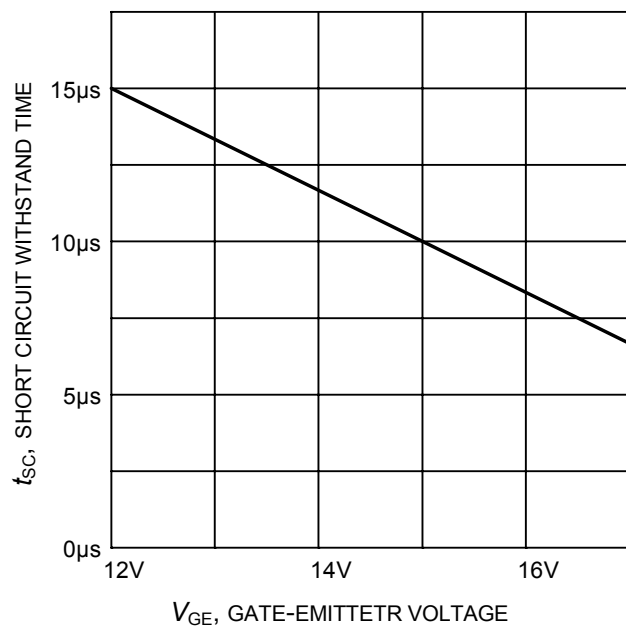


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
($V_{CE} = 600\text{ V}$, start at $T_J = 25^\circ\text{C}$)

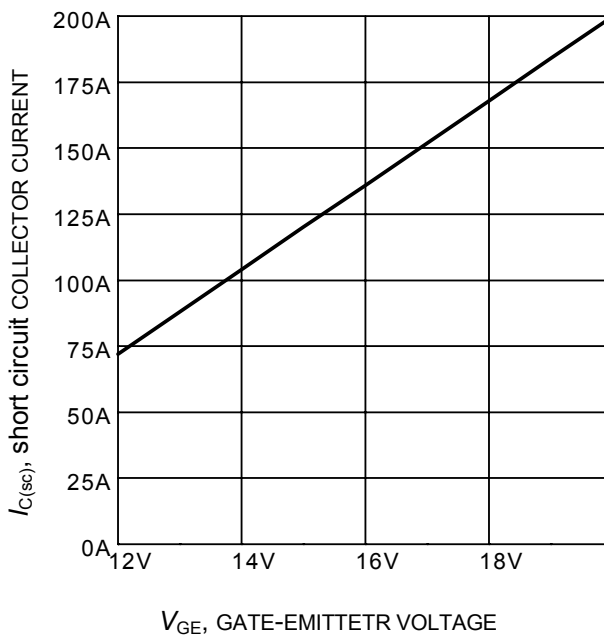


Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \leq 600\text{ V}$, $T_J \leq 150^\circ\text{C}$)

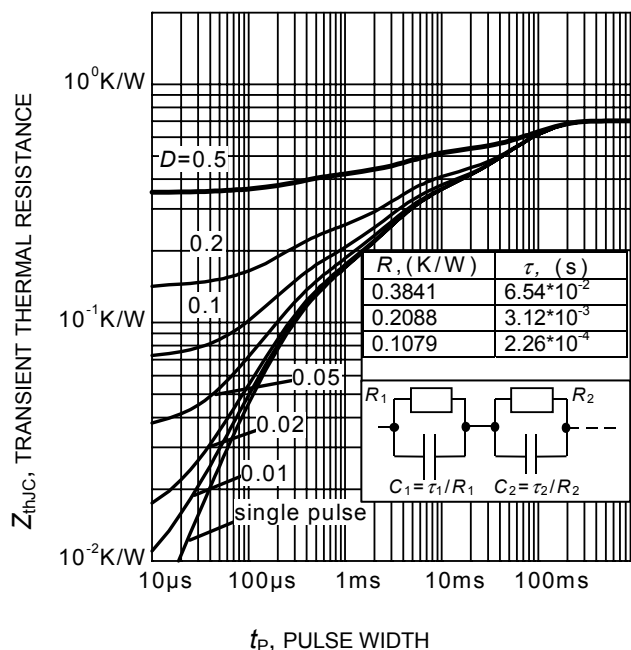


Figure 23. IGBT transient thermal resistance
 $(D = t_p / T)$

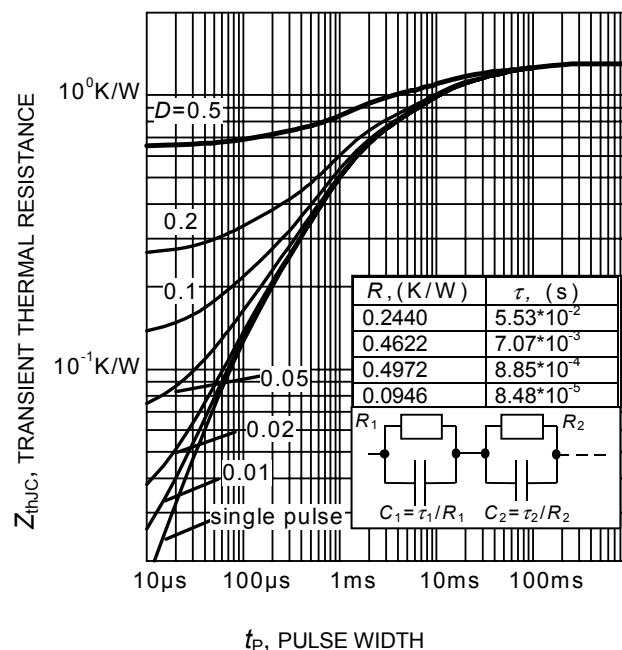


Figure 24. Typical Diode transient thermal impedance as a function of pulse width
 $(D = t_p / T)$

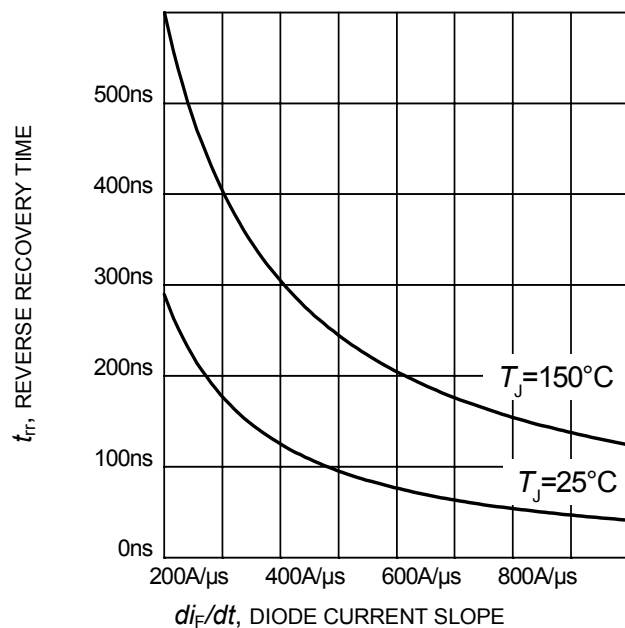


Figure 23. Typical reverse recovery time as a function of diode current slope
 $(V_R = 600V, I_F = 8A,$
Dynamic test circuit in Figure E)

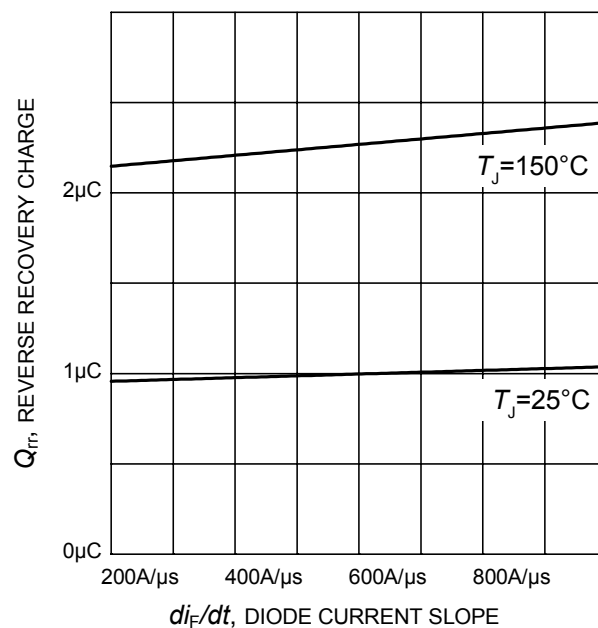


Figure 24. Typical reverse recovery charge as a function of diode current slope
 $(V_R = 600V, I_F = 8A,$
Dynamic test circuit in Figure E)

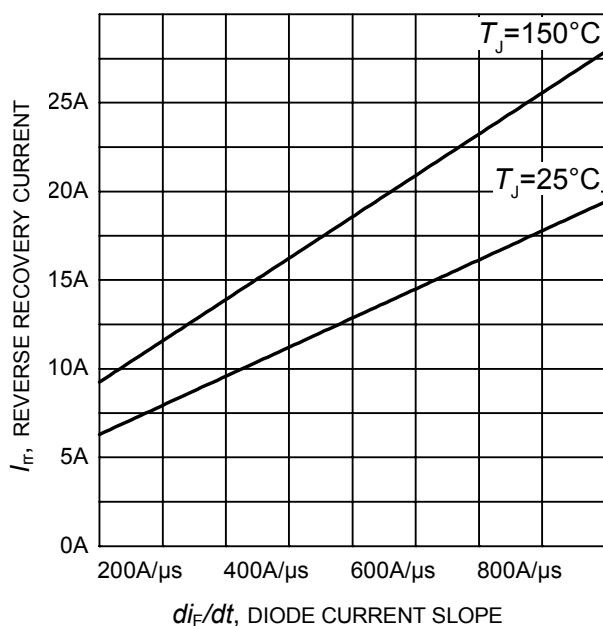


Figure 25. Typical reverse recovery current as a function of diode current slope
($V_R=600V$, $I_F=8A$,
Dynamic test circuit in Figure E)

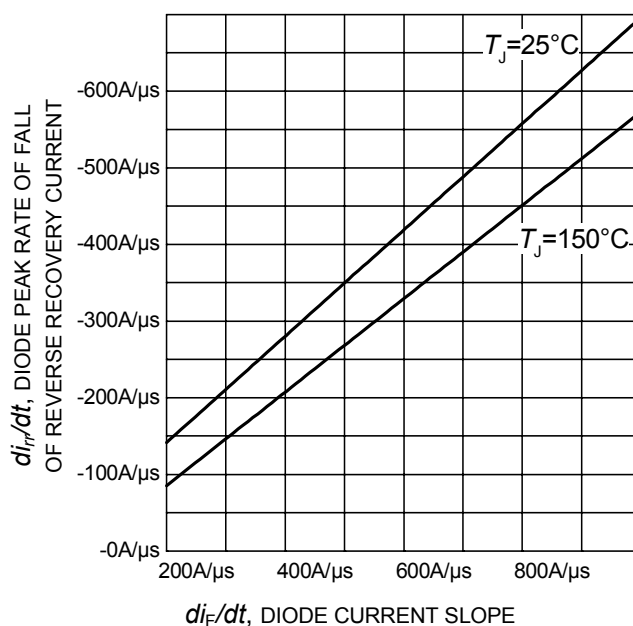


Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
($V_R=600V$, $I_F=8A$,
Dynamic test circuit in Figure E)

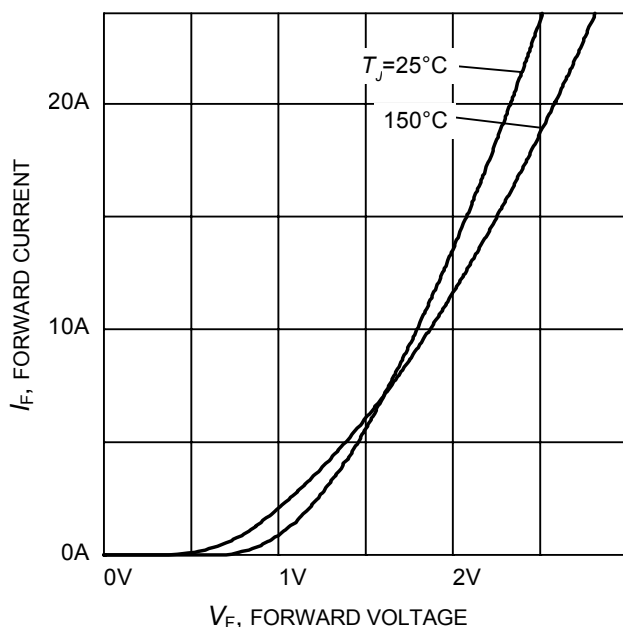


Figure 27. Typical diode forward current as a function of forward voltage

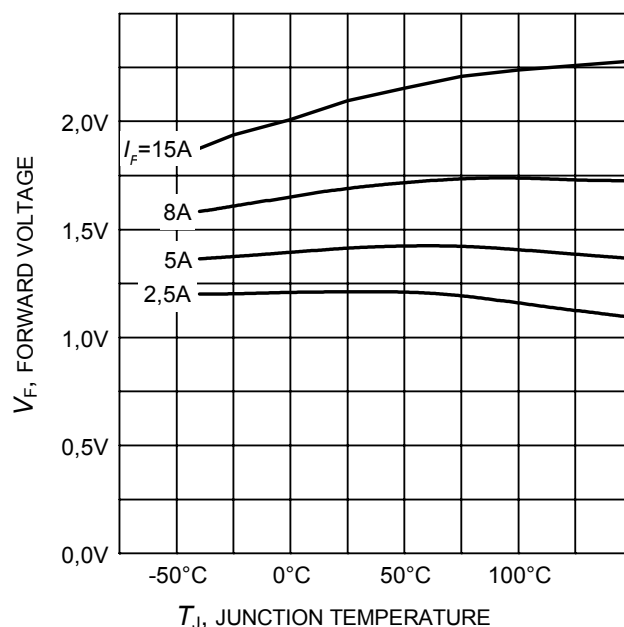
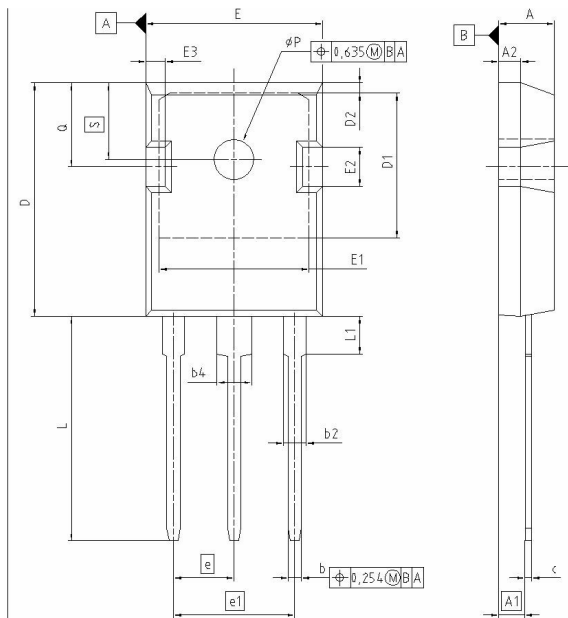


Figure 28. Typical diode forward voltage as a function of junction temperature

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
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
pP	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

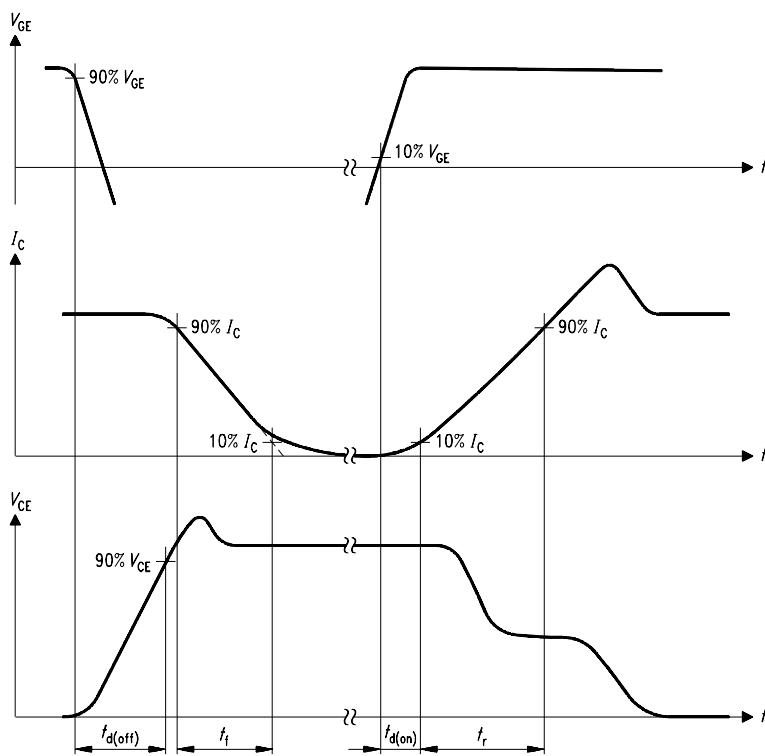


Figure A. Definition of switching times

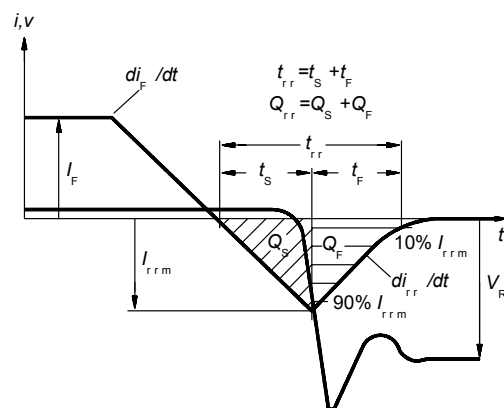


Figure C. Definition of diodes switching characteristics

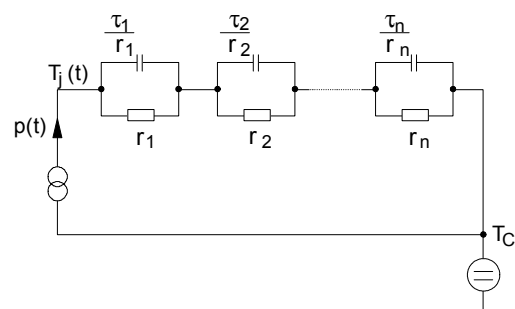


Figure D. Thermal equivalent circuit

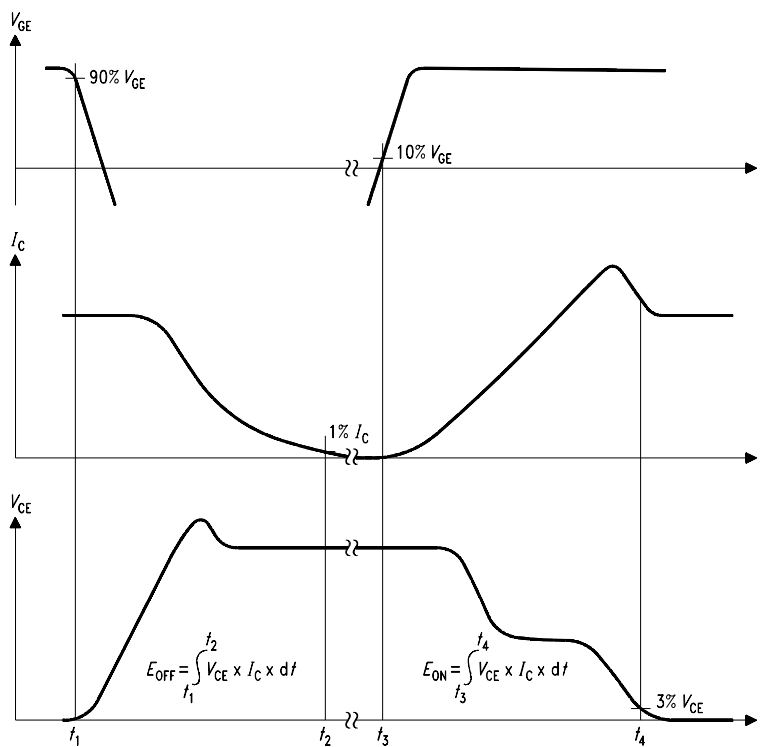


Figure B. Definition of switching losses

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