

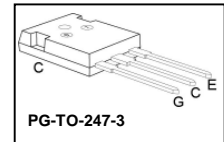
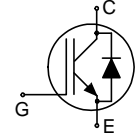


# THE DATASHEET OF PIC12F1822-E/SN



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

- Approx. 1.0V reduced  $V_{CE(sat)}$  and 0.5V reduced  $V_F$  compared to BUP314D
- Short circuit withstand time – 10 $\mu$ s
- Designed for :
  - Frequency Converters
  - Uninterrupted Power Supply
- **TrenchStop®** and Fieldstop technology for 1200 V applications offers :
  - very tight parameter distribution
  - high ruggedness, temperature stable behavior
- NPT technology offers easy parallel switching capability due to positive temperature coefficient in  $V_{CE(sat)}$
- Low EMI
- Low Gate Charge
- Very soft, fast recovery anti-parallel Emitter Controlled HE diode
- Qualified according to JEDEC<sup>1</sup> for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models : <http://www.infineon.com/igbt/>



Type	$V_{CE}$	$I_C$	$V_{CE(sat), T_j=25^\circ C}$	$T_{j,max}$	Marking Code	Package
IKW25T120	1200V	25A	1.7V	150°C	K25T120	PG-TO-247-3

**Maximum Ratings**

Parameter	Symbol	Value	Unit
Collector-emitter voltage	$V_{CE}$	1200	V
DC collector current $T_C = 25^\circ C$ $T_C = 100^\circ C$	$I_C$	50 25	A
Pulsed collector current, $t_p$ limited by $T_{j,max}$	$I_{C,puls}$	75	
Turn off safe operating area $V_{CE} \leq 1200V, T_j \leq 150^\circ C$	-	75	
Diode forward current $T_C = 25^\circ C$ $T_C = 100^\circ C$	$I_F$	50 25	
Diode pulsed current, $t_p$ limited by $T_{j,max}$	$I_{F,puls}$	75	
Gate-emitter voltage	$V_{GE}$	$\pm 20$	V
Short circuit withstand time <sup>2)</sup> $V_{GE} = 15V, V_{CC} \leq 1200V, T_j \leq 150^\circ C$	$t_{SC}$	10	$\mu s$
Power dissipation $T_C = 25^\circ C$	$P_{tot}$	190	W
Operating junction temperature	$T_j$	-40...+150	°C
Storage temperature	$T_{stg}$	-55...+150	

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

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



TrenchStop® Series

IKW25T120

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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	$R_{thJC}$		0.65	K/W
Diode thermal resistance, junction – case	$R_{thJCD}$		1.0	
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	$V_{CE(sat)}$	$V_{GE} = 15V, I_C=25A$ $T_j=25^\circ\text{C}$ $T_j=125^\circ\text{C}$ $T_j=150^\circ\text{C}$	- - -	1.7 2.0 2.2	2.2 - -	
Diode forward voltage	$V_F$	$V_{GE}=0V, I_F=25A$ $T_j=25^\circ\text{C}$ $T_j=125^\circ\text{C}$ $T_j=150^\circ\text{C}$	- - -	1.7 1.7 1.7	2.2 - -	
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C=1mA,$ $V_{CE}=V_{GE}$	5.0	5.8	6.5	
Zero gate voltage collector current	$I_{CES}$	$V_{CE}=1200V,$ $V_{GE}=0V$ $T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$	- -	- -	0.25 2.5	mA
Gate-emitter leakage current	$I_{GES}$	$V_{CE}=0V, V_{GE}=20V$	-	-	600	
Transconductance	$g_{fs}$	$V_{CE}=20V, I_C=25A$	-	16	-	S
Integrated gate resistor	$R_{Gint}$			8		$\Omega$

**Dynamic Characteristic**

Input capacitance	$C_{iss}$	$V_{CE}=25V,$	-	1860	-	pF
Output capacitance	$C_{oss}$	$V_{GE}=0V,$	-	96	-	
Reverse transfer capacitance	$C_{rss}$	$f=1MHz$	-	82	-	
Gate charge	$Q_{Gate}$	$V_{CC}=960V, I_C=25A$ $V_{GE}=15V$	-	155	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	$L_E$		-	13	-	nH
Short circuit collector current <sup>1)</sup>	$I_{C(SC)}$	$V_{GE}=15V, t_{SC} \leq 10\mu s$ $V_{CC} = 600V,$ $T_j = 25^\circ C$	-	150	-	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	$t_{d(on)}$	$T_j=25^\circ C,$ $V_{CC}=600V, I_C=25A$ $V_{GE}=0/15V,$ $R_G=22\Omega,$ $L_\sigma^{2)}=180nH,$ $C_\sigma^{2)}=39pF$ Energy losses include "tail" and diode reverse recovery.	-	50	-	ns
Rise time	$t_r$		-	30	-	
Turn-off delay time	$t_{d(off)}$		-	560	-	
Fall time	$t_f$		-	70	-	
Turn-on energy	$E_{on}$		-	2.0	-	mJ
Turn-off energy	$E_{off}$		-	2.2	-	
Total switching energy	$E_{ts}$		-	4.2	-	

**Anti-Parallel Diode Characteristic**

Diode reverse recovery time	$t_{rr}$	$T_j=25^\circ C,$	-	200	-	ns
Diode reverse recovery charge	$Q_{rr}$	$V_R=600V, I_F=25A,$	-	2.3	-	$\mu C$
Diode peak reverse recovery current	$I_{rrm}$	$di_F/dt=800A/\mu s$	-	21	-	A
Diode peak rate of fall of reverse recovery current during $t_b$	$di_{rr}/dt$		-	390	-	$A/\mu s$

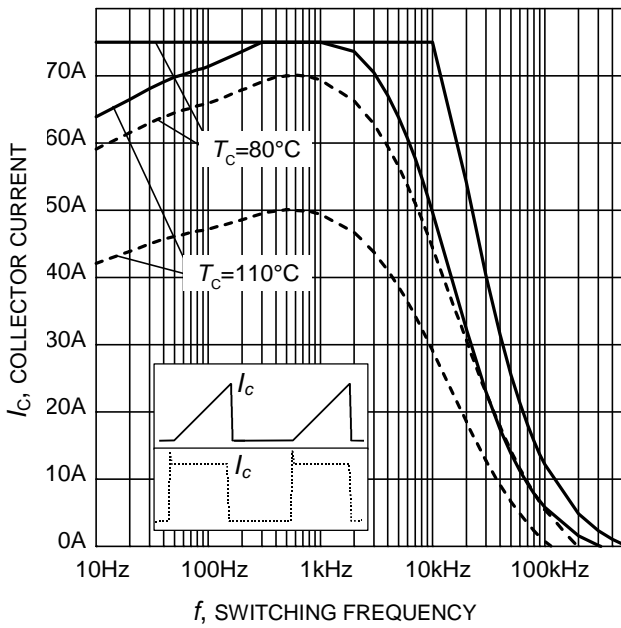
<sup>1)</sup> Allowed number of short circuits: <1000; time between short circuits: >1s.

<sup>2)</sup> Leakage inductance  $L_\sigma$  and Stray capacity  $C_\sigma$  due to dynamic test circuit in Figure E.

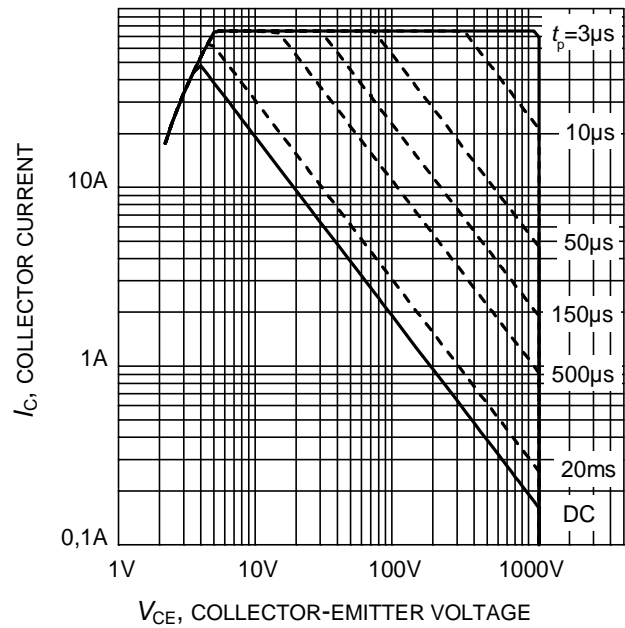
**Switching Characteristic, Inductive Load, at  $T_j=150^\circ\text{C}$** 

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>IGBT Characteristic</b>						
Turn-on delay time	$t_{d(on)}$	$T_j=150^\circ\text{C}$ $V_{CC}=600\text{V}, I_C=25\text{A},$ $V_{GE}=0/15\text{V},$ $R_G=22\Omega,$ $L_\sigma^{1)}=180\text{nH},$ $C_\sigma^{1)}=39\text{pF}$ Energy losses include "tail" and diode reverse recovery.	-	50	-	ns
Rise time	$t_r$		-	32	-	
Turn-off delay time	$t_{d(off)}$		-	660	-	
Fall time	$t_f$		-	130	-	
Turn-on energy	$E_{on}$		-	3.0	-	mJ
Turn-off energy	$E_{off}$		-	4.0	-	
Total switching energy	$E_{ts}$		-	7.0	-	
<b>Anti-Parallel Diode Characteristic</b>						
Diode reverse recovery time	$t_{rr}$	$T_j=150^\circ\text{C}$ $V_R=600\text{V}, I_F=25\text{A},$ $di_F/dt=800\text{A}/\mu\text{s}$	-	320	-	ns
Diode reverse recovery charge	$Q_{rr}$		-	5.2	-	$\mu\text{C}$
Diode peak reverse recovery current	$I_{rrm}$		-	29	-	A
Diode peak rate of fall of reverse recovery current during $t_b$	$di_{rr}/dt$		-	320		A/ $\mu\text{s}$

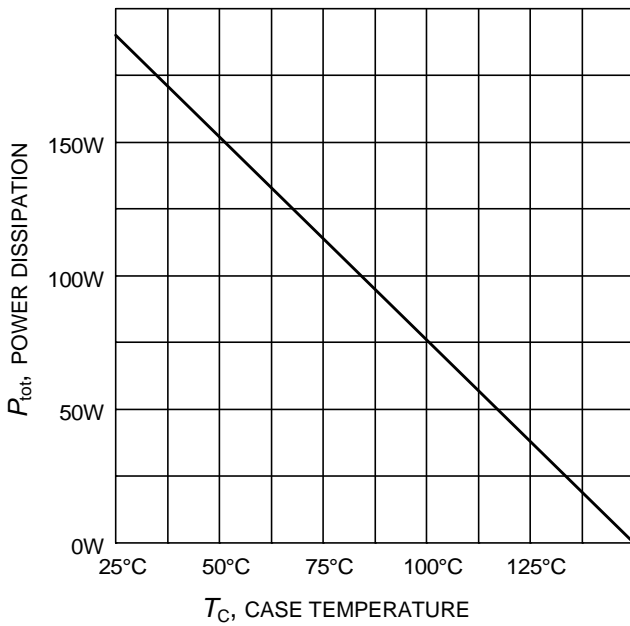
<sup>1)</sup> Leakage inductance  $L_\sigma$  and Stray capacity  $C_\sigma$  due to dynamic test circuit in Figure E.



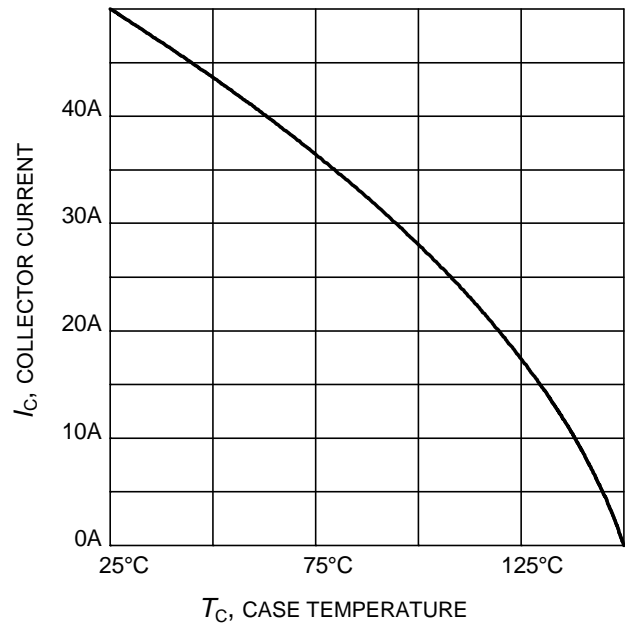
**Figure 1. Collector current as a function of switching frequency**  
 ( $T_j \leq 150^\circ\text{C}$ ,  $D = 0.5$ ,  $V_{CE} = 600\text{V}$ ,  
 $V_{GE} = 0/+15\text{V}$ ,  $R_G = 22\Omega$ )



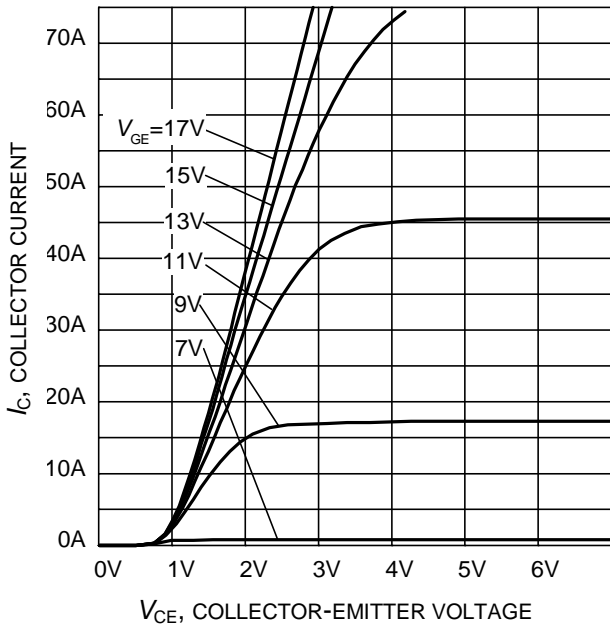
**Figure 2. Safe operating area**  
 ( $D = 0$ ,  $T_C = 25^\circ\text{C}$ ,  
 $T_j \leq 150^\circ\text{C}$ ;  $V_{GE} = 15\text{V}$ )



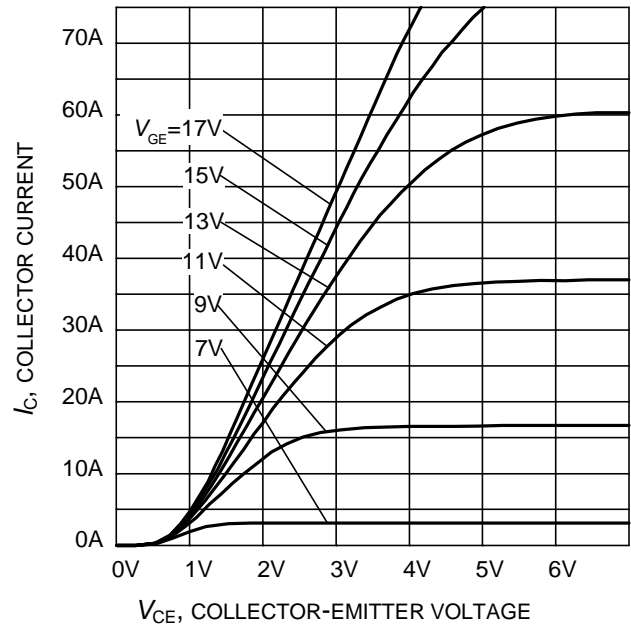
**Figure 3. Power dissipation as a function of case temperature**  
 ( $T_j \leq 150^\circ\text{C}$ )



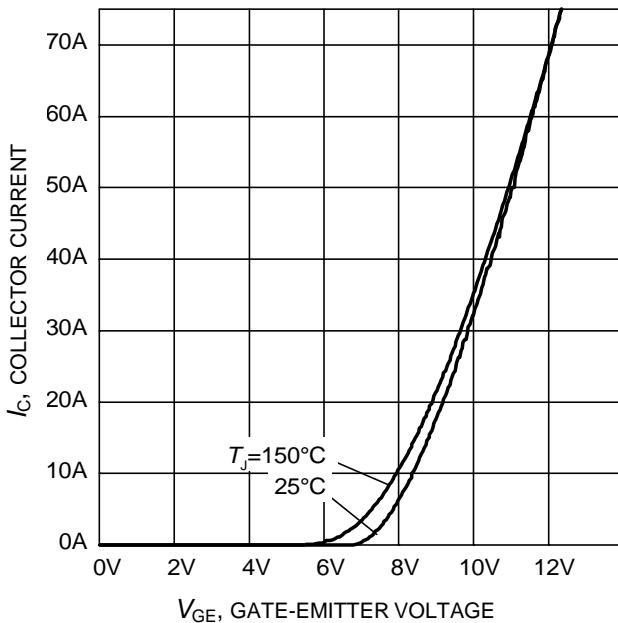
**Figure 4. Collector current as a function of case temperature**  
 ( $V_{GE} \geq 15\text{V}$ ,  $T_j \leq 150^\circ\text{C}$ )



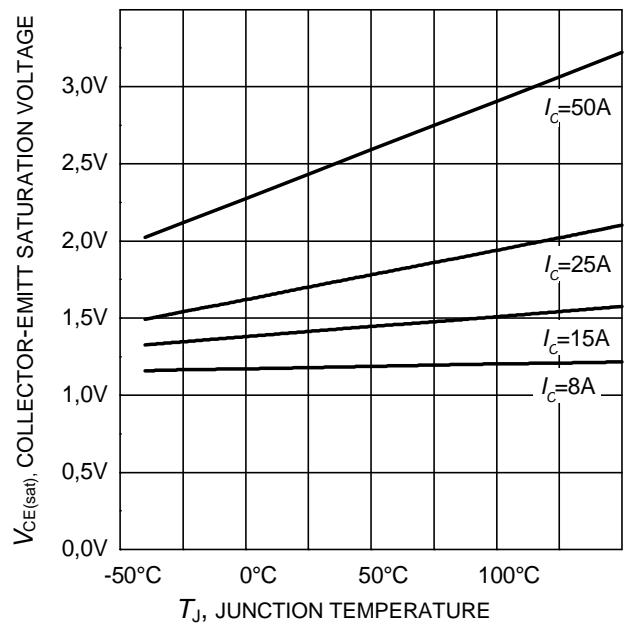
**Figure 5. Typical output characteristic**  
( $T_j = 25^\circ\text{C}$ )



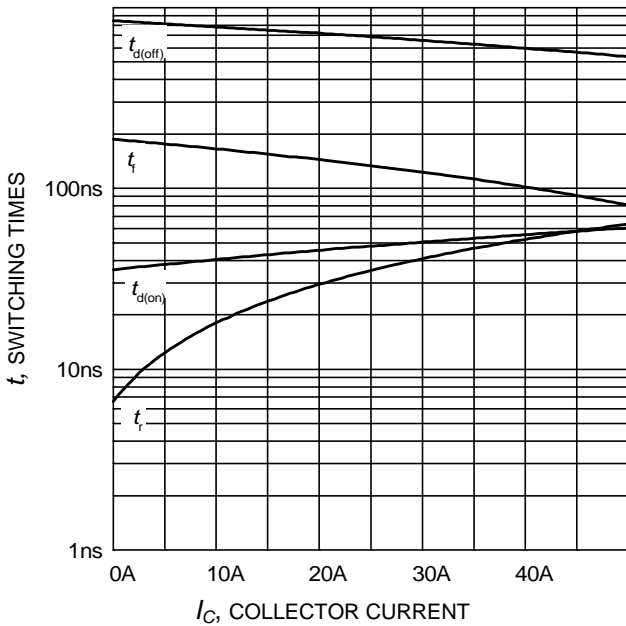
**Figure 6. Typical output characteristic**  
( $T_j = 150^\circ\text{C}$ )



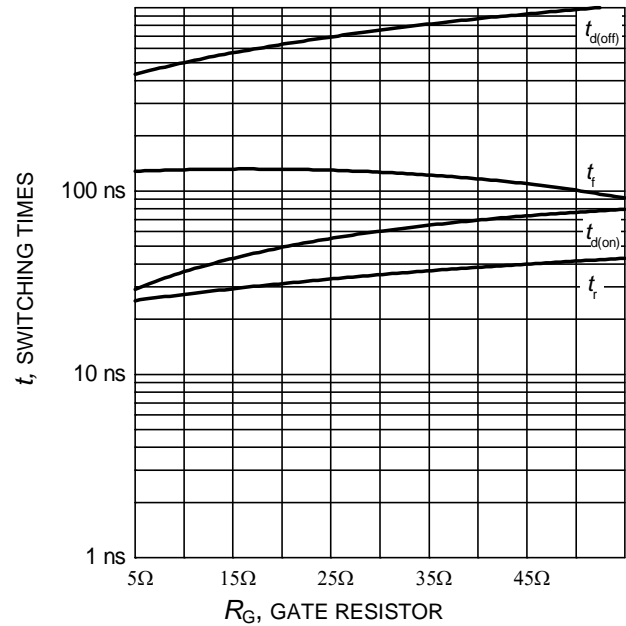
**Figure 7. Typical transfer characteristic**  
( $V_{CE} = 20\text{V}$ )



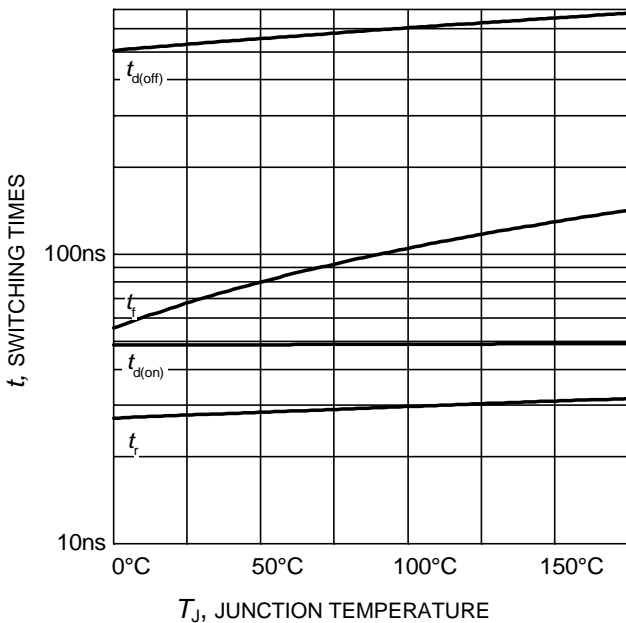
**Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature**  
( $V_{GE} = 15\text{V}$ )



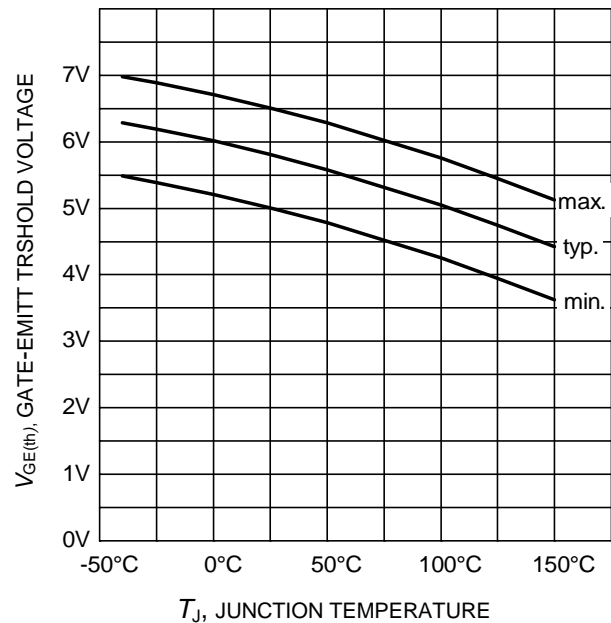
**Figure 9. Typical switching times as a function of collector current**  
 (inductive load,  $T_J=150^{\circ}\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $R_G=22\Omega$ , Dynamic test circuit in Figure E)



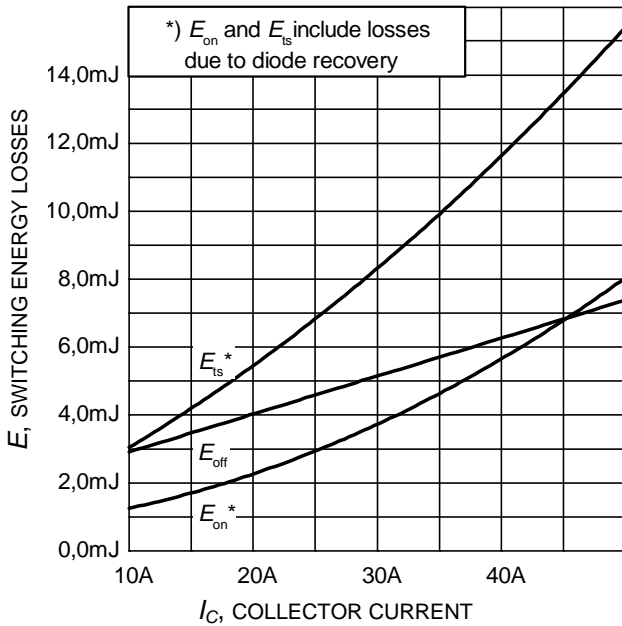
**Figure 10. Typical switching times as a function of gate resistor**  
 (inductive load,  $T_J=150^{\circ}\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=25\text{A}$ , Dynamic test circuit in Figure E)



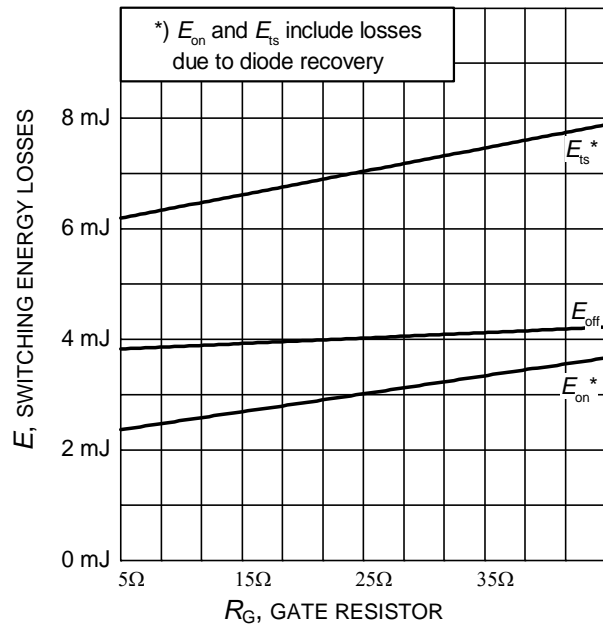
**Figure 11. Typical switching times as a function of junction temperature**  
 (inductive load,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=25\text{A}$ ,  $R_G=22\Omega$ , Dynamic test circuit in Figure E)



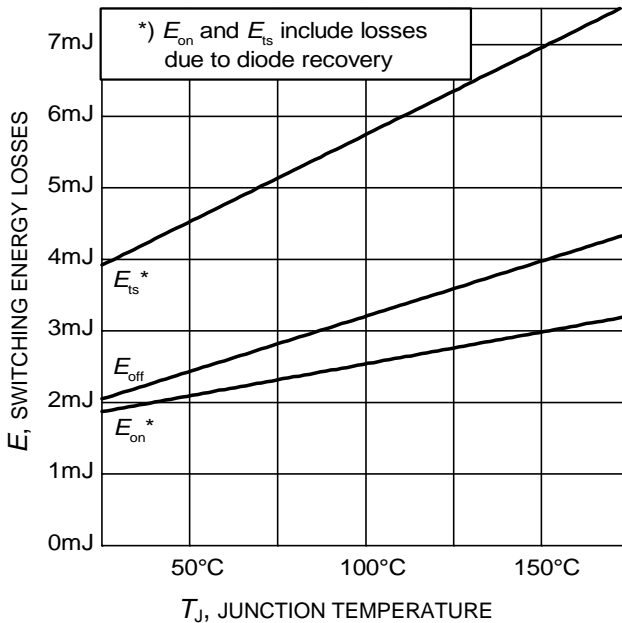
**Figure 12. Gate-emitter threshold voltage as a function of junction temperature**  
 ( $I_C = 1.0\text{mA}$ )



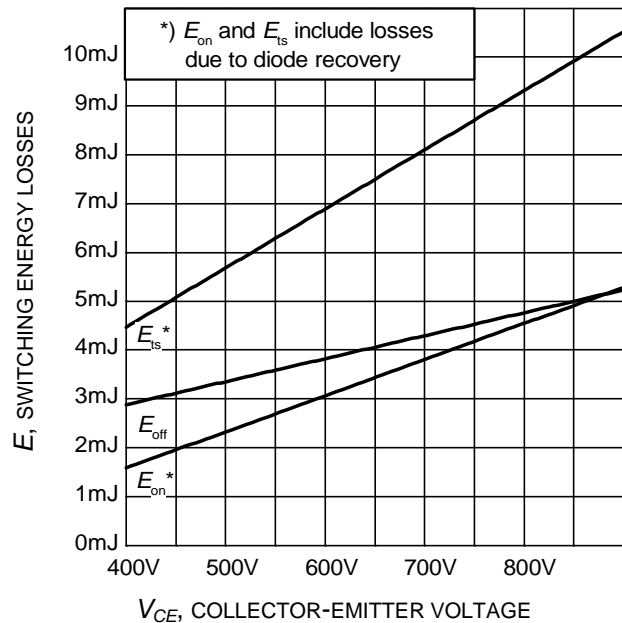
**Figure 13. Typical switching energy losses as a function of collector current**  
 (inductive load,  $T_J=150^{\circ}\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $R_G=22\Omega$ , Dynamic test circuit in Figure E)



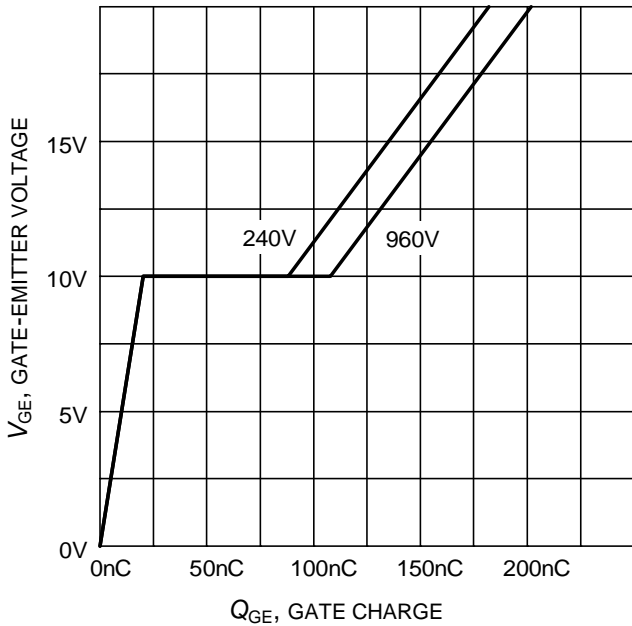
**Figure 14. Typical switching energy losses as a function of gate resistor**  
 (inductive load,  $T_J=150^{\circ}\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=25\text{A}$ , Dynamic test circuit in Figure E)



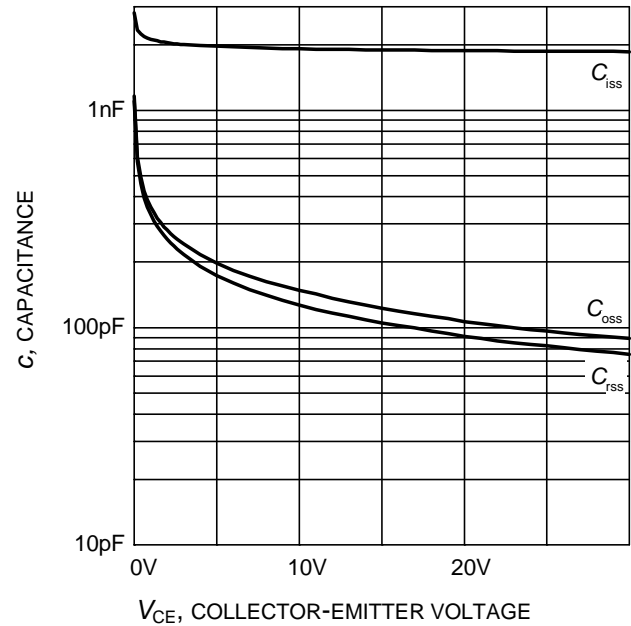
**Figure 15. Typical switching energy losses as a function of junction temperature**  
 (inductive load,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=25\text{A}$ ,  $R_G=22\Omega$ , Dynamic test circuit in Figure E)



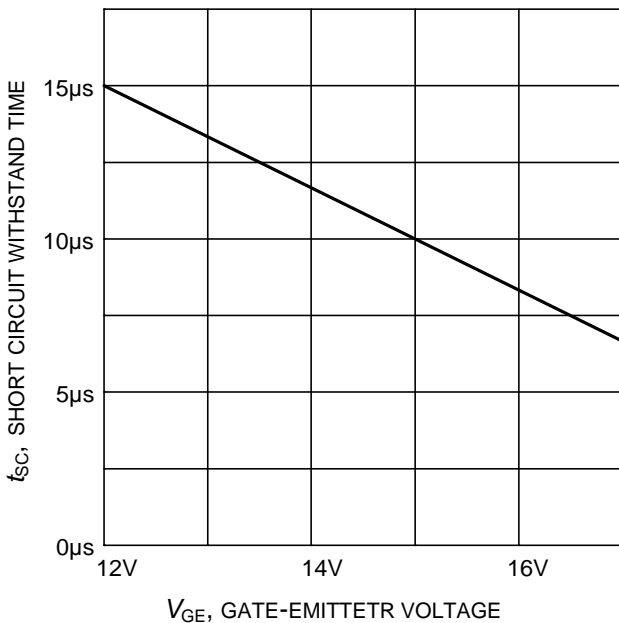
**Figure 16. Typical switching energy losses as a function of collector emitter voltage**  
 (inductive load,  $T_J=150^{\circ}\text{C}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=25\text{A}$ ,  $R_G=22\Omega$ , Dynamic test circuit in Figure E)



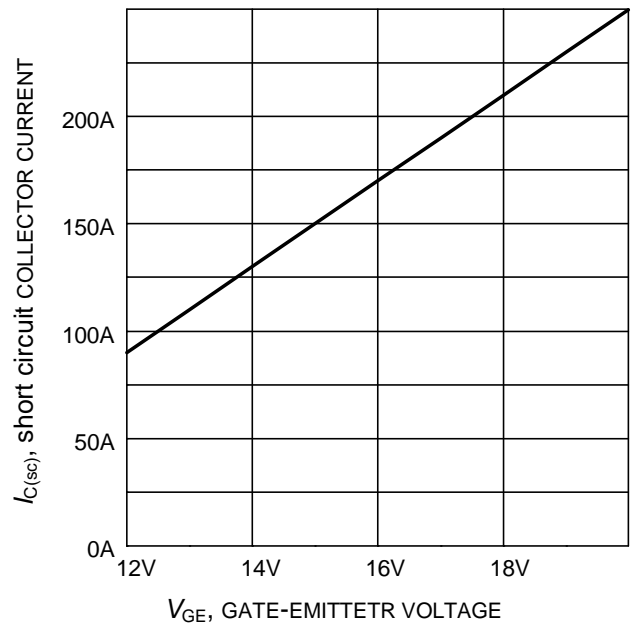
**Figure 17. Typical gate charge**  
( $I_C=25\text{ A}$ )



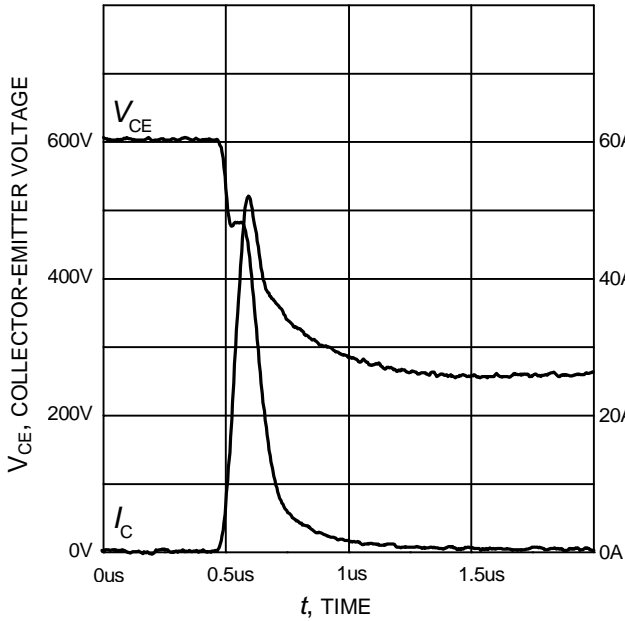
**Figure 18. Typical capacitance as a function of collector-emitter voltage**  
( $V_{GE}=0\text{V}$ ,  $f = 1\text{ MHz}$ )



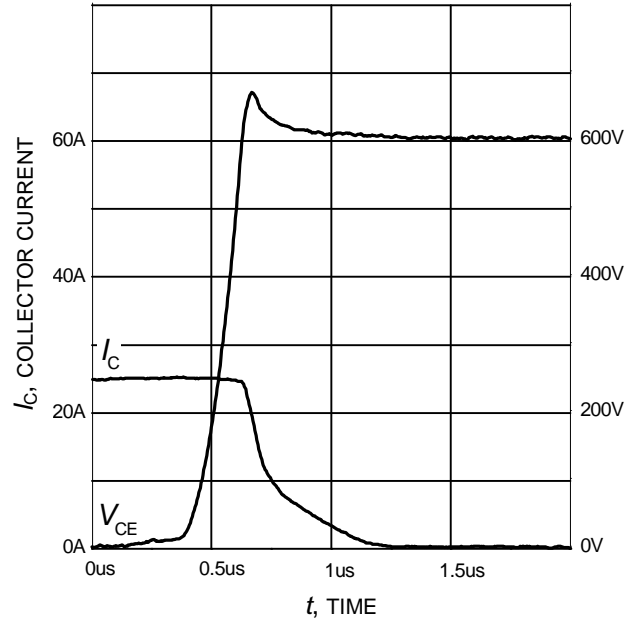
**Figure 19. Short circuit withstand time as a function of gate-emitter voltage**  
( $V_{CE}=600\text{V}$ , start at  $T_j=25^\circ\text{C}$ )



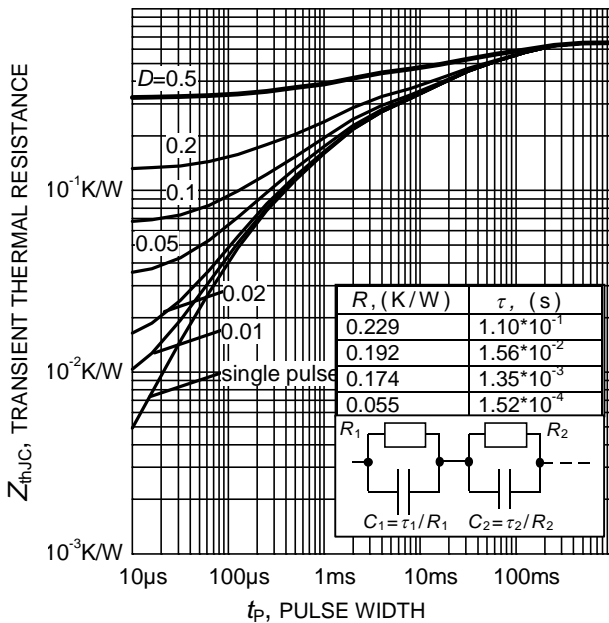
**Figure 20. Typical short circuit collector current as a function of gate-emitter voltage**  
( $V_{CE} \leq 600\text{V}$ ,  $T_j \leq 150^\circ\text{C}$ )



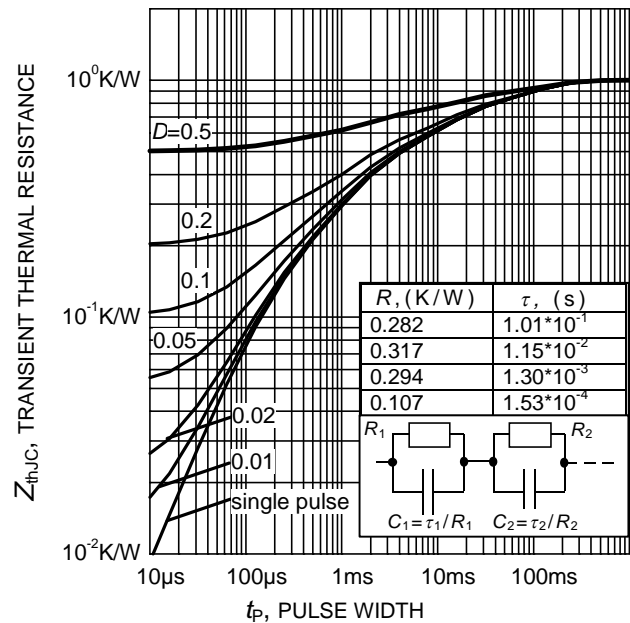
**Figure 21. Typical turn on behavior**  
 ( $V_{GE}=0/15V$ ,  $R_G=22\Omega$ ,  $T_j = 150^\circ C$ ,  
 Dynamic test circuit in Figure E)



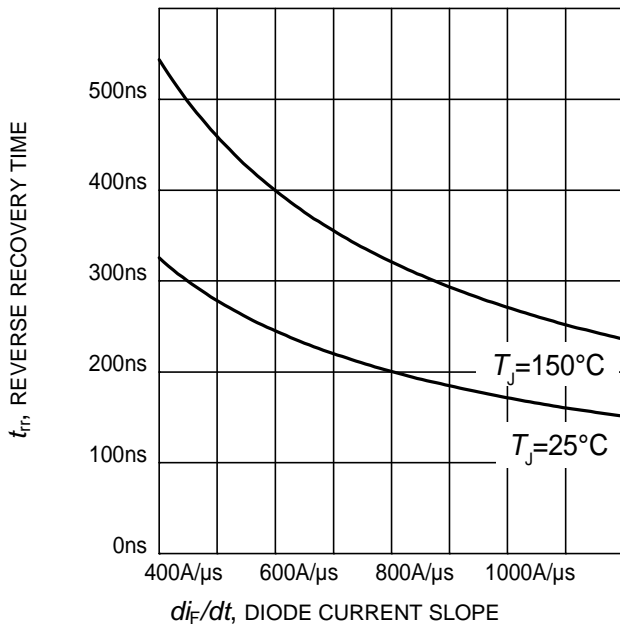
**Figure 22. Typical turn off behavior**  
 ( $V_{GE}=15/0V$ ,  $R_G=22\Omega$ ,  $T_j = 150^\circ C$ ,  
 Dynamic test circuit in Figure E)



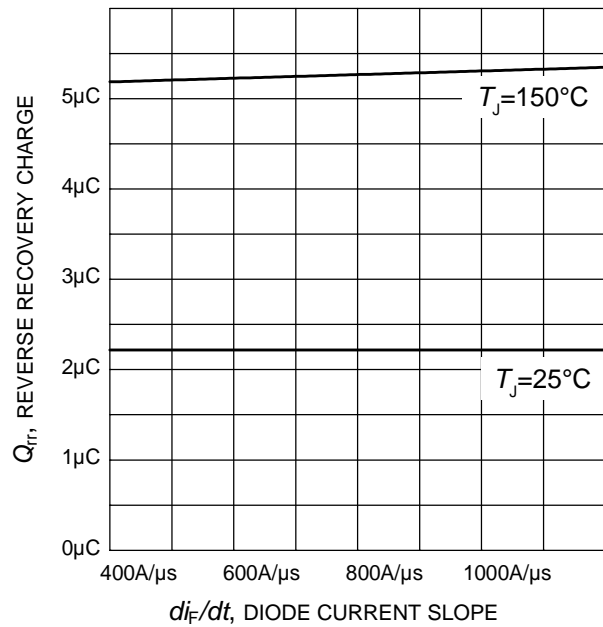
**Figure 23. IGBT transient thermal resistance**  
 ( $D = t_p / T$ )



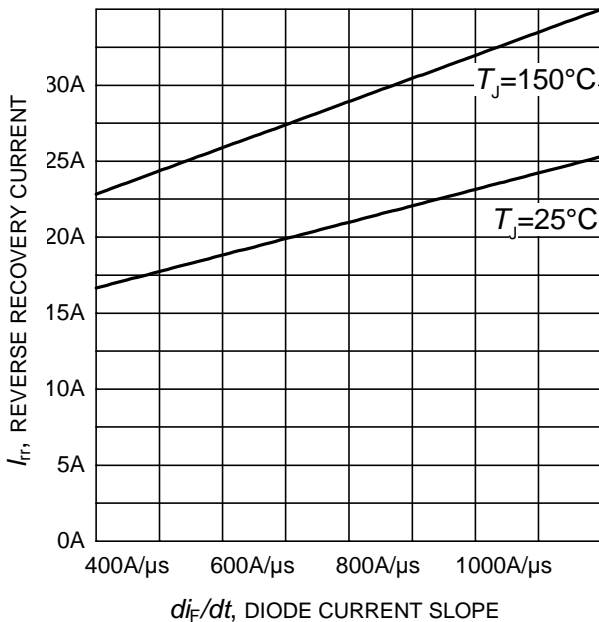
**Figure 24. Diode transient thermal impedance as a function of pulse width**  
 ( $D=t_p/T$ )



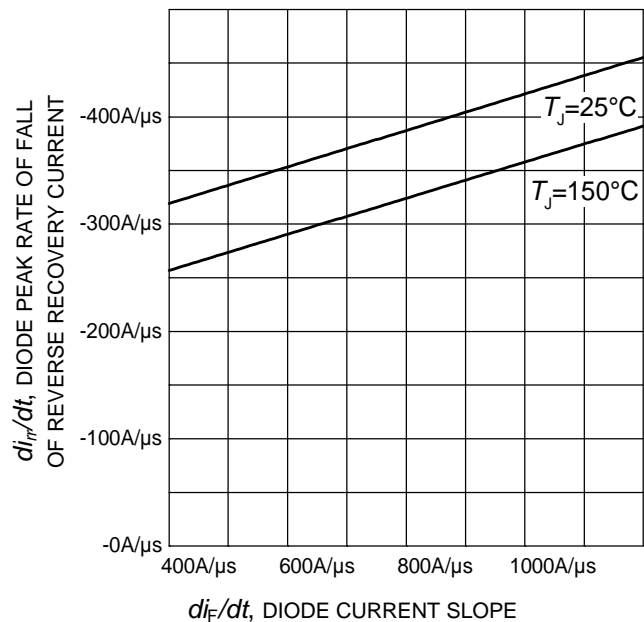
**Figure 23. Typical reverse recovery time as a function of diode current slope**  
 ( $V_R=600\text{V}$ ,  $I_F=25\text{A}$ ,  
 Dynamic test circuit in Figure E)



**Figure 24. Typical reverse recovery charge as a function of diode current slope**  
 ( $V_R=600\text{V}$ ,  $I_F=25\text{A}$ ,  
 Dynamic test circuit in Figure E)



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

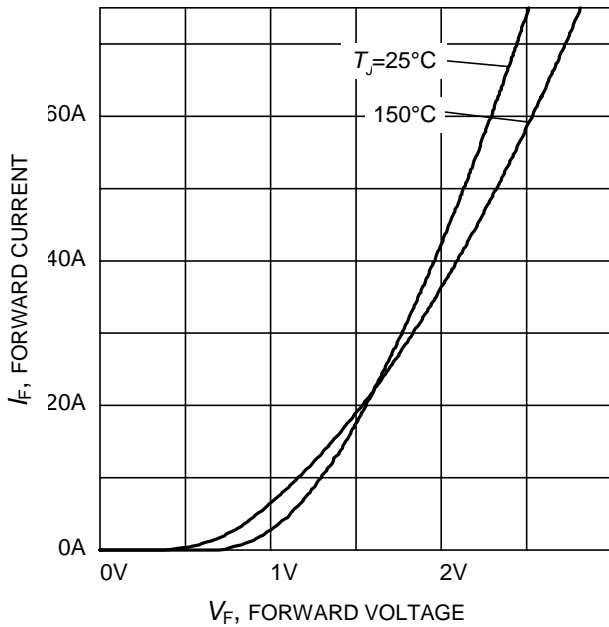


Figure 27. Typical diode forward current as a function of forward voltage

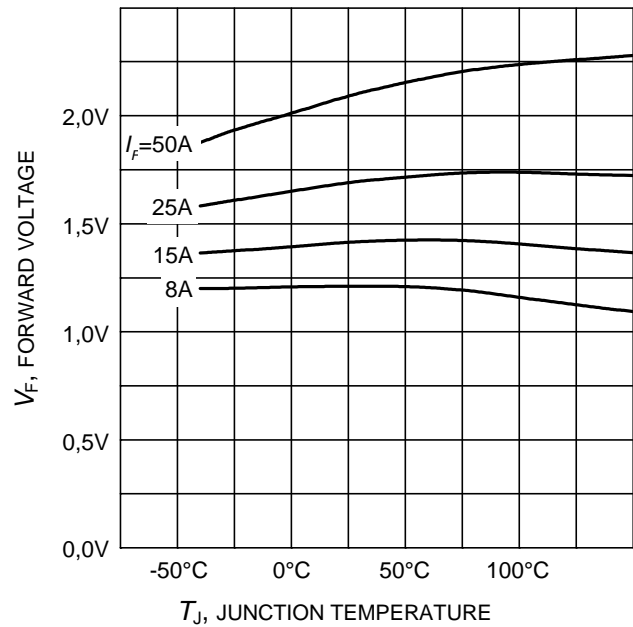
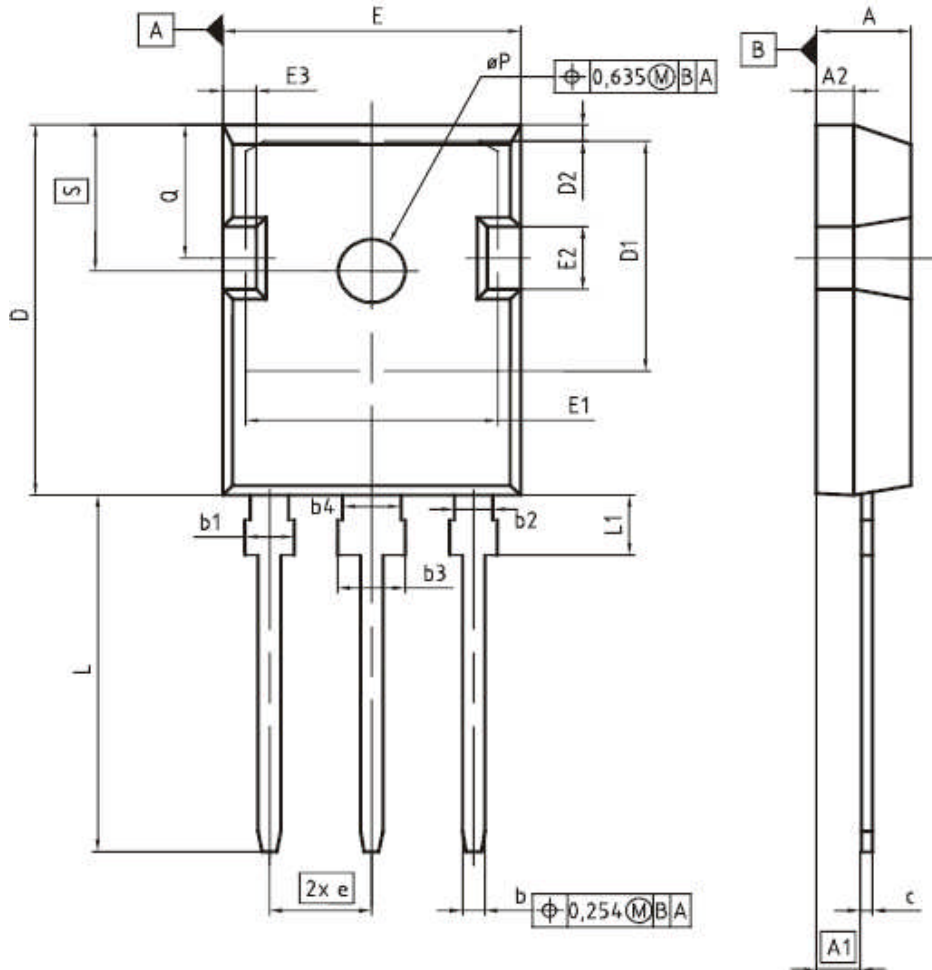


Figure 28. Typical diode forward voltage as a function of junction temperature

PG-TO247-3



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4,83	5,21	0,190	0,205
A1	2,27	2,54	0,089	0,100
A2	1,85	2,16	0,073	0,085
b	1,07	1,33	0,042	0,052
b1	1,90	2,41	0,075	0,095
b2	1,90	2,16	0,075	0,085
b3	2,87	3,38	0,113	0,133
b4	2,87	3,13	0,113	0,123
c	0,55	0,68	0,022	0,027
D	20,80	21,10	0,819	0,831
D1	16,25	17,65	0,640	0,695
D2	0,95	1,35	0,037	0,053
E	15,70	16,13	0,618	0,635
E1	13,10	14,15	0,516	0,557
E2	3,68	5,10	0,145	0,201
E3	1,00	2,60	0,039	0,102
e	5,44 (BSC)		0,214 (BSC)	
N	3		3	
L	19,80	20,32	0,780	0,800
L1	4,10	4,47	0,161	0,176
øP	3,50	3,70	0,138	0,146
Q	5,49	6,00	0,216	0,236
S	6,04	6,30	0,238	0,248

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SCALE

EUROPEAN PROJECTION

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REVISION  
05

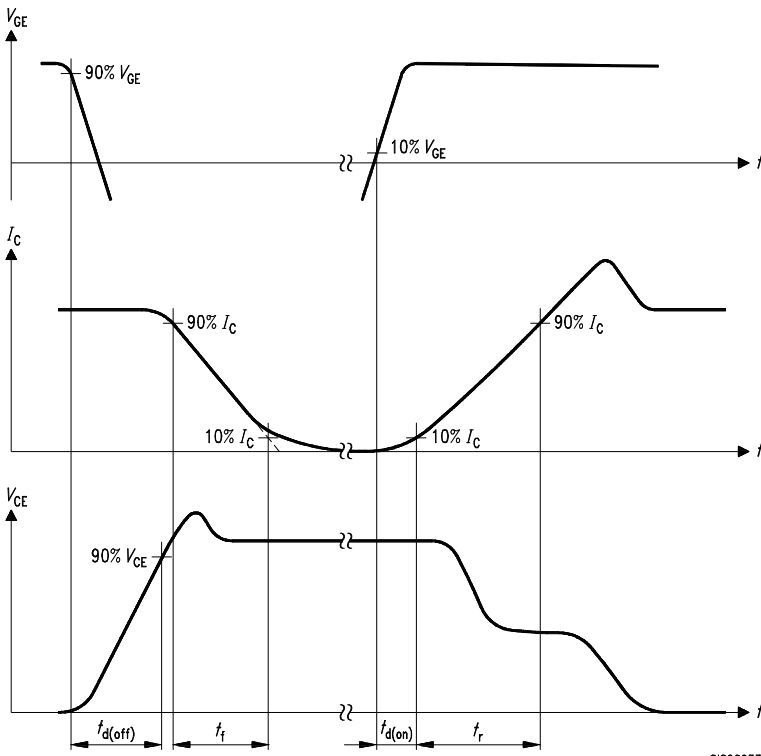


Figure A. Definition of switching times

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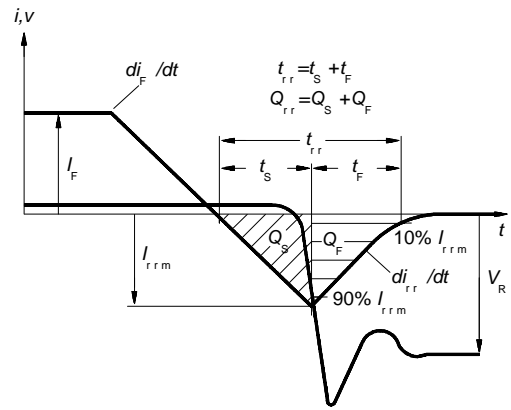


Figure C. Definition of diodes switching characteristics

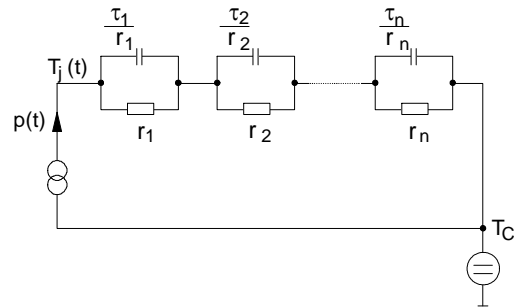


Figure D. Thermal equivalent circuit

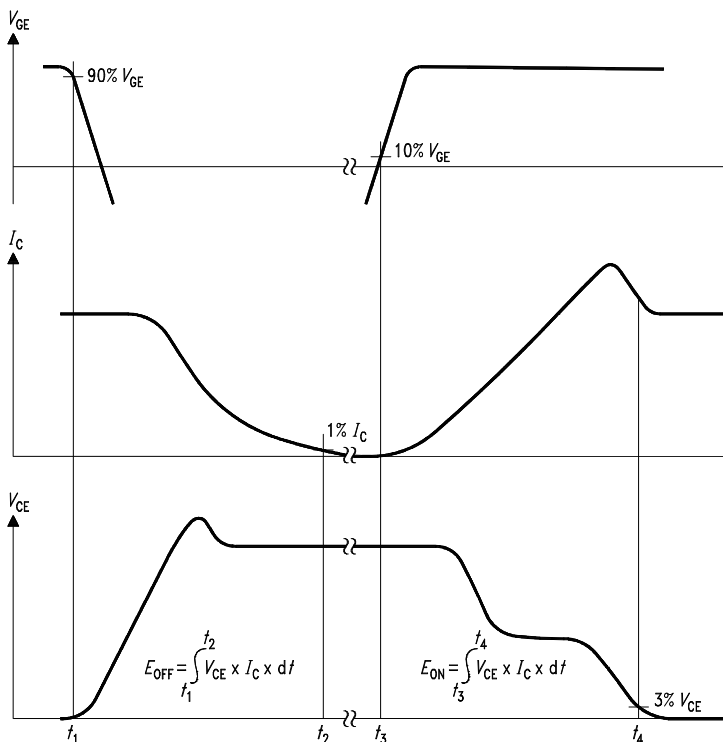


Figure B. Definition of switching losses

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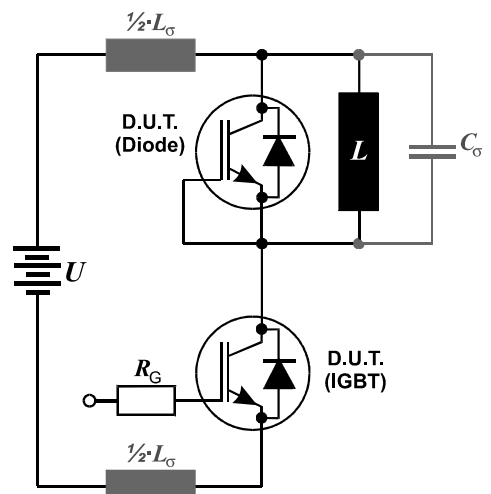


Figure E. Dynamic test circuit  
Leakage inductance  $L_{\sigma} = 180\text{nH}$   
and Stray capacity  $C_{\sigma} = 39\text{pF}$ .

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