

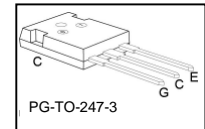
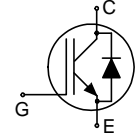


THE DATASHEET OF PIC12F510-I/P



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

- Best in class TO247
- Short circuit withstand time – 10µs
- 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 JEDEC¹ 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
IKW40T120	1200V	40A	1.7V	150°C	K40T120	PG-TO-247-3

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
DC collector current	I_C		A
$T_C = 25^\circ C$		75	
$T_C = 100^\circ C$		40	
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	105	
Turn off safe operating area	-	105	
$V_{CE} \leq 1200V, T_j \leq 150^\circ C$			
Diode forward current	I_F		
$T_C = 25^\circ C$		80	
$T_C = 100^\circ C$		40	
Diode pulsed current, t_p limited by T_{jmax}	I_{Fpuls}	105	
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	P_{tot}	270	W
$T_C = 25^\circ C$			
Operating junction temperature	T_j	-40...+150	°C
Storage temperature	T_{stg}	-55...+150	

¹ J-STD-020 and JESD-022

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



TrenchStop® Series

IKW40T120

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}		0.45	K/W
Diode thermal resistance, junction – case	R_{thJCD}		0.81	
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	$V_{(BR)CES}$	$V_{GE}=0V, I_C=1.5mA$	1200	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE} = 15V, I_C=40A$ $T_j=25^\circ\text{C}$ $T_j=125^\circ\text{C}$ $T_j=150^\circ\text{C}$	- - -	1.7 2.1 2.3	2.3 - -	
Diode forward voltage	V_F	$V_{GE}=0V, I_F=40A$ $T_j=25^\circ\text{C}$ $T_j=125^\circ\text{C}$ $T_j=150^\circ\text{C}$	- - -	1.75 1.75 1.75	2.3 - -	
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C=1.5mA, V_{CE}=V_{GE}$	5.0	5.8	6.5	
Zero gate voltage collector current	I_{CES}	$V_{CE}=1200V, V_{GE}=0V$ $T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$	- -	- -	0.4 4.0	mA
Gate-emitter leakage current	I_{GES}	$V_{CE}=0V, V_{GE}=20V$	-	-	600	
Transconductance	g_{fs}	$V_{CE}=20V, I_C=40A$	-	21	-	S
Integrated gate resistor	R_{Gint}			6		Ω

Dynamic Characteristic

Input capacitance	C_{iss}	$V_{CE}=25V,$	-	2500	-	pF
Output capacitance	C_{oss}	$V_{GE}=0V,$	-	130	-	
Reverse transfer capacitance	C_{rss}	$f=1MHz$	-	110	-	
Gate charge	Q_{Gate}	$V_{CC}=960V, I_C=40A$ $V_{GE}=15V$	-	203	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13	-	nH
Short circuit collector current ¹⁾	$I_{C(SC)}$	$V_{GE}=15V, t_{SC} \leq 10\mu s$ $V_{CC} = 600V,$ $T_j = 25^\circ C$	-	210	-	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	$t_{d(on)}$	$T_j=25^\circ C,$ $V_{CC}=600V, I_C=40A,$ $V_{GE}=0/15V,$ $R_G=15\Omega,$ $L_\sigma^{2)}=180nH,$ $C_\sigma^{2)}=39pF$ Energy losses include "tail" and diode reverse recovery.	-	48	-	ns
Rise time	t_r		-	34	-	
Turn-off delay time	$t_{d(off)}$		-	480	-	
Fall time	t_f		-	70	-	
Turn-on energy	E_{on}		-	3.3	-	mJ
Turn-off energy	E_{off}		-	3.2	-	
Total switching energy	E_{ts}		-	6.5	-	

Anti-Parallel Diode Characteristic

Diode reverse recovery time	t_{rr}	$T_j=25^\circ C,$	-	240	-	ns
Diode reverse recovery charge	Q_{rr}	$V_R=600V, I_F=40A,$	-	3.8		μC
Diode peak reverse recovery current	I_{rrm}	$di_F/dt=800A/\mu s$	-	28		A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	370	-	$A/\mu s$

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

²⁾ Leakage inductance L_σ and Stray capacity C_σ 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.		
IGBT Characteristic							
Turn-on delay time	$t_{d(on)}$	$T_j=150^\circ\text{C}$ $V_{CC}=600\text{V}, I_C=40\text{A},$ $V_{GE}=0/15\text{V},$ $R_G=15\Omega,$ $L_{\sigma}^{(1)}=180\text{nH},$ $C_{\sigma}^{(1)}=39\text{pF}$ Energy losses include "tail" and diode reverse recovery.	-	52	-	ns	
Rise time	t_r		-	40	-		
Turn-off delay time	$t_{d(off)}$		-	580	-		
Fall time	t_f		-	120	-		
Turn-on energy	E_{on}			-	5.0	-	mJ
Turn-off energy	E_{off}			-	5.4	-	
Total switching energy	E_{ts}			-	10.4	-	
Anti-Parallel Diode Characteristic							
Diode reverse recovery time	t_{rr}	$T_j=150^\circ\text{C}$ $V_R=600\text{V}, I_F=40\text{A},$ $di_F/dt=800\text{A}/\mu\text{s}$	-	410	-	ns	
Diode reverse recovery charge	Q_{rr}		-	8.8	-	μC	
Diode peak reverse recovery current	I_{rrm}		-	36	-	A	
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	330		$\text{A}/\mu\text{s}$	

¹⁾ Leakage inductance L_{σ} and Stray capacity C_{σ} due to dynamic test circuit in Figure E.

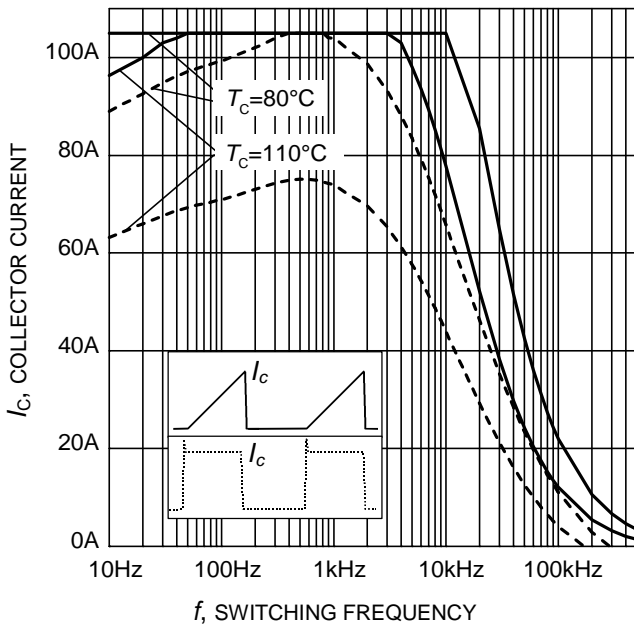


Figure 1. Collector current as a function of switching frequency
 ($T_j \leq 150^\circ\text{C}$, $D = 0.5$, $V_{CE} = 600\text{V}$,
 $V_{GE} = 0/+15\text{V}$, $R_G = 15\Omega$)

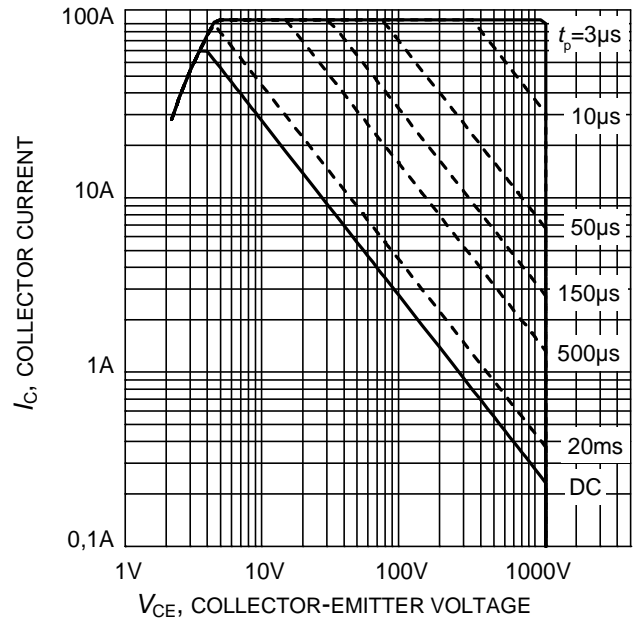


Figure 2. Safe operating area
 ($D = 0$, $T_C = 25^\circ\text{C}$,
 $T_j \leq 150^\circ\text{C}$; $V_{GE} = 15\text{V}$)

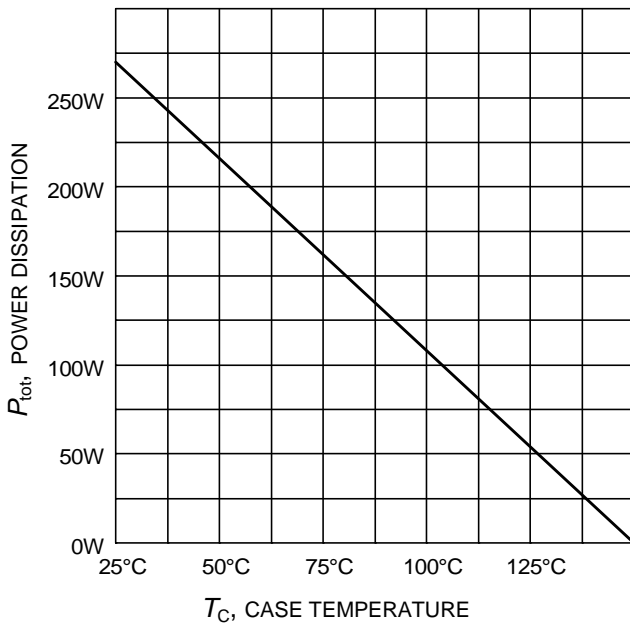


Figure 3. Power dissipation as a function of case temperature
 ($T_j \leq 150^\circ\text{C}$)

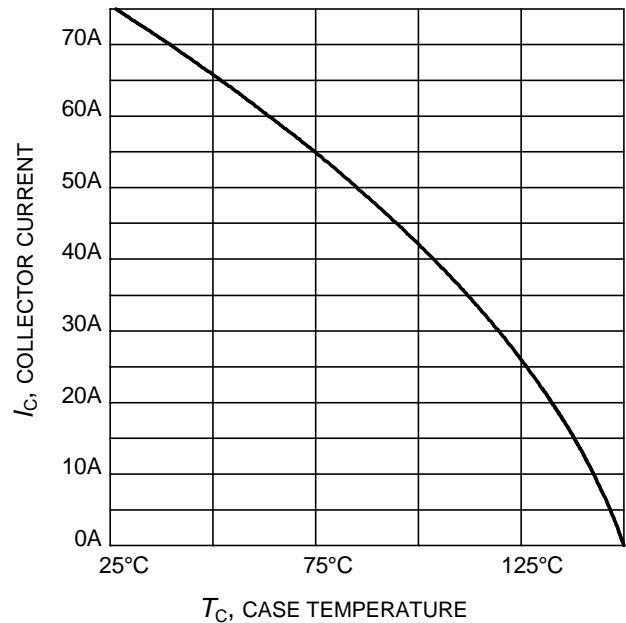


Figure 4. Collector current as a function of case temperature
 ($V_{GE} \geq 15\text{V}$, $T_j \leq 150^\circ\text{C}$)

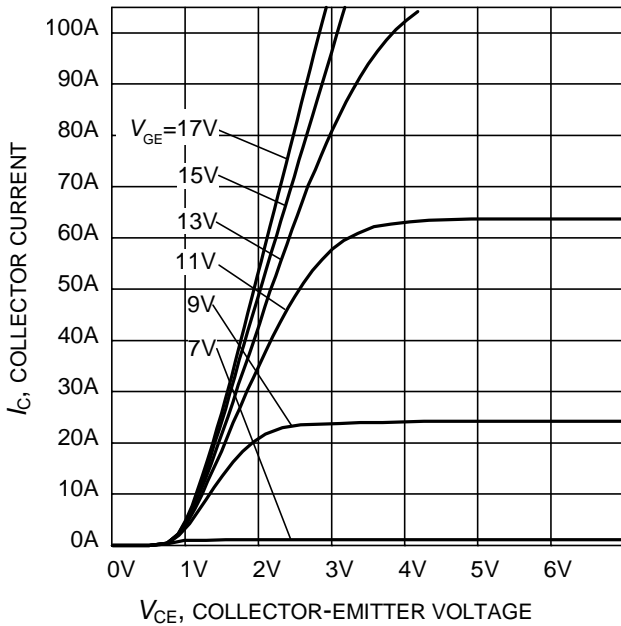


Figure 5. Typical output characteristic
($T_j = 25^\circ\text{C}$)

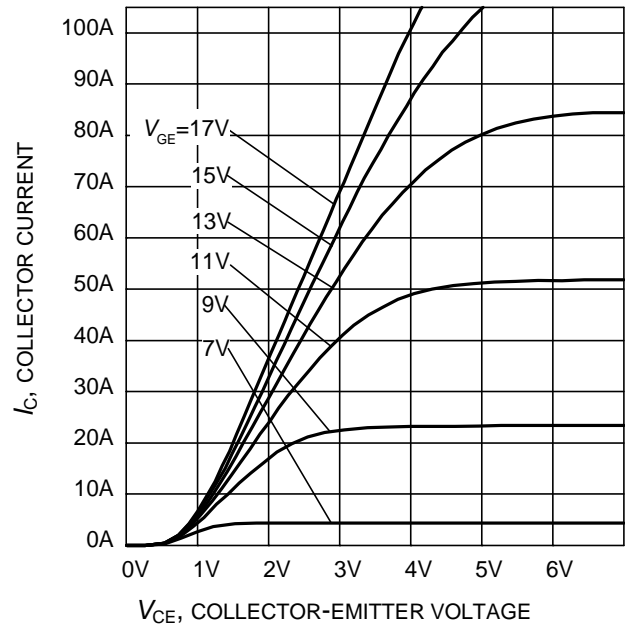


Figure 6. Typical output characteristic
($T_j = 150^\circ\text{C}$)

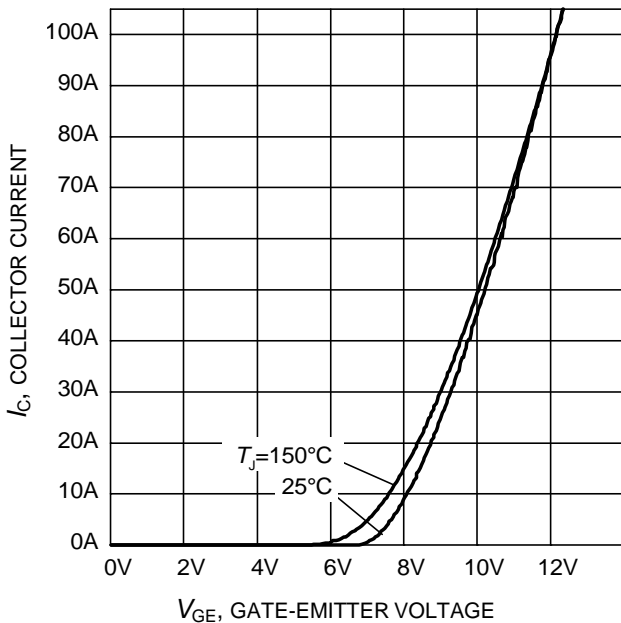


Figure 7. Typical transfer characteristic
($V_{CE} = 20\text{V}$)

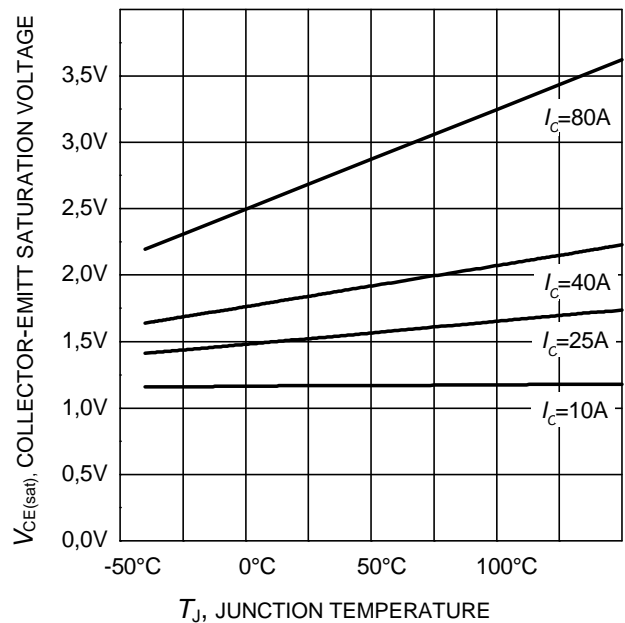


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
($V_{GE} = 15\text{V}$)

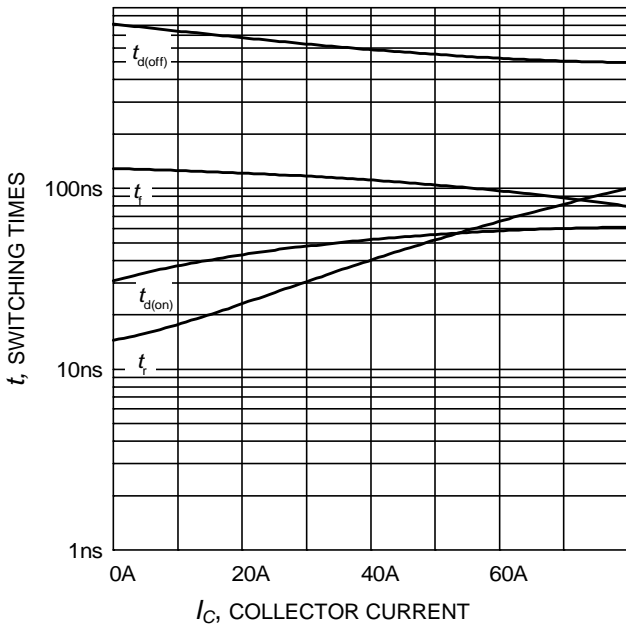


Figure 9. Typical switching times as a function of collector current
 (inductive load, $T_J=150^{\circ}\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=15\Omega$, Dynamic test circuit in Figure E)

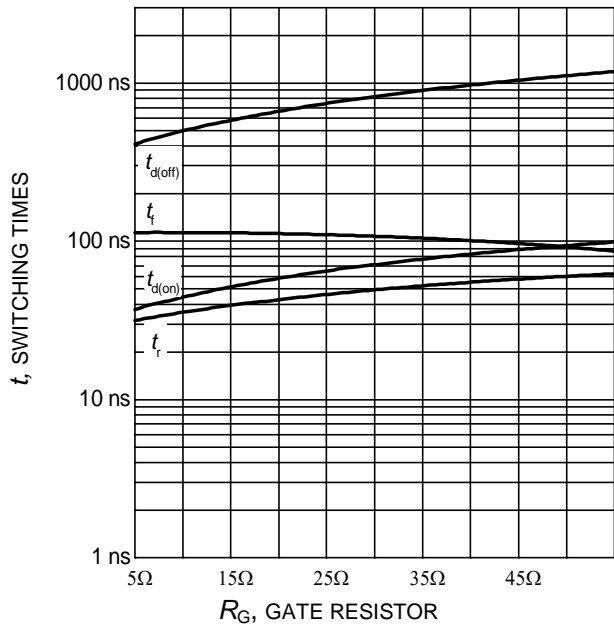


Figure 10. Typical switching times as a function of gate resistor
 (inductive load, $T_J=150^{\circ}\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, Dynamic test circuit in Figure E)

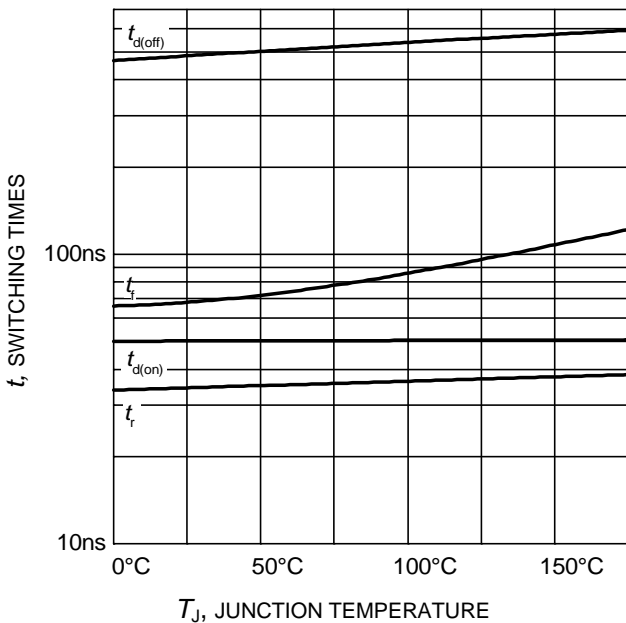


Figure 11. Typical switching times as a function of junction temperature
 (inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, $R_G=15\Omega$, Dynamic test circuit in Figure E)

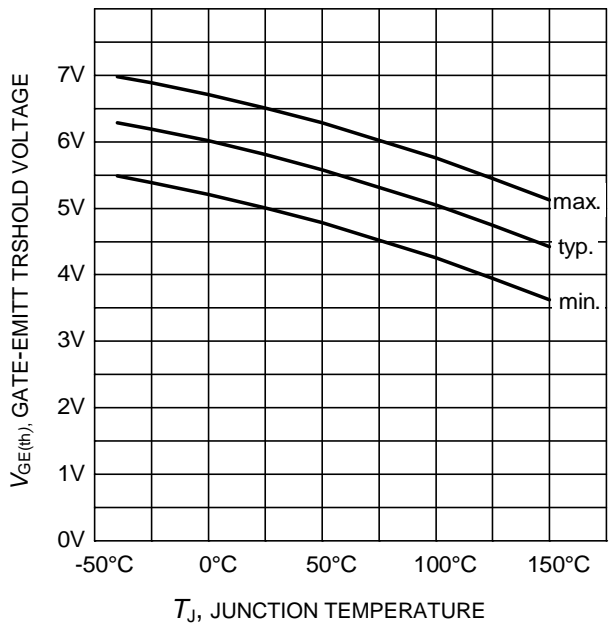


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
 ($I_C = 1.5\text{mA}$)

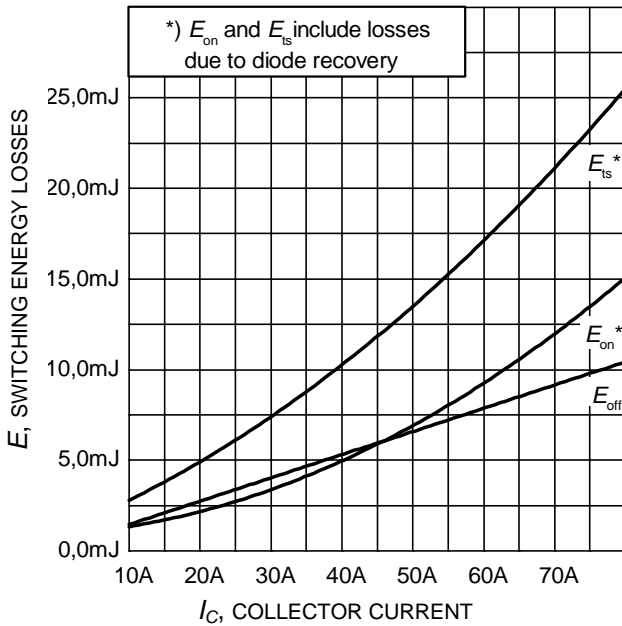


Figure 13. Typical switching energy losses as a function of collector current
 (inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=15\Omega$, Dynamic test circuit in Figure E)

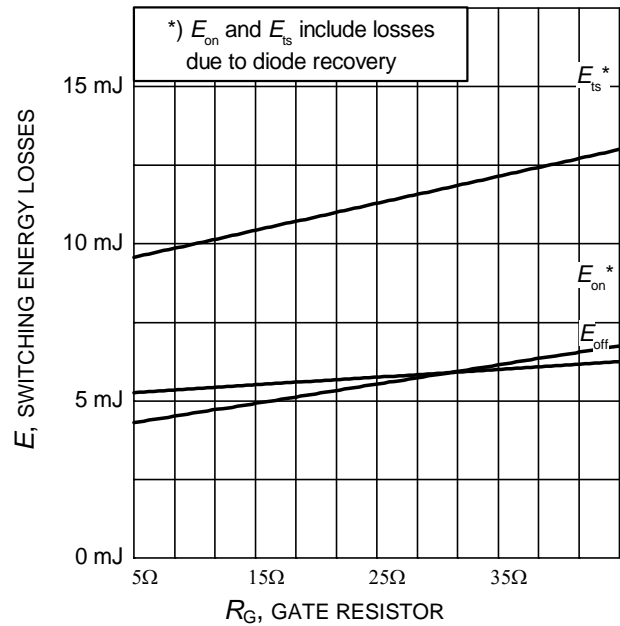


Figure 14. Typical switching energy losses as a function of gate resistor
 (inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, Dynamic test circuit in Figure E)

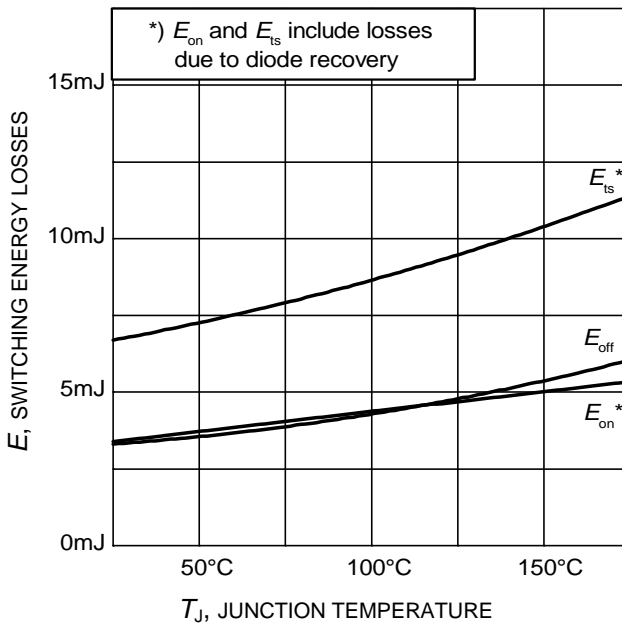


Figure 15. Typical switching energy losses as a function of junction temperature
 (inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, $R_G=15\Omega$, Dynamic test circuit in Figure E)

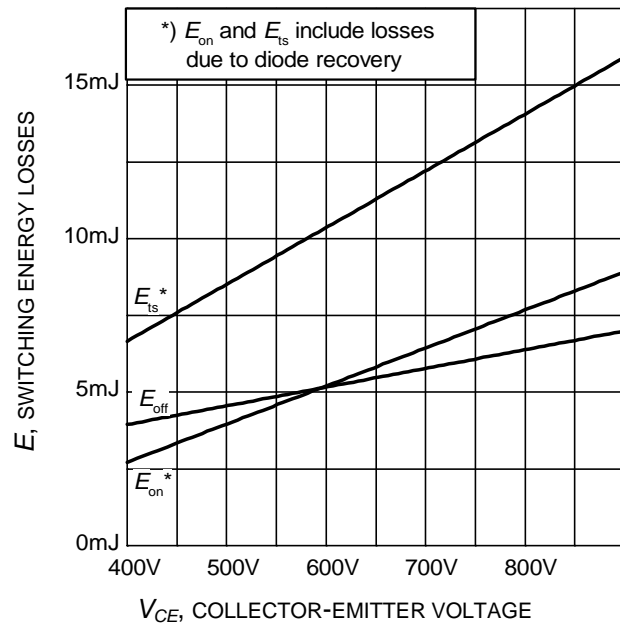


Figure 16. Typical switching energy losses as a function of collector emitter voltage
 (inductive load, $T_J=150^\circ\text{C}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, $R_G=15\Omega$, Dynamic test circuit in Figure E)

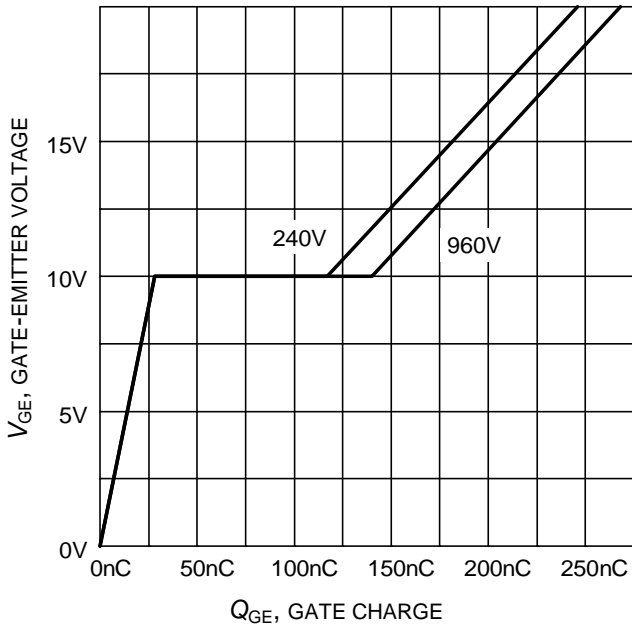


Figure 17. Typical gate charge
($I_C=40\text{ A}$)

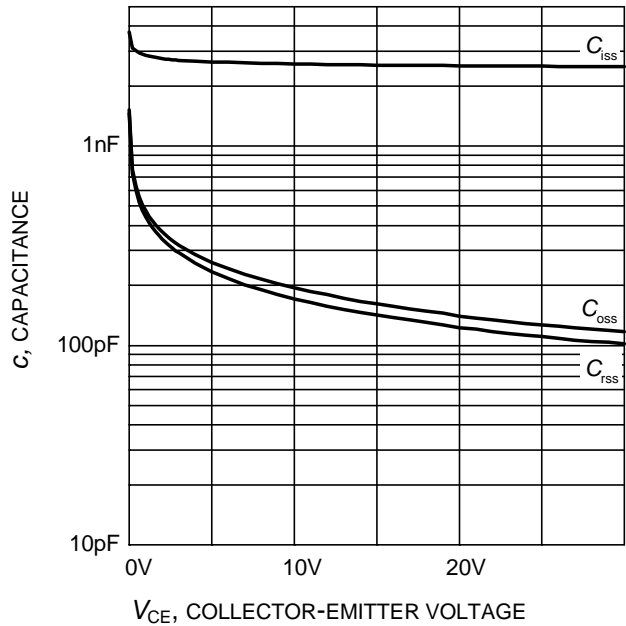


Figure 18. Typical capacitance as a function of collector-emitter voltage
($V_{GE}=0\text{V}$, $f = 1\text{ MHz}$)

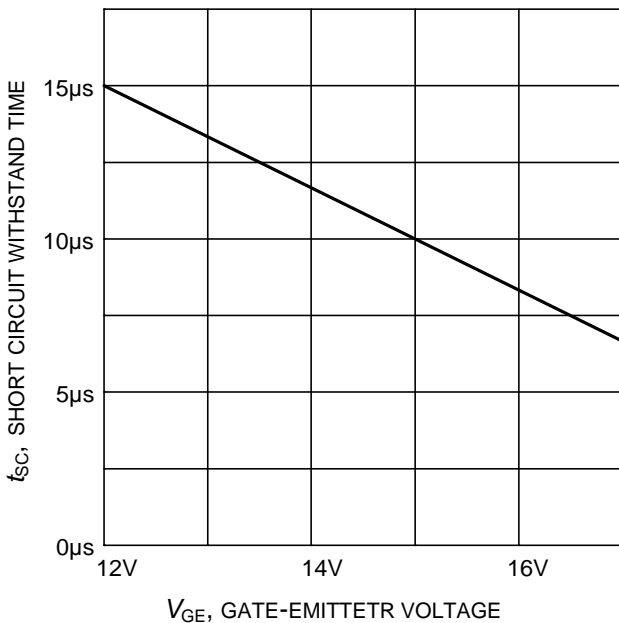


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
($V_{CE}=600\text{V}$, start at $T_j=25^\circ\text{C}$)

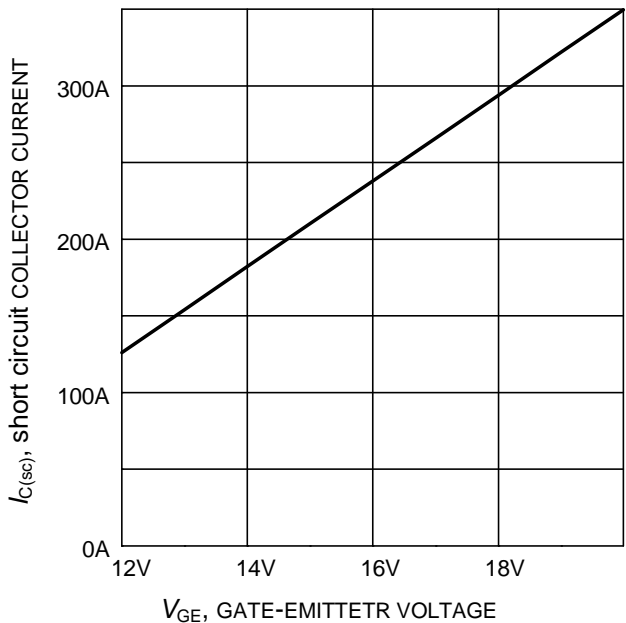


Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \leq 600\text{V}$, $T_j \leq 150^\circ\text{C}$)

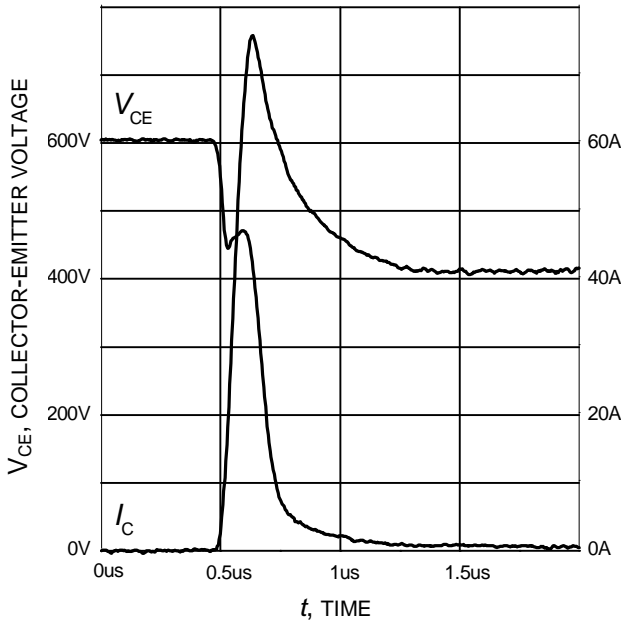


Figure 21. Typical turn on behavior
 ($V_{GE}=0/15V$, $R_G=15\Omega$, $T_j = 150^\circ C$,
 Dynamic test circuit in Figure E)

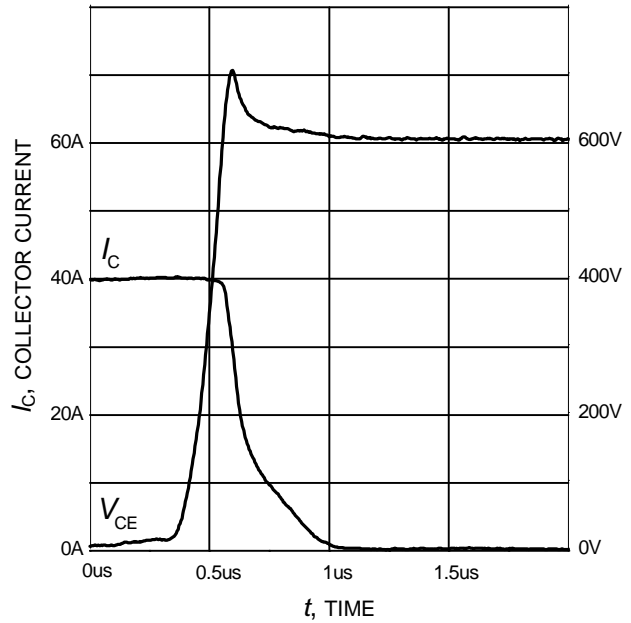


Figure 22. Typical turn off behavior
 ($V_{GE}=15/0V$, $R_G=15\Omega$, $T_j = 150^\circ C$,
 Dynamic test circuit in Figure E)

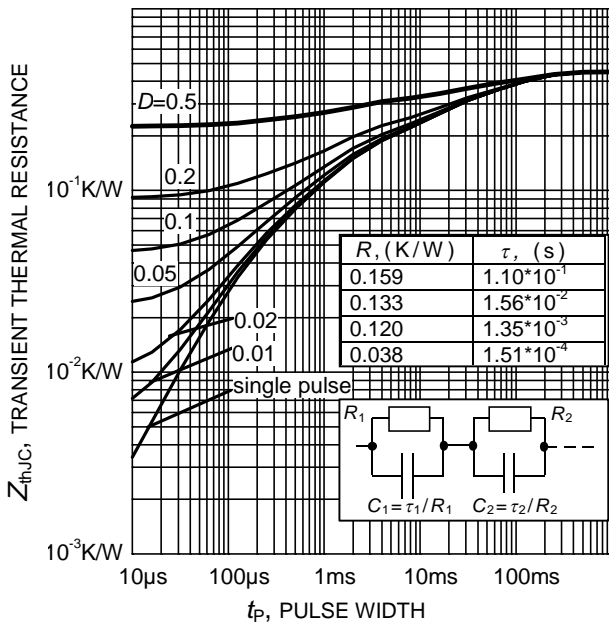


Figure 23. IGBT transient thermal resistance
 ($D = t_p / T$)

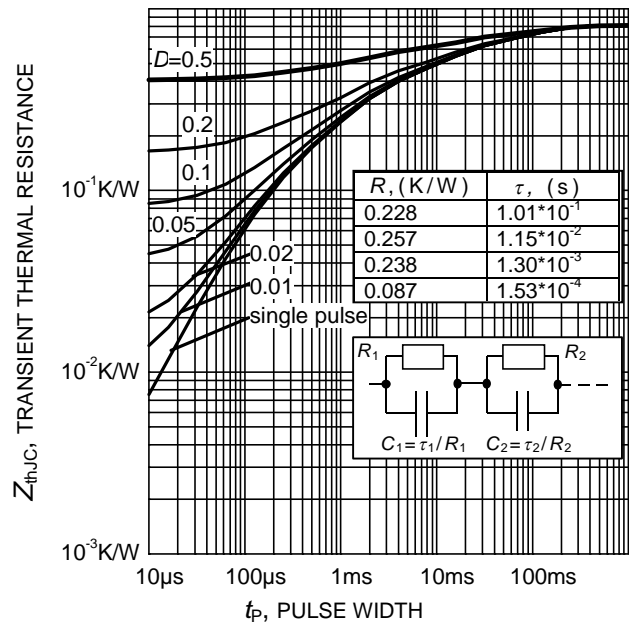


Figure 24. Diode transient thermal impedance as a function of pulse width
 ($D = t_p / T$)

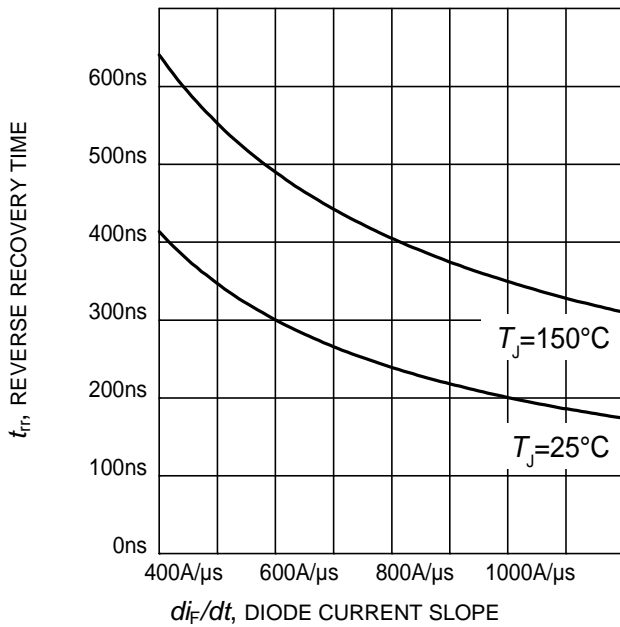


Figure 23. Typical reverse recovery time as a function of diode current slope
 ($V_R=600\text{V}$, $I_F=40\text{A}$,
 Dynamic test circuit in Figure E)

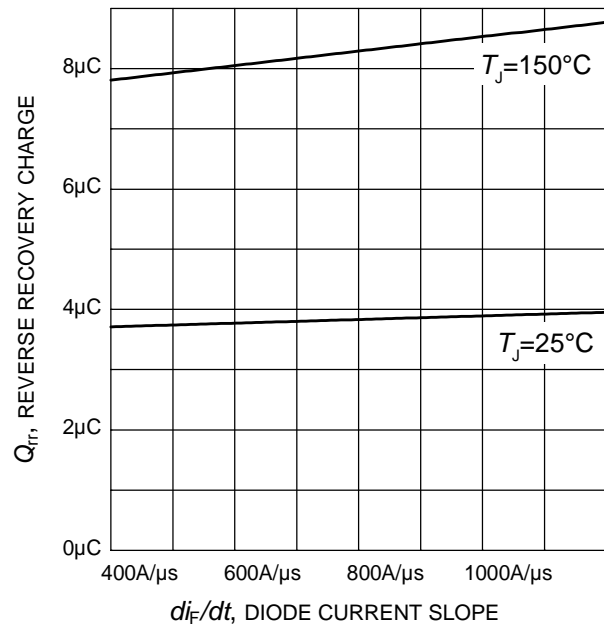


Figure 24. Typical reverse recovery charge as a function of diode current slope
 ($V_R=600\text{V}$, $I_F=40\text{A}$,
 Dynamic test circuit in Figure E)

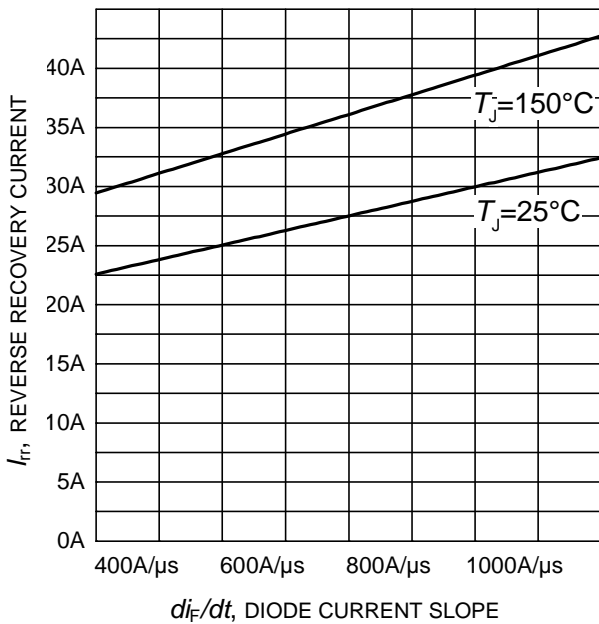


Figure 25. Typical reverse recovery current as a function of diode current slope
 ($V_R=600\text{V}$, $I_F=40\text{A}$,
 Dynamic test circuit in Figure E)

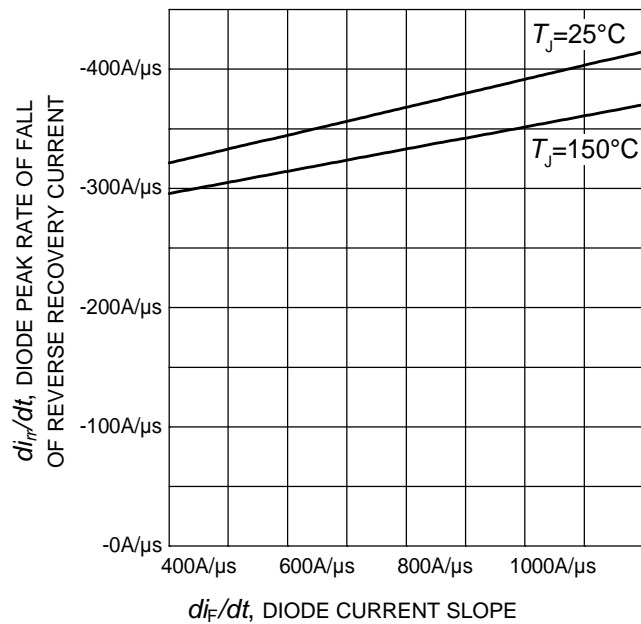


Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
 ($V_R=600\text{V}$, $I_F=40\text{A}$,
 Dynamic test circuit in Figure E)

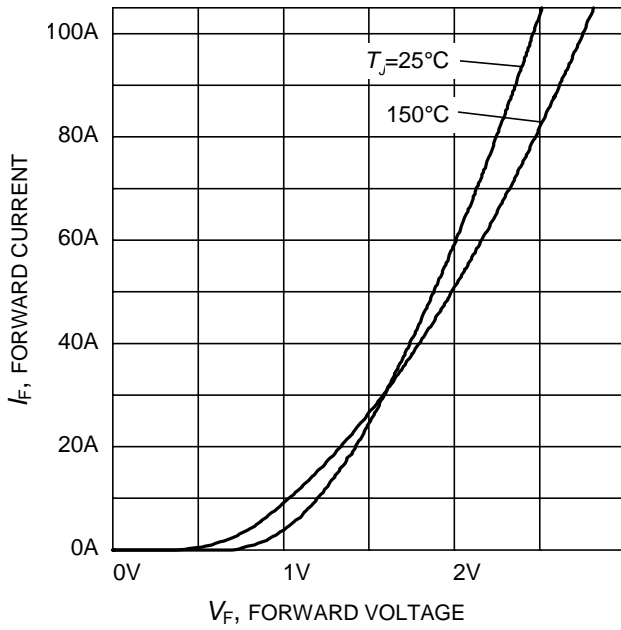


Figure 27. Typical diode forward current as a function of forward voltage

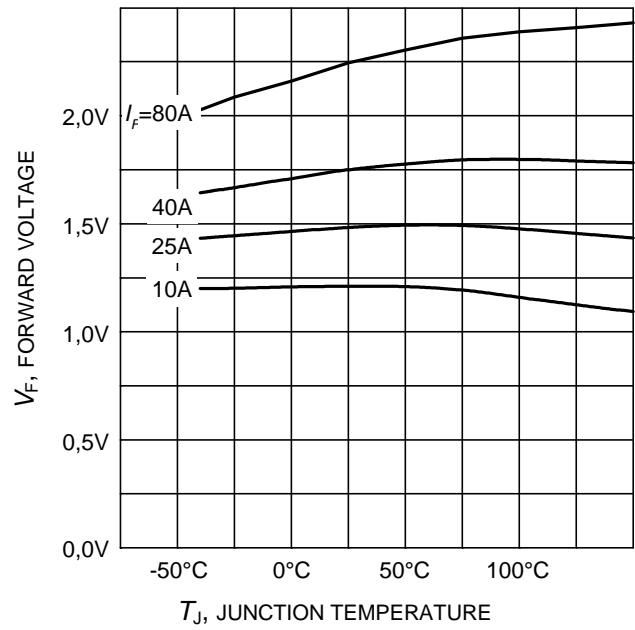
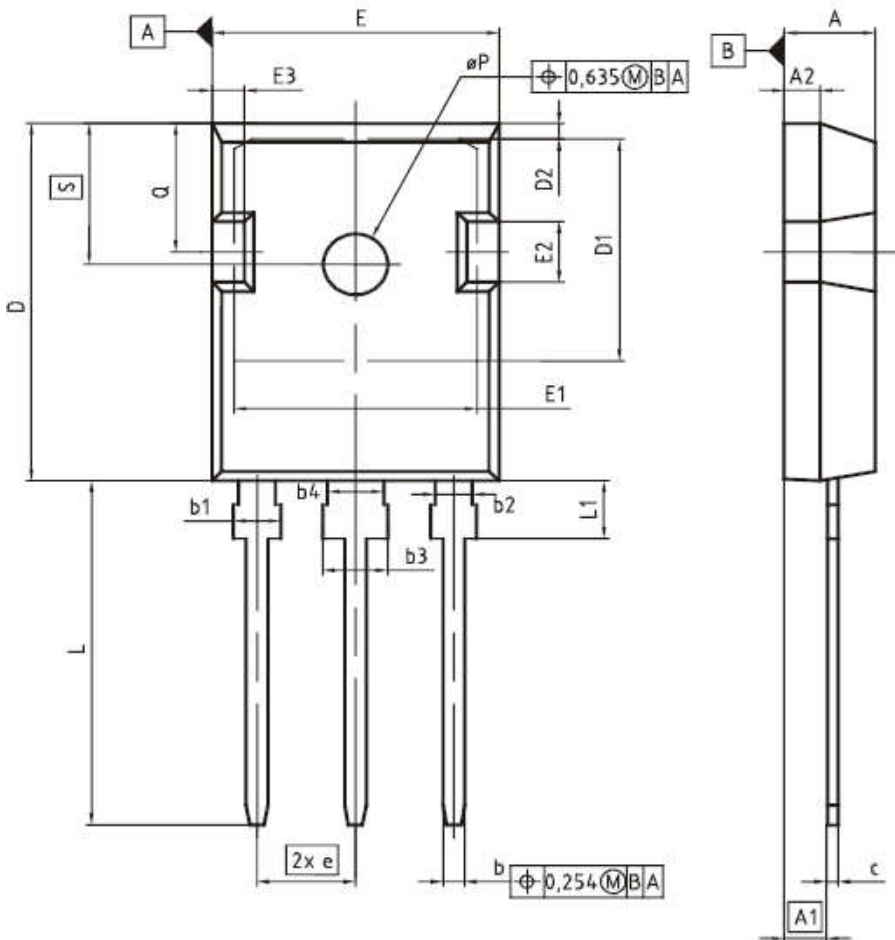


Figure 28. Typical diode forward voltage as a function of junction temperature

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
aP	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

DOCUMENT NO.
Z8B00003327

SCALE

EUROPEAN PROJECTION

ISSUE DATE
09-07-2010

REVISION
05

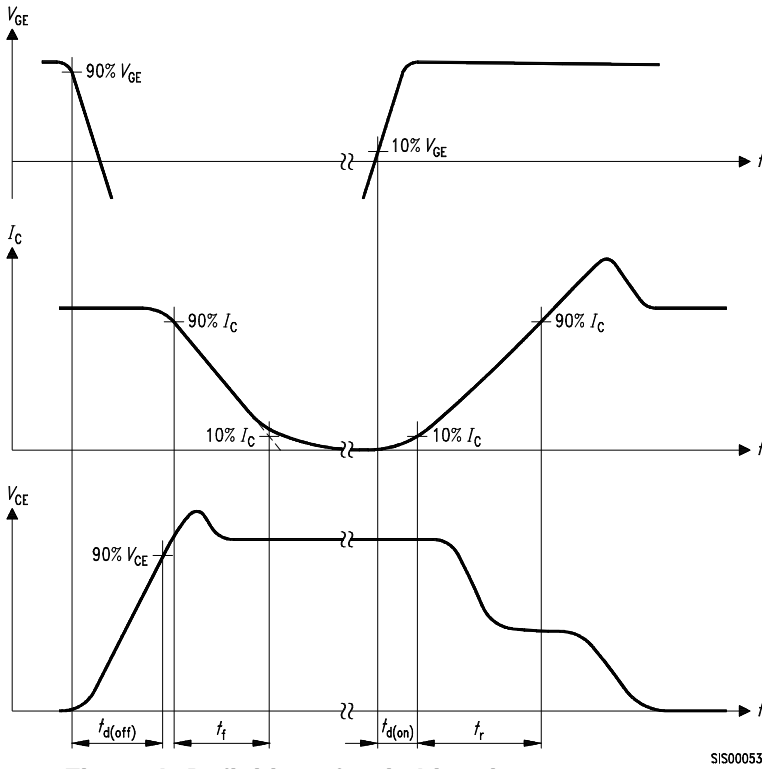


Figure A. Definition of switching times

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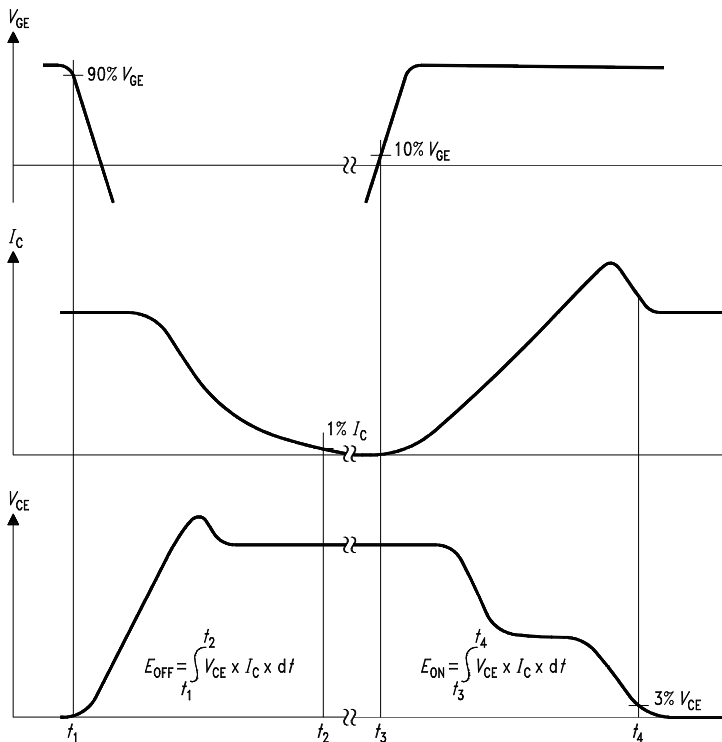


Figure B. Definition of switching losses

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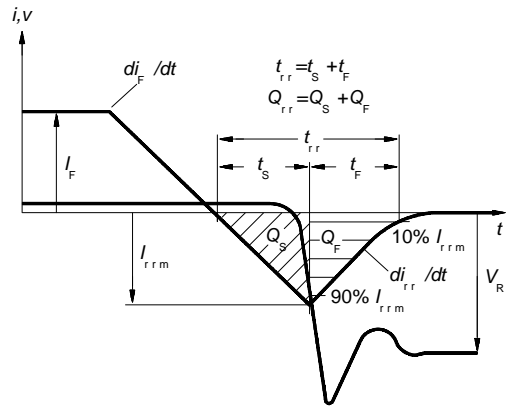


Figure C. Definition of diodes switching characteristics

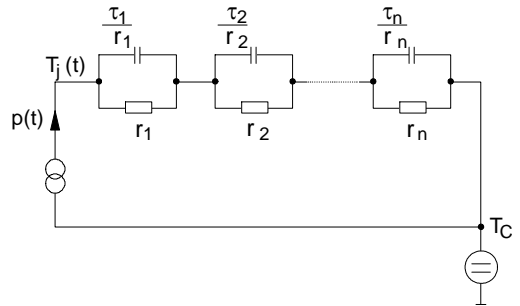


Figure D. Thermal equivalent circuit

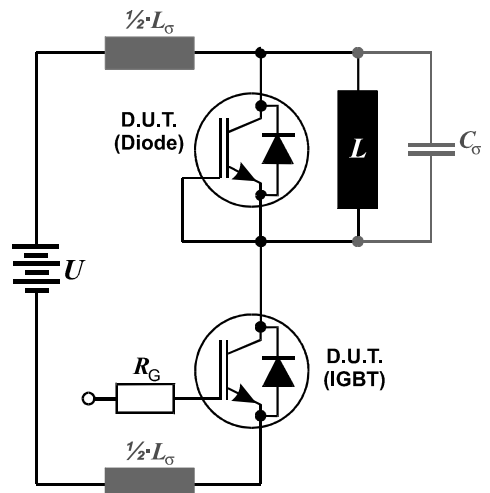


Figure E. Dynamic test circuit
Leakage inductance $L_{\sigma} = 180\text{nH}$
and Stray capacity $C_{\sigma} = 39\text{pF}$.

Published by
Infineon Technologies AG
81726 Munich, Germany
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