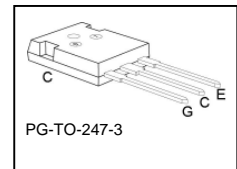
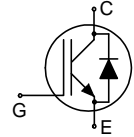


Fast IGBT in NPT-technology with soft, fast recovery anti-parallel Emitter Controlled Diode

- Lower E_{off} compared to previous generation
- Short circuit withstand time – 10 μ s
- Designed for:
 - Motor controls
 - Inverter
 - SMPS
- NPT-Technology offers:
 - very tight parameter distribution
 - high ruggedness, temperature stable behaviour
 - parallel switching capability
- 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	E_{off}	T_j	Marking	Package
SKW15N120	1200V	15A	1.5mJ	150°C	K15N120	PG-TO-247-3

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
DC collector current	I_C		A
$T_C = 25^\circ\text{C}$		30	
$T_C = 100^\circ\text{C}$		15	
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	52	
Turn off safe operating area $V_{CE} \leq 1200\text{V}$, $T_j \leq 150^\circ\text{C}$	-	52	
Diode forward current	I_F		
$T_C = 25^\circ\text{C}$		32	
$T_C = 100^\circ\text{C}$		15	
Diode pulsed current, t_p limited by T_{jmax}	I_{Fpuls}	50	
Gate-emitter voltage	V_{GE}	± 20	V
Short circuit withstand time ² $V_{GE} = 15\text{V}$, $100\text{V} \leq V_{CC} \leq 1200\text{V}$, $T_j \leq 150^\circ\text{C}$	t_{SC}	10	μ s
Power dissipation $T_C = 25^\circ\text{C}$	P_{tot}	198	W
Operating junction and storage temperature	T_j, T_{stg}	-55...+150	°C
Soldering temperature, wavesoldering, 1.6mm (0.063 in.) from case for 10s	T_s	260	

¹ J-STD-020 and JESD-022

² 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}		0.63	K/W
Diode thermal resistance, junction – case	R_{thJCD}		1.5	
Thermal resistance, junction – ambient	R_{thJA}		40	

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

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Static Characteristic						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE}=0V,$ $I_C=1000\mu A$	1200	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE} = 15V, I_C=15A$ $T_j=25\text{ °C}$ $T_j=150\text{ °C}$	2.5 -	3.1 3.7	3.6 4.3	
Diode forward voltage	V_F	$V_{GE}=0V, I_F=15A$ $T_j=25\text{ °C}$ $T_j=150\text{ °C}$	-	2.0 1.75	2.5	
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C=600\mu A, V_{CE}=V_{GE}$	3	4	5	
Zero gate voltage collector current	I_{CES}	$V_{CE}=1200V, V_{GE}=0V$ $T_j=25\text{ °C}$ $T_j=150\text{ °C}$	- -	- -	200 800	μA
Gate-emitter leakage current	I_{GES}	$V_{CE}=0V, V_{GE}=20V$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE}=20V, I_C=15A$		11	-	S
Dynamic Characteristic						
Input capacitance	C_{iss}	$V_{CE}=25V,$ $V_{GE}=0V,$ $f=1\text{ MHz}$	-	1250	1500	pF
Output capacitance	C_{oss}		-	155	185	
Reverse transfer capacitance	C_{riss}		-	65	80	
Gate charge	Q_{Gate}	$V_{CC}=960V, I_C=15A$ $V_{GE}=15V$	-	130	175	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13	-	nH
Short circuit collector current ¹⁾	$I_{C(SC)}$	$V_{GE}=15V, t_{SC}\leq 10\mu s$ $100V\leq V_{CC}\leq 1200V,$ $T_j\leq 150\text{ °C}$	-	145	-	A

¹⁾ 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.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	$T_j=25\text{ }^\circ\text{C}$, $V_{CC}=800\text{V}$, $I_C=15\text{A}$, $V_{GE}=15\text{V}/0\text{V}$, $R_G=33\Omega$, $L_\sigma^{(1)}=180\text{nH}$, $C_\sigma^{(1)}=40\text{pF}$ Energy losses include "tail" and diode reverse recovery.	-	18	24	ns
Rise time	t_r		-	23	30	
Turn-off delay time	$t_{d(off)}$		-	580	750	
Fall time	t_f		-	22	29	
Turn-on energy	E_{on}		-	1.1	1.5	mJ
Turn-off energy	E_{off}		-	0.8	1.1	
Total switching energy	E_{ts}		-	1.9	2.6	

Anti-Parallel Diode Characteristic

Diode reverse recovery time	t_{rr}	$T_j=25\text{ }^\circ\text{C}$, $V_R=800\text{V}$, $I_F=15\text{A}$, $di_F/dt=650\text{A}/\mu\text{s}$	-	65		ns
	t_s		-			
	t_F		-			
Diode reverse recovery charge	Q_{rr}		-	0.5		μC
Diode peak reverse recovery current	I_{rrm}		-	15		A
Diode peak rate of fall of reverse recovery current during t_F	di_{rr}/dt	-	500		$\text{A}/\mu\text{s}$	

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

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	$T_j=150\text{ }^\circ\text{C}$ $V_{CC}=800\text{V}$, $I_C=15\text{A}$, $V_{GE}=15\text{V}/0\text{V}$, $R_G=33\Omega$, $L_\sigma^{(1)}=180\text{nH}$, $C_\sigma^{(1)}=40\text{pF}$ Energy losses include "tail" and diode reverse recovery.	-	38	46	ns
Rise time	t_r		-	30	36	
Turn-off delay time	$t_{d(off)}$		-	652	780	
Fall time	t_f		-	31	37	
Turn-on energy	E_{on}		-	1.9	2.3	mJ
Turn-off energy	E_{off}		-	1.5	2.0	
Total switching energy	E_{ts}		-	3.4	4.3	

Anti-Parallel Diode Characteristic

Diode reverse recovery time	t_{rr}	$T_j=150\text{ }^\circ\text{C}$ $V_R=800\text{V}$, $I_F=15\text{A}$, $di_F/dt=650\text{A}/\mu\text{s}$	-	200		ns
	t_s		-			
	t_F		-			
Diode reverse recovery charge	Q_{rr}		-	2.0		μC
Diode peak reverse recovery current	I_{rrm}		-	23		A
Diode peak rate of fall of reverse recovery current during t_F	di_{rr}/dt	-	140		$\text{A}/\mu\text{s}$	

¹⁾ Leakage inductance L_σ and stray capacity C_σ due to dynamic test circuit in figure E.

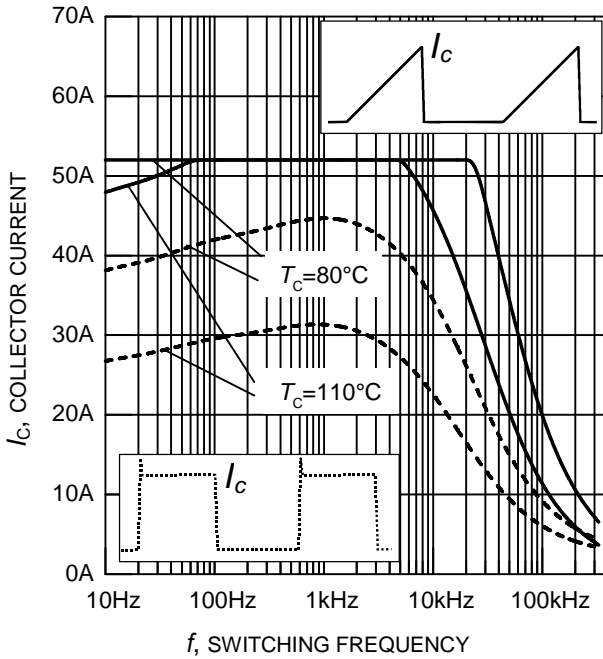


Figure 1. Collector current as a function of switching frequency

($T_i \leq 150^\circ\text{C}$, $D = 0.5$, $V_{CE} = 800\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $R_G = 33\Omega$)

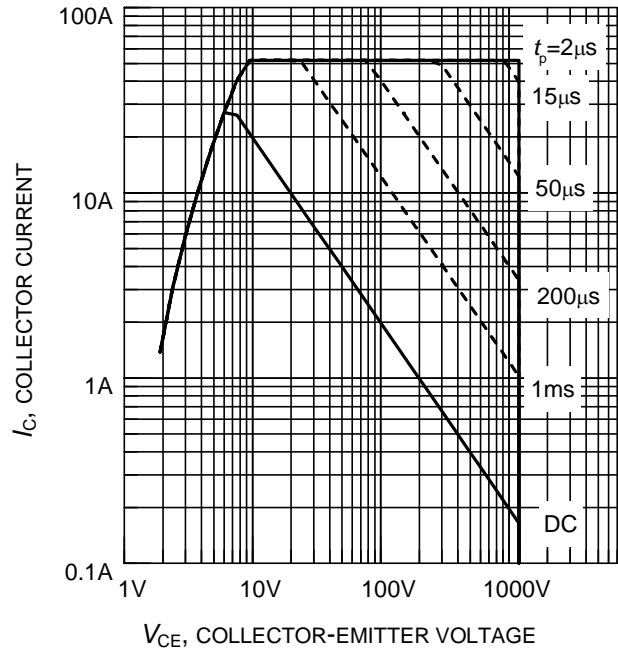


Figure 2. Safe operating area

($D = 0$, $T_C = 25^\circ\text{C}$, $T_i \leq 150^\circ\text{C}$)

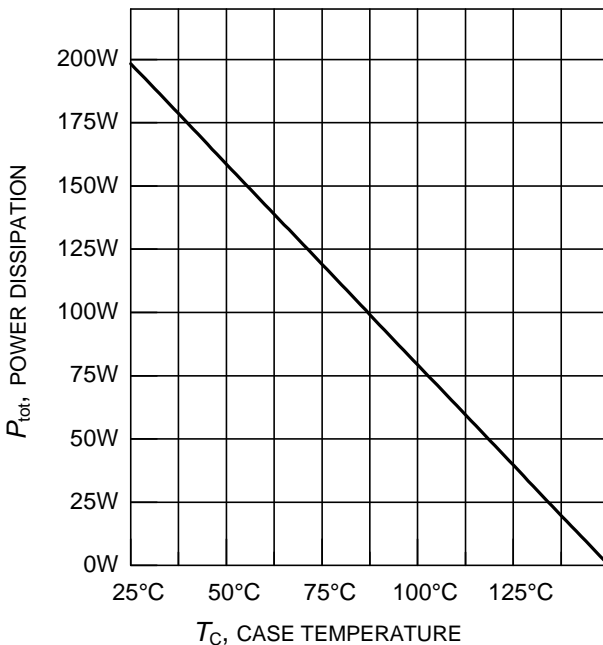


Figure 3. Power dissipation as a function of case temperature

($T_i \leq 150^\circ\text{C}$)

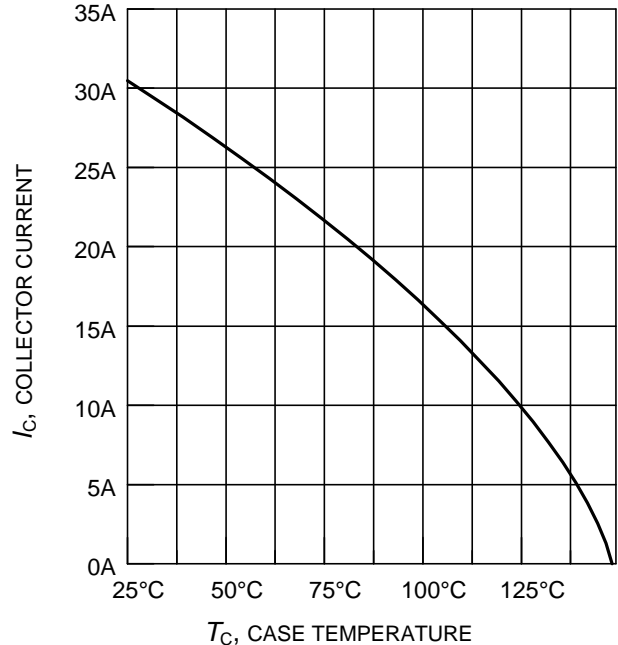


Figure 4. Collector current as a function of case temperature

($V_{GE} \leq 15\text{V}$, $T_i \leq 150^\circ\text{C}$)

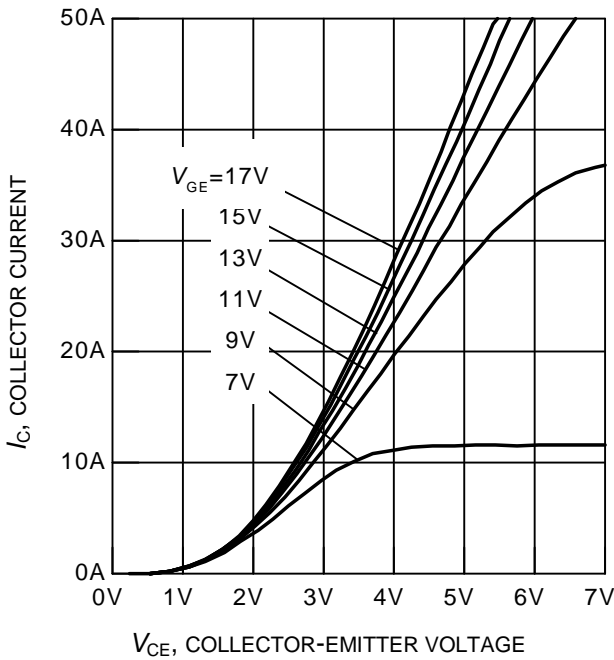


Figure 5. Typical output characteristics
($T_j = 25^\circ\text{C}$)

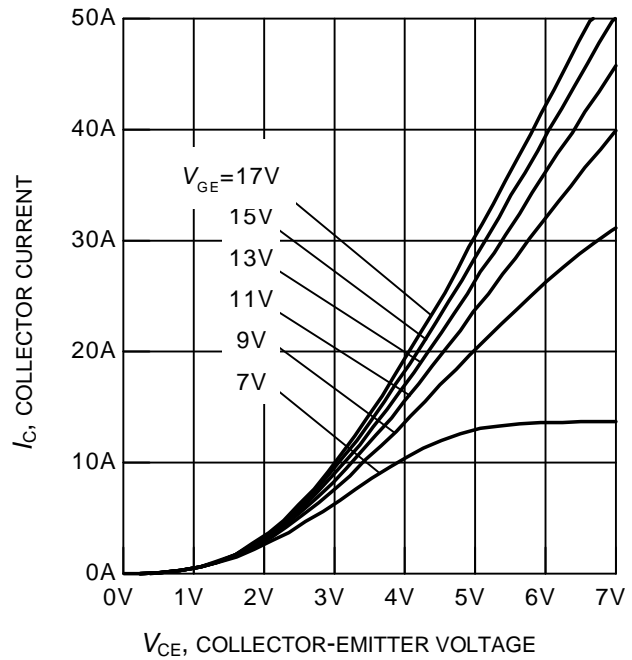


Figure 6. Typical output characteristics
($T_j = 150^\circ\text{C}$)

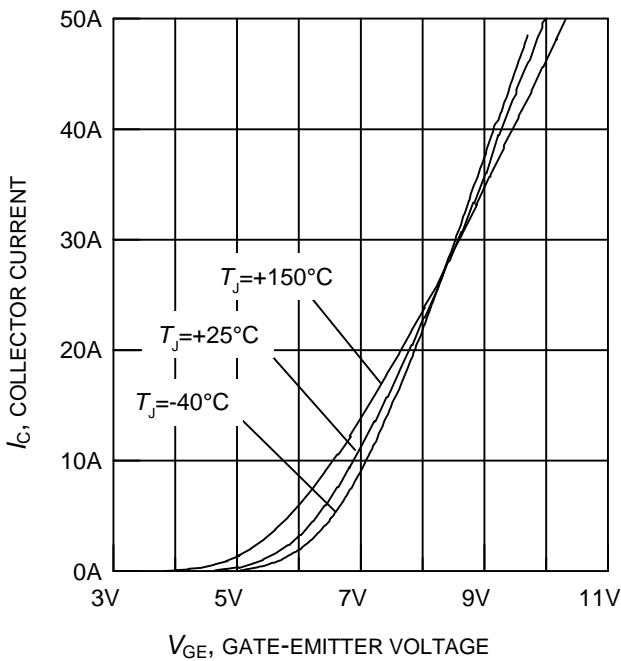


Figure 7. Typical transfer characteristics
($V_{CE} = 20\text{V}$)

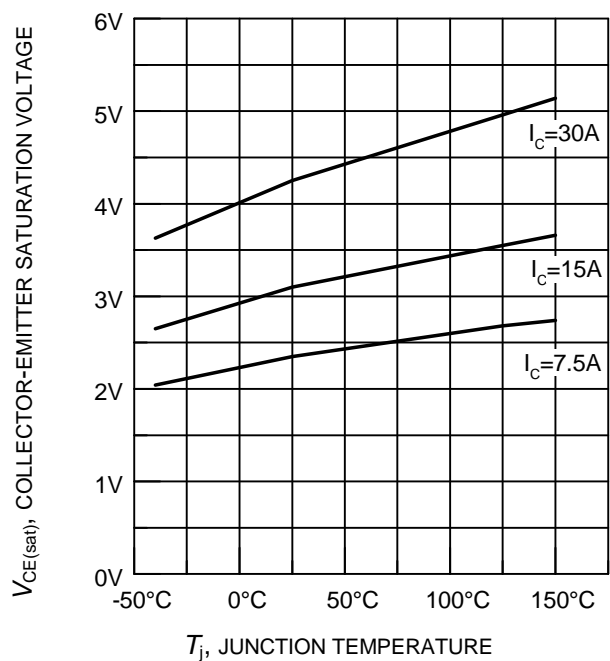


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
($V_{GE} = 15\text{V}$)

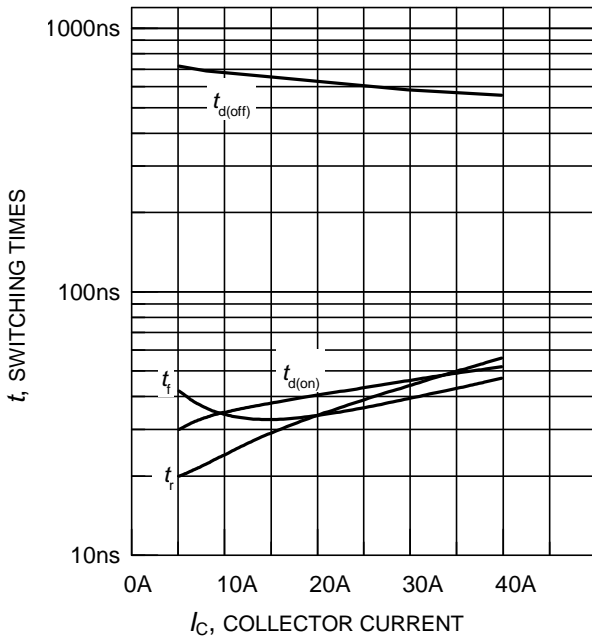


Figure 9. Typical switching times as a function of collector current
 (inductive load, $T_j = 150^\circ\text{C}$,
 $V_{CE} = 8600\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $R_G = 33\Omega$,
 dynamic test circuit in Fig.E)

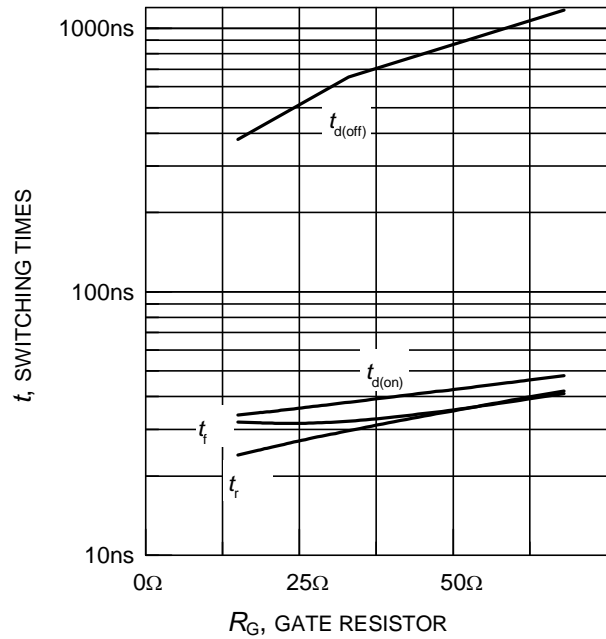


Figure 10. Typical switching times as a function of gate resistor
 (inductive load, $T_j = 150^\circ\text{C}$,
 $V_{CE} = 800\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $I_C = 15\text{A}$,
 dynamic test circuit in Fig.E)

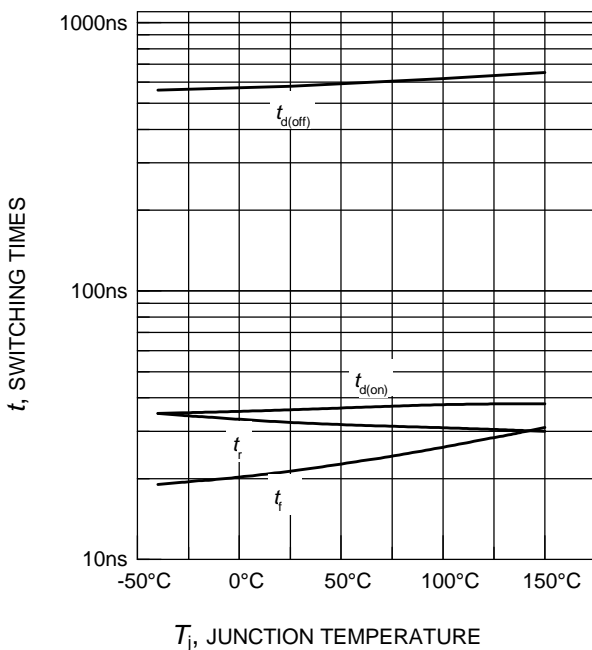


Figure 11. Typical switching times as a function of junction temperature
 (inductive load, $V_{CE} = 800\text{V}$,
 $V_{GE} = +15\text{V}/0\text{V}$, $I_C = 15\text{A}$, $R_G = 33\Omega$,
 dynamic test circuit in Fig.E)

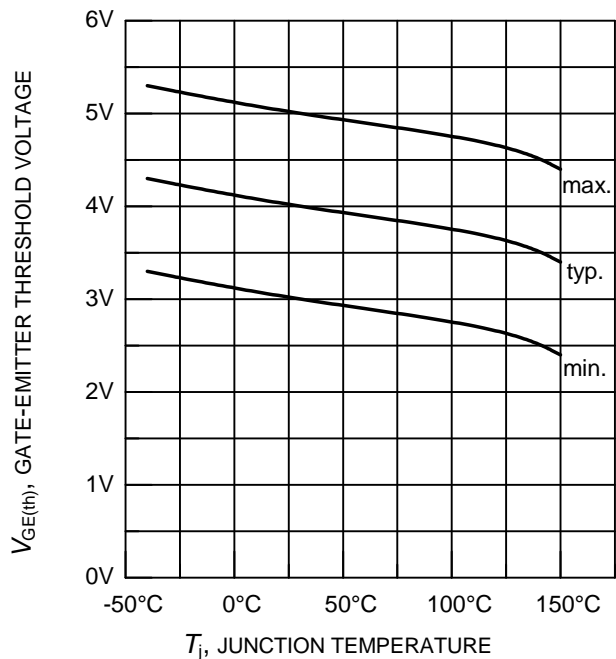


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
 ($I_C = 0.3\text{mA}$)

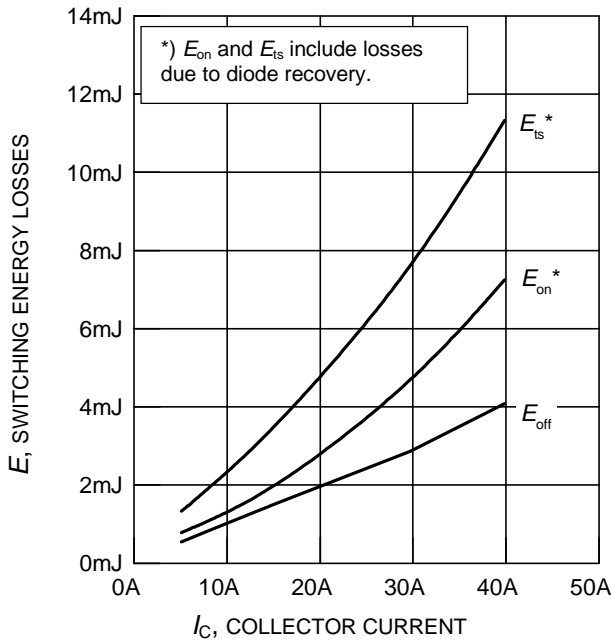


Figure 13. Typical switching energy losses as a function of collector current
 (inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 800\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $R_G = 33\Omega$, dynamic test circuit in Fig.E)

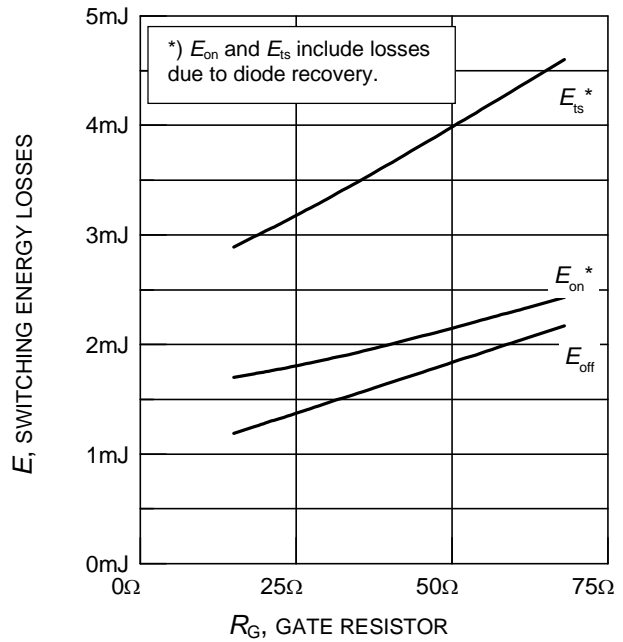


Figure 14. Typical switching energy losses as a function of gate resistor
 (inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 800\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $I_C = 15\text{A}$, dynamic test circuit in Fig.E)

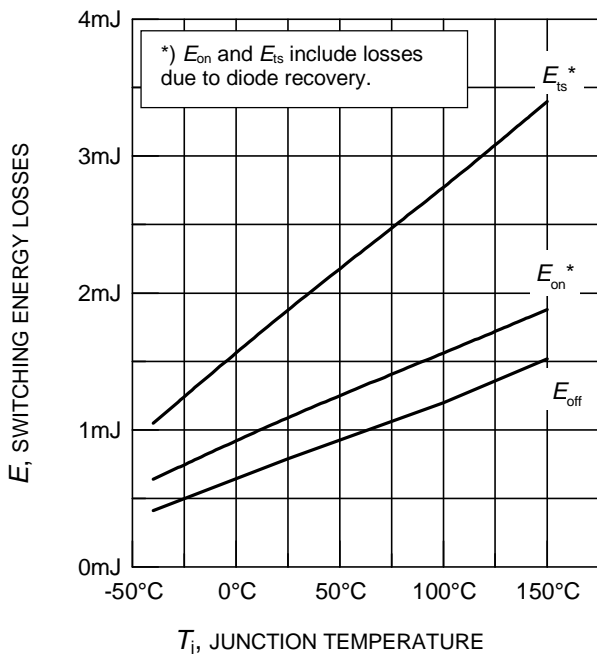


Figure 15. Typical switching energy losses as a function of junction temperature
 (inductive load, $V_{CE} = 800\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $I_C = 15\text{A}$, $R_G = 33\Omega$, dynamic test circuit in Fig.E)

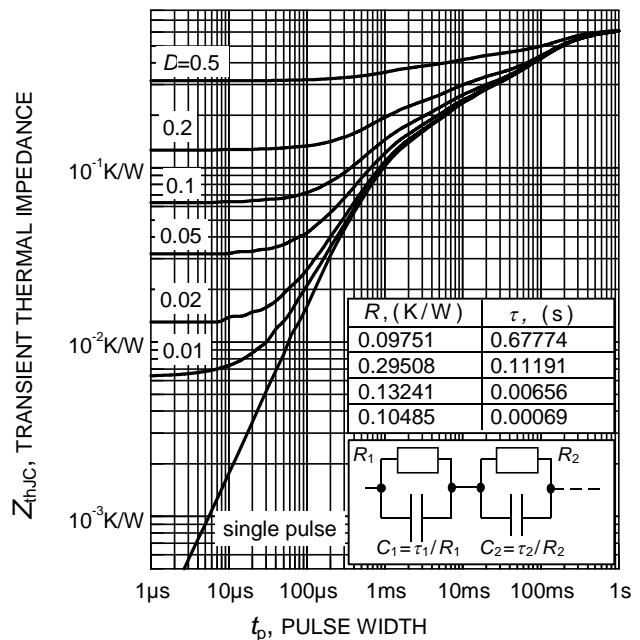


Figure 16. IGBT transient thermal impedance as a function of pulse width
 ($D = t_p / T$)

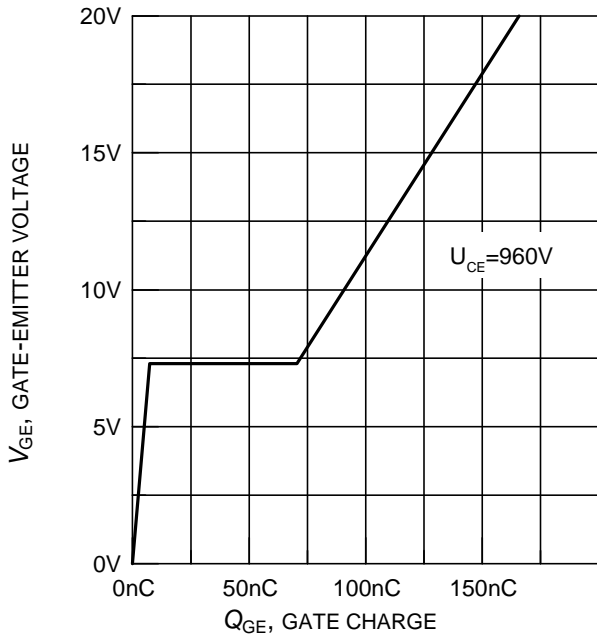


Figure 17. Typical gate charge
($I_C = 15A$)

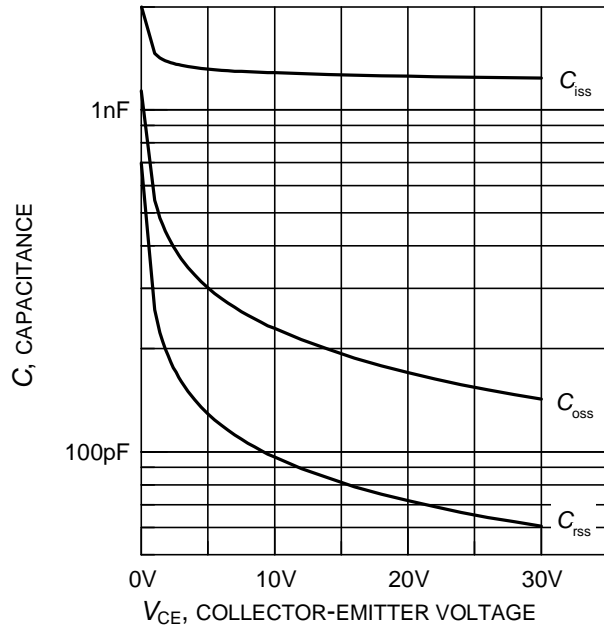


Figure 18. Typical capacitance as a function of collector-emitter voltage
($V_{GE} = 0V, f = 1MHz$)

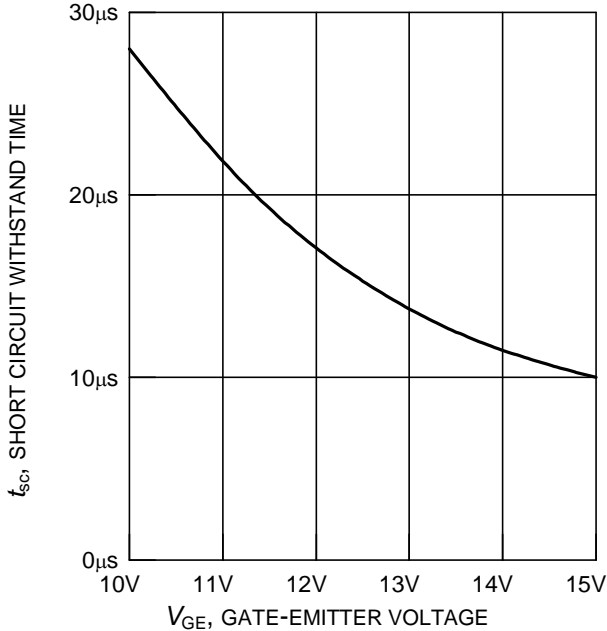


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
($V_{CE} = 1200V, \text{start at } T_j = 25^\circ C$)

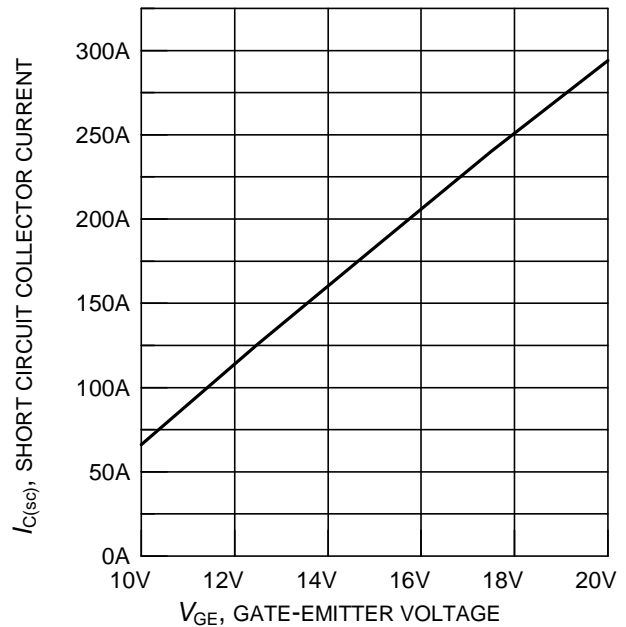


Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
($100V \leq V_{CE} \leq 1200V, T_C = 25^\circ C, T_j \leq 150^\circ C$)

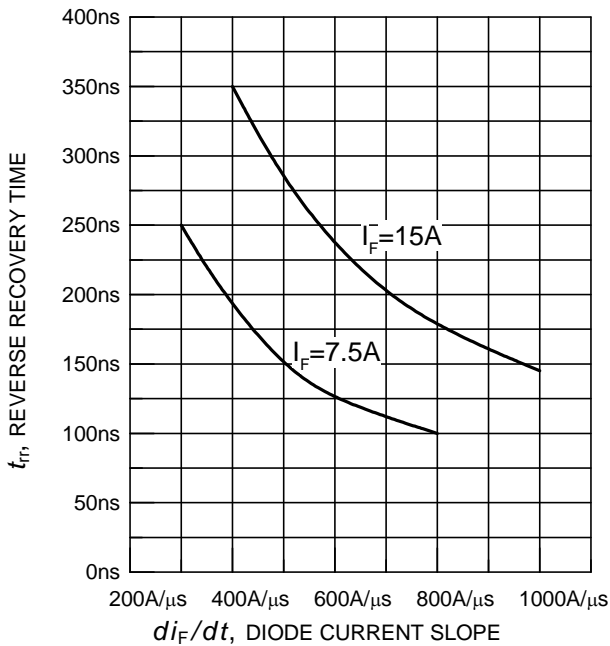


Figure 21. Typical reverse recovery time as a function of diode current slope
 ($V_R = 800V$, $T_j = 150^\circ C$,
 dynamic test circuit in Fig.E)

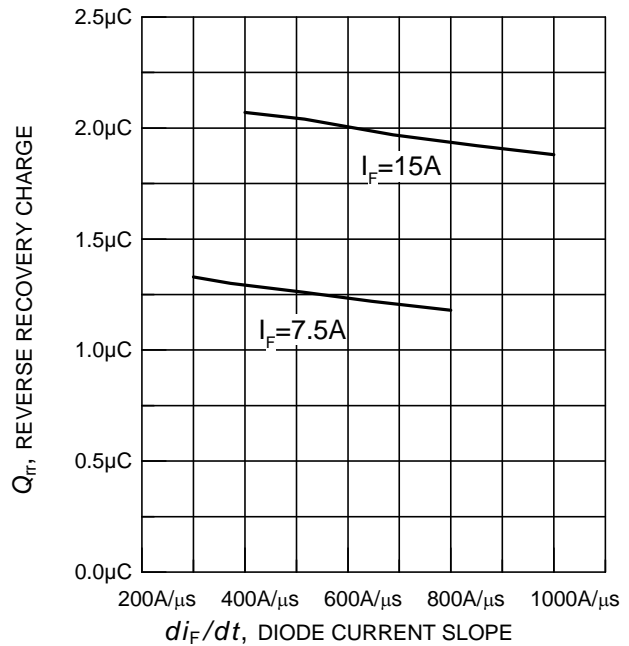


Figure 22. Typical reverse recovery charge as a function of diode current slope
 ($V_R = 800V$, $T_j = 150^\circ C$,
 dynamic test circuit in Fig.E)

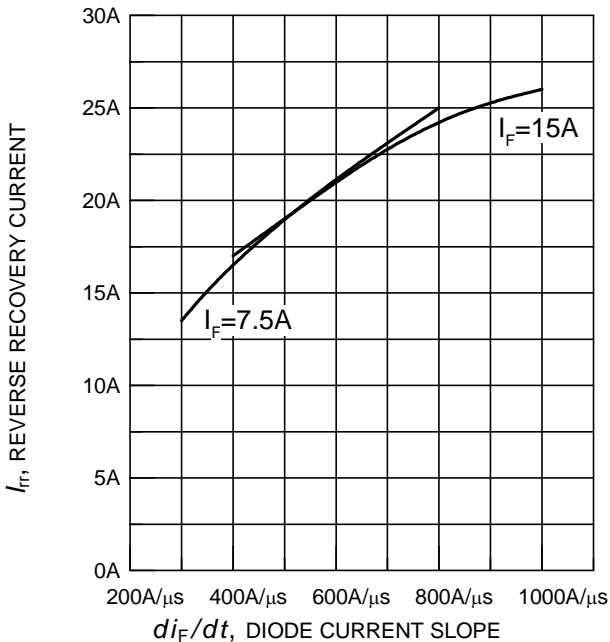


Figure 23. Typical reverse recovery current as a function of diode current slope
 ($V_R = 800V$, $T_j = 150^\circ C$,
 dynamic test circuit in Fig.E)

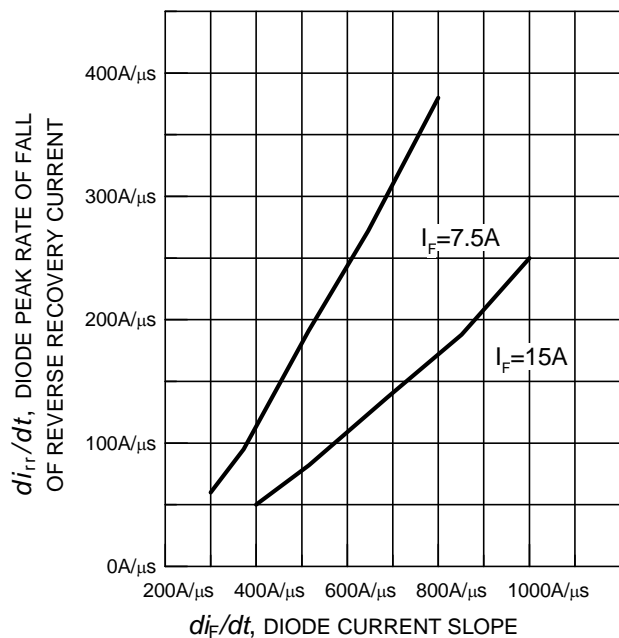


Figure 24. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
 ($V_R = 800V$, $T_j = 150^\circ C$,
 dynamic test circuit in Fig.E)

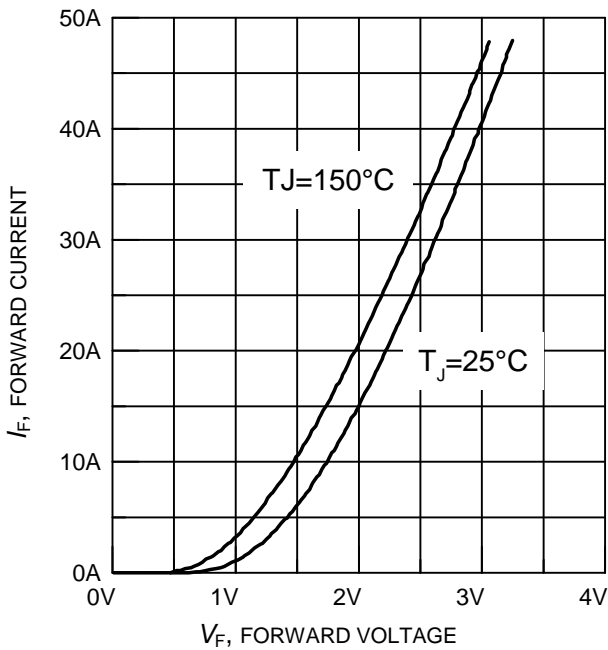


Figure 25. Typical diode forward current as a function of forward voltage

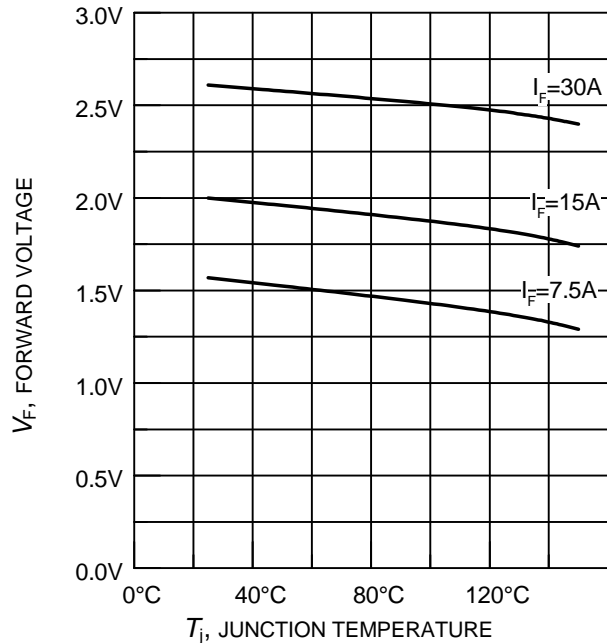


Figure 26. Typical diode forward voltage as a function of junction temperature

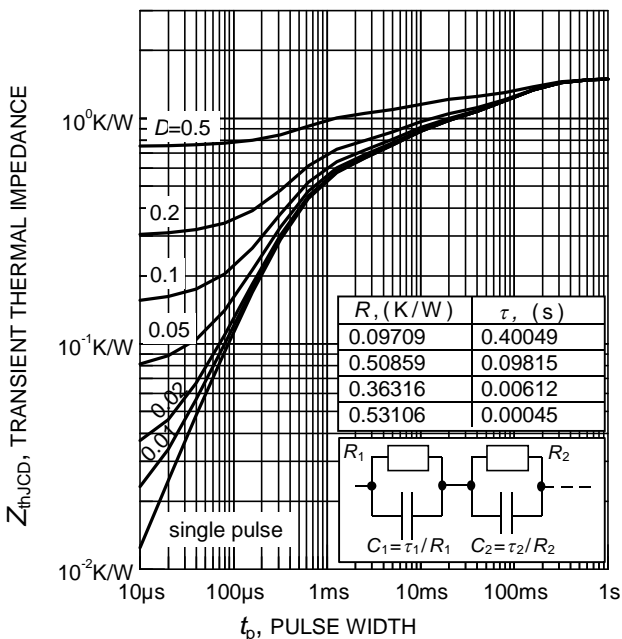
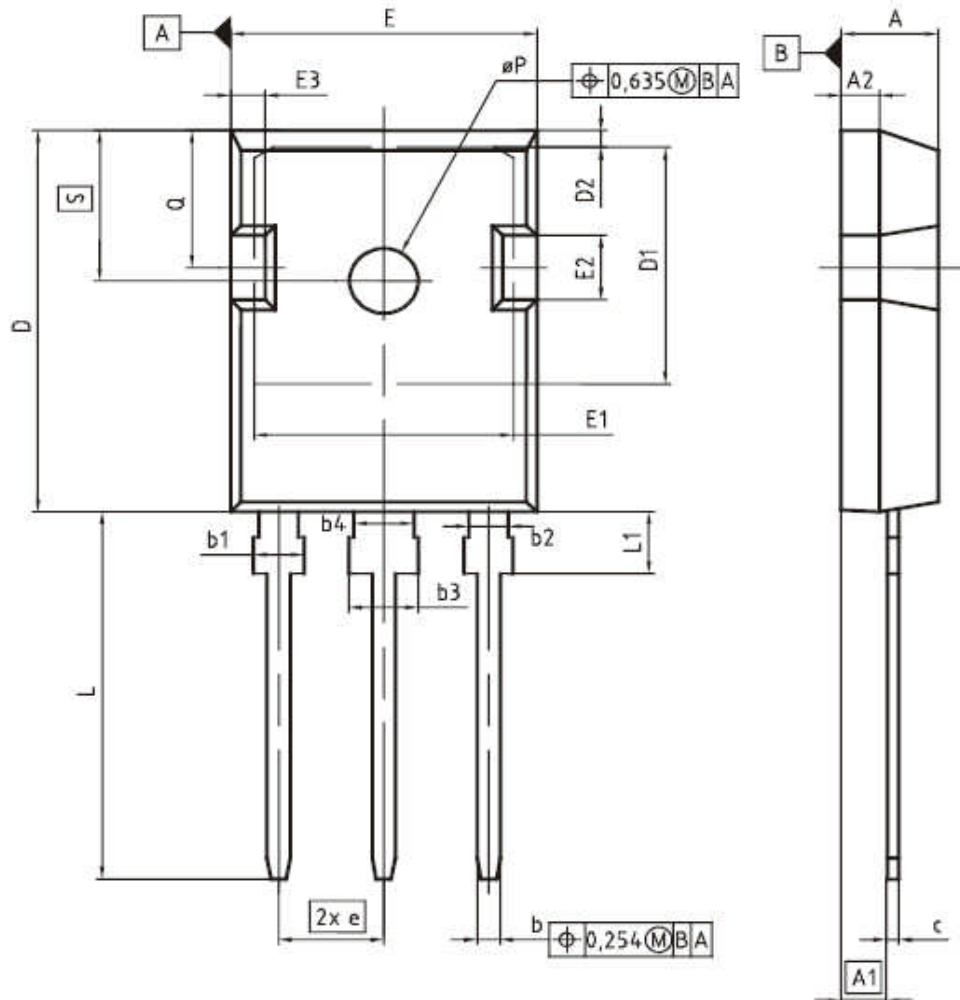


Figure 27. Diode transient thermal impedance as a function of pulse width ($D = t_p / T$)

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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05

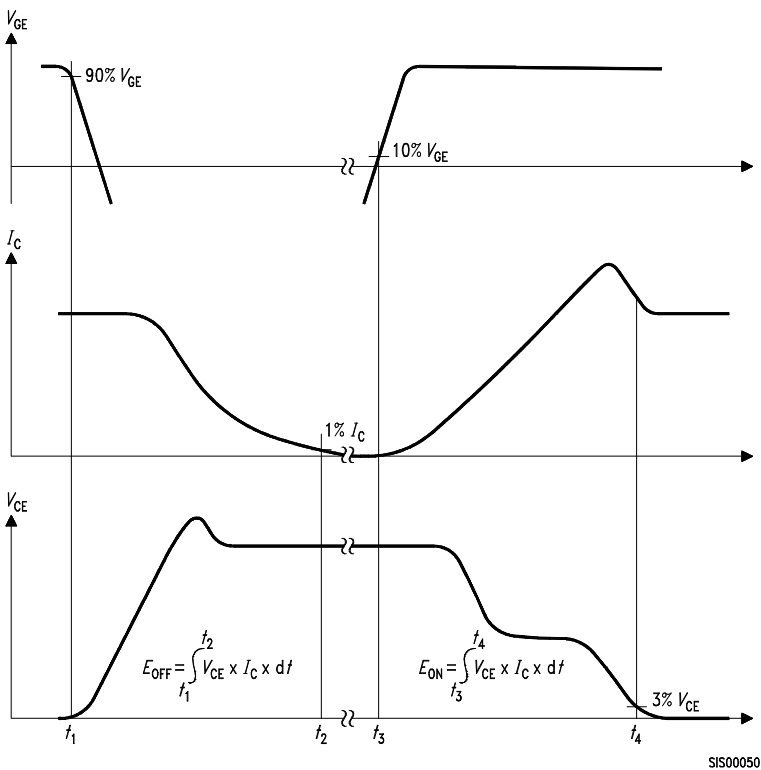
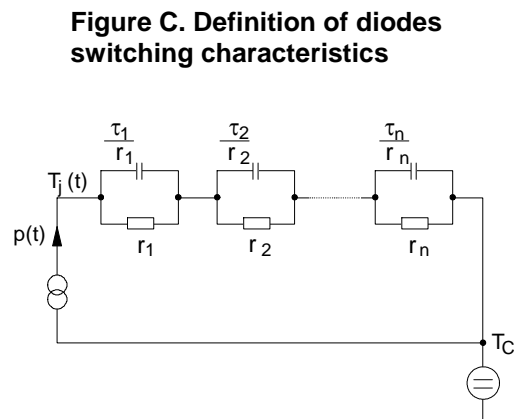
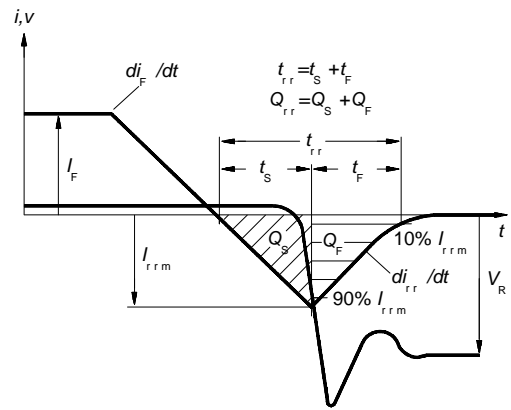
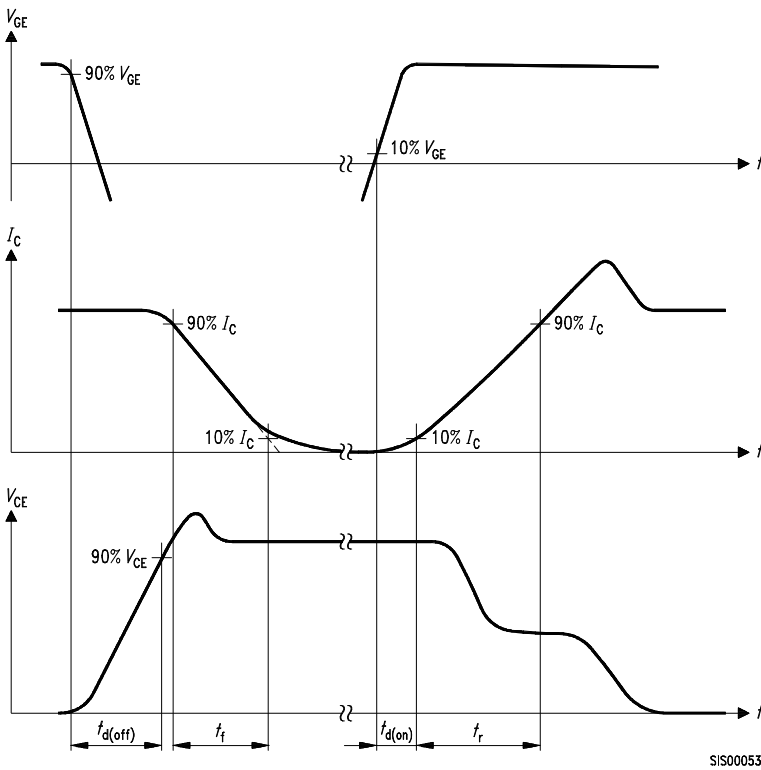
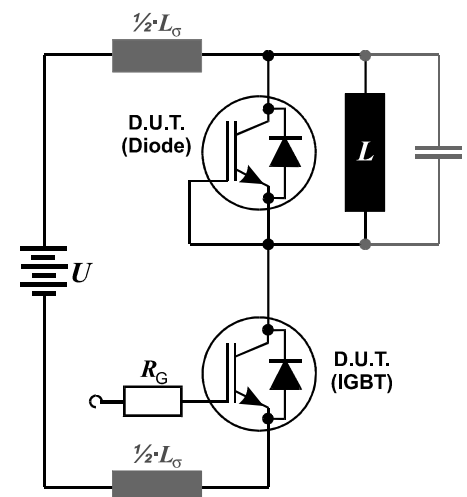


Figure D. Thermal equivalent circuit



Leakage inductance $L_{\sigma}=180\text{nH}$, and stray capacity $C_{\sigma}=40\text{pF}$.

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