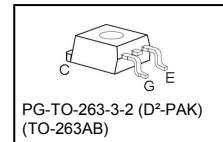
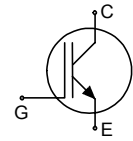


Fast IGBT in NPT-technology

- 75% lower E_{off} compared to previous generation combined with low conduction losses
- Short circuit withstand time – 10 μ s
- Designed for:
 - Motor controls
 - Inverter
- NPT-Technology for 600V applications offers:
 - very tight parameter distribution
 - high ruggedness, temperature stable behaviour
 - parallel switching capability
- Qualified according to JEDEC² 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	$V_{CE(sat)150^\circ C}$	T_j	Marking	Package
SGB02N60	600V	2A	2.2V	150°C	G02N60	PG-TO-263-3-2

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	600	V
DC collector current	I_C	6.0	A
$T_C = 25^\circ C$		2.9	
$T_C = 100^\circ C$			
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	12	
Turn off safe operating area	-	12	
$V_{CE} \leq 600V, T_j \leq 150^\circ C$			
Gate-emitter voltage	V_{GE}	± 20	V
Avalanche energy, single pulse	E_{AS}	13	mJ
$I_C = 2 A, V_{CC} = 50 V, R_{GE} = 25 \Omega,$ start at $T_j = 25^\circ C$			
Short circuit withstand time ¹⁾	t_{SC}	10	μ s
$V_{GE} = 15V, V_{CC} \leq 600V, T_j \leq 150^\circ C$			
Power dissipation	P_{tot}	30	W
$T_C = 25^\circ C$			
Operating junction and storage temperature	T_j, T_{stg}	-55...+150	°C
Soldering temperature (reflow soldering, MSL1)		245	

² J-STD-020 and JESD-022

¹⁾ 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}		4.2	K/W
Thermal resistance, junction – ambient ¹⁾	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	$V_{(BR)CES}$	$V_{GE}=0V, I_C=500\mu A$	600	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE} = 15V, I_C=2A$	1.7	1.9	2.4	
		$T_j=25\text{ °C}$	-	2.2	2.7	
		$T_j=150\text{ °C}$	-	-	-	
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C=150\mu A, V_{CE}=V_{GE}$	3	4	5	
Zero gate voltage collector current	I_{CES}	$V_{CE}=600V, V_{GE}=0V$	-	-	20	μA
		$T_j=25\text{ °C}$	-	-	250	
		$T_j=150\text{ °C}$	-	-	-	
Gate-emitter leakage current	I_{GES}	$V_{CE}=0V, V_{GE}=20V$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE}=20V, I_C=2A$	-	1.6	-	S
Dynamic Characteristic						
Input capacitance	C_{iss}	$V_{CE}=25V,$	-	142	170	pF
Output capacitance	C_{oss}	$V_{GE}=0V,$	-	18	22	
Reverse transfer capacitance	C_{riss}	$f=1\text{ MHz}$	-	10	12	
Gate charge	Q_{Gate}	$V_{CC}=480V, I_C=2A$ $V_{GE}=15V$	-	14	18	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	7	-	nH
Short circuit collector current ²⁾	$I_{C(SC)}$	$V_{GE}=15V, t_{SC}\leq 10\mu s$ $V_{CC}\leq 600V,$ $T_j\leq 150\text{ °C}$	-	20	-	A

¹⁾ Device on 50mm*50mm*1.5mm epoxy PCB FR4 with 6cm² (one layer, 70μm thick) copper area for collector connection. PCB is vertical without blown air.

²⁾ 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	$t_{d(on)}$	$T_j=25\text{ }^\circ\text{C}$, $V_{CC}=400\text{V}$, $I_C=2\text{A}$, $V_{GE}=0/15\text{V}$, $R_G=118\Omega$, $L_{\sigma}^{(1)}=180\text{nH}$, $C_{\sigma}^{(1)}=180\text{pF}$ Energy losses include "tail" and diode reverse recovery.	-	20	24	ns
Rise time	t_r		-	13	16	
Turn-off delay time	$t_{d(off)}$		-	259	311	
Fall time	t_f		-	52	62	
Turn-on energy	E_{on}		-	0.036	0.041	mJ
Turn-off energy	E_{off}		-	0.028	0.036	
Total switching energy	E_{ts}		-	0.064	0.078	

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	$t_{d(on)}$	$T_j=150\text{ }^\circ\text{C}$, $V_{CC}=400\text{V}$, $I_C=2\text{A}$, $V_{GE}=0/15\text{V}$, $R_G=118\Omega$, $L_{\sigma}^{(1)}=180\text{nH}$, $C_{\sigma}^{(1)}=180\text{pF}$ Energy losses include "tail" and diode reverse recovery.	-	20	24	ns
Rise time	t_r		-	14	17	
Turn-off delay time	$t_{d(off)}$		-	287	344	
Fall time	t_f		-	67	80	
Turn-on energy	E_{on}		-	0.054	0.062	mJ
Turn-off energy	E_{off}		-	0.043	0.056	
Total switching energy	E_{ts}		-	0.097	0.118	

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

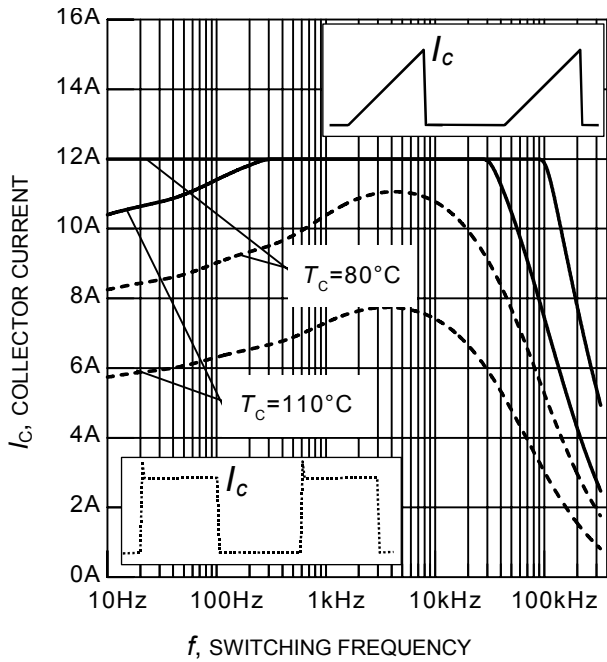


Figure 1. Collector current as a function of switching frequency

($T_j \leq 150^\circ\text{C}$, $D = 0.5$, $V_{CE} = 400\text{V}$, $V_{GE} = 0/+15\text{V}$, $R_G = 118\Omega$)

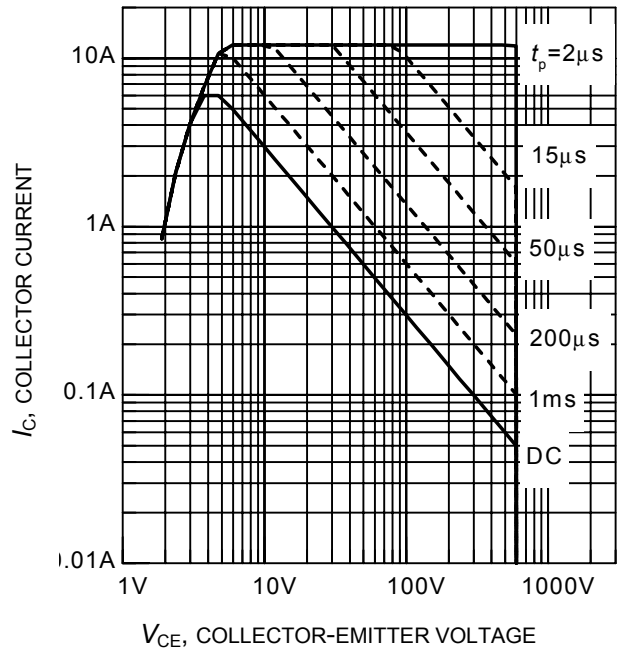


Figure 2. Safe operating area
($D = 0$, $T_C = 25^\circ\text{C}$, $T_j \leq 150^\circ\text{C}$)

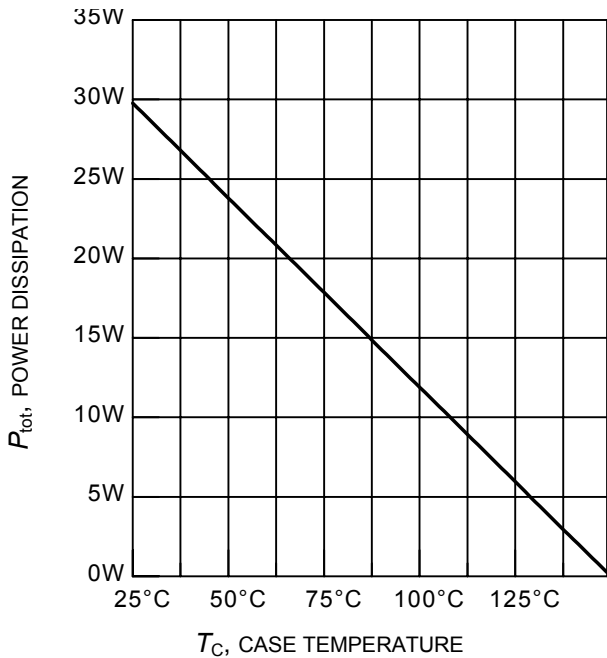


Figure 3. Power dissipation (IGBT) as a function of case temperature

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

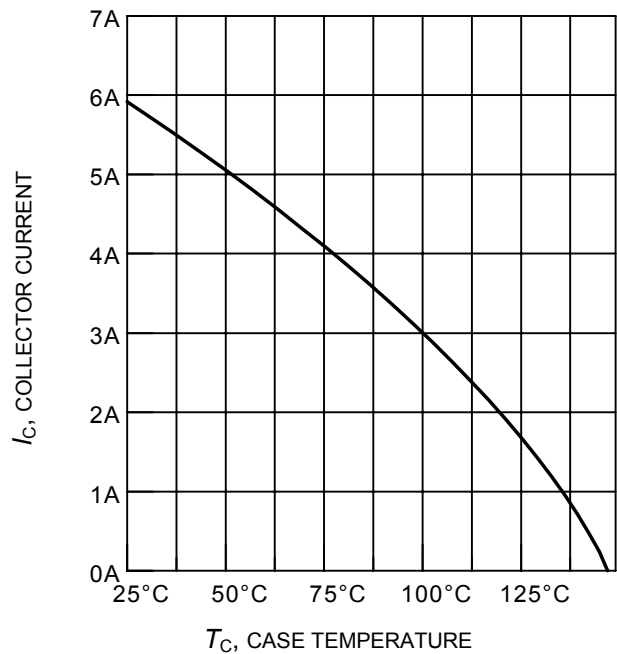


Figure 4. Collector current as a function of case temperature

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

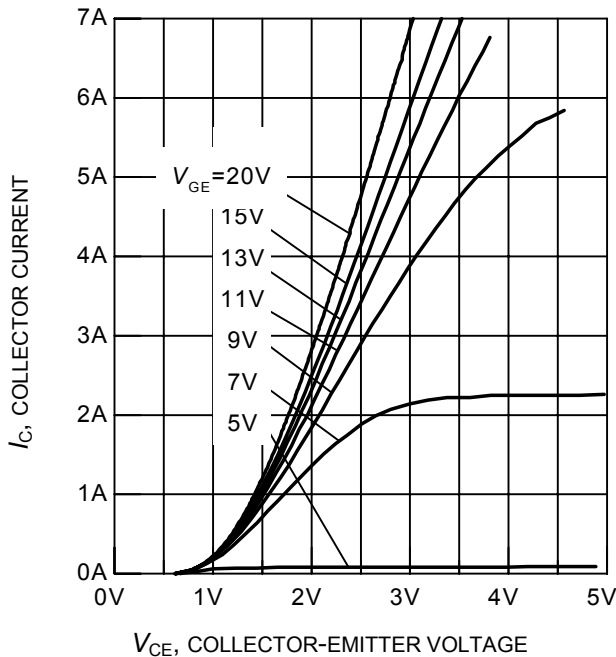


Figure 5. Typical output characteristics
($T_j = 25^\circ\text{C}$)

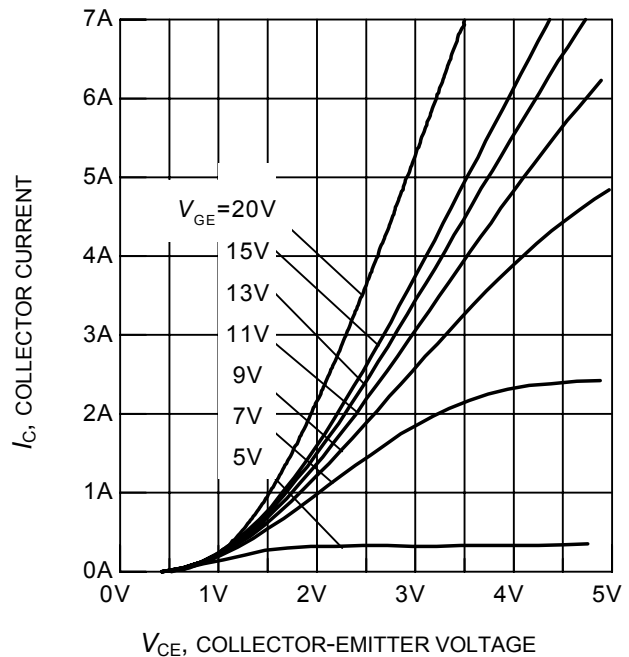


Figure 6. Typical output characteristics
($T_j = 150^\circ\text{C}$)

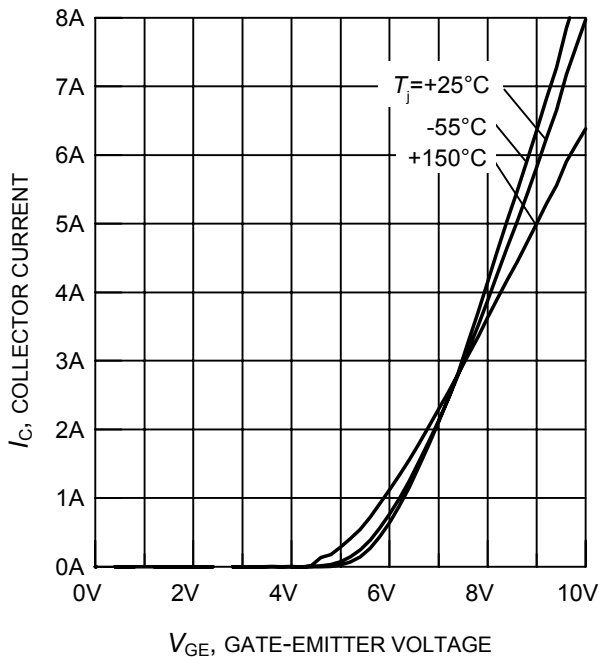


Figure 7. Typical transfer characteristics
($V_{CE} = 10\text{V}$)

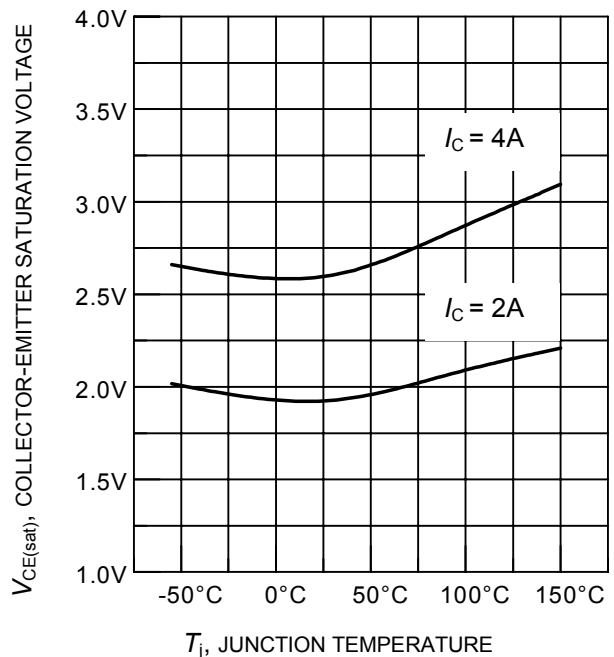


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
($V_{GE} = 15\text{V}$)

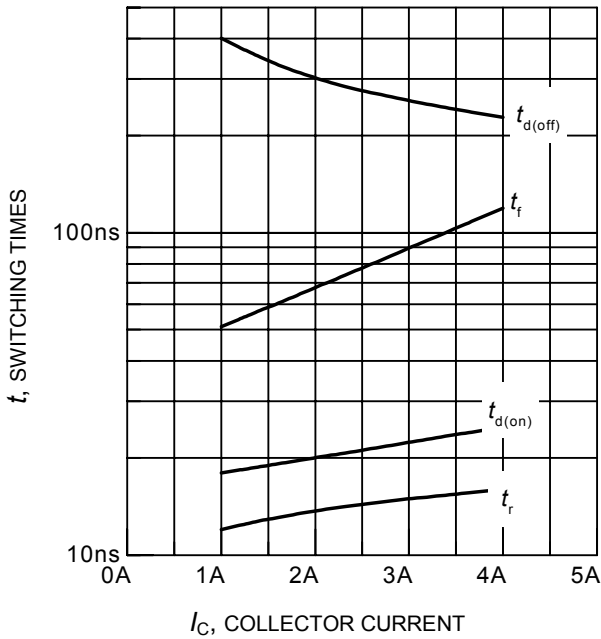


Figure 9. Typical switching times as a function of collector current
 (inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 400\text{V}$, $V_{GE} = 0/+15\text{V}$, $R_G = 118\Omega$,
 $I_C = 2\text{A}$, Dynamic test circuit in Figure E)

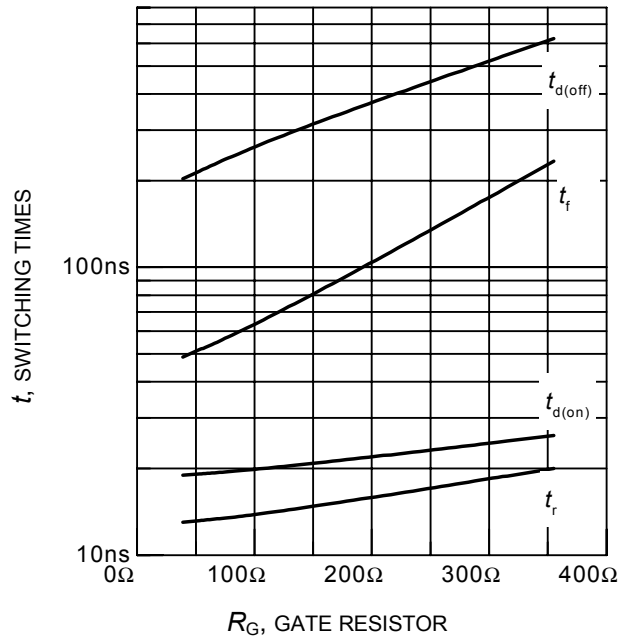


Figure 10. Typical switching times as a function of gate resistor
 (inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 400\text{V}$, $V_{GE} = 0/+15\text{V}$, $I_C = 2\text{A}$,
 Dynamic test circuit in Figure E)

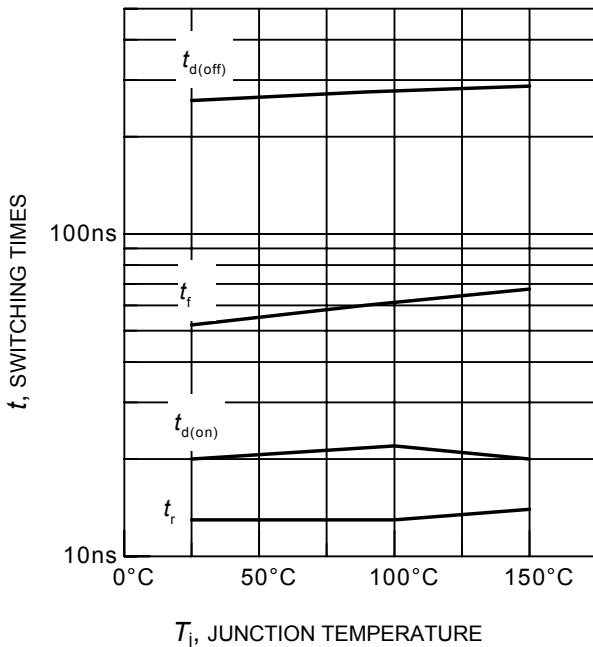


Figure 11. Typical switching times as a function of junction temperature
 (inductive load, $V_{CE} = 400\text{V}$, $V_{GE} = 0/+15\text{V}$,
 $I_C = 2\text{A}$, $R_G = 118\Omega$,
 Dynamic test circuit in Figure E)

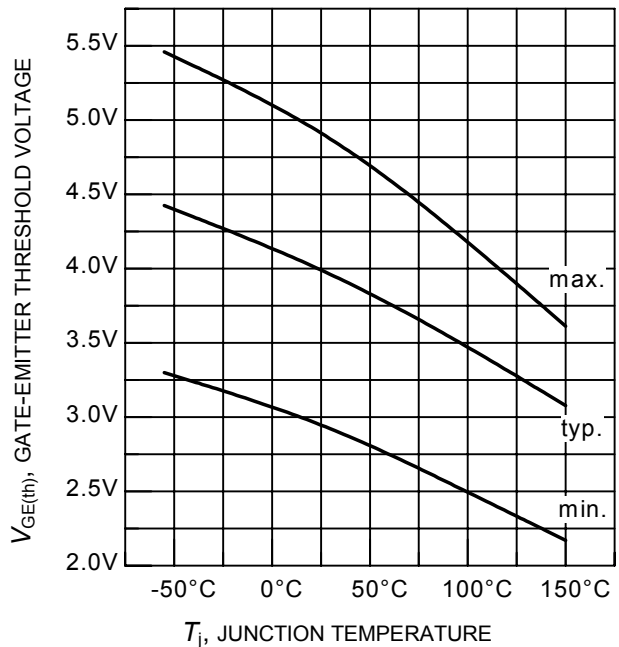


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
 ($I_C = 0.15\text{mA}$)

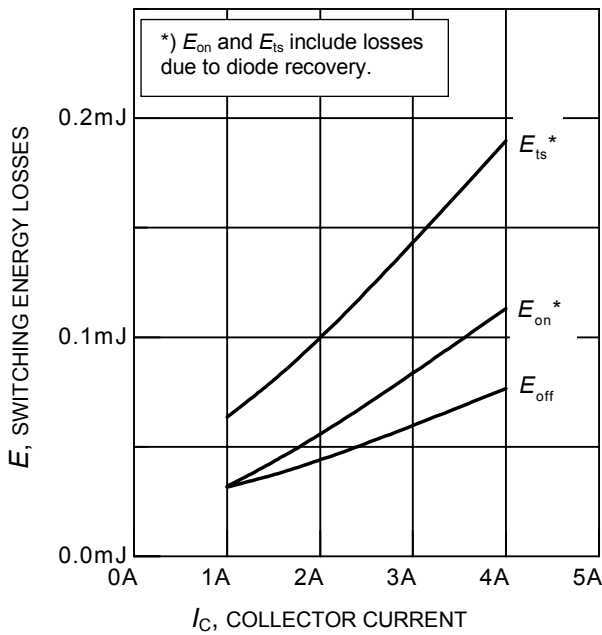


Figure 13. Typical switching energy losses as a function of collector current
 (inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 400\text{V}$, $V_{GE} = 0/+15\text{V}$, $R_G = 118\Omega$,
 Dynamic test circuit in Figure E)

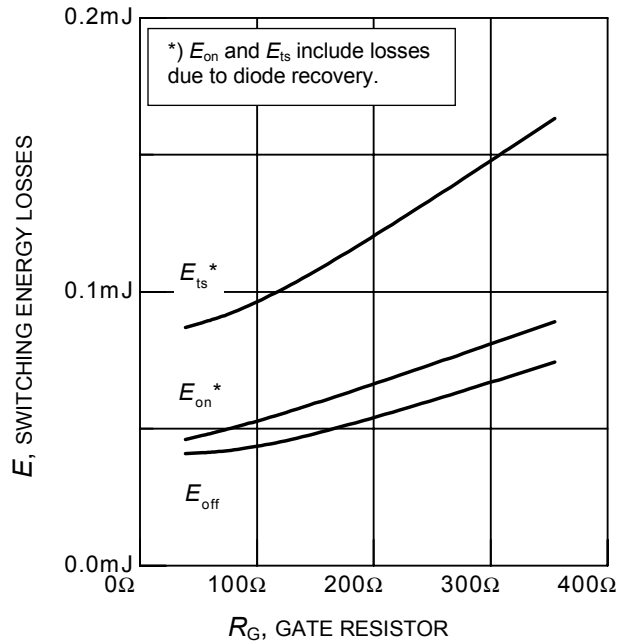


Figure 14. Typical switching energy losses as a function of gate resistor
 (inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 400\text{V}$, $V_{GE} = 0/+15\text{V}$, $I_C = 2\text{A}$,
 Dynamic test circuit in Figure E)

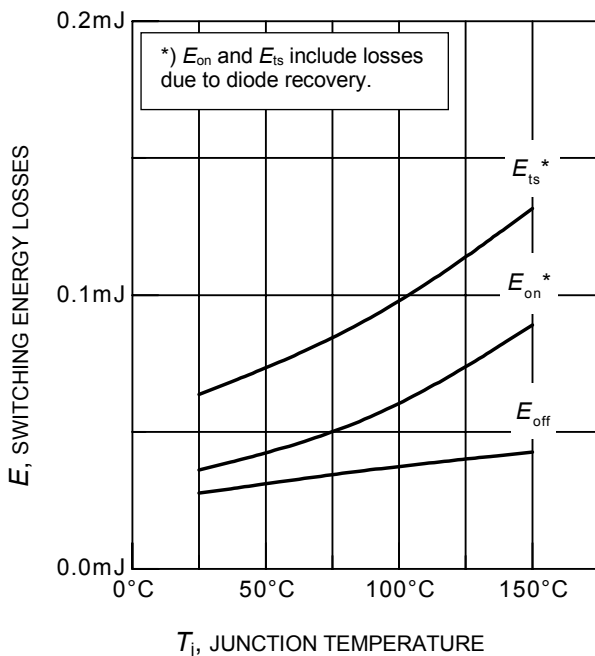


Figure 15. Typical switching energy losses as a function of junction temperature
 (inductive load, $V_{CE} = 400\text{V}$, $V_{GE} = 0/+15\text{V}$, $I_C = 2\text{A}$, $R_G = 118\Omega$,
 Dynamic test circuit in Figure E)

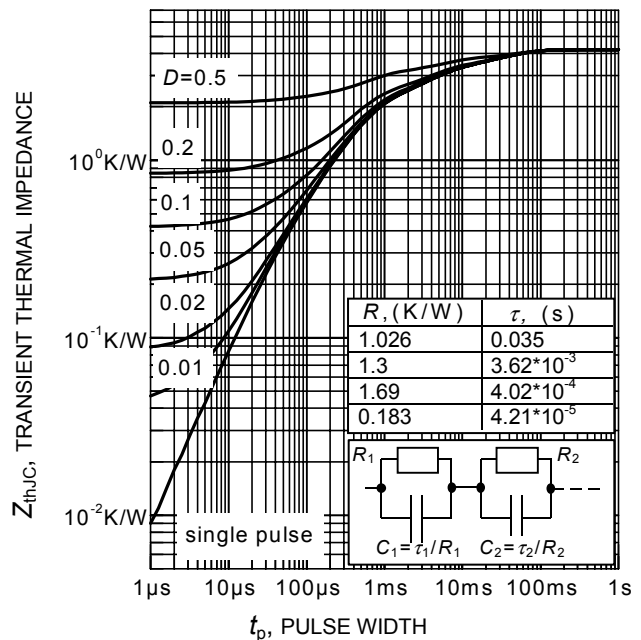


Figure 16. IGBT transient thermal impedance as a function of pulse width
 ($D = t_p / T$)

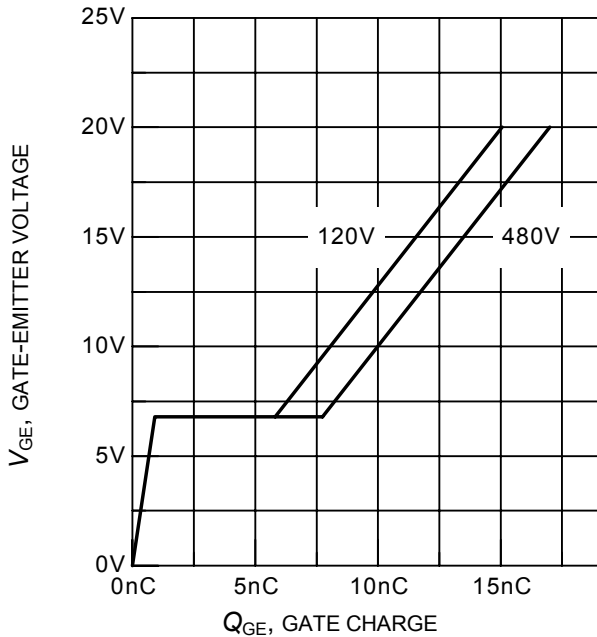


Figure 17. Typical gate charge
($I_C = 2A$)

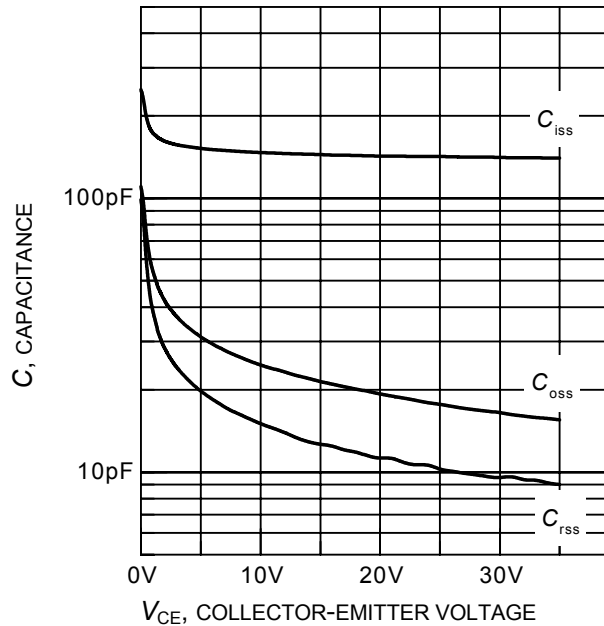


Figure 18. Typical capacitance as a function of collector-emitter voltage
($V_{GE} = 0V, f = 1MHz$)

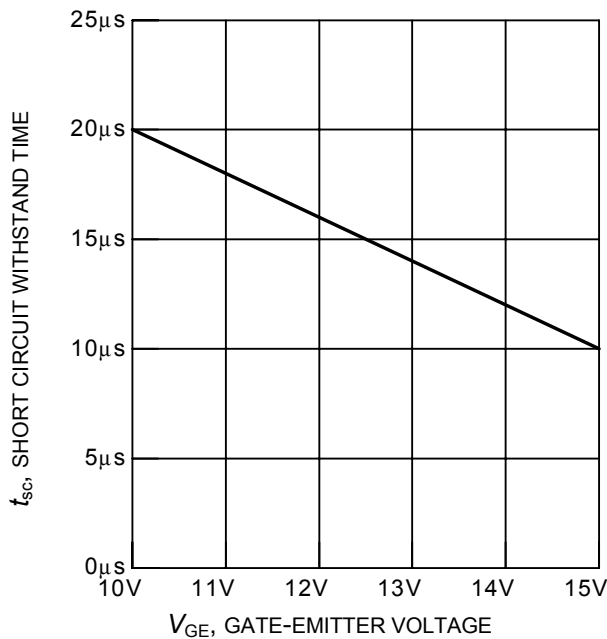


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
($V_{CE} = 600V, \text{start at } T_j = 25^\circ C$)

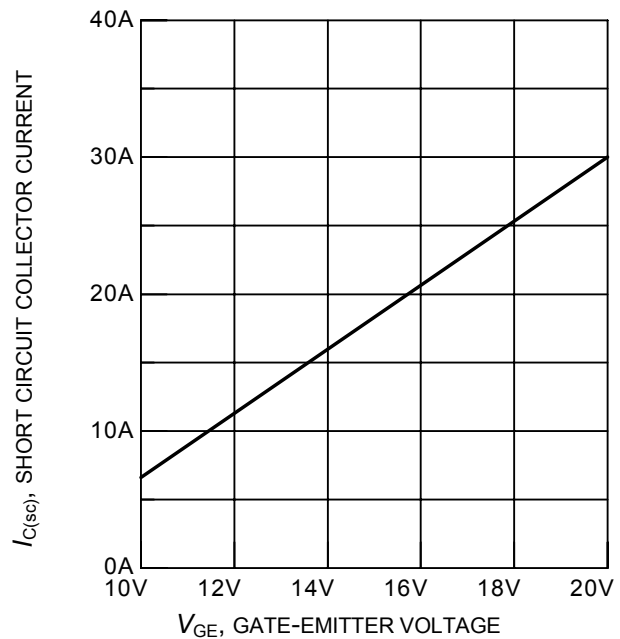


Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \leq 600V, T_j = 150^\circ C$)

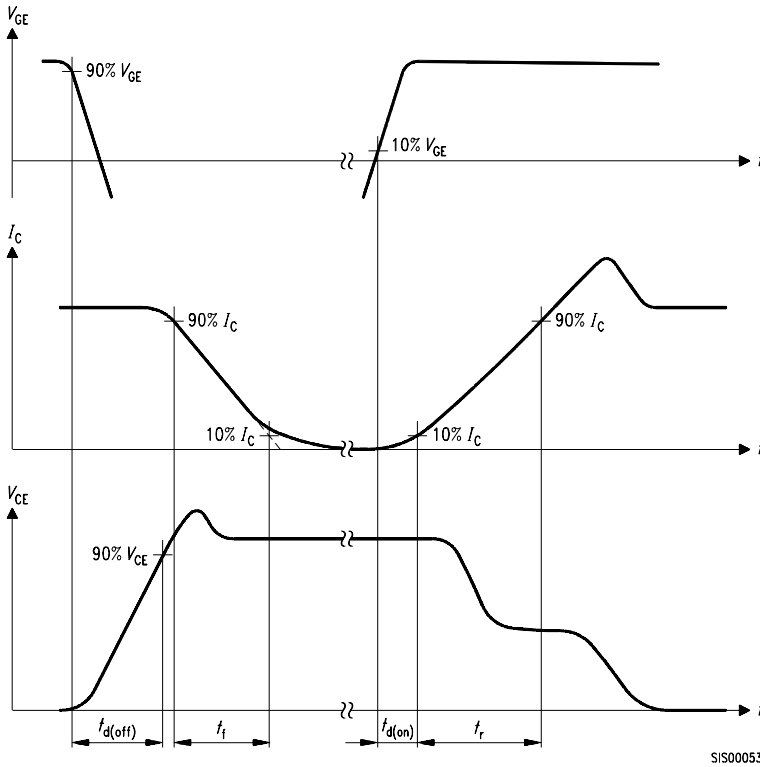


Figure A. Definition of switching times

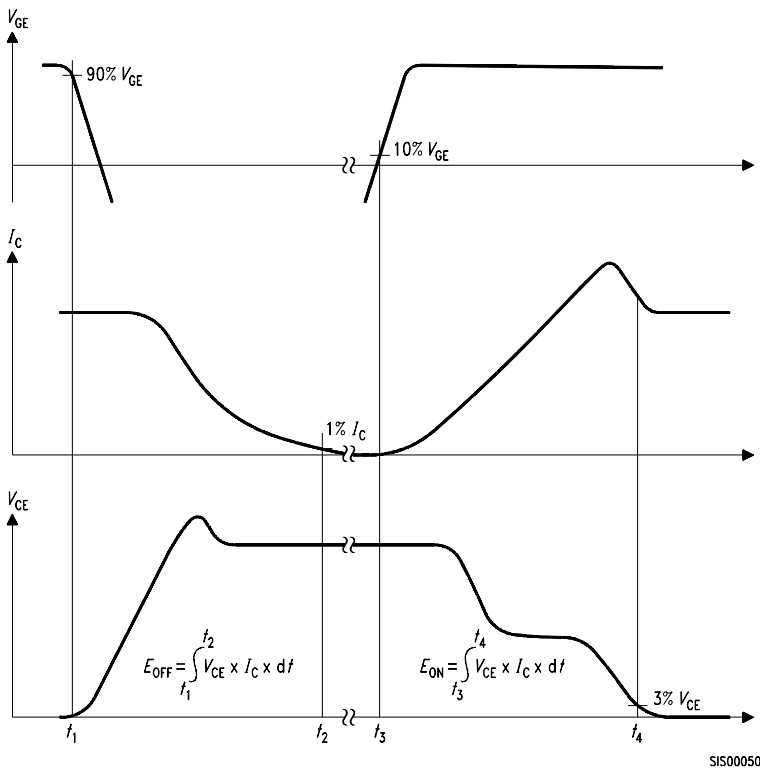


Figure B. Definition of switching losses

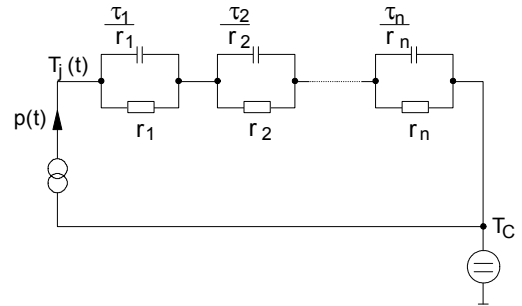


Figure D. Thermal equivalent circuit

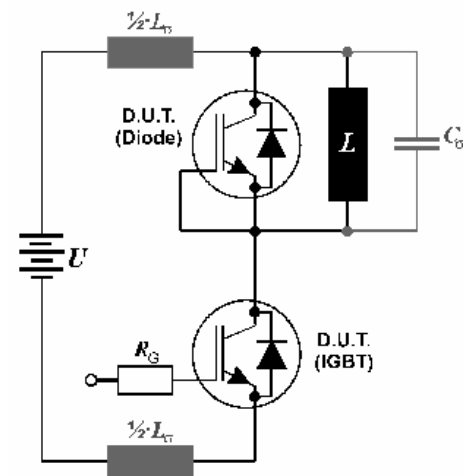


Figure E. Dynamic test circuit
Leakage inductance $L_{\sigma} = 180\text{nH}$
and Stray capacity $C_{\sigma} = 180\text{pF}$.

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