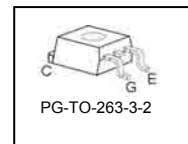
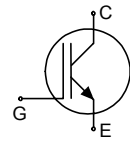


Fast IGBT in NPT-technology

- 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 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	Marking	Package
SGB15N60	600V	15A	2.3V	150°C	G15N60	PG-TO-263-3-2

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	600	V
DC collector current	I_C	31	A
$T_C = 25^\circ\text{C}$		15	
$T_C = 100^\circ\text{C}$			
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	62	
Turn off safe operating area	-	62	
$V_{CE} \leq 600\text{V}, T_j \leq 150^\circ\text{C}$			
Gate-emitter voltage	V_{GE}	± 20	V
Avalanche energy, single pulse	E_{AS}	85	mJ
$I_C = 15\text{ A}, V_{CC} = 50\text{ V}, R_{GE} = 25\ \Omega,$ start at $T_j = 25^\circ\text{C}$			
Short circuit withstand time ²	t_{SC}	10	μ s
$V_{GE} = 15\text{V}, V_{CC} \leq 600\text{V}, T_j \leq 150^\circ\text{C}$			
Power dissipation	P_{tot}	139	W
$T_C = 25^\circ\text{C}$			
Operating junction and storage temperature	T_j, T_{stg}	-55...+150	$^\circ\text{C}$
Soldering temperature (reflow soldering, MSL1)		245	

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}		0.9	K/W
Thermal resistance, junction – ambient ¹⁾	R_{thJA}		40	

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

Parameter	Symbol	Conditions	Value			Unit	
			min.	Typ.	max.		
Static Characteristic							
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE}=0V, I_C=500\mu A$	600	-	-	V	
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE} = 15V, I_C=15A$	1.7	2	2.4		
		$T_j=150^\circ\text{C}$	-	2.3	2.8		
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C=400\mu A, V_{CE}=V_{GE}$	3	4	5		
Zero gate voltage collector current	I_{CES}	$V_{CE}=600V, V_{GE}=0V$	$T_j=25^\circ\text{C}$	-	-	40	μA
			$T_j=150^\circ\text{C}$	-	-	2000	
Gate-emitter leakage current	I_{GES}	$V_{CE}=0V, V_{GE}=20V$	-	-	100	nA	
Transconductance	g_{fs}	$V_{CE}=20V, I_C=15A$	3	10.9	-	S	
Dynamic Characteristic							
Input capacitance	C_{iss}	$V_{CE}=25V,$ $V_{GE}=0V,$ $f=1\text{MHz}$	-	800	960	pF	
Output capacitance	C_{oss}		-	84	101		
Reverse transfer capacitance	C_{riss}		-	52	62		
Gate charge	Q_{Gate}	$V_{CC}=480V, I_C=15A$ $V_{GE}=15V$	-	76	99	nC	
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	7	-	nH	
Short circuit collector current ²⁾	$I_{C(SC)}$	$V_{GE}=15V, t_{SC}\leq 10\mu s$ $V_{CC}\leq 600V,$ $T_j\leq 150^\circ\text{C}$	-	150	-	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 $T_j=25^\circ\text{C}$

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(\text{on})}$	$T_j=25^\circ\text{C}$, $V_{\text{CC}}=400\text{V}$, $I_{\text{C}}=15\text{A}$, $V_{\text{GE}}=0/15\text{V}$, $R_{\text{G}}=21\Omega$, $L_{\sigma}^{1)}=180\text{nH}$, $C_{\sigma}^{1)}=250\text{pF}$ Energy losses include "tail" and diode reverse recovery.	-	32	38	ns
Rise time	t_{r}		-	23	28	
Turn-off delay time	$t_{d(\text{off})}$		-	234	281	
Fall time	t_{f}		-	46	55	
Turn-on energy	E_{on}		-	0.30	0.36	mJ
Turn-off energy	E_{off}		-	0.27	0.35	
Total switching energy	E_{ts}		-	0.57	0.71	

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	$t_{d(\text{on})}$	$T_j=150^\circ\text{C}$ $V_{\text{CC}}=400\text{V}$, $I_{\text{C}}=15\text{A}$, $L_{\sigma}^{1)}=180\text{nH}$, $C_{\sigma}^{1)}=250\text{pF}$ $V_{\text{GE}}=0/15\text{V}$, $R_{\text{G}}=21\Omega$ Energy losses include "tail" and diode reverse recovery.	-	31	38	ns
Rise time	t_{r}		-	23	28	
Turn-off delay time	$t_{d(\text{off})}$		-	261	313	
Fall time	t_{f}		-	54	65	
Turn-on energy	E_{on}		-	0.45	0.54	mJ
Turn-off energy	E_{off}		-	0.41	0.53	
Total switching energy	E_{ts}		-	0.86	1.07	

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

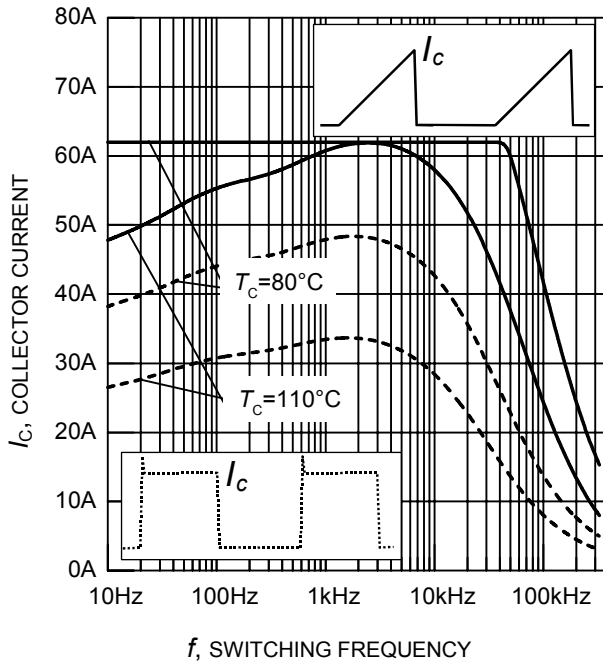


Figure 1. Collector current as a function of switching frequency
 ($T_j \leq 150^\circ\text{C}$, $D = 0.5$, $V_{CE} = 400\text{V}$, $V_{GE} = 0/+15\text{V}$, $R_G = 21\Omega$)

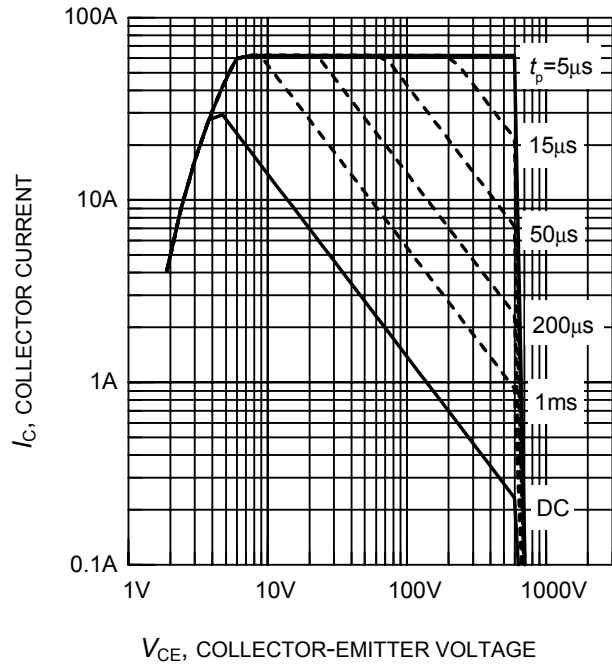


Figure 2. Safe operating area
 ($D = 0$, $T_C = 25^\circ\text{C}$, $T_j \leq 150^\circ\text{C}$)

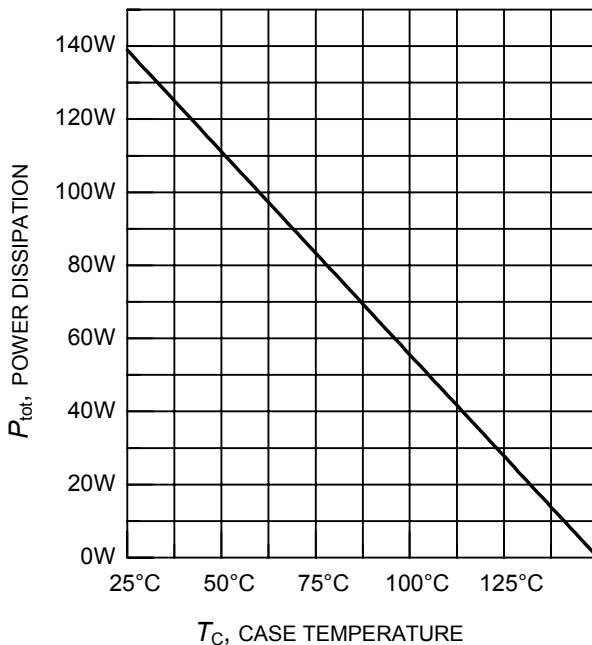


Figure 3. Power dissipation as a function of case temperature
 ($T_j \leq 150^\circ\text{C}$)

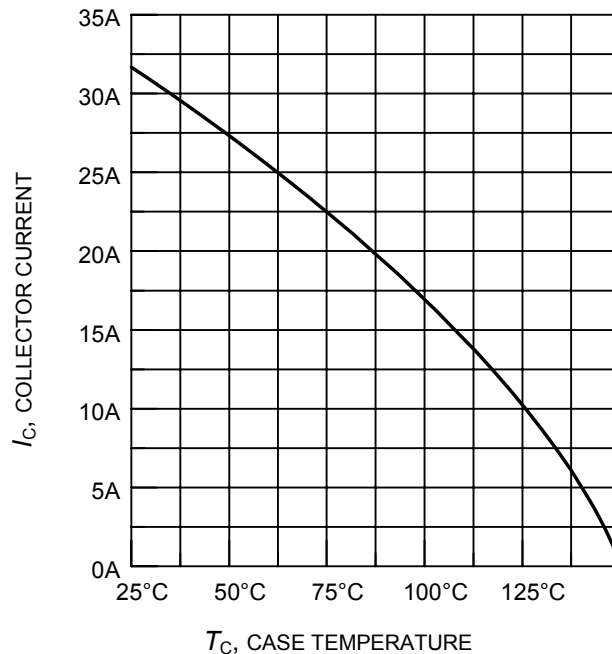


Figure 4. Collector current as a function of case temperature
 ($V_{GE} \leq 15\text{V}$, $T_j \leq 150^\circ\text{C}$)

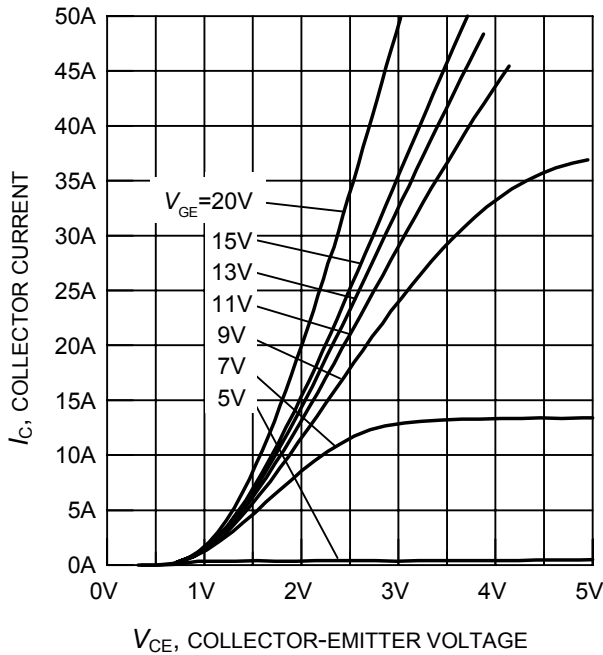


Figure 5. Typical output characteristics
($T_j = 25^\circ\text{C}$)

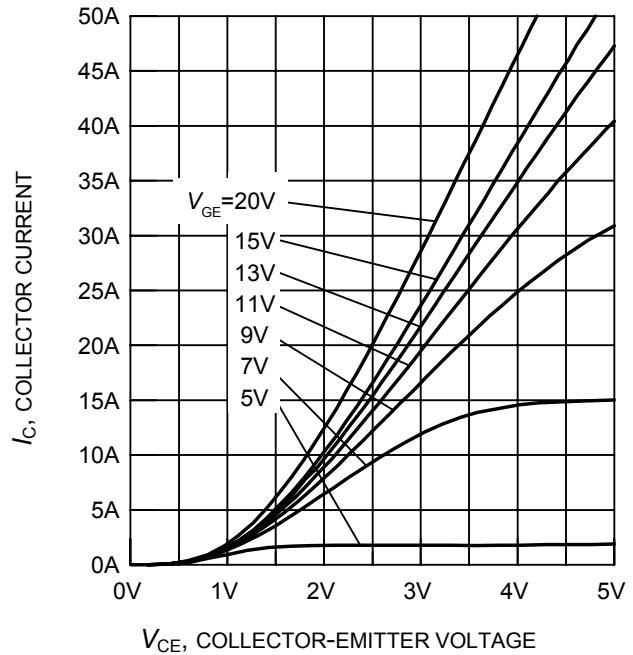


Figure 6. Typical output characteristics
($T_j = 150^\circ\text{C}$)

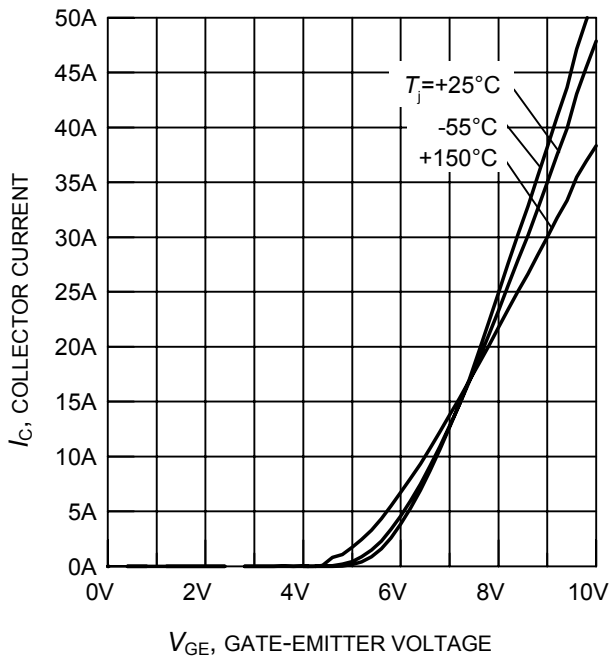


Figure 7. Typical transfer characteristics
($V_{CE} = 10\text{V}$)

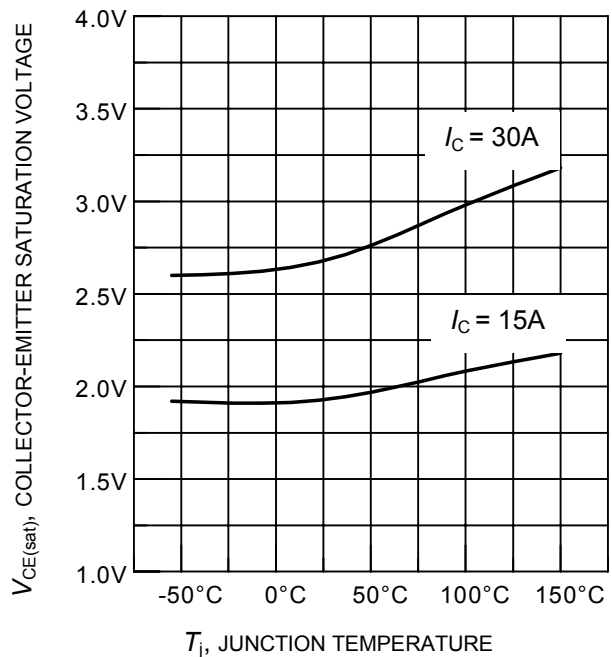


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
($V_{GE} = 15\text{V}$)

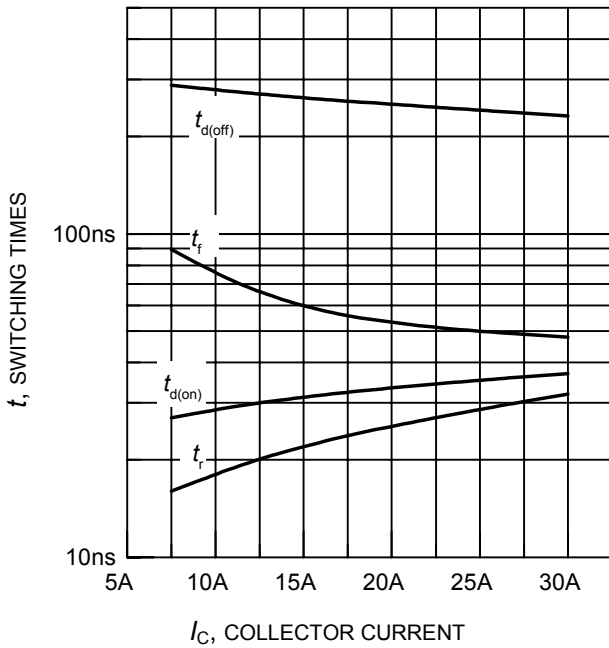


Figure 9. Typical switching times as a function of collector current
 (inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 400\text{V}$,
 $V_{GE} = 0/+15\text{V}$, $R_G = 21\Omega$,
 Dynamic test circuit in Figure E)

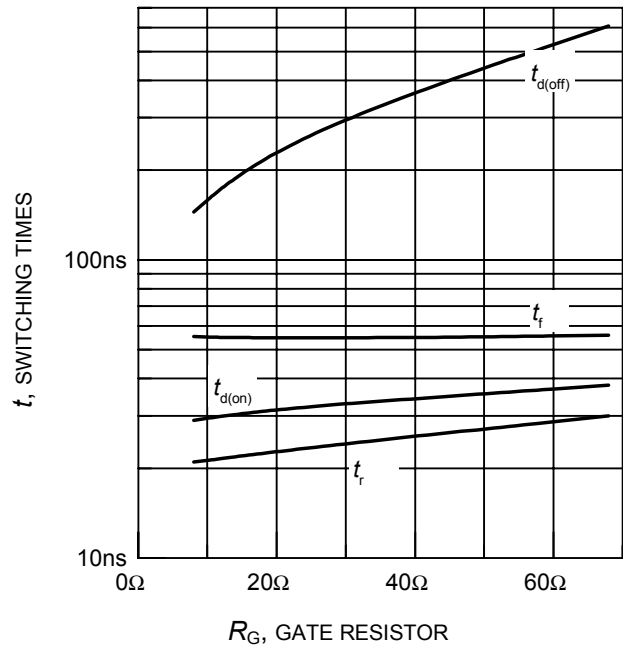


Figure 10. Typical switching times as a function of gate resistor
 (inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 400\text{V}$,
 $V_{GE} = 0/+15\text{V}$, $I_C = 15\text{A}$,
 Dynamic test circuit in Figure E)

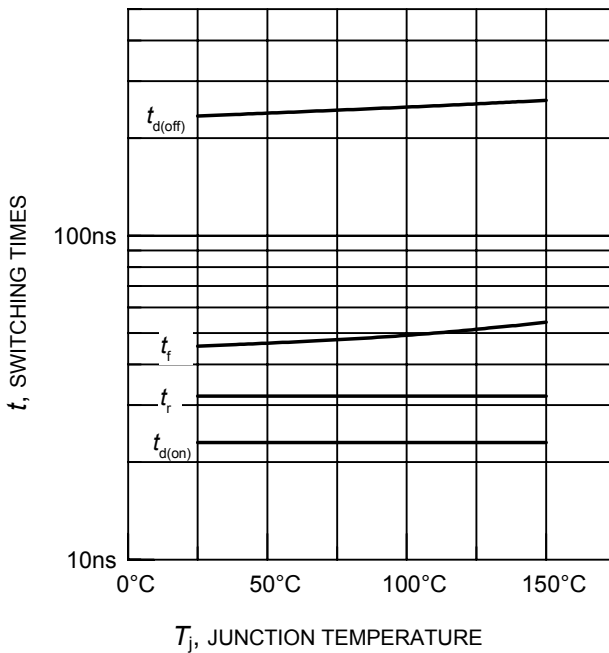


Figure 11. Typical switching times as a function of junction temperature
 (inductive load, $V_{CE} = 400\text{V}$, $V_{GE} = 0/+15\text{V}$,
 $I_C = 15\text{A}$, $R_G = 21\Omega$,
 Dynamic test circuit in Figure E)

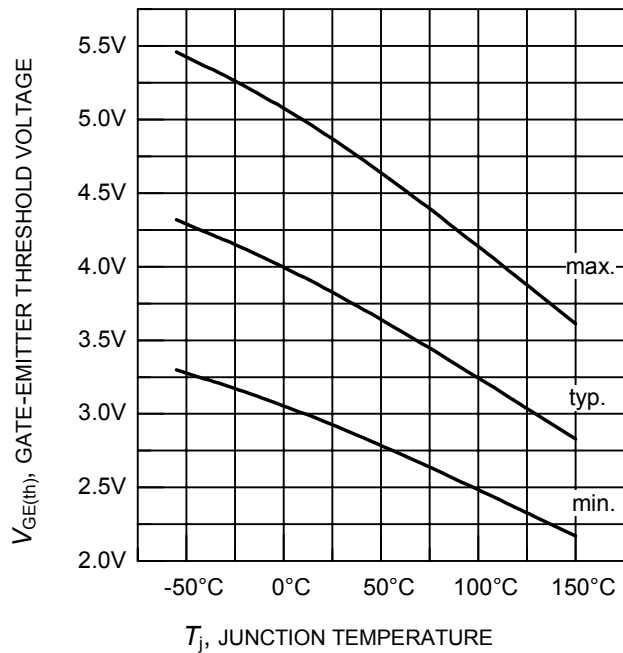


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
 ($I_C = 0.4\text{mA}$)

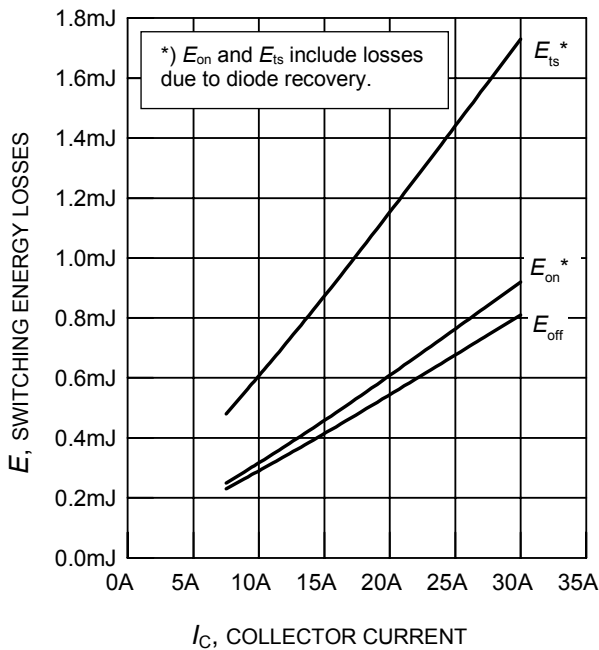


Figure 13. Typical switching energy losses as a function of collector current
 (inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 400\text{V}$, $V_{GE} = 0/+15\text{V}$, $R_G = 21\Omega$,
 Dynamic test circuit in Figure E)

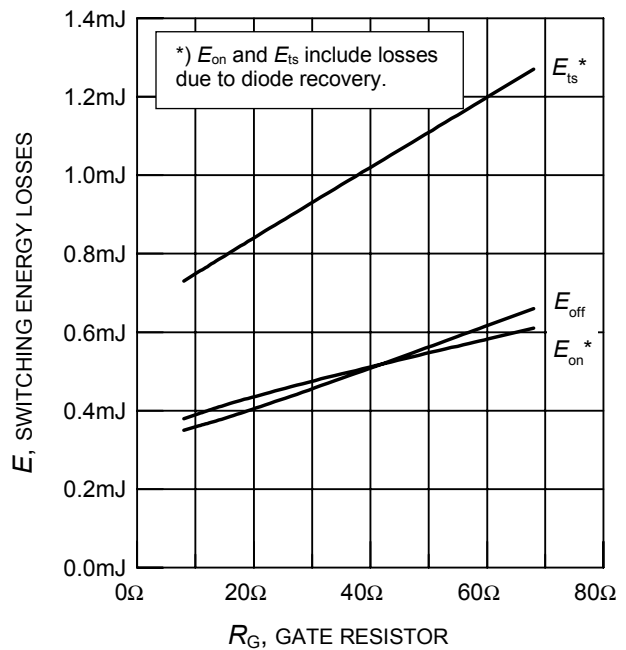


Figure 14. Typical switching energy losses as a function of gate resistor
 (inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 400\text{V}$, $V_{GE} = 0/+15\text{V}$, $I_C = 15\text{A}$,
 Dynamic test circuit in Figure E)

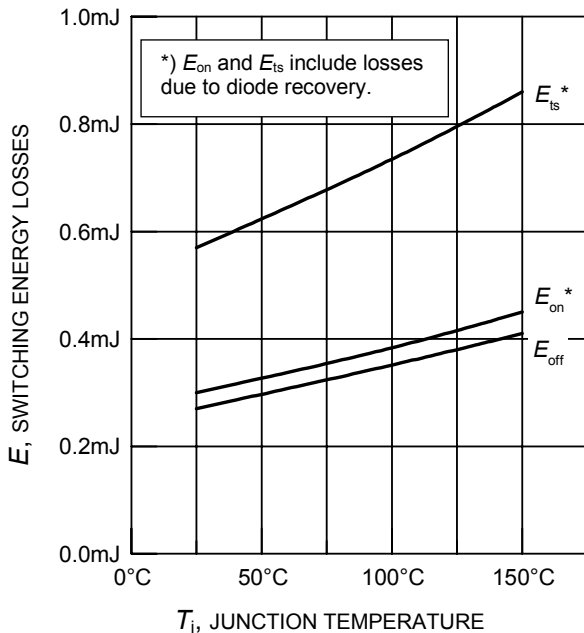


Figure 15. Typical switching energy losses as a function of junction temperature
 (inductive load, $V_{CE} = 400\text{V}$, $V_{GE} = 0/+15\text{V}$, $I_C = 15\text{A}$, $R_G = 21\Omega$,
 Dynamic test circuit in Figure E)

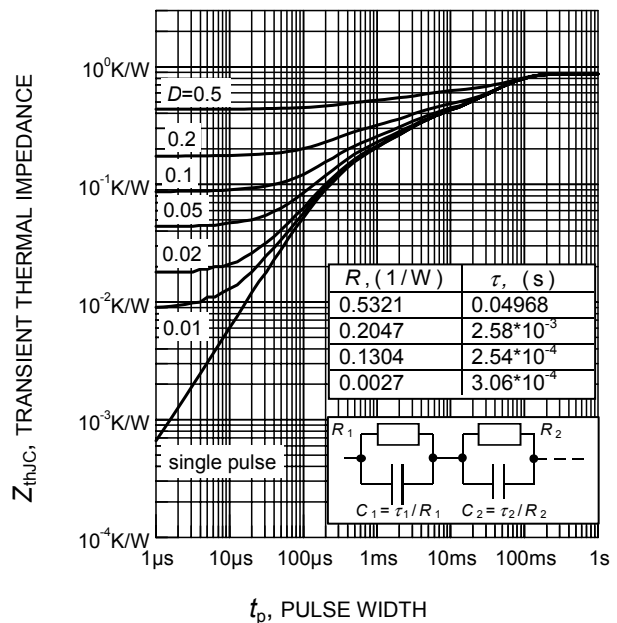


Figure 16. IGBT transient thermal impedance as a function of pulse width
 ($D = t_p / T$)

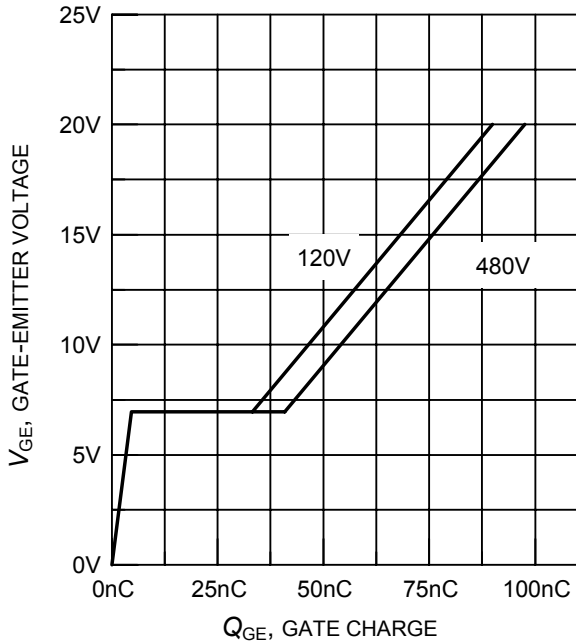


Figure 17. Typical gate charge
($I_C = 15A$)

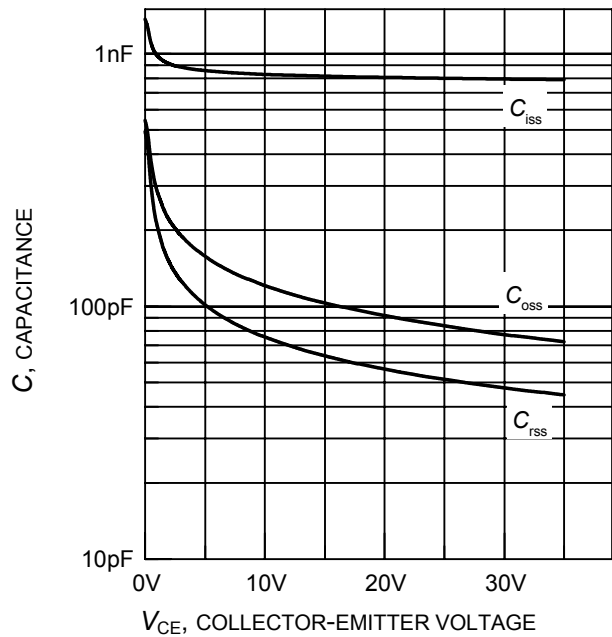


Figure 18. Typical capacitance as a function of collector-emitter voltage
($V_{GE} = 0V, f = 1MHz$)

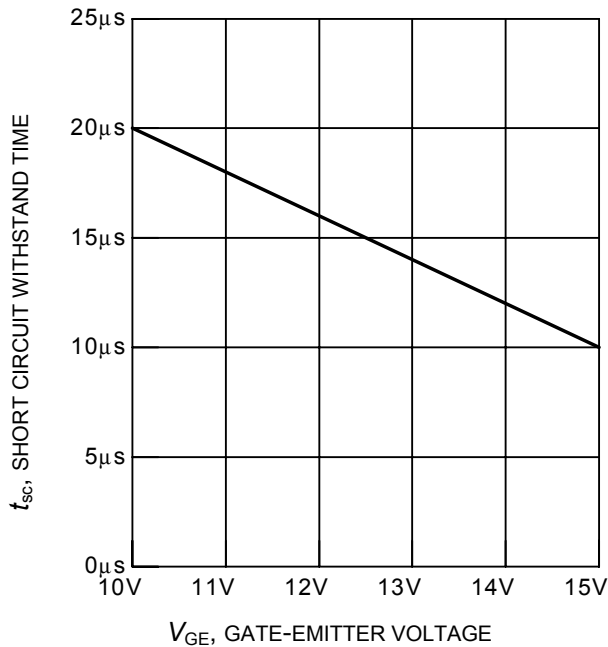


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
($V_{CE} = 600V$, start at $T_j = 25^\circ C$)

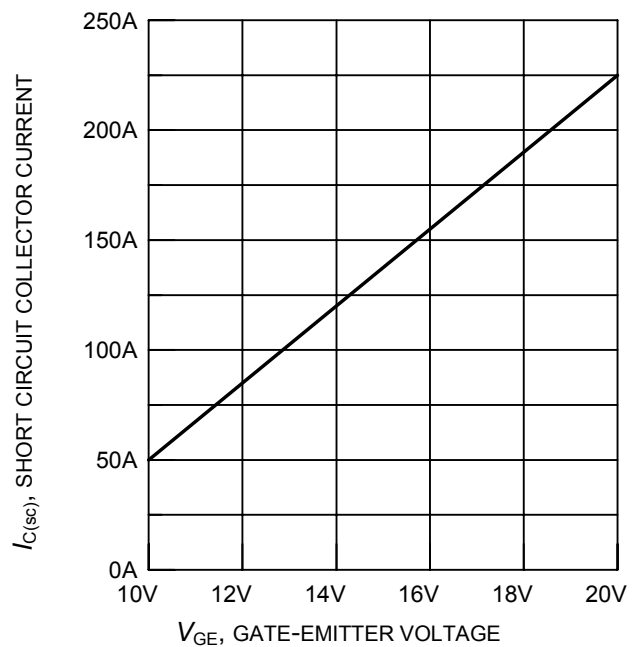


Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \leq 600V, T_j = 150^\circ C$)

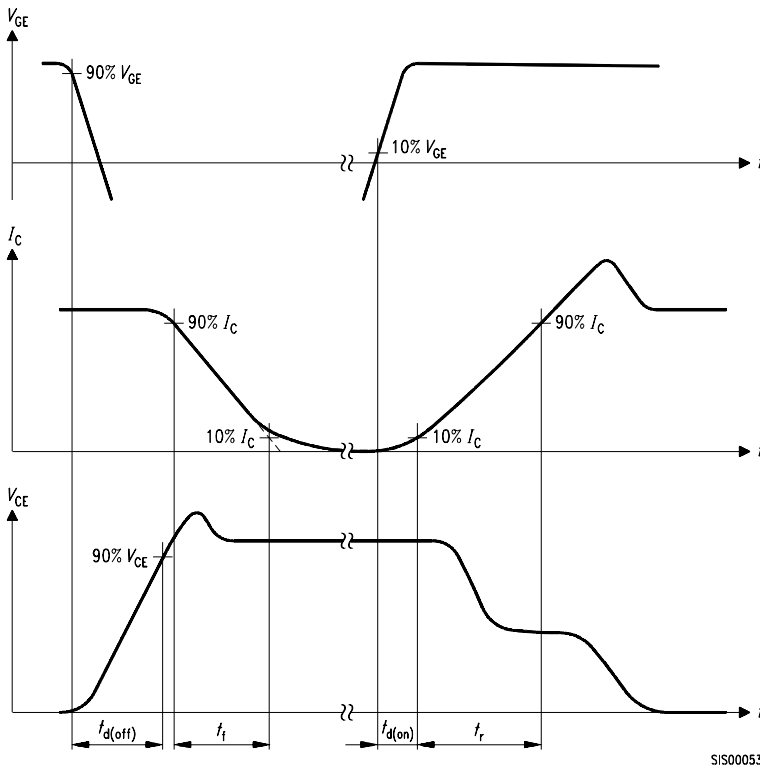


Figure A. Definition of switching times

SIS00053

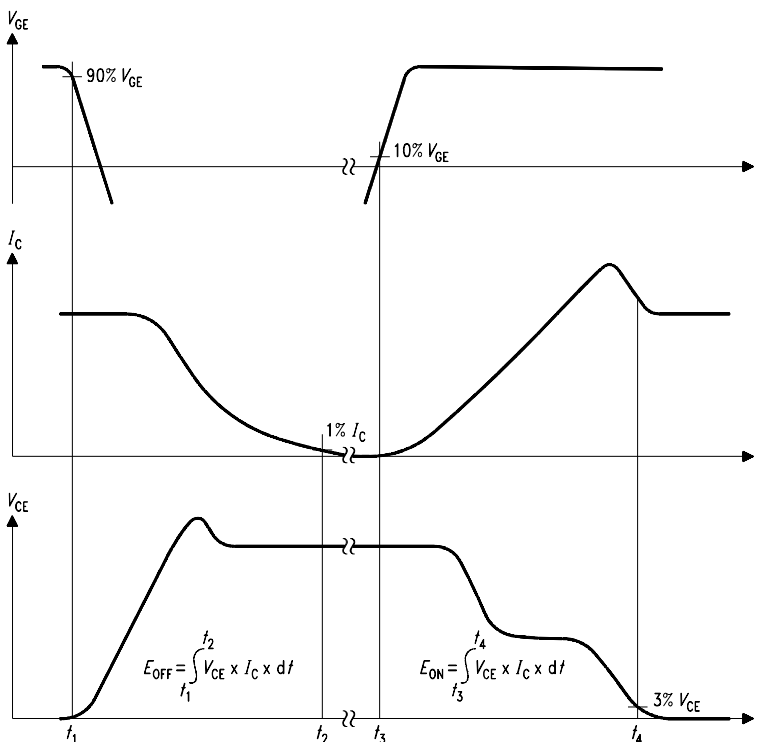


Figure B. Definition of switching losses

SIS00050

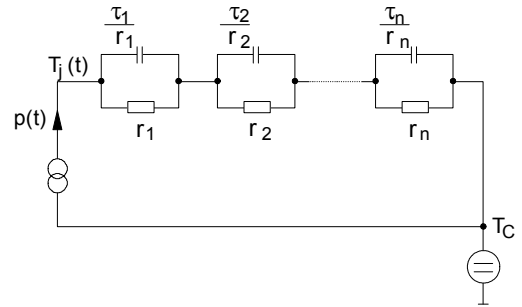


Figure D. Thermal equivalent circuit

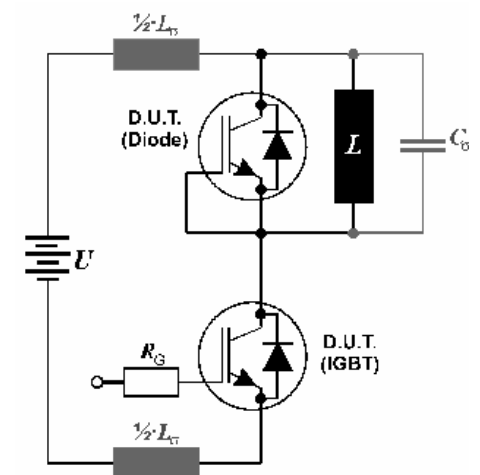


Figure E. Dynamic test circuit
Leakage inductance $L_{\sigma} = 180\text{nH}$
and Stray capacity $C_{\sigma} = 250\text{pF}$.

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