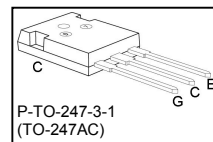
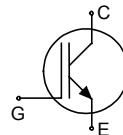


Low Loss IGBT in Trench and Fieldstop technology

- Best in class TO247
- Short circuit withstand time – 10μs
- Designed for :
 - Frequency Converters
 - Uninterrupted Power Supply
- Trench 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
- Complete product spectrum and PSpice Models : <http://www.infineon.com/igbt/>



Type	V_{CE}	I_C	$V_{CE(sat)}, T_j=25^\circ\text{C}$	$T_{j,max}$	Package	Ordering Code
IGW60T120	1200V	60A	1.9V	150°C	TO-247AC	Q67040-S4521

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
DC collector current	I_C	100 60	A
$T_C = 25^\circ\text{C}$			
$T_C = 90^\circ\text{C}$			
Pulsed collector current, t_p limited by $T_{j,max}$	$I_{C,puls}$	150	
Turn off safe operating area $V_{CE} \leq 1200\text{V}, T_j \leq 150^\circ\text{C}$	-	150	
Gate-emitter voltage	V_{GE}	± 20	V
Short circuit withstand time ¹⁾ $V_{GE} = 15\text{V}, V_{CC} \leq 1200\text{V}, T_j \leq 150^\circ\text{C}$	t_{SC}	10	μs
Power dissipation $T_C = 25^\circ\text{C}$	P_{tot}	375	W
Operating junction temperature	T_j	-40...+150	°C
Storage temperature	T_{stg}	-55...+150	
Soldering temperature, 1.6mm (0.063 in.) from case for 10s	-	260	

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}		0.33	K/W
Thermal resistance, junction – ambient	R_{thJA}	TO-247AC	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	$V_{(BR)CES}$	$V_{GE}=0V, I_C=3.0mA$	1200	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE} = 15V, I_C=60A$				
		$T_j=25^{\circ}C$	-	1.9	2.4	
		$T_j=125^{\circ}C$	-	2.1	-	
		$T_j=150^{\circ}C$	-	2.3	-	
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C=2.0mA, V_{CE}=V_{GE}$	5.0	5.8	6.5	
Zero gate voltage collector current	I_{CES}	$V_{CE}=1200V,$ $V_{GE}=0V$				mA
		$T_j=25^{\circ}C$	-	-	0.6	
		$T_j=150^{\circ}C$	-	-	6.0	
Gate-emitter leakage current	I_{GES}	$V_{CE}=0V, V_{GE}=20V$	-	-	600	nA
Transconductance	g_{fs}	$V_{CE}=20V, I_C=60A$	-	30	-	S
Integrated gate resistor	R_{Gint}			4		Ω

Dynamic Characteristic

Input capacitance	C_{iss}	$V_{CE}=25V,$	-	3700	-	pF
Output capacitance	C_{oss}	$V_{GE}=0V,$	-	180	-	
Reverse transfer capacitance	C_{rss}	$f=1MHz$	-	150	-	
Gate charge	Q_{Gate}	$V_{CC}=960V, I_C=60A$ $V_{GE}=15V$	-	280	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E	TO-247AC	-	-	13	nH
Short circuit collector current ¹⁾	$I_{C(SC)}$	$V_{GE}=15V, t_{SC} \leq 10\mu s$ $V_{CC} = 600V,$ $T_j = 25^\circ C$	-	300	-	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	$t_{d(on)}$	$T_j=25^{\circ}\text{C}$, $V_{CC}=600\text{V}$, $I_C=60\text{A}$, $V_{GE}=0/15\text{V}$, $R_G=10\Omega$, $L_{\sigma}^{(2)}=180\text{nH}$, $C_{\sigma}^{(2)}=39\text{pF}$	-	50	-	ns
Rise time	t_r		-	44	-	
Turn-off delay time	$t_{d(off)}$		-	480	-	
Fall time	t_f		-	80	-	
Turn-on energy	E_{on}	Energy losses include “tail” and diode reverse recovery.	-	4.3	-	mJ
Turn-off energy	E_{off}		-	5.2	-	
Total switching energy	E_{ts}		-	9.5	-	

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

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	$T_j=150^{\circ}\text{C}$ $V_{CC}=600\text{V}, I_C=60\text{A},$ $V_{GE}=0/15\text{V},$ $R_G=10\Omega,$ $L_{\sigma^{(2)}}=180\text{nH},$ $C_{\sigma^{(2)}}=39\text{pF}$	-	50	-	ns
Rise time	t_r		-	45	-	
Turn-off delay time	$t_{d(off)}$		-	600	-	
Fall time	t_f		-	130	-	
Turn-on energy	E_{on}	Energy losses include “tail” and diode reverse recovery.	-	6.4	-	mJ
Turn-off energy	E_{off}		-	9.4	-	
Total switching energy	E_{ts}		-	15.8	-	

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.

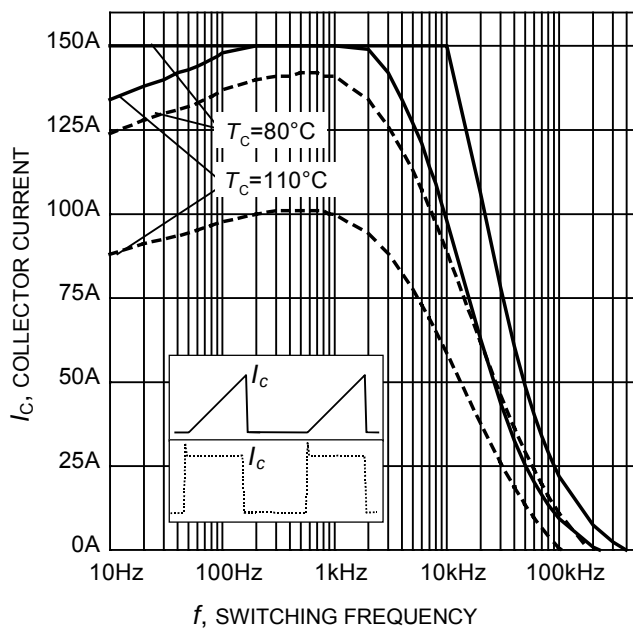


Figure 1. Collector current as a function of switching frequency
 $(T_j \leq 150^\circ\text{C}, D = 0.5, V_{CE} = 600\text{V}, V_{GE} = 0/+15\text{V}, R_G = 10\Omega)$

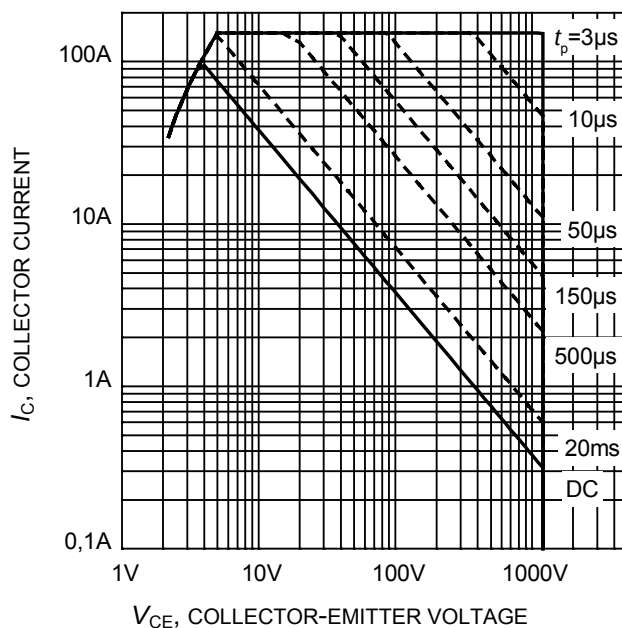


Figure 2. Safe operating area
 $(D = 0, T_C = 25^\circ\text{C}, T_j \leq 150^\circ\text{C}; V_{GE} = 15\text{V})$

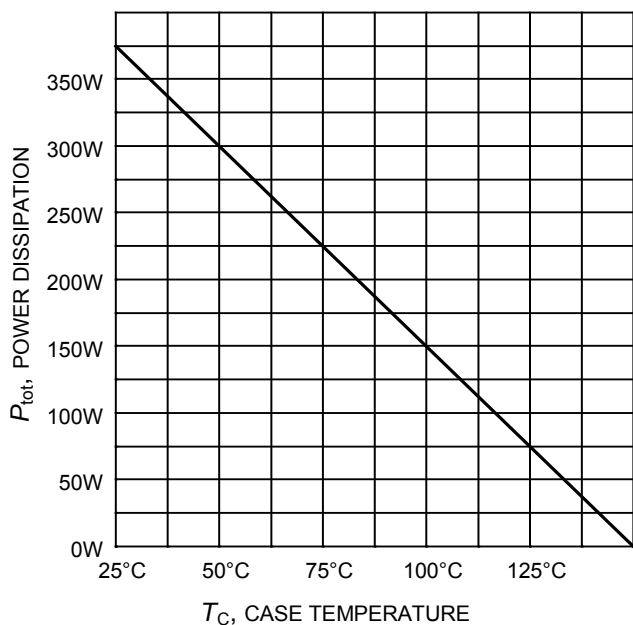


Figure 3. Power dissipation as a function of case temperature
 $(T_j \leq 150^\circ\text{C})$

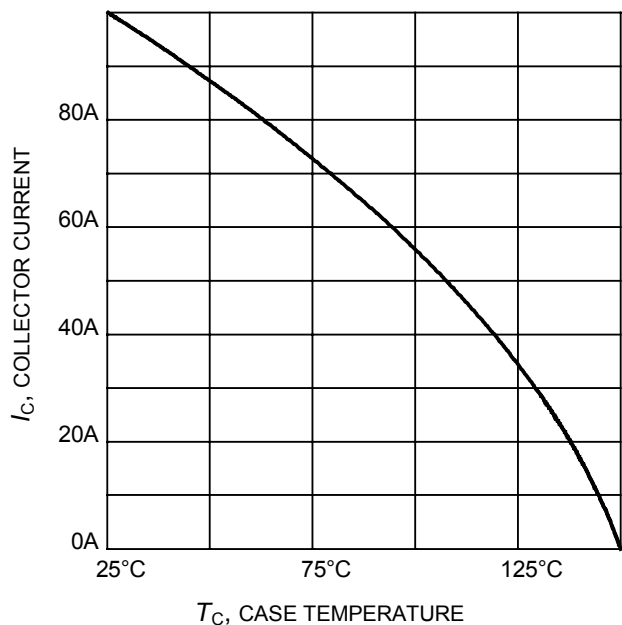


Figure 4. Collector current as a function of case temperature
 $(V_{GE} \geq 15\text{V}, T_j \leq 150^\circ\text{C})$

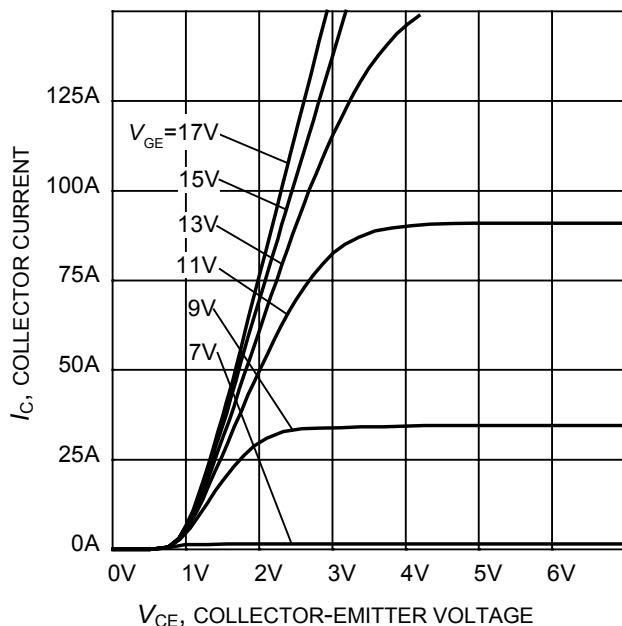


Figure 5. Typical output characteristic
($T_j = 25^\circ\text{C}$)

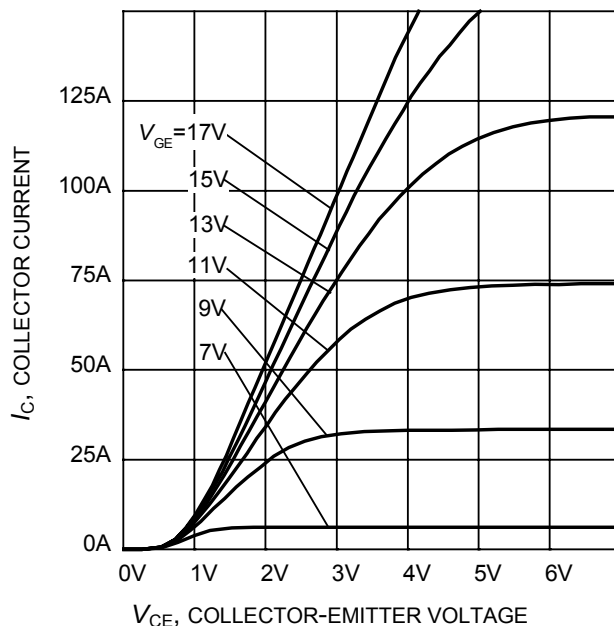


Figure 6. Typical output characteristic
($T_j = 150^\circ\text{C}$)

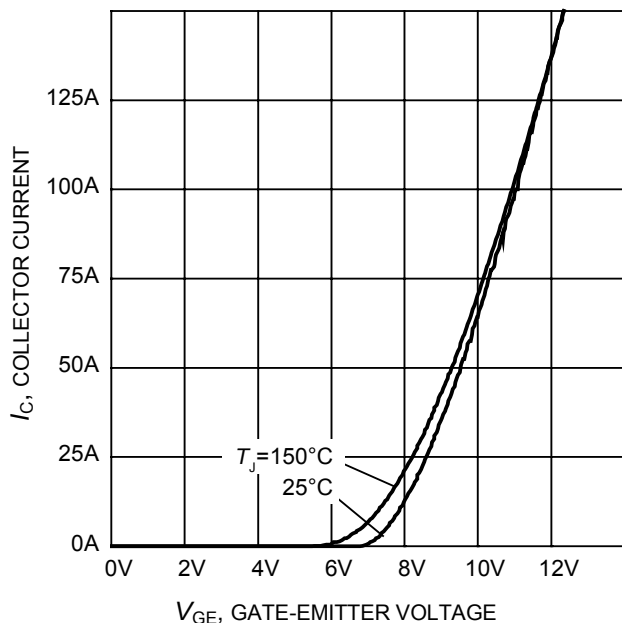


Figure 7. Typical transfer characteristic
($V_{ce} = 20\text{V}$)

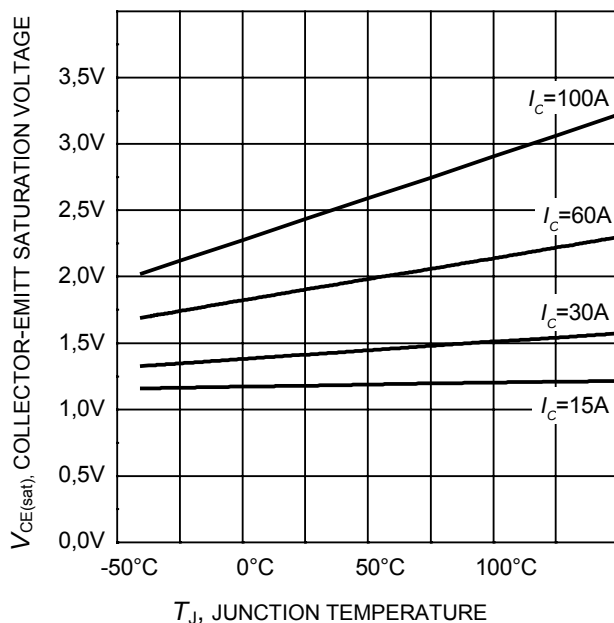


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
($V_{ge} = 15\text{V}$)

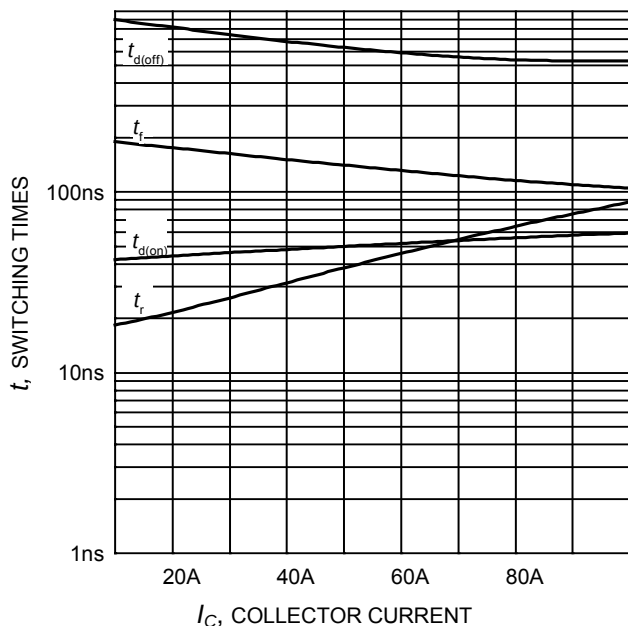


Figure 9. Typical switching times as a function of collector current
(inductive load, $T_J=150^{\circ}\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=10\Omega$, Dynamic test circuit in Figure E)

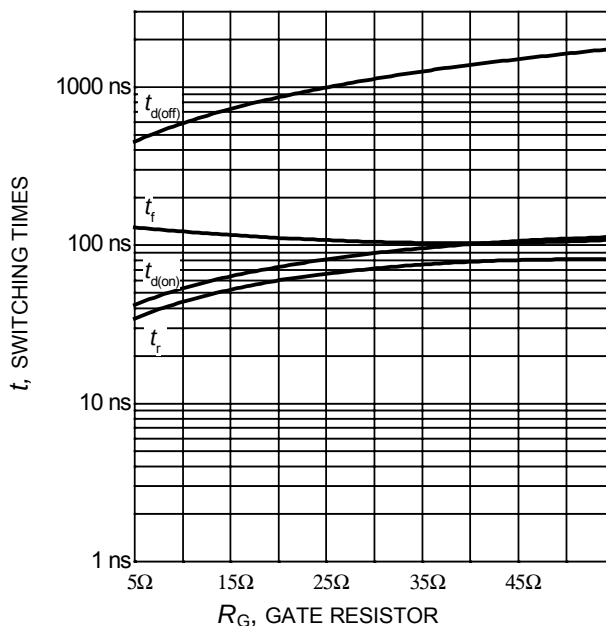


Figure 10. Typical switching times as a function of gate resistor
(inductive load, $T_J=150^{\circ}\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=60\text{A}$, Dynamic test circuit in Figure E)

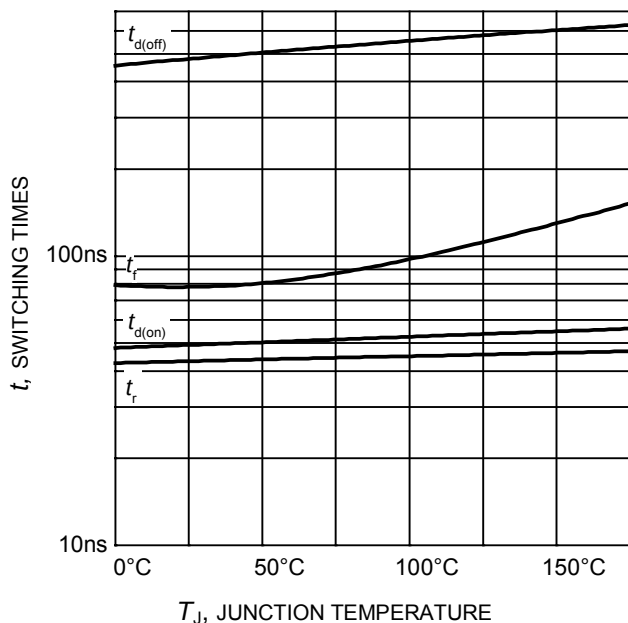


Figure 11. Typical switching times as a function of junction temperature
(inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=60\text{A}$, $R_G=10\Omega$, Dynamic test circuit in Figure E)

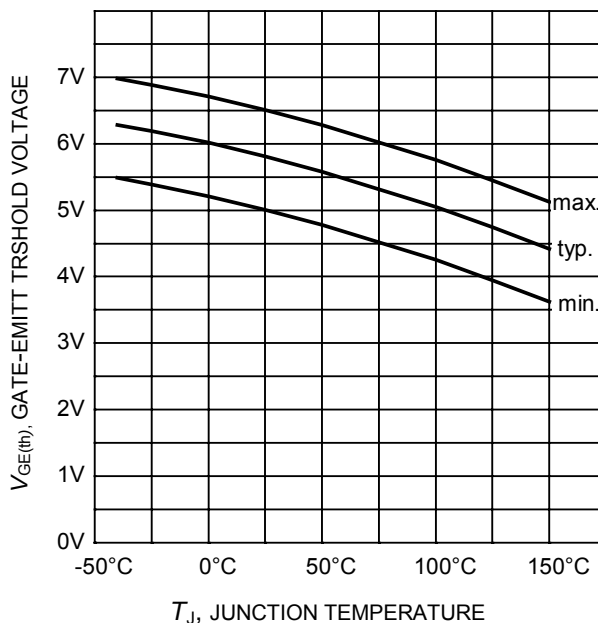


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
($I_C = 2.0\text{mA}$)

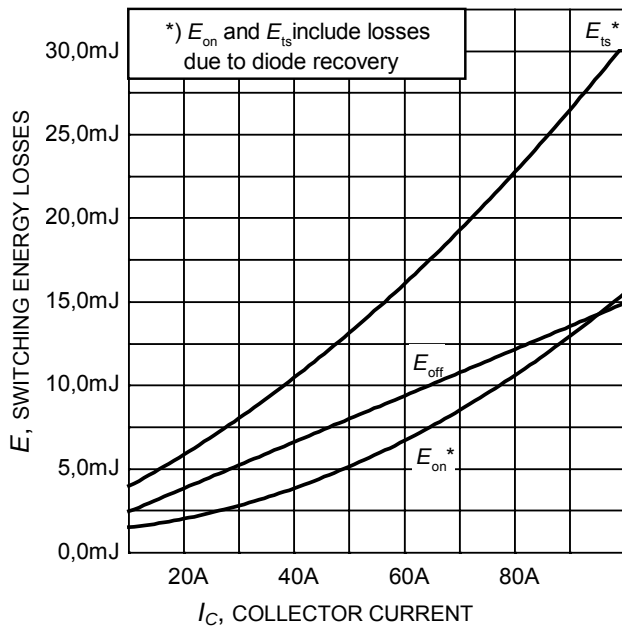


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=10\Omega$, Dynamic test circuit in Figure E)

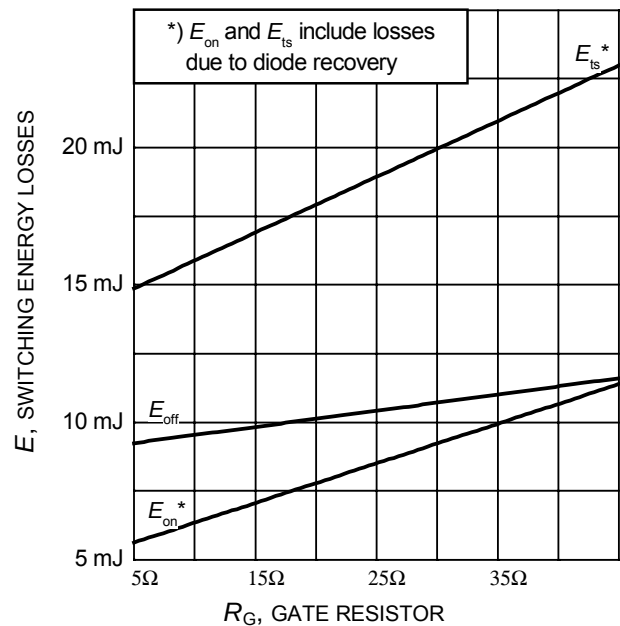


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=60\text{A}$, Dynamic test circuit in Figure E)

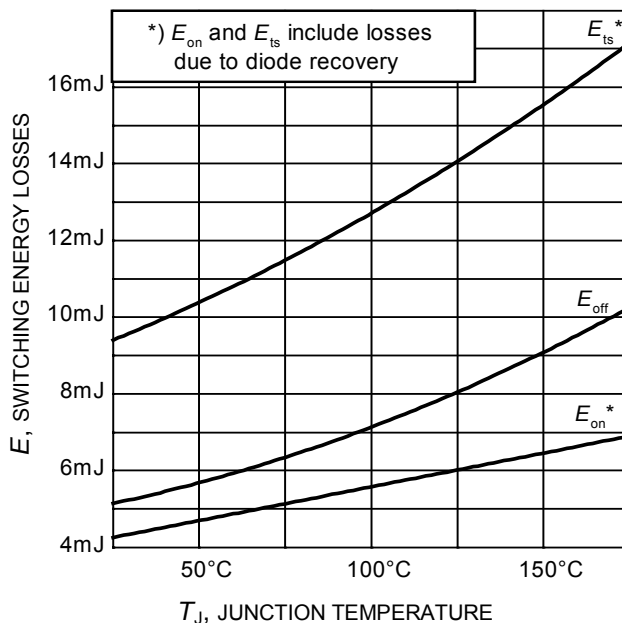


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=60\text{A}$, $R_G=10\Omega$, Dynamic test circuit in Figure E)

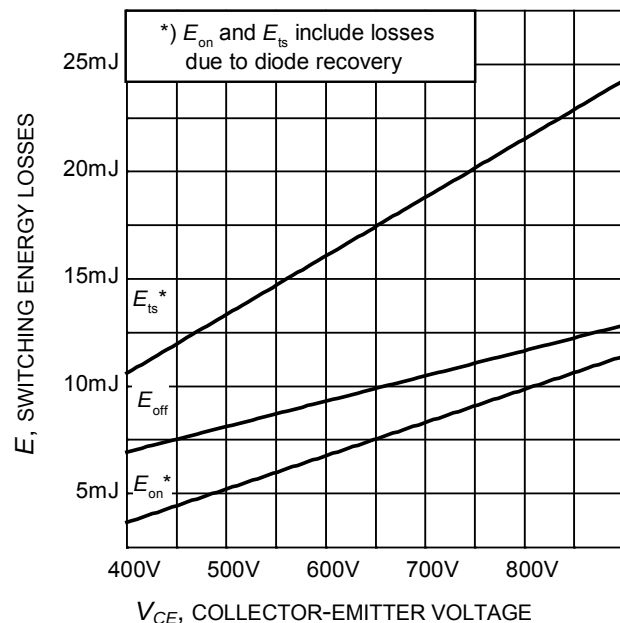


Figure 16. Typical switching energy losses as a function of collector emitter voltage
(inductive load, $T_J=150^\circ\text{C}$, $V_{GE}=0/15\text{V}$, $I_C=60\text{A}$, $R_G=10\Omega$, Dynamic test circuit in Figure E)

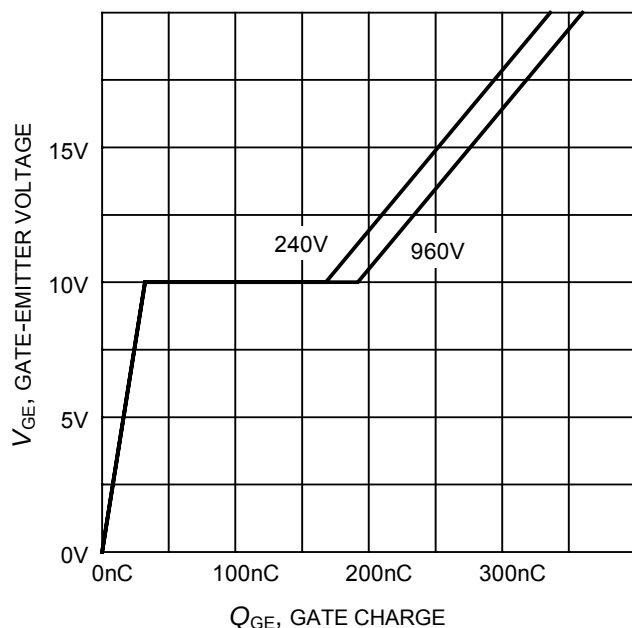


Figure 17. Typical gate charge
($I_C=60\text{ A}$)

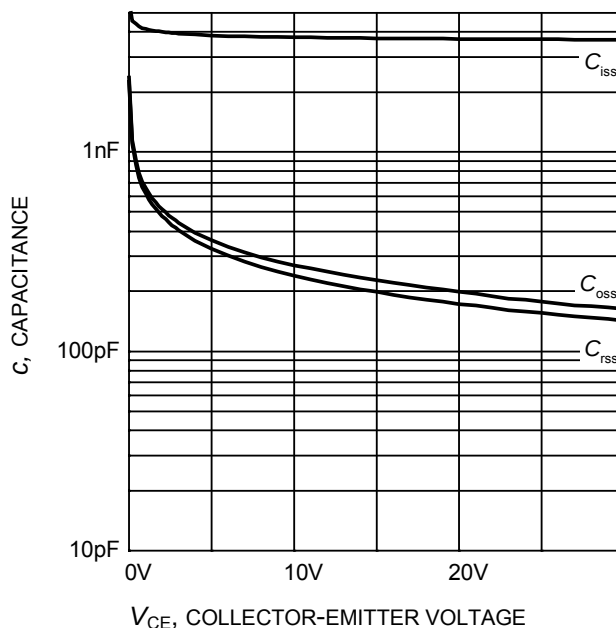


Figure 18. Typical capacitance as a function of collector-emitter voltage
($V_{GE}=0\text{V}$, $f = 1\text{ MHz}$)

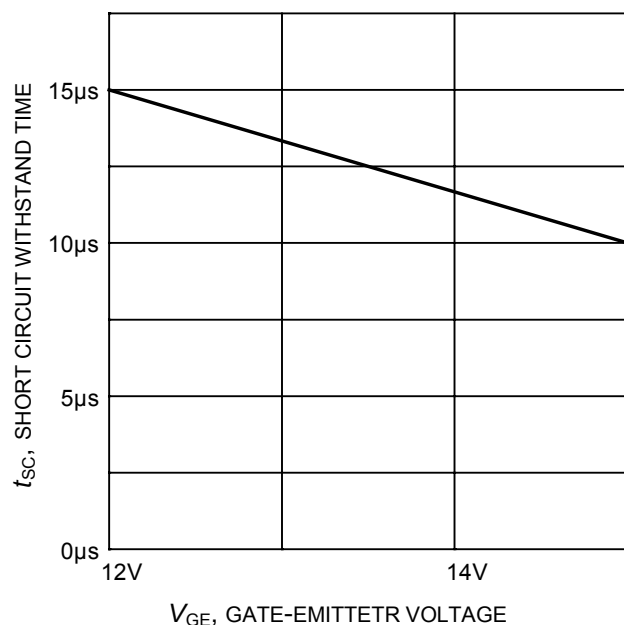


Figure 19. Short circuit withstand time as a function of gate-emittetr voltage
($V_{CE}=600\text{V}$, start at $T_J=25^\circ\text{C}$)

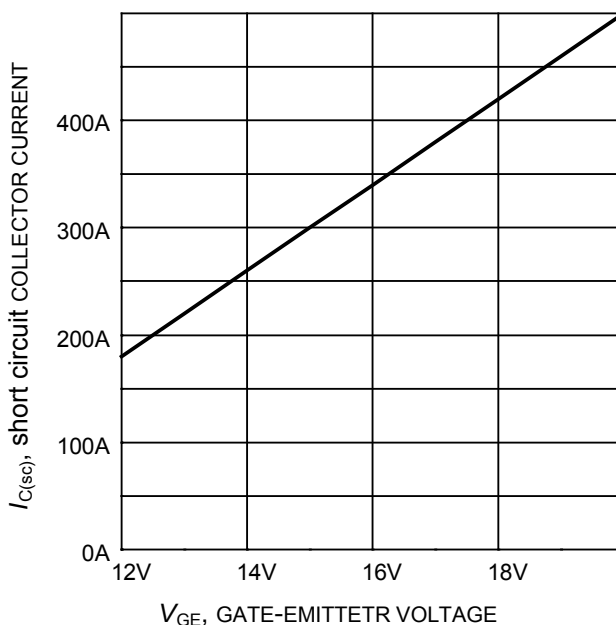


Figure 20. Typical short circuit collector current as a function of gate-emittetr voltage
($V_{CE} \leq 600\text{V}$, $T_J \leq 150^\circ\text{C}$)

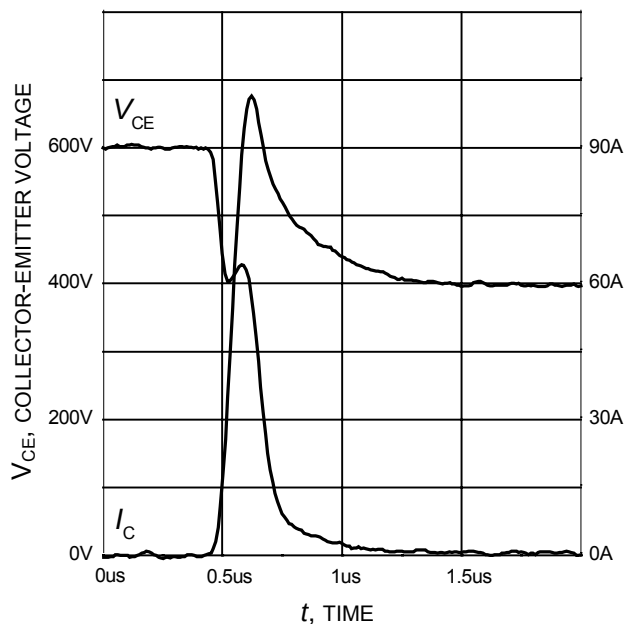


Figure 21. Typical turn on behavior
 $(V_{GE}=0/15V, R_G=10\Omega, T_j = 150^\circ C,$
 Dynamic test circuit in Figure E)

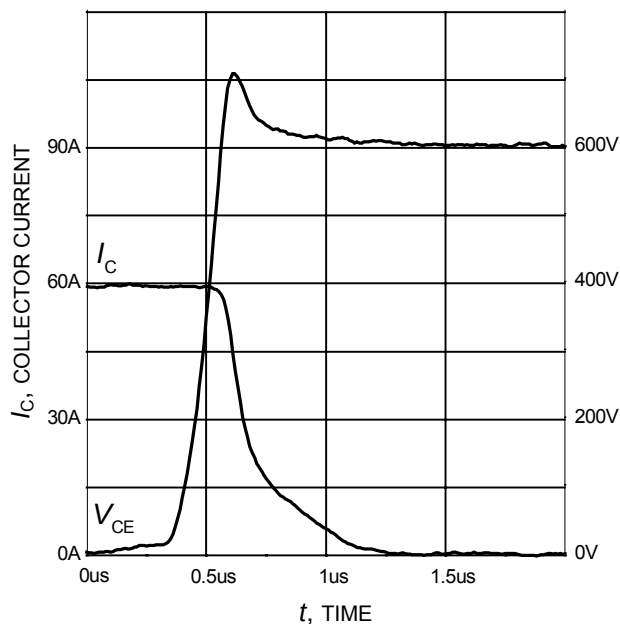


Figure 22. Typical turn off behavior
 $(V_{GE}=15/0V, R_G=10\Omega, T_j = 150^\circ C,$
 Dynamic test circuit in Figure E)

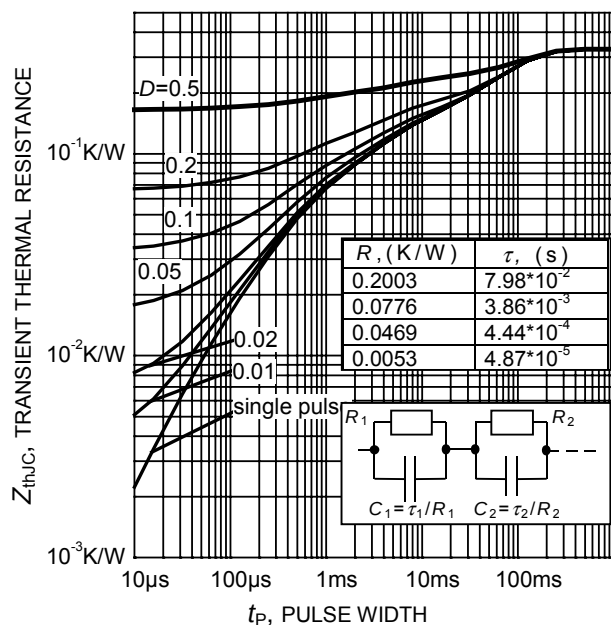
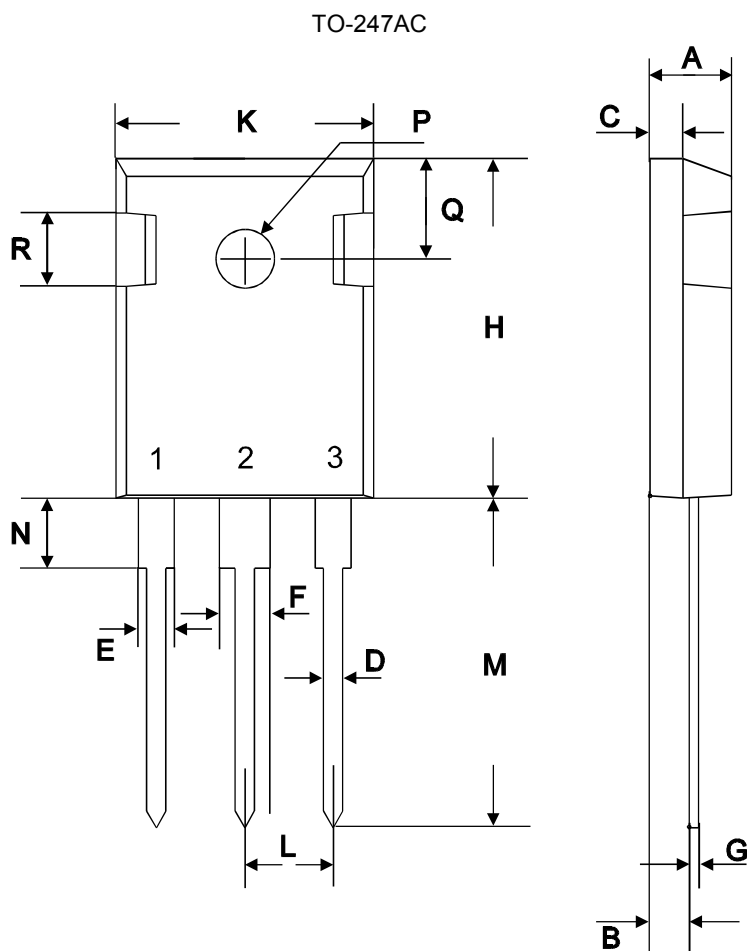


Figure 23. IGBT transient thermal resistance
 $(D = t_p / T)$



symbol	dimensions			
	[mm]		[inch]	
	min	max	min	max
A	4.78	5.28	0.1882	0.2079
B	2.29	2.51	0.0902	0.0988
C	1.78	2.29	0.0701	0.0902
D	1.09	1.32	0.0429	0.0520
E	1.73	2.06	0.0681	0.0811
F	2.67	3.18	0.1051	0.1252
G	0.76 max		0.0299 max	
H	20.80	21.16	0.8189	0.8331
K	15.65	16.15	0.6161	0.6358
L	5.21	5.72	0.2051	0.2252
M	19.81	20.68	0.7799	0.8142
N	3.560	4.930	0.1402	0.1941
ØP	3.61		0.1421	
Q	6.12	6.22	0.2409	0.2449

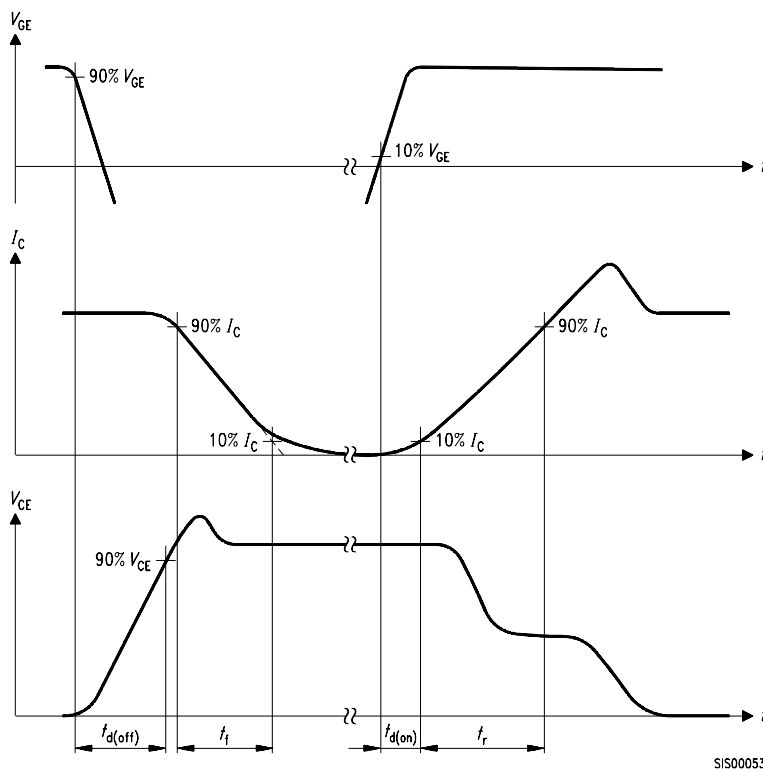


Figure A. Definition of switching times

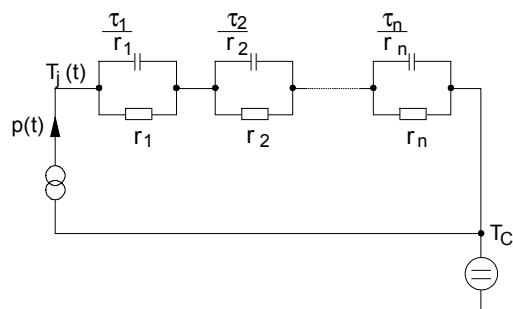


Figure D. Thermal equivalent circuit

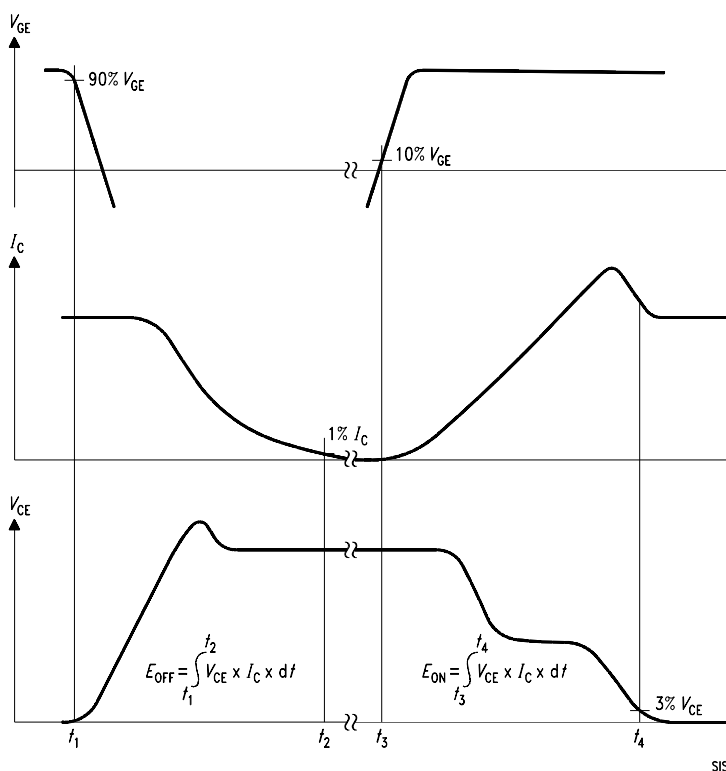
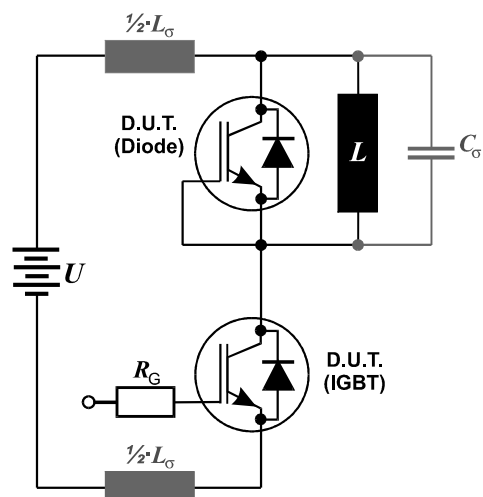


Figure B. Definition of switching losses


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

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Infineon Technologies AG,
Bereich Kommunikation
St.-Martin-Strasse 53,
D-81541 München
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