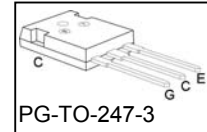
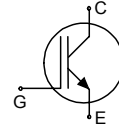


Low Loss IGBT in TrenchStop® and Fieldstop technology

- 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
- 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	$V_{CE(sat)}, T_J=25^\circ\text{C}$	$T_{j,max}$	Marking Code	Package
IGW60T120	1200V	60A	1.7V	150°C	G60T120	PG-TO-247-3

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
DC collector current	I_C	100	A
$T_C = 25^\circ\text{C}$		60	
$T_C = 90^\circ\text{C}$		150	
Pulsed collector current, t_p limited by $T_{j,max}$	$I_{C,puls}$	150	
Turn off safe operating area	-	150	
$V_{CE} \leq 1200\text{V}, T_J \leq 150^\circ\text{C}$			
Gate-emitter voltage	V_{GE}	± 20	V
Short circuit withstand time ²⁾	t_{SC}	10	µs
$V_{GE} = 15\text{V}, V_{CC} \leq 1200\text{V}, T_J \leq 150^\circ\text{C}$			
Power dissipation	P_{tot}	375	W
$T_C = 25^\circ\text{C}$			
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 J-STD-020 and JEDEC-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}		0.33	K/W
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	$V_{(BR)CES}$	$V_{GE}=0V, I_C=3.0mA$	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	mA
Zero gate voltage collector current	I_{CES}	$V_{CE}=1200V,$ $V_{GE}=0V$				
		$T_J=25^{\circ}C$	-	-	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}	$V_{CE}=25V,$ $V_{GE}=0V,$ $f=1MHz$	-	3700	-	pF
Output capacitance	C_{oss}		-	180	-	
Reverse transfer capacitance	C_{rss}		-	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		-	13	-	nH
Short circuit collector current ¹⁾	$I_{C(SC)}$	$V_{GE}=15V, t_{SC}\leq 10\mu s$ $V_{CC}=600V,$ $T_j=25^\circ\text{C}$	-	300	-	A

¹⁾ 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	$t_{d(on)}$	$T_J=25^{\circ}\text{C}$, $V_{CC}=600\text{V}$, $I_C=60\text{A}$, $V_{GE}=0/15\text{V}$, $R_G=10\Omega$, $L_{\sigma}^{2)}=180\text{nH}$, $C_{\sigma}^{2)}=39\text{pF}$	-	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 $T_j=150^\circ\text{C}$

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	$T_J=150^{\circ}\text{C}$ $V_{CC}=600\text{V}, I_C=60\text{A},$ $V_{GE}=0/15\text{V},$ $R_G=10\Omega,$ $L_{\sigma}^{(2)}=180\text{nH},$ $C_{\sigma}^{(2)}=39\text{pF}$	-	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	-	

²⁾ Leakage inductance L_{σ} and Stray capacity C_{σ} due to dynamic test circuit in Figure E.

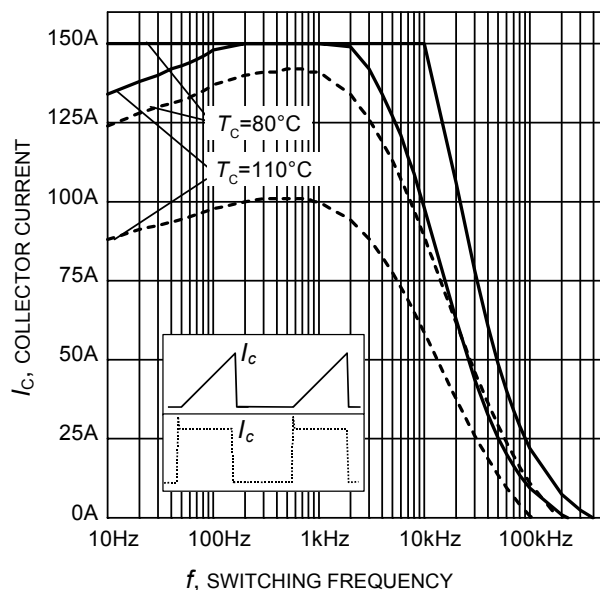


Figure 1. Collector current as a function of switching frequency
 $(T_j \leq 150^\circ\text{C}, D = 0.5, V_{CE} = 600\text{V}, V_{GE} = 0/+15\text{V}, R_G = 10\Omega)$

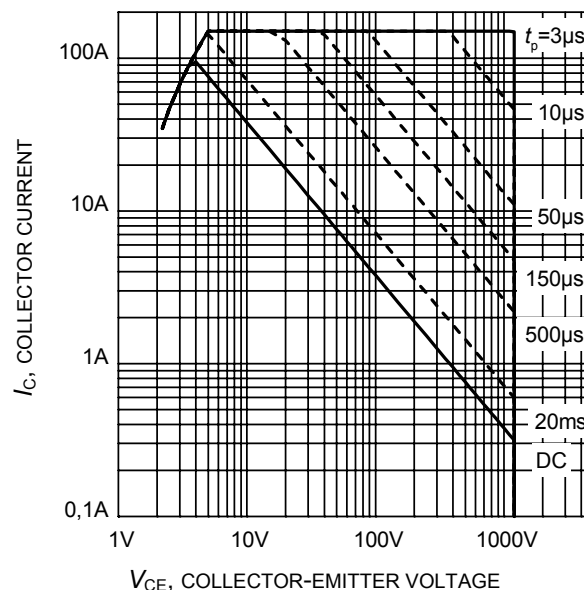


Figure 2. Safe operating area
 $(D = 0, T_C = 25^\circ\text{C}, T_j \leq 150^\circ\text{C}; V_{GE} = 15\text{V})$

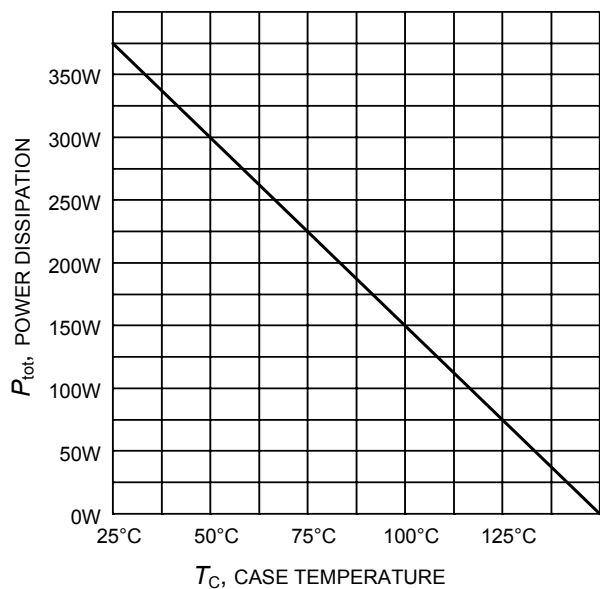


Figure 3. Power dissipation as a function of case temperature
 $(T_j \leq 150^\circ\text{C})$

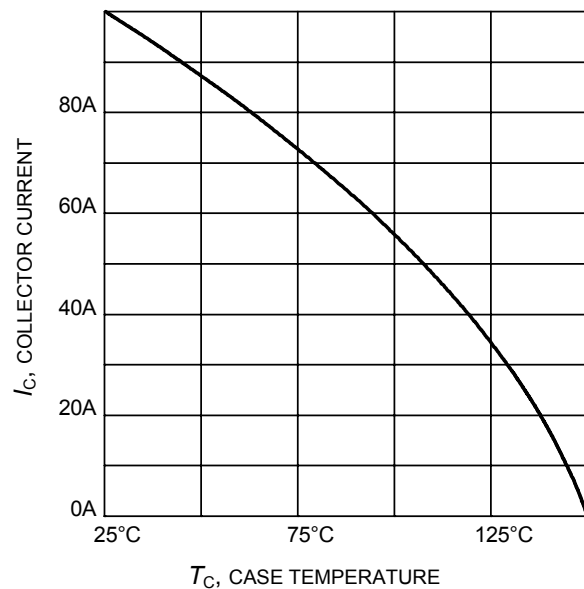


Figure 4. Collector current as a function of case temperature
 $(V_{GE} \geq 15\text{V}, T_j \leq 150^\circ\text{C})$

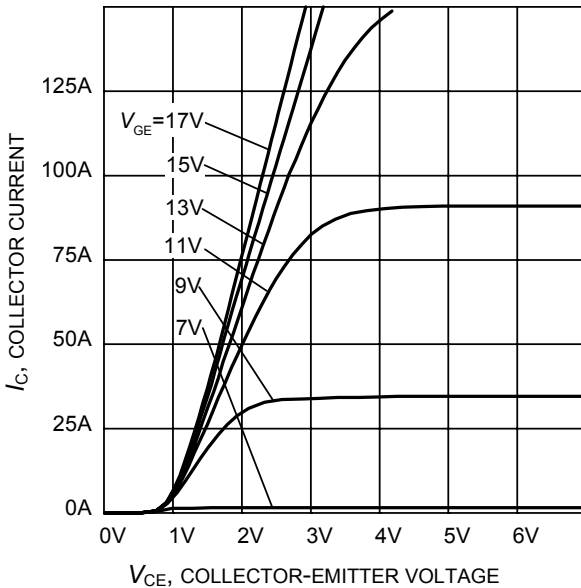


Figure 5. Typical output characteristic
($T_j = 25^\circ\text{C}$)

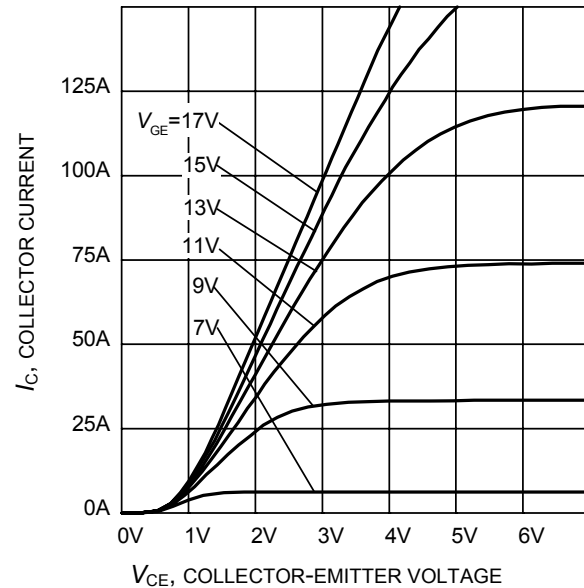


Figure 6. Typical output characteristic
($T_j = 150^\circ\text{C}$)

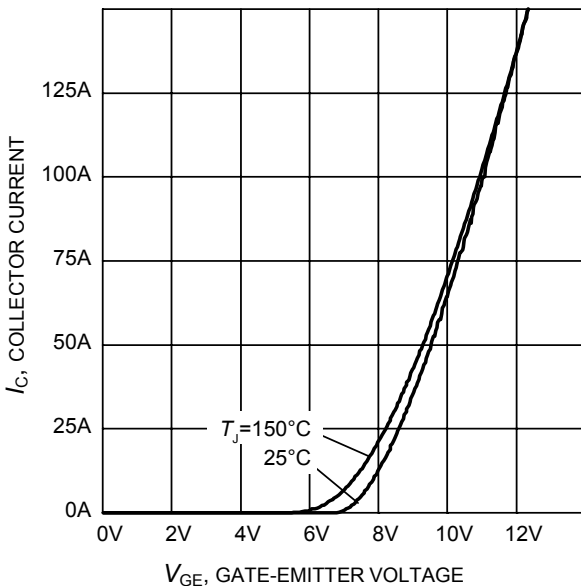


Figure 7. Typical transfer characteristic
($V_{ce}=20\text{V}$)

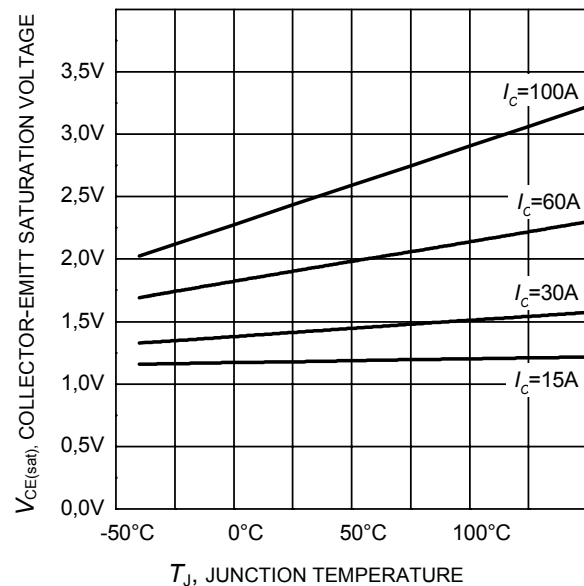


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
($V_{ge} = 15\text{V}$)

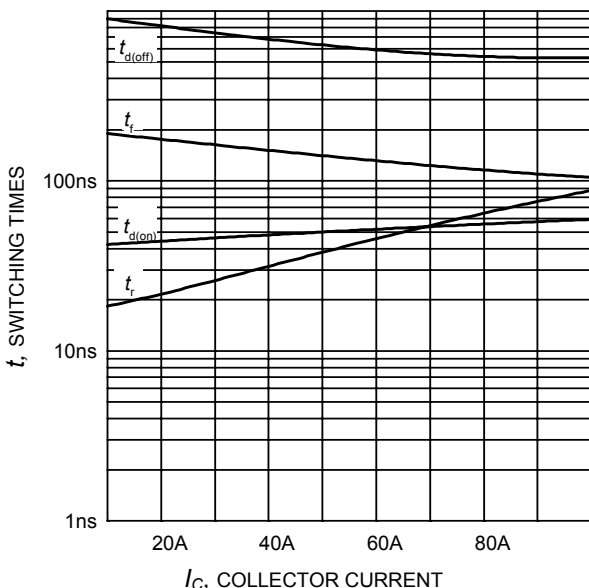


Figure 9. Typical switching times as a function of collector current
(inductive load, $T_J=150^\circ\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=10\Omega$,
Dynamic test circuit in Figure E)

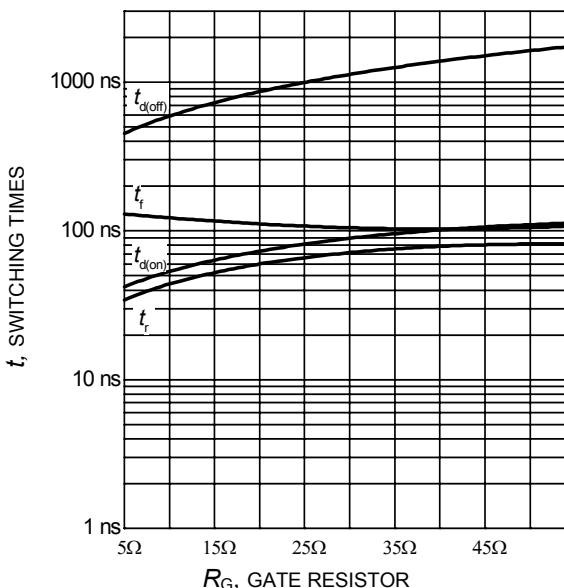


Figure 10. Typical switching times as a function of gate resistor
(inductive load, $T_J=150^\circ\text{C}$,
 $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=60\text{A}$,
Dynamic test circuit in Figure E)

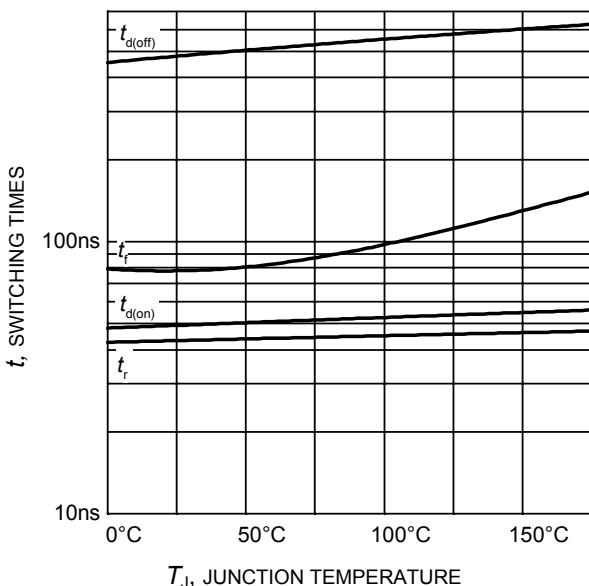


Figure 11. Typical switching times as a function of junction temperature
(inductive load, $V_{CE}=600\text{V}$,
 $V_{GE}=0/15\text{V}$, $I_C=60\text{A}$, $R_G=10\Omega$,
Dynamic test circuit in Figure E)

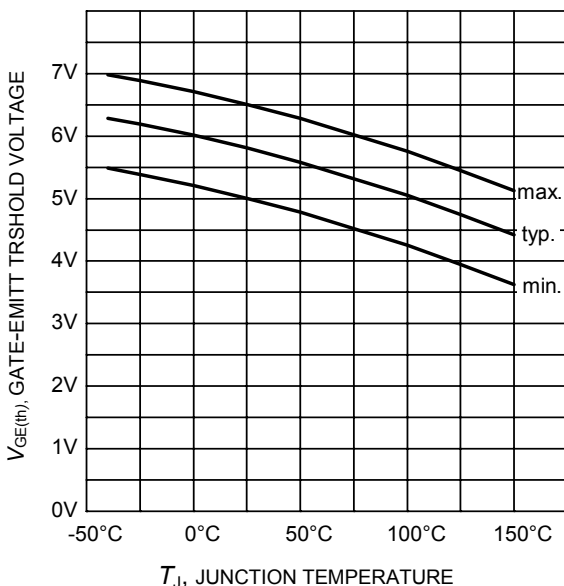


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
($I_C = 2.0\text{mA}$)

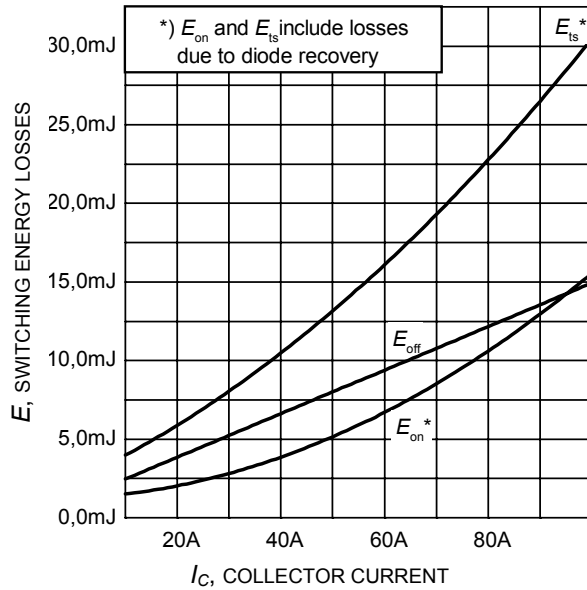


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=10\Omega$, Dynamic test circuit in Figure E)

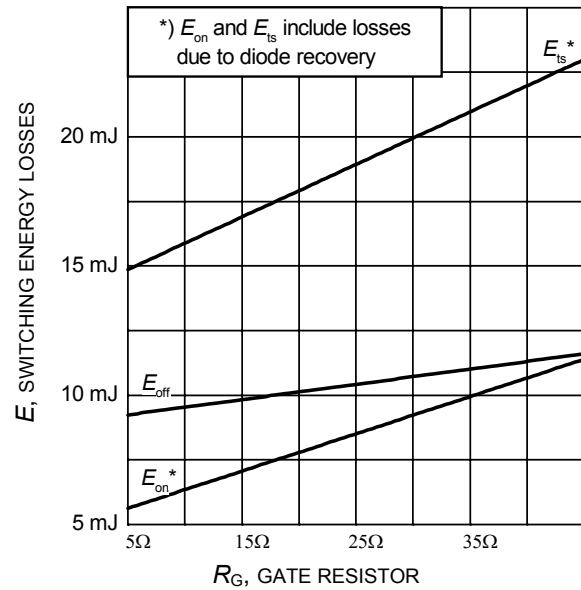


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=60\text{A}$, Dynamic test circuit in Figure E)

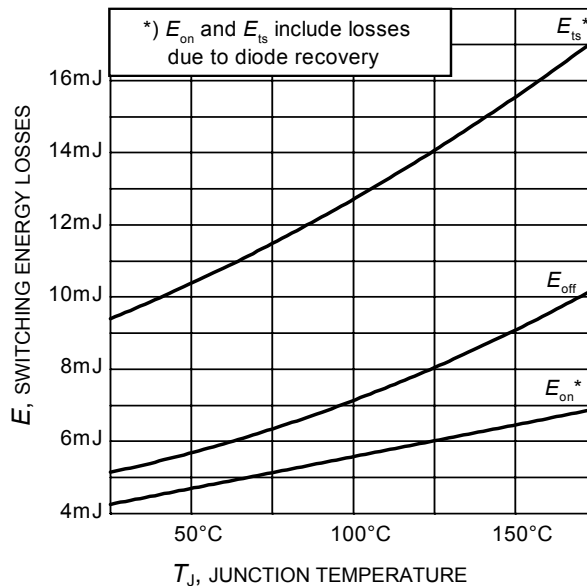


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=60\text{A}$, $R_G=10\Omega$, Dynamic test circuit in Figure E)

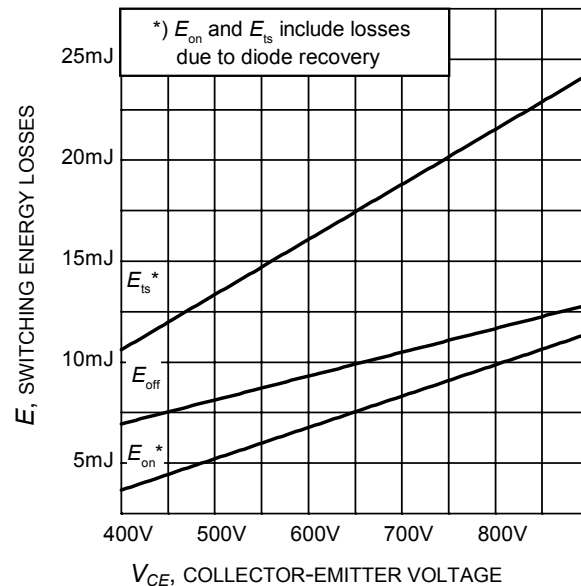


Figure 16. Typical switching energy losses as a function of collector emitter voltage
(inductive load, $T_J=150^\circ\text{C}$, $V_{GE}=0/15\text{V}$, $I_C=60\text{A}$, $R_G=10\Omega$, Dynamic test circuit in Figure E)

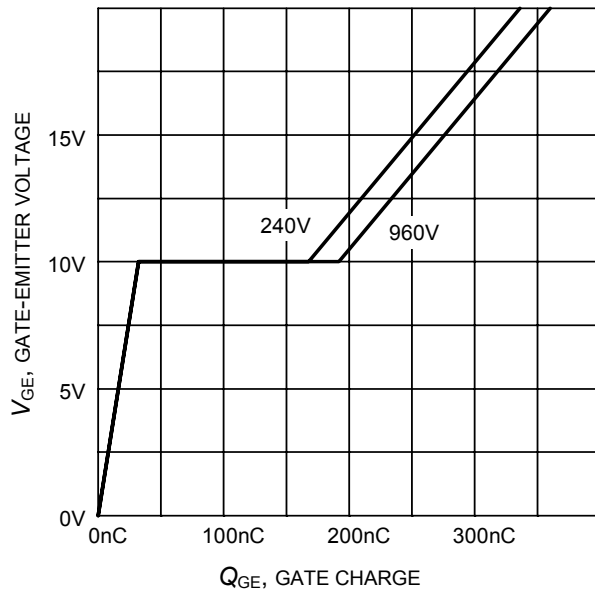


Figure 17. Typical gate charge
($I_C=60\text{ A}$)

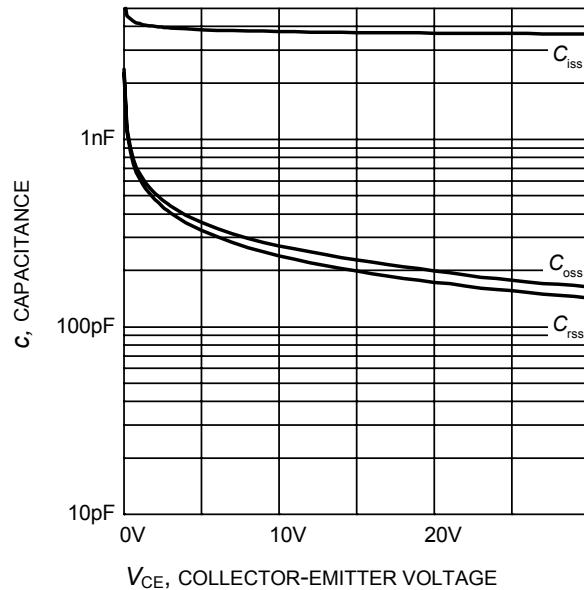


Figure 18. Typical capacitance as a function of collector-emitter voltage
($V_{GE}=0\text{ V}$, $f=1\text{ MHz}$)

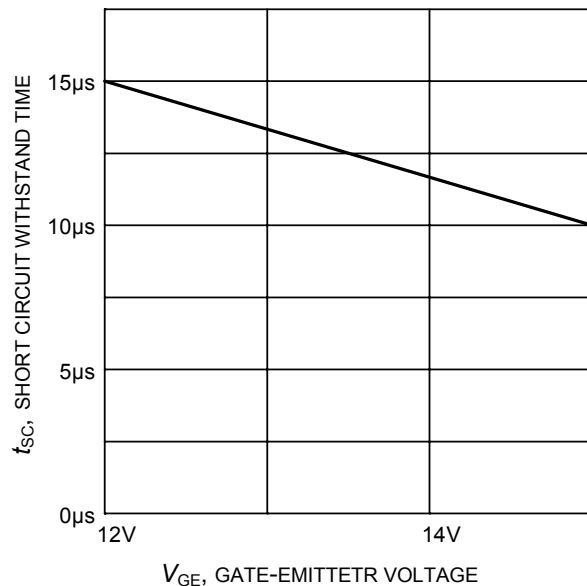


Figure 19. Short circuit withstand time as a function of gate-emittetr voltage
($V_{CE}=600\text{ V}$, start at $T_J=25^\circ\text{C}$)

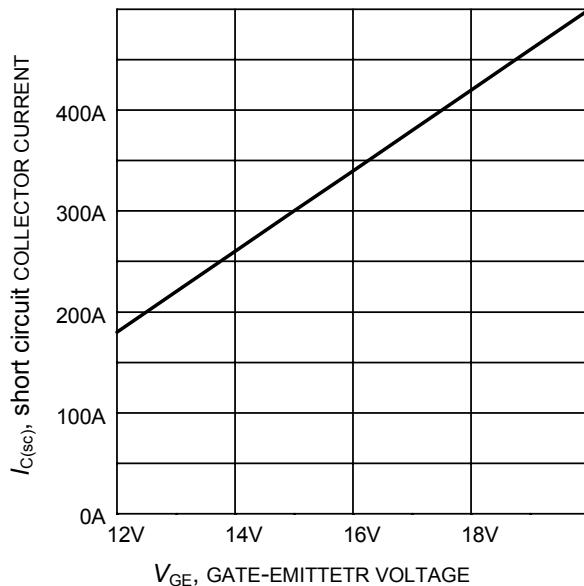


Figure 20. Typical short circuit collector current as a function of gate-emittetr voltage
($V_{CE} \leq 600\text{ V}$, $T_J \leq 150^\circ\text{C}$)

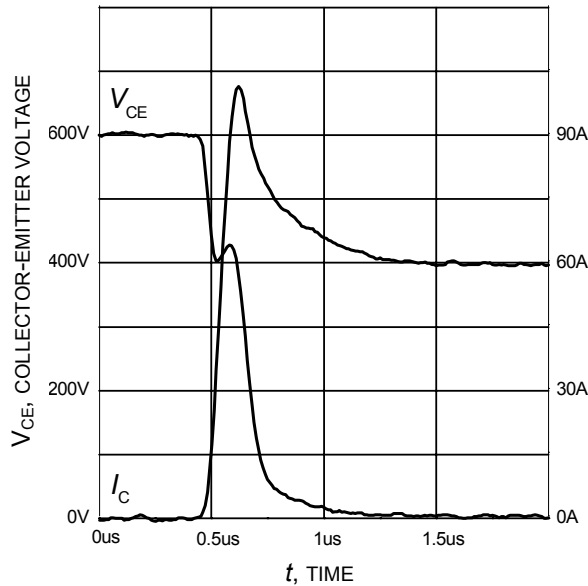


Figure 21. Typical turn on behavior
 $(V_{GE}=0/15V, R_G=10\Omega, T_j = 150^\circ C,$
 Dynamic test circuit in Figure E)

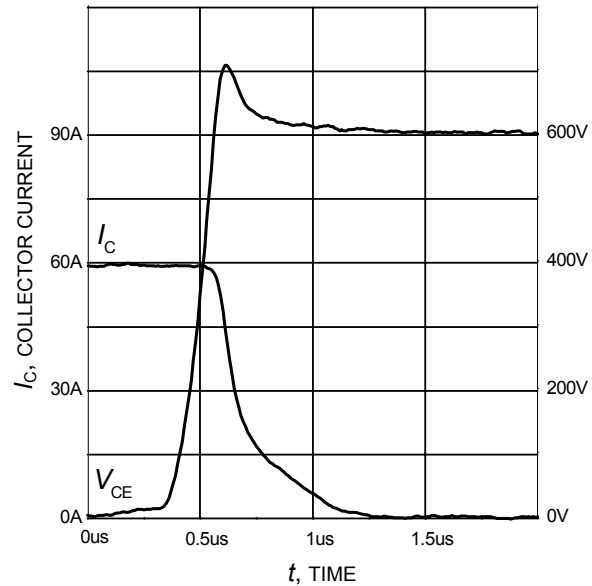


Figure 22. Typical turn off behavior
 $(V_{GE}=15/0V, R_G=10\Omega, T_j = 150^\circ C,$
 Dynamic test circuit in Figure E)

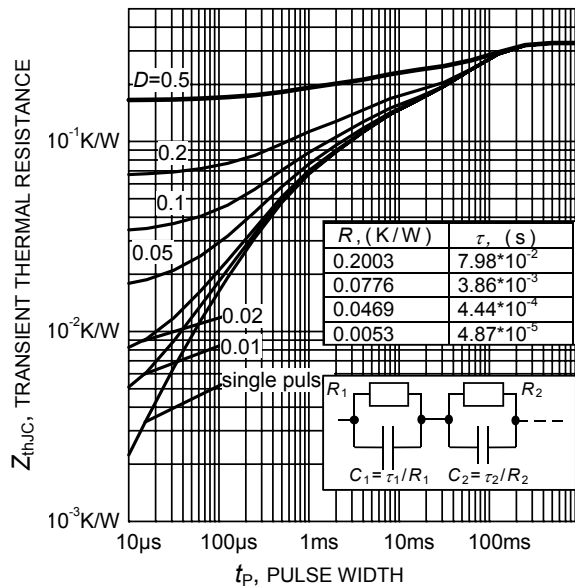
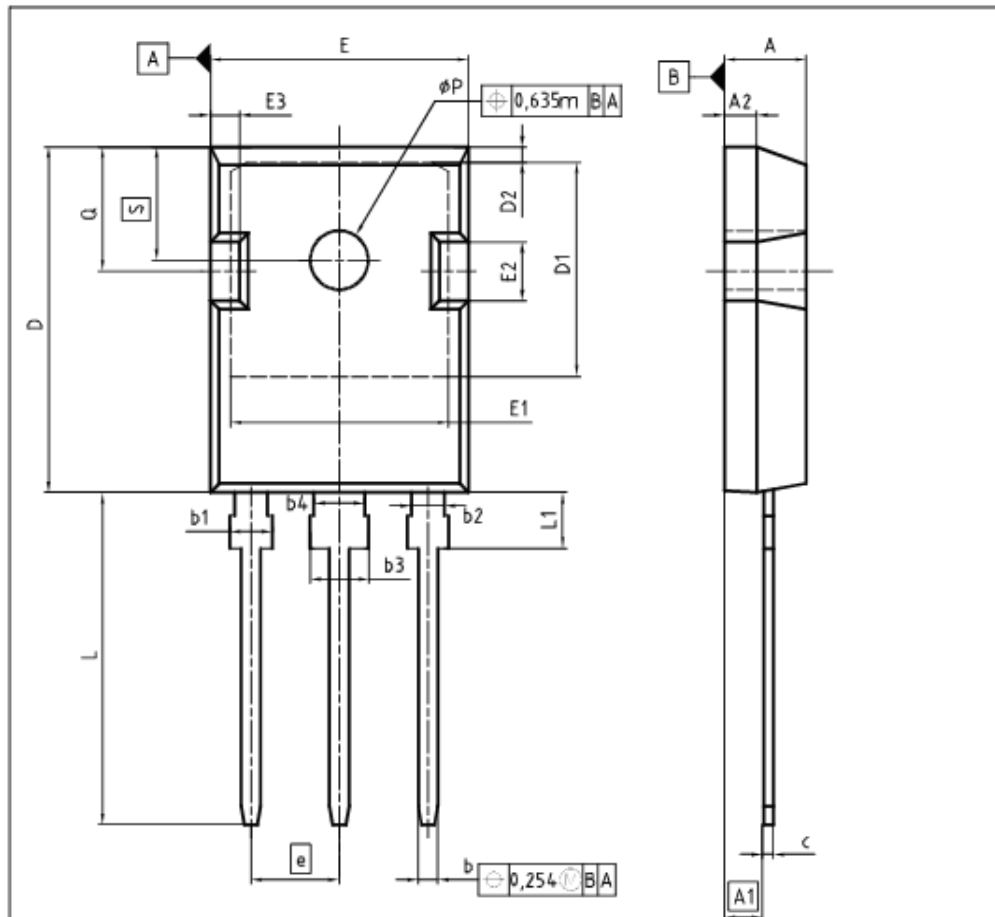
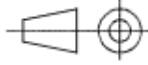


Figure 23. IGBT transient thermal resistance
 $(D = t_p / T)$

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	2.67	3.36	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		0.214	
N	3		3	
L	19.80	20.32	0.780	0.800
L1	4.10	4.47	0.161	0.176
φP	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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REVISION 04

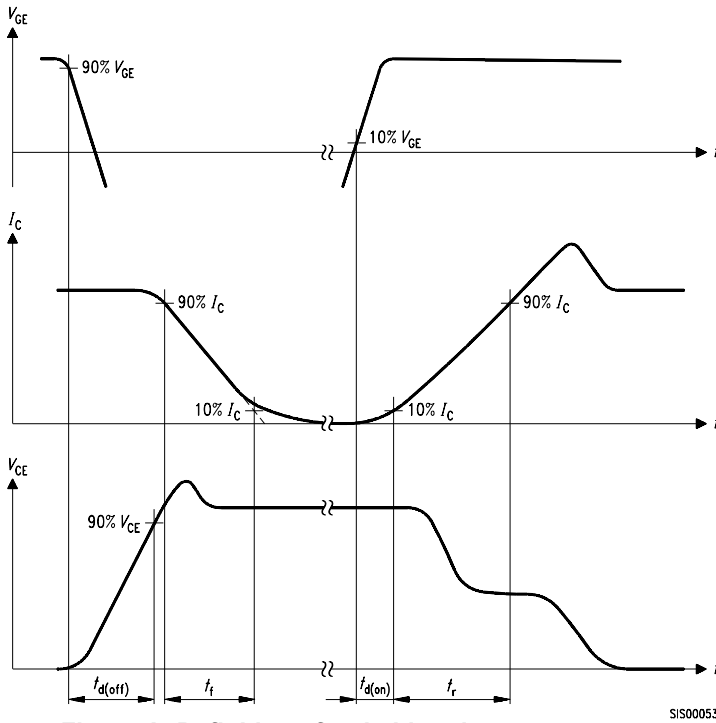


Figure A. Definition of switching times

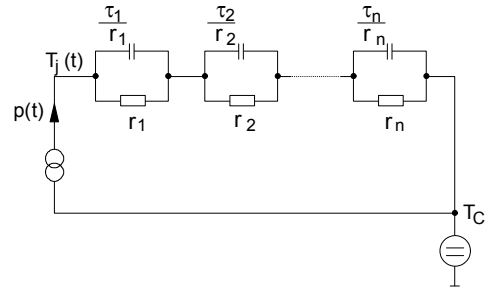


Figure D. Thermal equivalent circuit

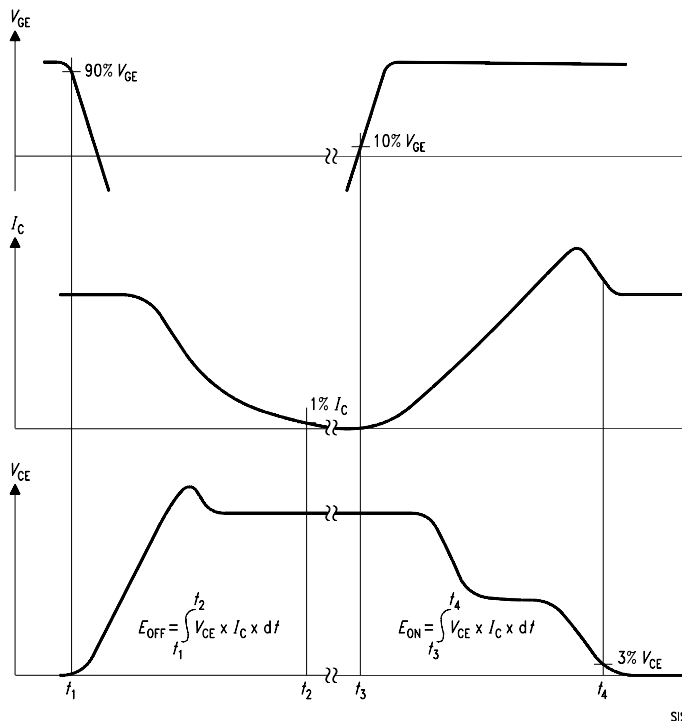


Figure B. Definition of switching losses

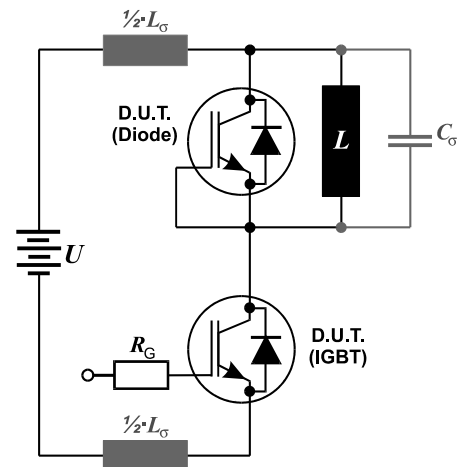


Figure E. Dynamic test circuit
Leakage inductance $L_\sigma = 180\text{nH}$
and Stray capacity $C_\sigma = 39\text{pF}$.

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