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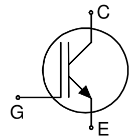
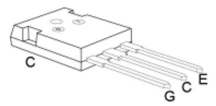
Low Loss IGBT: IGBT in TRENCHSTOP™ and Fieldstop technology





PG-TO247-3

Features:

- Very low $V_{CE(sat)}$ 1.5V (typ.)
- Maximum Junction Temperature 175°C
- Short circuit withstand time 5µs
- Designed for :
  - Frequency Converters
  - Uninterrupted Power Supply
- TRENCHSTOP™ and Fieldstop technology for 600V applications offers :
  - very tight parameter distribution
  - high ruggedness, temperature stable behavior
  - very high switching speed
- Positive temperature coefficient in $V_{CE(sat)}$
- Low EMI
- Low Gate Charge
- Qualified according to JEDEC[1] 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	$V_{CE(sat),Tj=25°C}$	$T_{j,max}$	Marking	Package
IGW75N60T	600V	75A	1.5V	175°C	G75T60	PG-TO247-3

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage, $T_j \geq 25°C$	V_{CE}	600	V
DC collector current, limited by T_{jmax} $T_C = 25°C$ $T_C = 100°C$	I_C	 150 75	A
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	225	
Turn off safe operating area $V_{CE} = 600V$, $T_j = 175°C$, $t_p = 1µs$	-	225	
Gate-emitter voltage	V_{GE}	±20	V
Short circuit withstand time[2)] $V_{GE} = 15V$, $V_{CC} \leq 400V$, $T_j \leq 150°C$	t_{SC}	5	µs
Power dissipation $T_C = 25°C$	P_{tot}	428	W
Operating junction temperature	T_j	-40...+175	°C
Storage temperature	T_{stg}	-55...+150	
Soldering temperature, 1.6mm (0.063 in.) from case for 10s	-	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}		0.35	K/W
Thermal resistance, junction – ambient	R_{thJA}		40	

Electrical Characteristic, at T_j = 25 °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=0.2mA	600	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE} = 15V, I_C=75A T_j=25°C T_j=175°C	 - -	 1.5 1.9	 2.0 -	
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C=1.2mA, V_{CE}=V_{GE}	4.1	4.9	5.7	
Zero gate voltage collector current	I_{CES}	V_{CE}=600V, V_{GE}=0V T_j=25°C T_j=175°C	 - -	 - -	 40 5000	µA
Gate-emitter leakage current	I_{GES}	V_{CE}=0V, V_{GE}=20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE}=20V, I_C=75A	-	41	-	S
Integrated gate resistor	R_{Gint}			-		Ω

Dynamic Characteristic

Parameter	Symbol	Conditions	min.	Typ.	max.	Unit
Input capacitance	C_{iss}	V_{CE}=25V,	-	4620	-	pF
Output capacitance	C_{oss}	V_{GE}=0V,	-	288	-	
Reverse transfer capacitance	C_{rss}	f=1MHz	-	137	-	
Gate charge	Q_{Gate}	V_{CC}=480V, I_C=75A V_{GE}=15V	-	470	-	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}≤5µs V_{CC} = 400V, T_j ≤ 150°C	-	687.5	-	A

1) Allowed number of short circuits: <1000; time between short circuits: >1s.

Switching Characteristic, Inductive Load, at T_j=25 °C

Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	T_j=25°C, V_{CC}=400V, I_C=75A, V_{GE}=0/15V, r_G=5Ω, L_σ=100nH, C_σ=39pF L_σ, C_σ from Fig. E Energy losses include "tail" and diode reverse recovery. Diode from IKW75N60T	-	33	-	ns
Rise time	t_r		-	36	-	
Turn-off delay time	$t_{d(off)}$		-	330	-	
Fall time	t_f		-	35	-	
Turn-on energy[1)]	E_{on}		-	2.0	-	mJ
Turn-off energy	E_{off}		-	2.5	-	
Total switching energy	E_{ts}		-	4.5	-	

Switching Characteristic, Inductive Load, at T_j=175 °C

Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	T_j=175°C, V_{CC}=400V, I_C=75A, V_{GE}=0/15V, r_G=5Ω, L_σ=100nH, C_σ=39pF L_σ, C_σ from Fig. E Energy losses include "tail" and diode reverse recovery. Diode from IKW75N60T	-	32	-	ns
Rise time	t_r		-	37	-	
Turn-off delay time	$t_{d(off)}$		-	363	-	
Fall time	t_f		-	38	-	
Turn-on energy[1)]	E_{on}		-	2.9	-	mJ
Turn-off energy	E_{off}		-	2.9	-	
Total switching energy	E_{ts}		-	5.8	-	

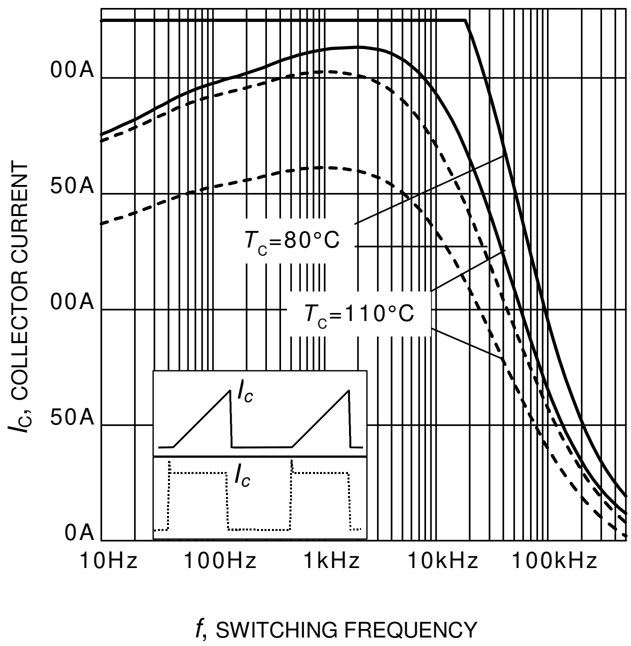


Figure 1. Collector current as a function of switching frequency
($T_j \leq 175°C$, $D = 0.5$, $V_{CE} = 400V$, $V_{GE} = 0/15V$, $r_G = 5\Omega$)

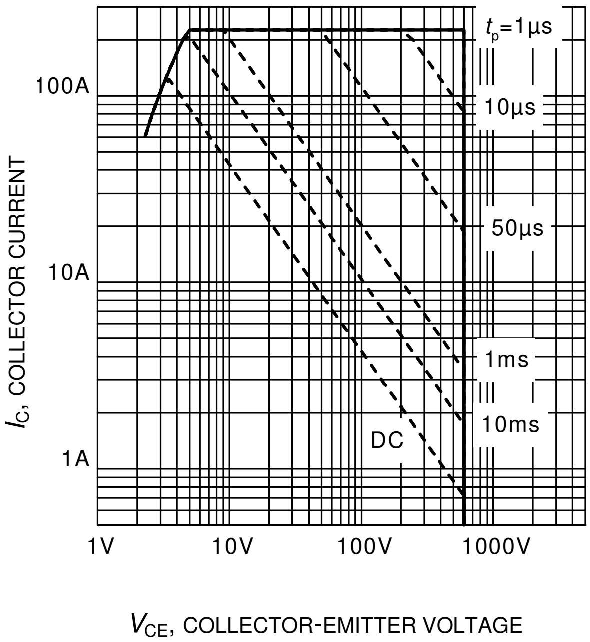


Figure 2. Safe operating area
($D = 0$, $T_C = 25°C$, $T_j \leq 175°C$; V_{GE}=0/15V)

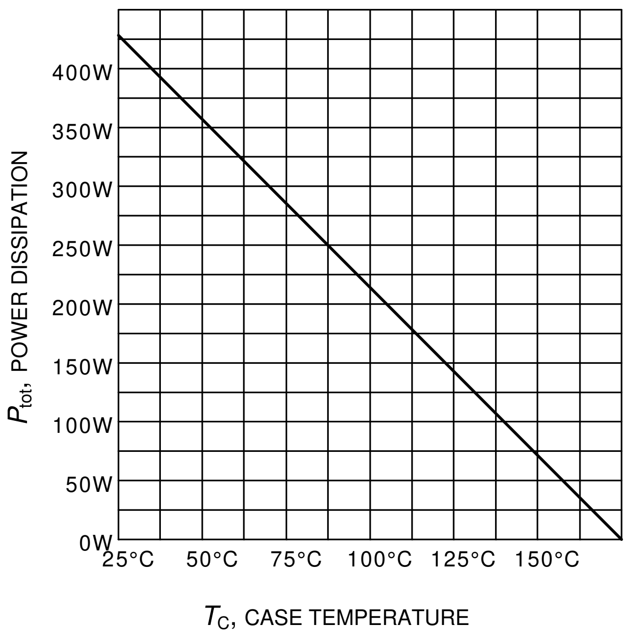


Figure 3. Power dissipation as a function of case temperature
($T_j \leq 175°C$)

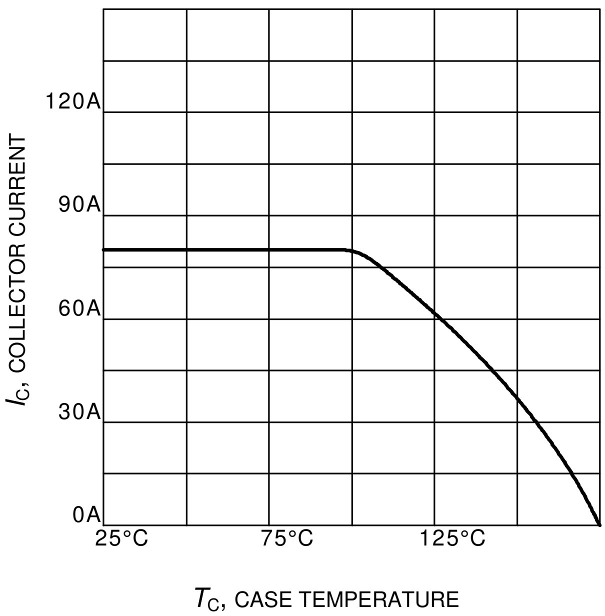


Figure 4. DC Collector current as a function of case temperature
($V_{GE} \geq 15V$, $T_j \leq 175°C$)

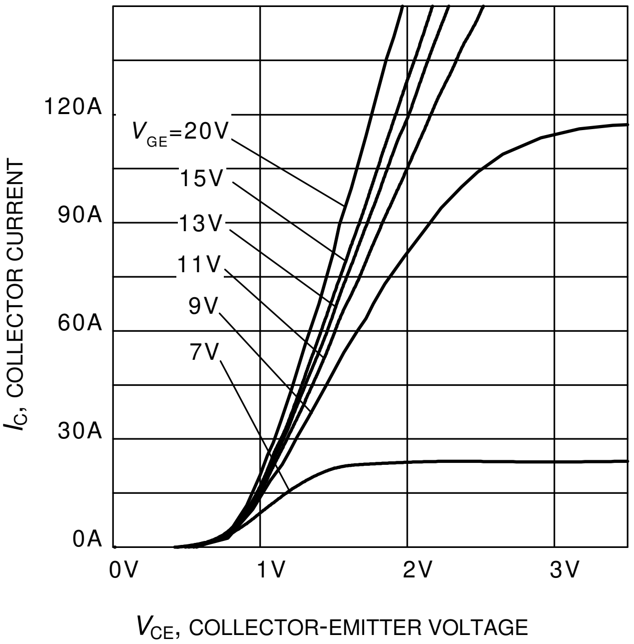


Figure 5. Typical output characteristic
(T_j = 25°C)

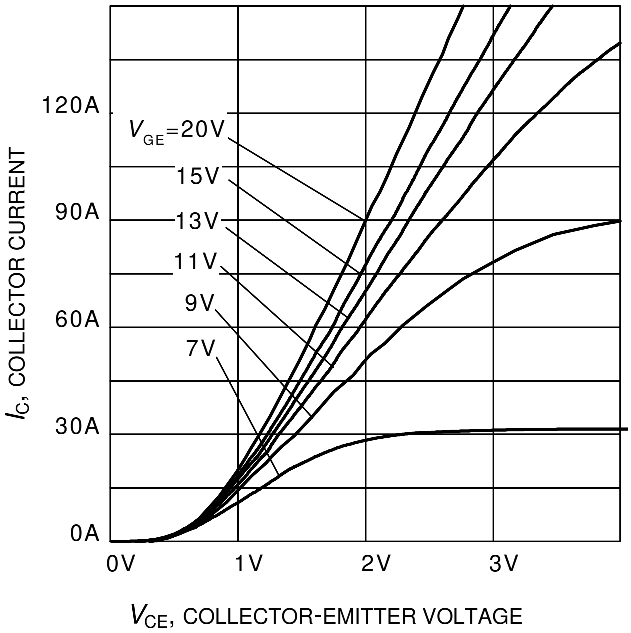


Figure 6. Typical output characteristic
(T_j = 175°C)

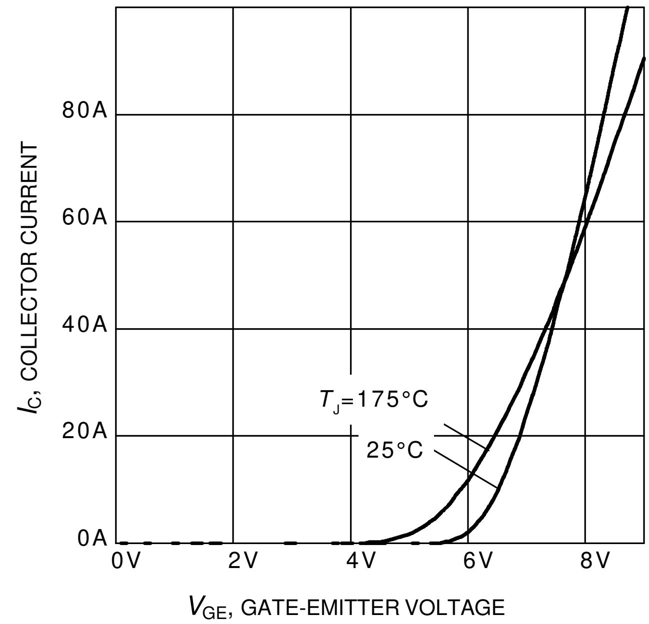


Figure 7. Typical transfer characteristic
(V_{CE}=20V)

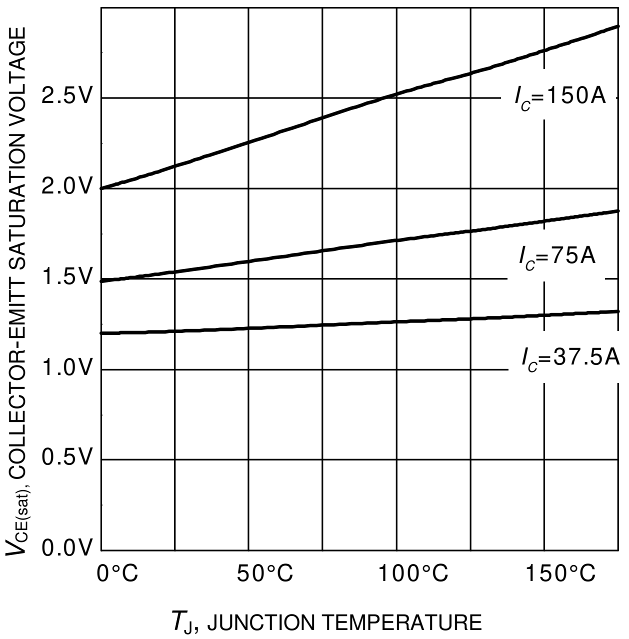


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE} = 15V)

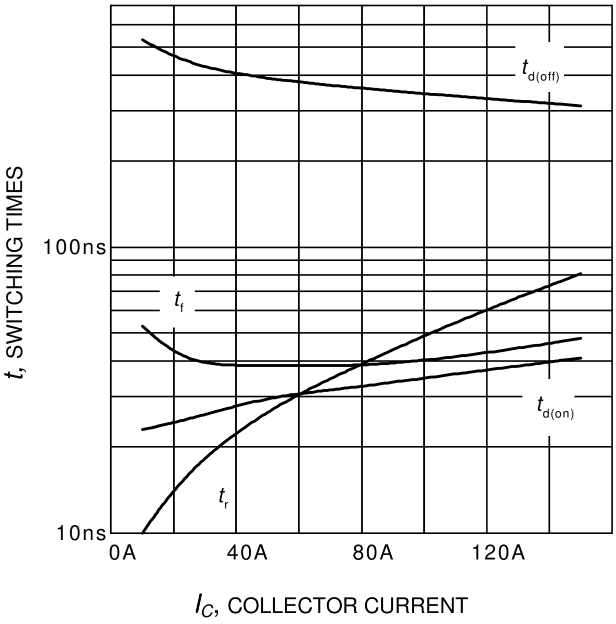


Figure 9. Typical switching times as a function of collector current
(inductive load, T_J=175°C, V_{CE} = 400V, V_{GE} = 0/15V, r_G = 5Ω, Dynamic test circuit in Figure E)

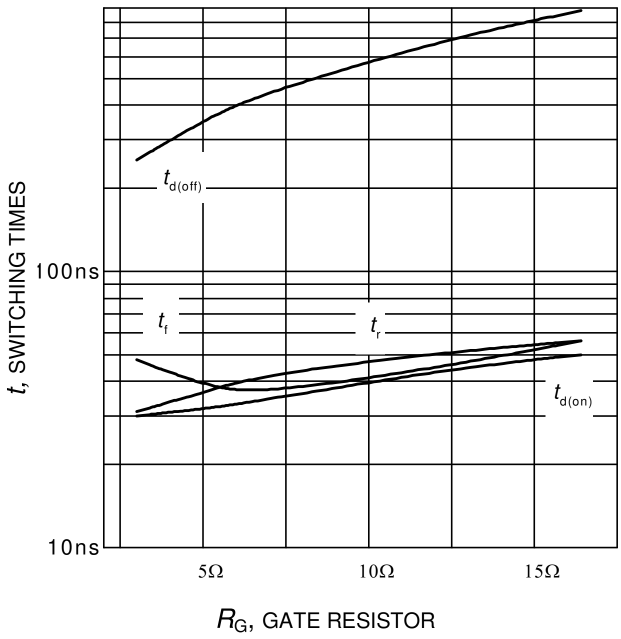


Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_J = 175°C, V_{CE}= 400V, V_{GE} = 0/15V, I_C = 75A, Dynamic test circuit in Figure E)

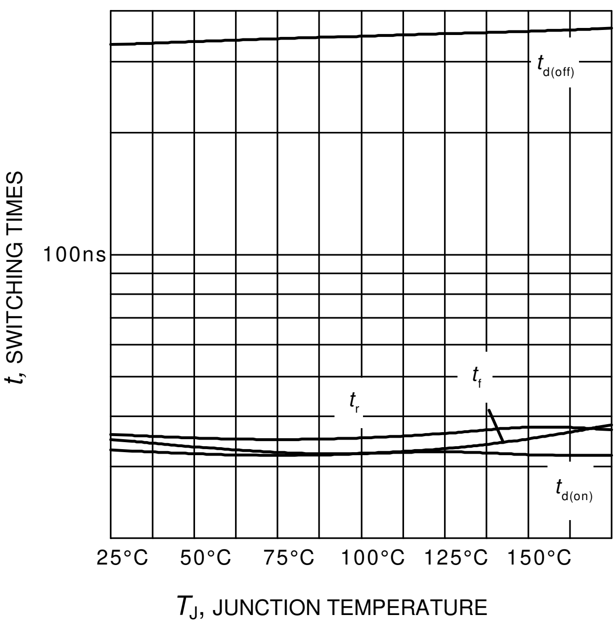


Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE} = 400V, V_{GE} = 0/15V, I_C = 75A, r_G=5Ω, Dynamic test circuit in Figure E)

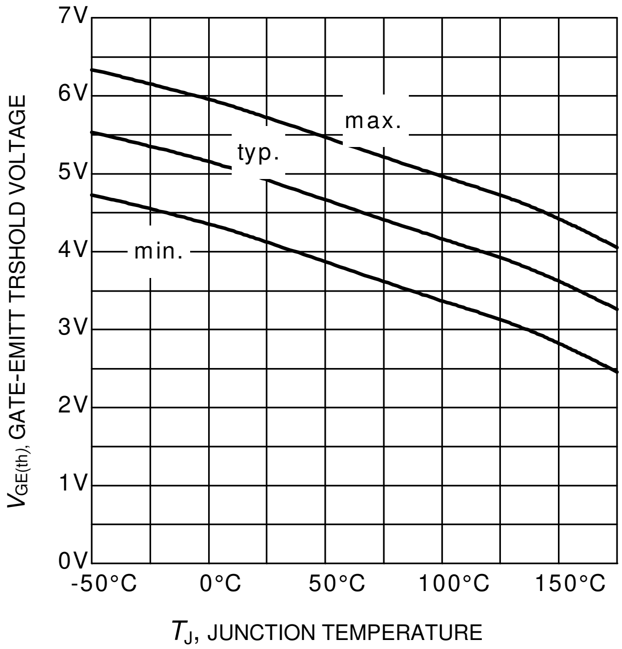


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C = 1.2mA)

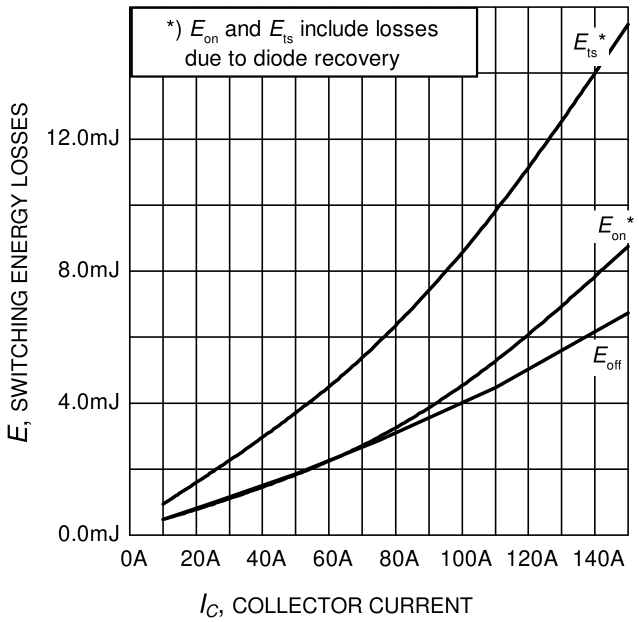


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_J = 175°C, V_{CE} = 400V, V_{GE} = 0/15V, r_G = 5Ω, Dynamic test circuit in Figure E)

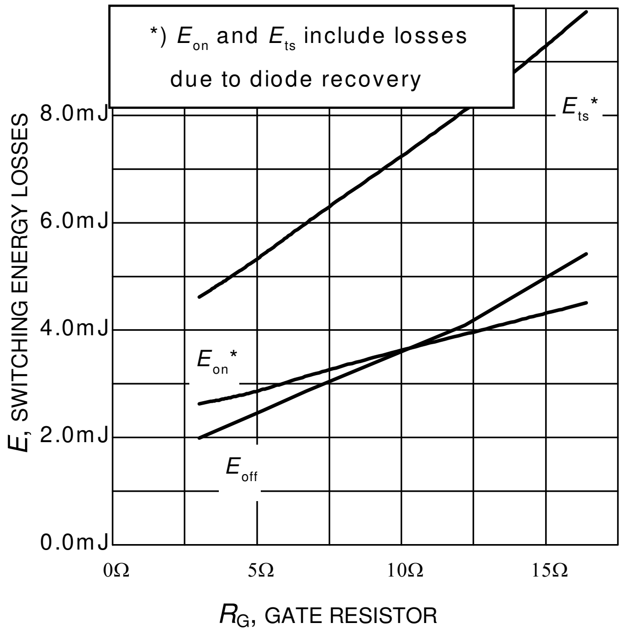


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_J = 175°C, V_{CE} = 400V, V_{GE} = 0/15V, I_C = 75A, Dynamic test circuit in Figure E)

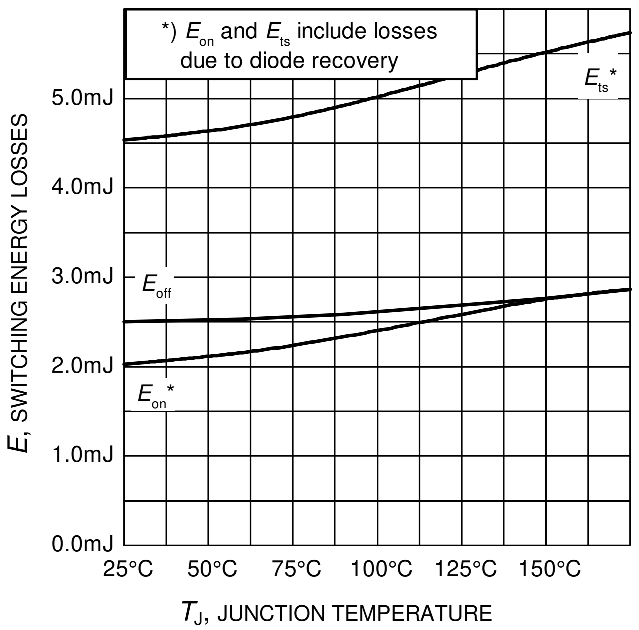


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE} = 400V, V_{GE} = 0/15V, I_C = 75A, r_G = 5Ω, Dynamic test circuit in Figure E)

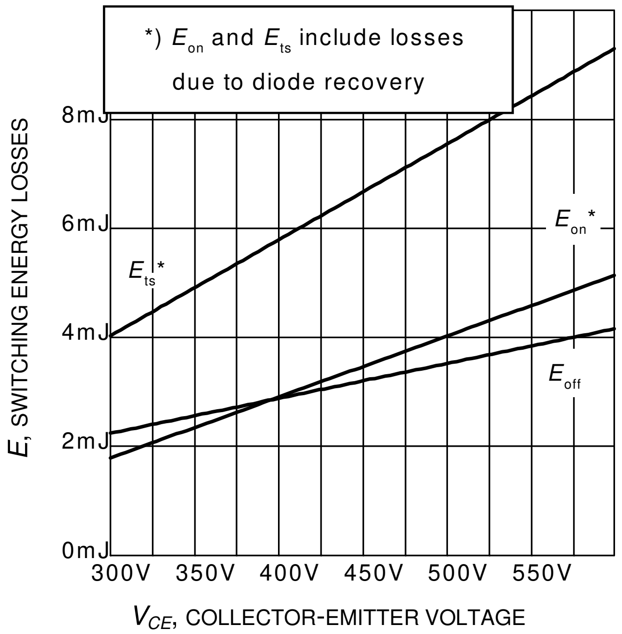
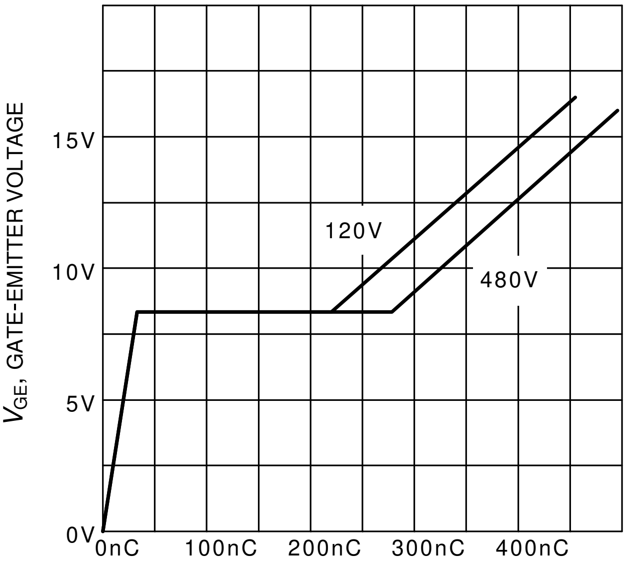
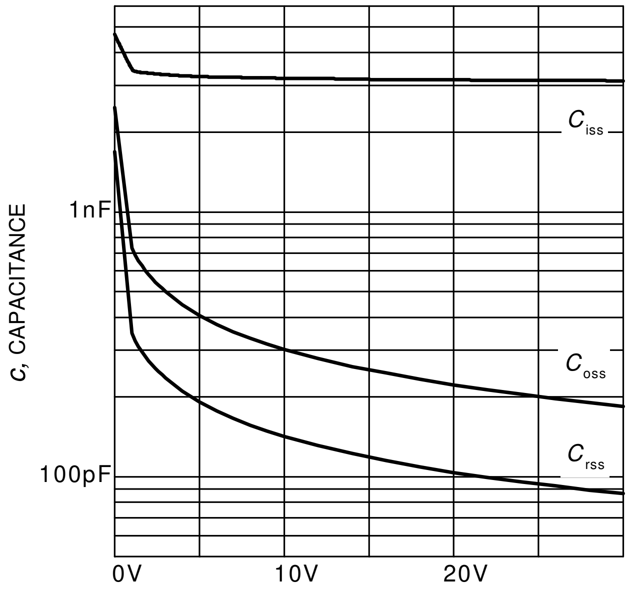


Figure 16. Typical switching energy losses as a function of collector emitter voltage
(inductive load, T_J = 175°C, V_{GE} = 0/15V, I_C = 75A, r_G = 5Ω, Dynamic test circuit in Figure E)



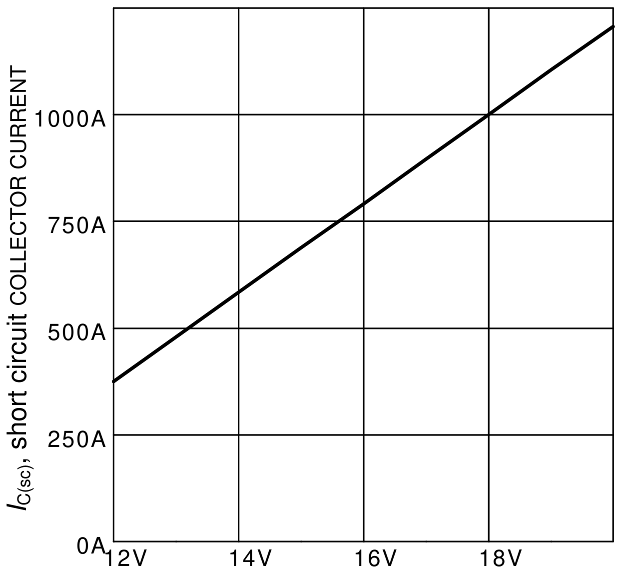
Q_{GE}, GATE CHARGE

Figure 17. Typical gate charge
(I_C=75 A)



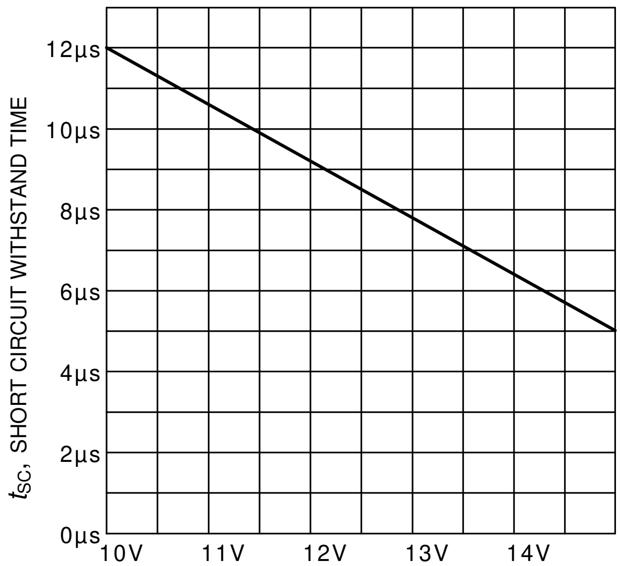
V_{CE}, COLLECTOR-EMITTER VOLTAGE

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



V_{GE}, GATE-EMITTETR VOLTAGE

Figure 19. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \leq$ 400V, $T_j \leq$ 150°C)



V_{GE}, GATE-EMITETR VOLTAGE

Figure 20. Short circuit withstand time as a function of gate-emitter voltage
(V_{CE}=400V, start at T_J=25°C, T_{Jmax}<150°C)

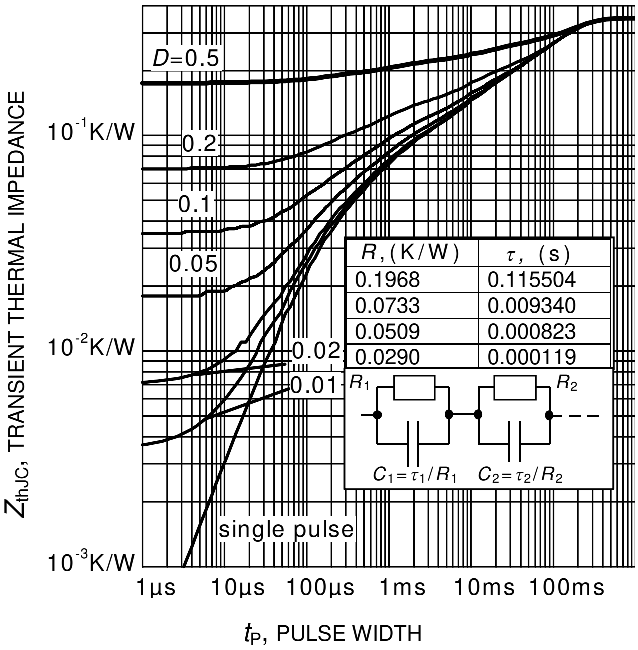


Figure 21. IGBT transient thermal impedance
($D = t_p / T$)

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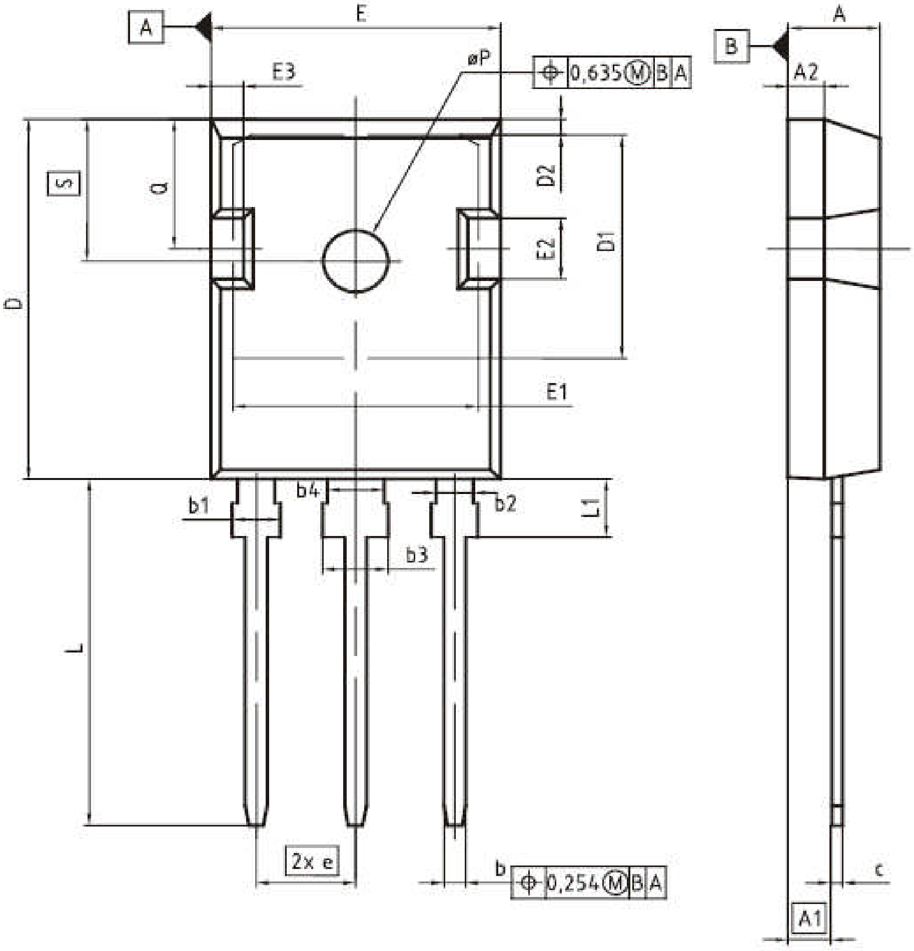

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.27	2.54	0.089	0.100
A2	1.85	2.16	0.073	0.085
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	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 0 5 0 5 7.5mm

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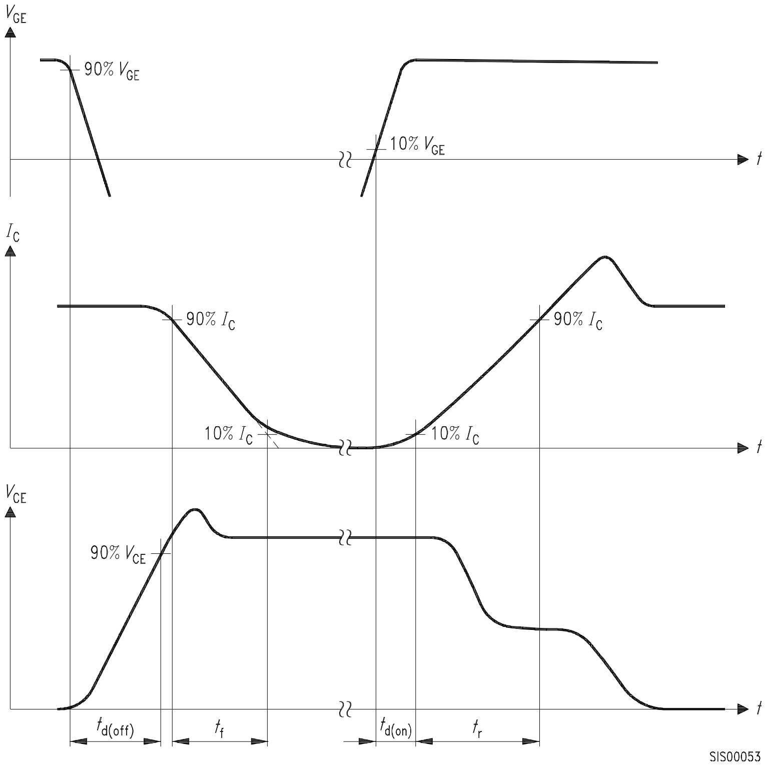

Figure A. Definition of switching times

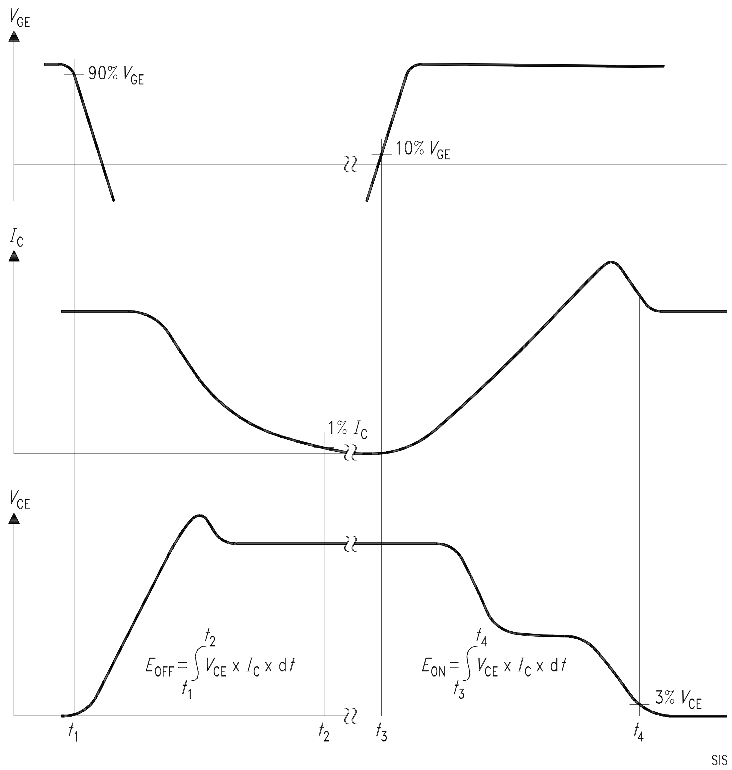

Figure B. Definition of switching losses

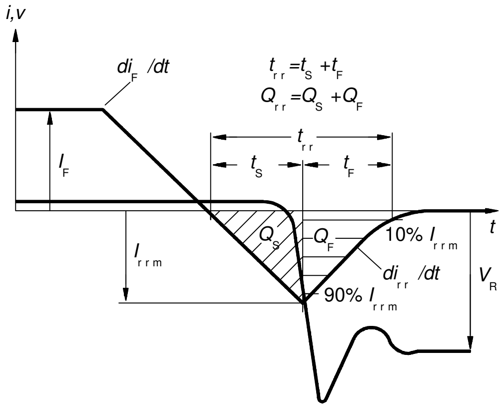

Figure C. Definition of diodes switching characteristics

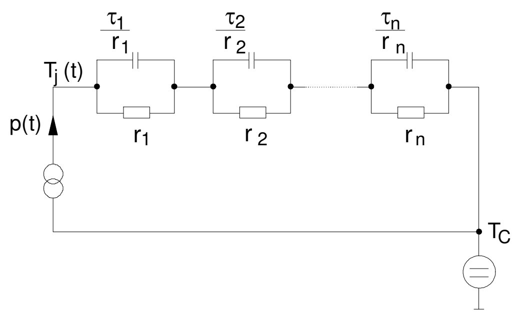

Figure D. Thermal equivalent circuit

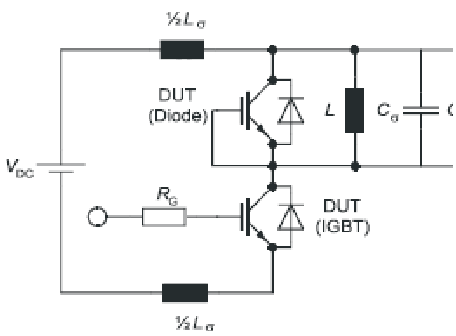

Figure E. Dynamic test circuit
Parasitic inductance L_σ,
Parasitic capacitor C_σ,
Relief capacitor C_r,
(only for ZVT switching)

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