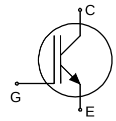
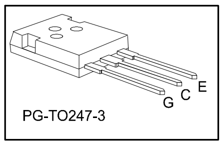
Low Loss IGBT: IGBT in TrenchStop ® and Fieldstop technology

- TrenchStop ® and Fieldstop technology for 1000 V applications offers:
  - low V_{CEsat}
  - very tight parameter distribution
  - high ruggedness, temperature stable behavior
  - positive temperature coefficient in V_{CEsat}
- Designed for:
  - frequency Converters
  - uninterrupted Power Supply
- Low EMI
- Low gate charge
- Qualified according to JEDEC 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_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IGW30N100T	1000V	30A	1.55V	175°C	G30T100	PG-TO247-3

Maximum ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1000	V
DC collector current, limited by T_{vjmax} T_C = 25°C T_C = 100°C	I_C	60.0 30.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	90.0	A
Turn off safe operating area V_{CE} = 1000V, T_{vj}= 175°C	-	90.0	A
Gate-emitter voltage Transient Gate-emitter voltage (t_p = 5µs, D < 0.010)	V_{GE}	±20 ±25	V
Power dissipation T_C = 25°C	P_{tot}	412.0	W
Operating junction temperature	T_{vj}	-55...+175	°C
Storage temperature	T_{stg}	-55...+175	°C
Soldering temperature, wavesoldering 1.6 mm (0.063 in.) from case for 10s		260	°C
Mounting torque, M3 screw Maximum of mounting processes: 3	M	0.6	Nm

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction - case	$R_{th(j-c)}$		0.36	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		40	K/W

Electrical Characteristic, at T_{vj} = 25°C, unless otherwise specified

Parameter	Symbol	Conditions	Value min.	Value typ.	Value max.	Unit
Static Characteristic						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0V, I_C = 0.50mA	1000	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 30.0A T_{vj} = 25°C T_{vj} = 150°C T_{vj} = 175°C	 - - -	 1.55 1.70 1.80	 1.90 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.80mA, V_{CE} = V_{GE}	5.1	5.8	6.4	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 1000V, V_{GE} = 0V T_{vj} = 25°C T_{vj} = 175°C	 - -	 - -	 50.0 2500.0	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	600	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 30.0A	-	28.0	-	S
Integrated gate resistor	r_G			none		Ω

Electrical Characteristic, at T_{vj} = 25°C, unless otherwise specified

Parameter	Symbol	Conditions	Value min.	Value typ.	Value max.	Unit
Dynamic Characteristic						
Input capacitance	C_{ies}	V_{CE} = 25V, V_{GE} = 0V, f = 1MHz	-	3575	-	pF
Output capacitance	C_{oes}		-	98	-	
Reverse transfer capacitance	C_{res}		-	76	-	
Gate charge	Q_G	V_{CC} = 800V, I_C = 30.0A, V_{GE} = 15V	-	217.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13.0	-	nH

Switching Characteristic, Inductive Load, at T_{vj} = 25°C

Parameter	Symbol	Conditions	Value min.	Value typ.	Value max.	Unit
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 600V, I_C = 30.0A, V_{GE} = 0.0/15.0V, r_G = 16.0Ω, L_σ = 105nH, C_σ = 50pF L_σ, C_σ from Fig. E Energy losses include “tail” and diode reverse recovery using the IKW30N100T duopak.	-	33	-	ns
Rise time	t_r		-	21	-	ns
Turn-off delay time	$t_{d(off)}$		-	535	-	ns
Fall time	t_f		-	34	-	ns
Turn-on energy	E_{on}		-	2.20	-	mJ
Turn-off energy	E_{off}		-	1.60	-	mJ
Total switching energy	E_{ts}		-	3.80	-	mJ

Switching Characteristic, Inductive Load, at T_{vj} = 175°C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 175°C, V_{CC} = 600V, I_C = 30.0A, V_{GE} = 0.0/15.0V, r_G = 16.0Ω, L_σ = 105nH, C_σ = 50pF L_σ, C_σ from Fig. E Energy losses include "tail" and diode reverse recovery using the IKW30N100T duopak.	-	33	-	ns
Rise time	t_r		-	30	-	ns
Turn-off delay time	$t_{d(off)}$		-	610	-	ns
Fall time	t_f		-	60	-	ns
Turn-on energy	E_{on}		-	3.20	-	mJ
Turn-off energy	E_{off}		-	2.40	-	mJ
Total switching energy	E_{ts}		-	5.60	-	mJ

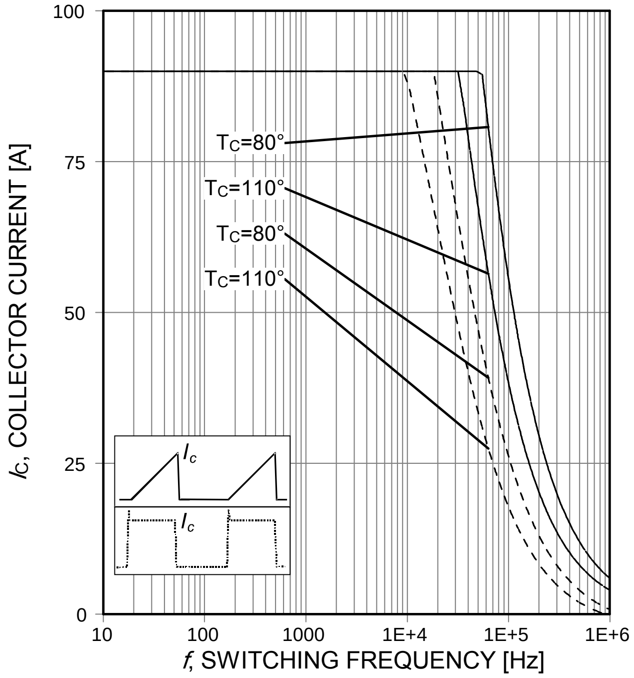


Figure 1. Collector current as a function of switching frequency
(T_j≤175°C, D=0.5, V_{CE}=600V, V_{GE}=15/0V, R_G=16Ω)

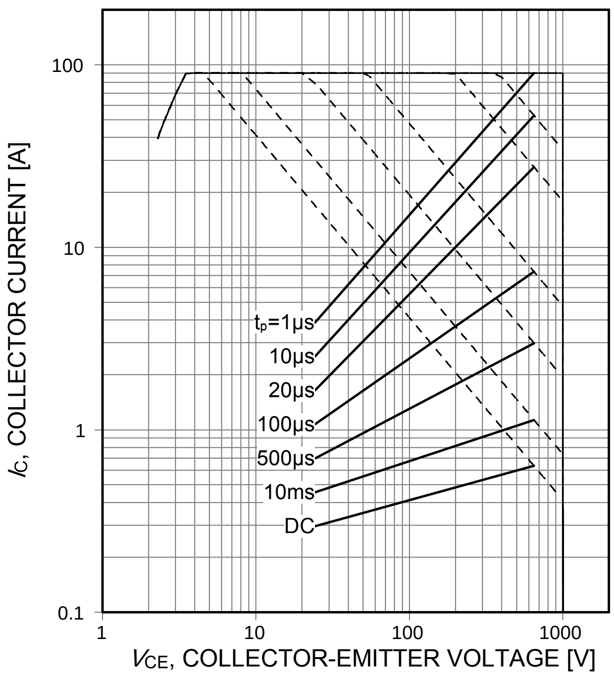


Figure 2. Forward bias safe operating area
(D=0, T_C=25°C, T_j≤175°C; V_{GE}=15V)

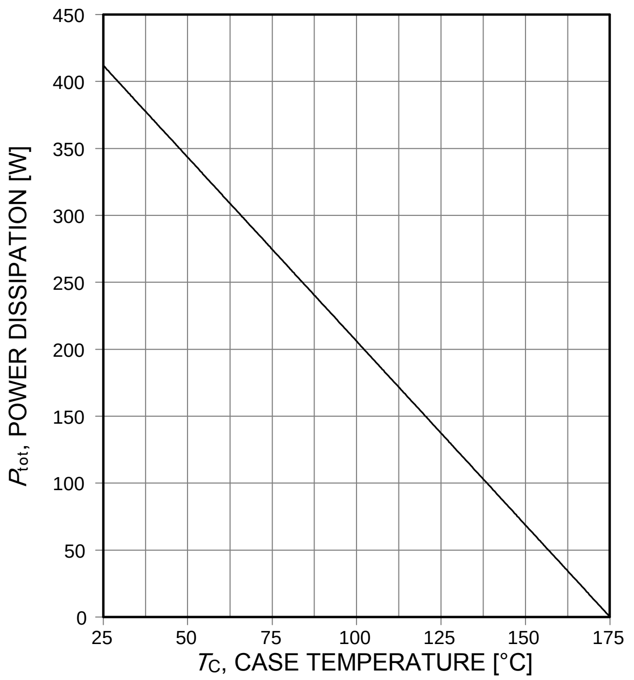


Figure 3. Power dissipation as a function of case temperature
(T_j≤175°C)

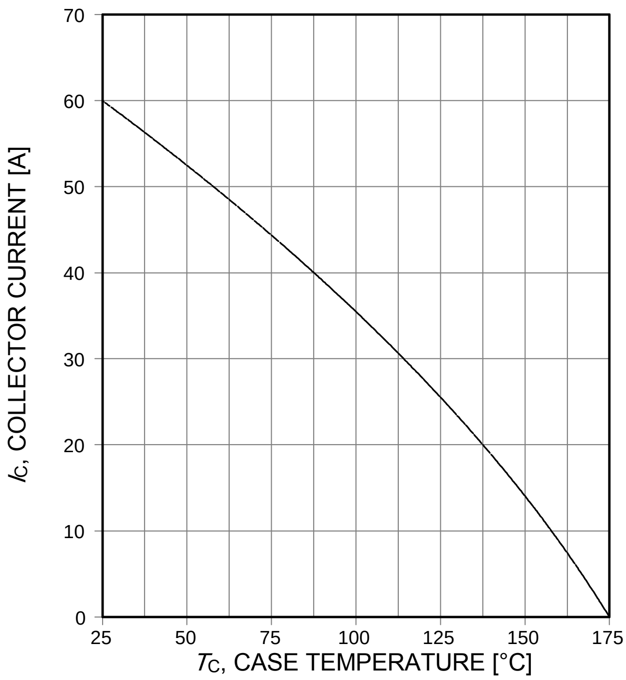


Figure 4. Collector current as a function of case temperature
(V_{GE}≥15V, T_j≤175°C)

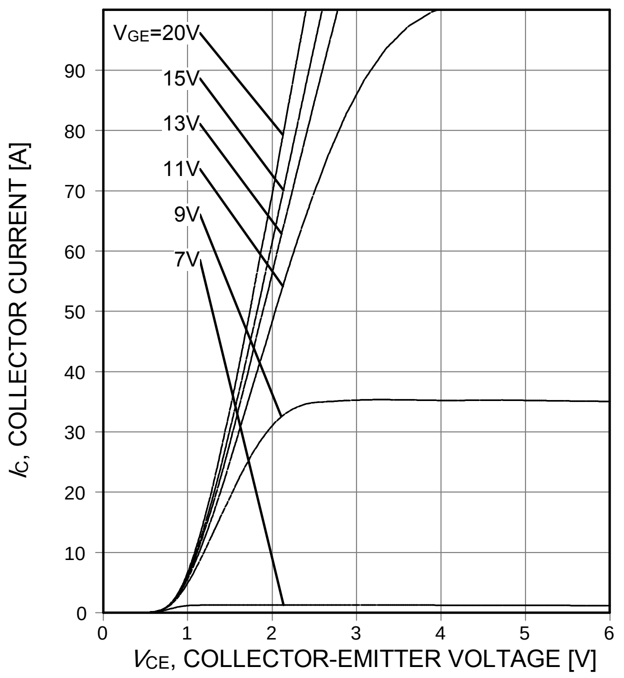


Figure 5. Typical output characteristic
(T_j=25°C)

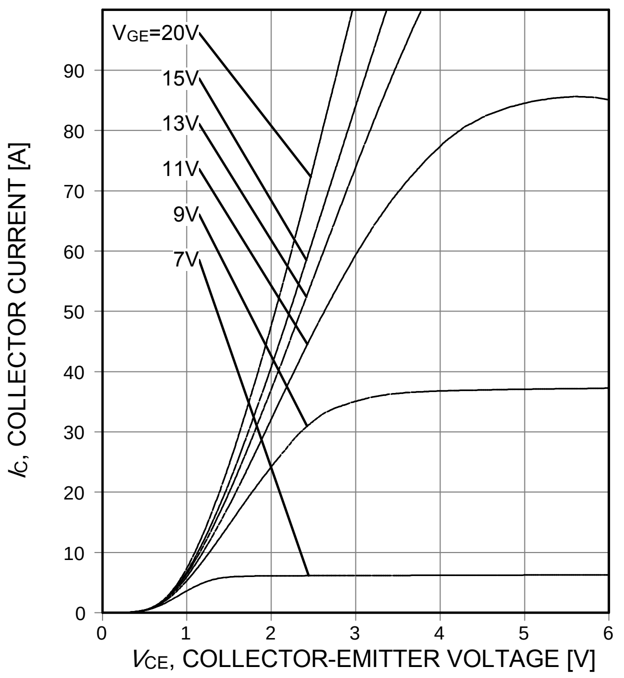


Figure 6. Typical output characteristic
(T_j=175°C)

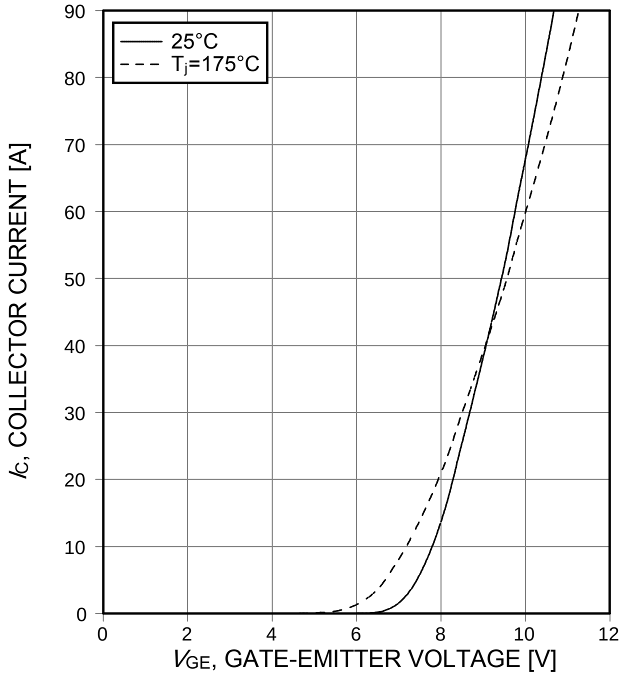


Figure 7. Typical transfer characteristic
(V_{CE}=20V)

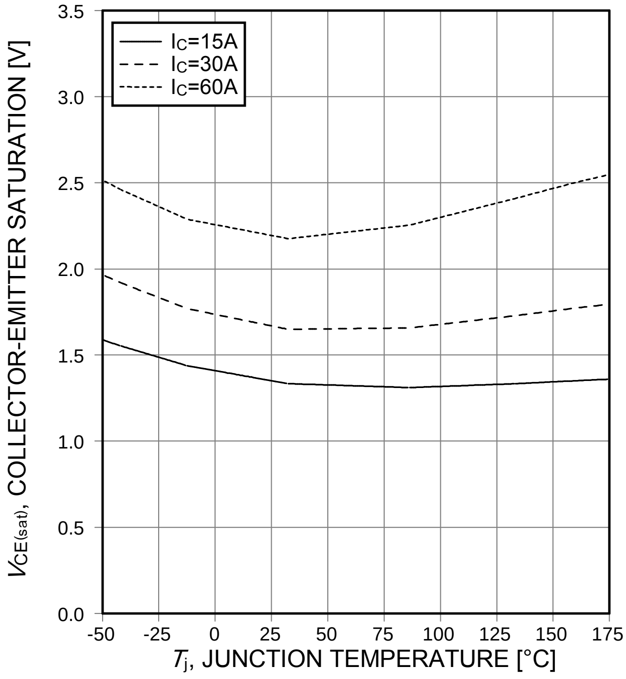


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE}=15V)

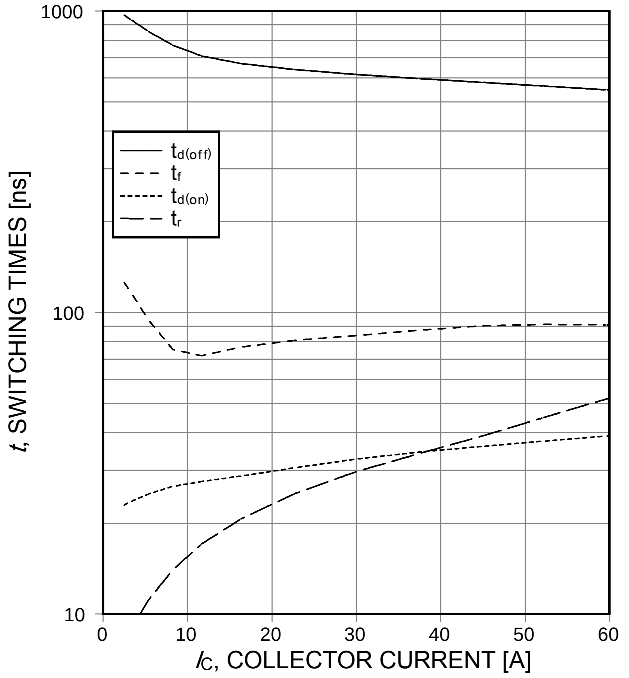


Figure 9. Typical switching times as a function of collector current
(inductive load, T_j=175°C, V_{CE}=600V, V_{GE}=15/0V, R_G=16Ω,Dynamic test circuit in Figure E)

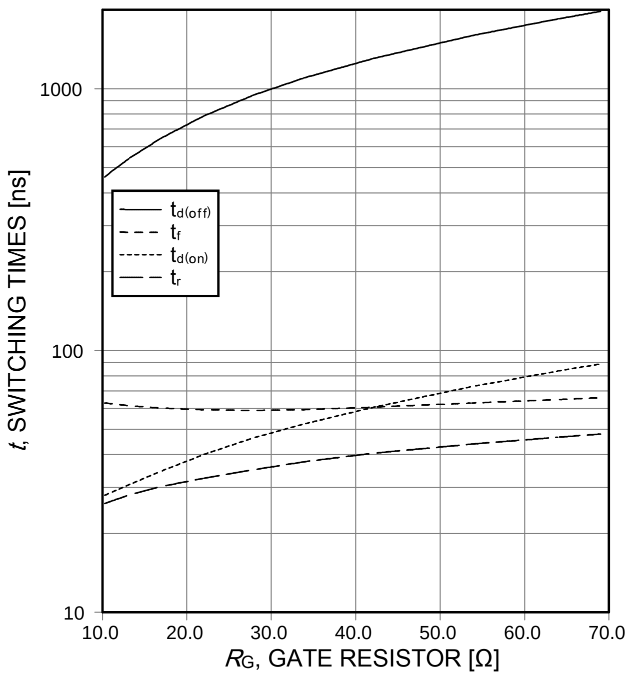


Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_j=175°C, V_{CE}=600V, V_{GE}=15/0V, I_C=30A,Dynamic test circuit in Figure E)

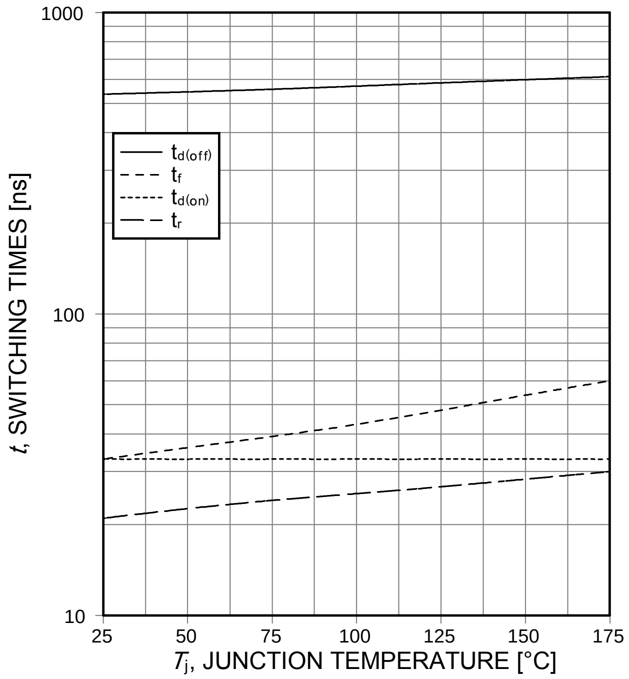


Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE}=600V, V_{GE}=15/0V, I_C=30A, R_G=16Ω,Dynamic test circuit in Figure E)

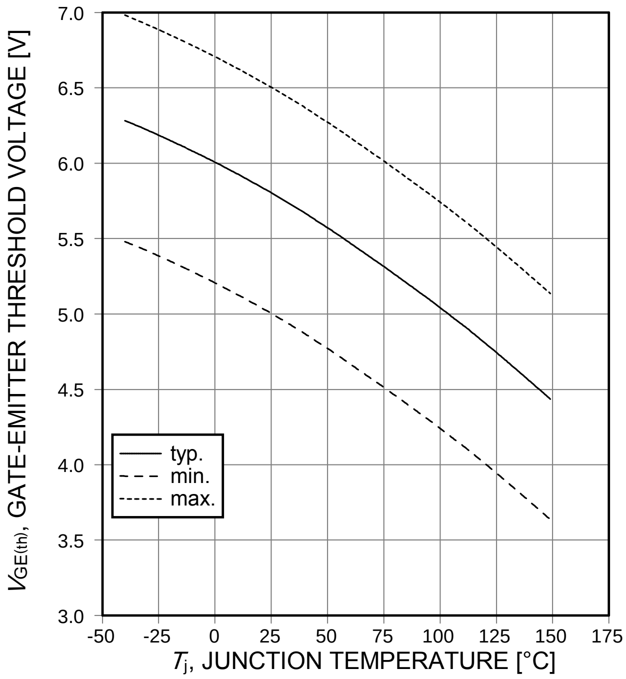


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C=0.7mA)

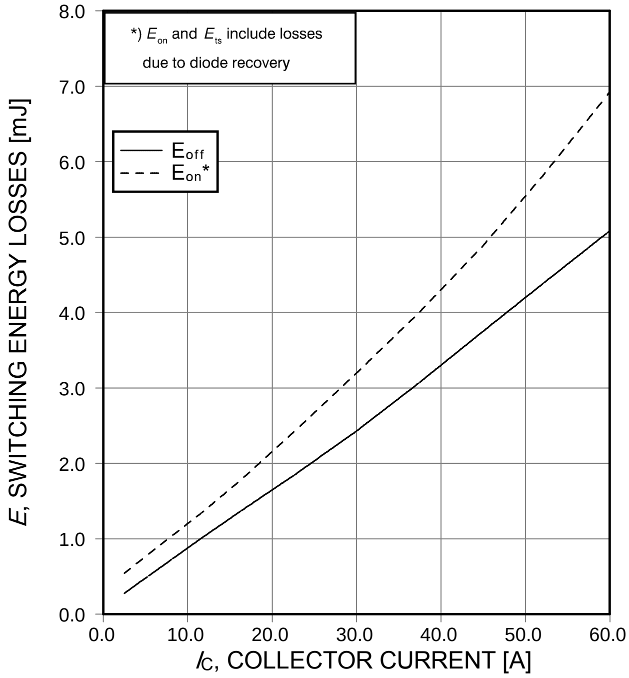


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_j=175°C, V_{CE}=600V, V_{GE}=15/0V, R_G=16Ω,Dynamic test circuit in Figure E)

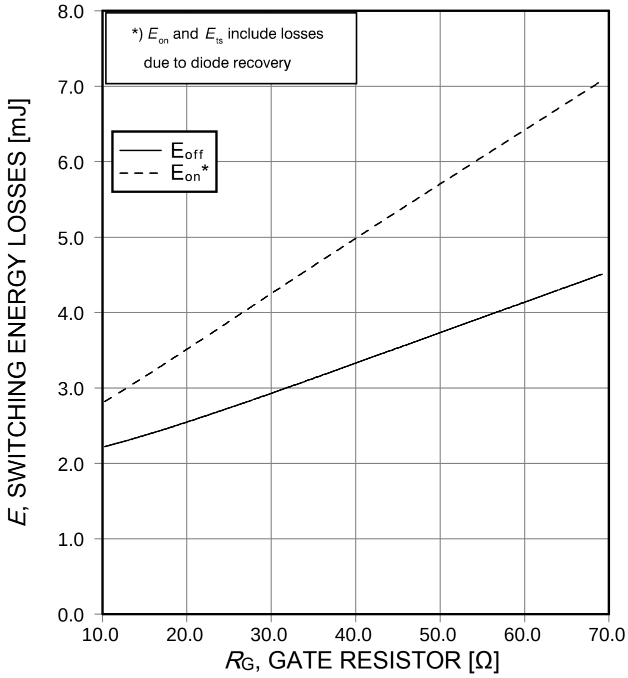


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_j=175°C, V_{CE}=600V, V_{GE}=15/0V, I_C=30A,Dynamic test circuit in Figure E)

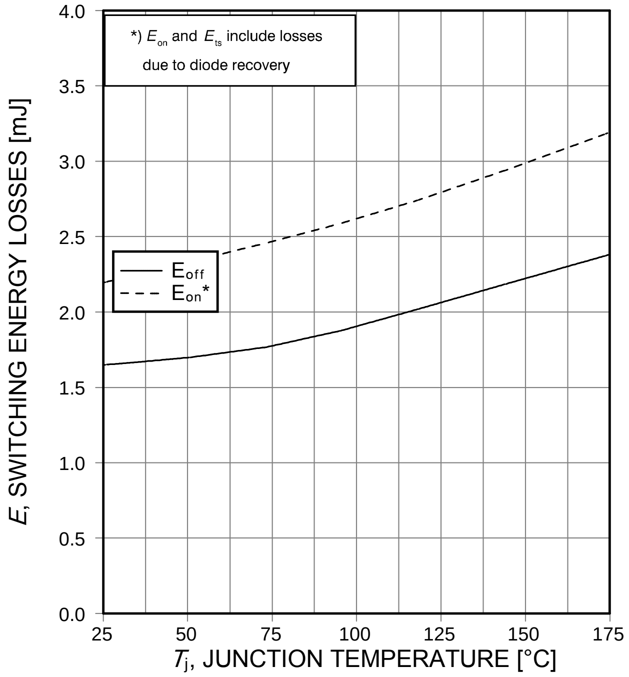


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE}=600V, V_{GE}=15/0V, I_C=30A, R_G=16Ω,Dynamic test circuit in Figure E)

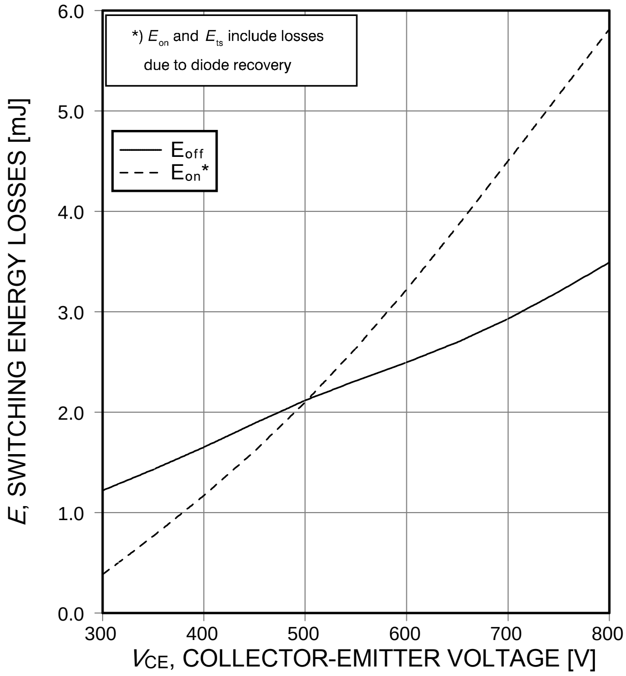


Figure 16. Typical switching energy losses as a function of collector emitter voltage
(inductive load, T_j=175°C, V_{GE}=15/0V, I_C=30A, R_G=16Ω,Dynamic test circuit in Figure E)

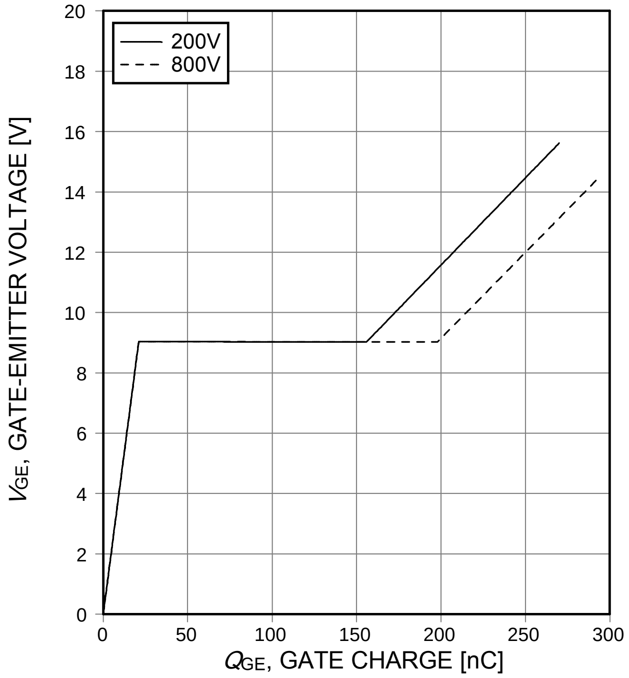


Figure 17. Typical gate charge
(I_C=30A)

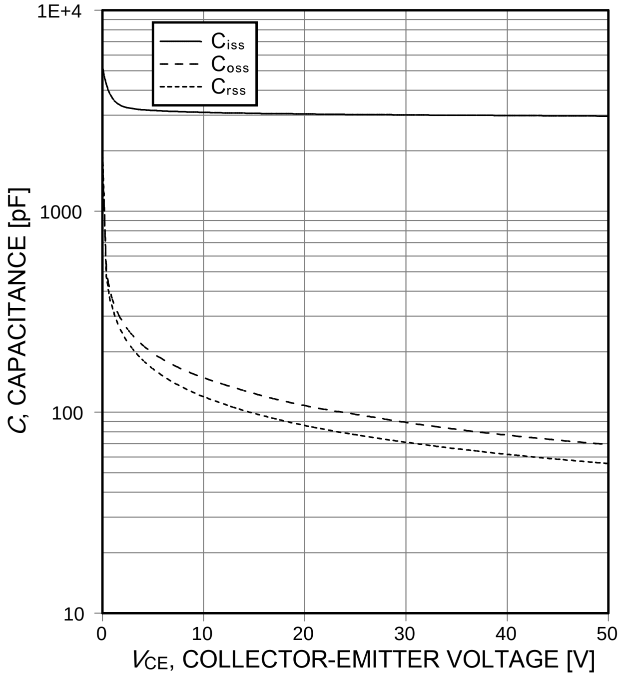


Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE}=0V, f=1MHz)

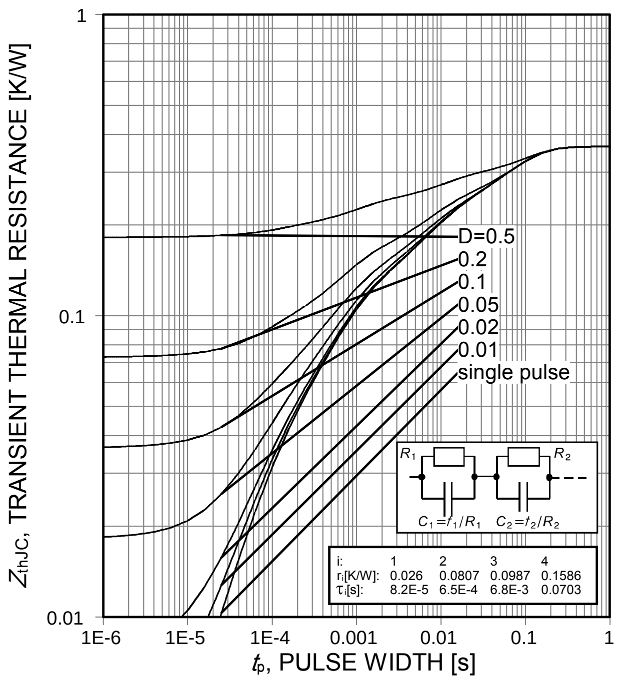


Figure 19. IGBT transient thermal resistance
(D=t_p/T)

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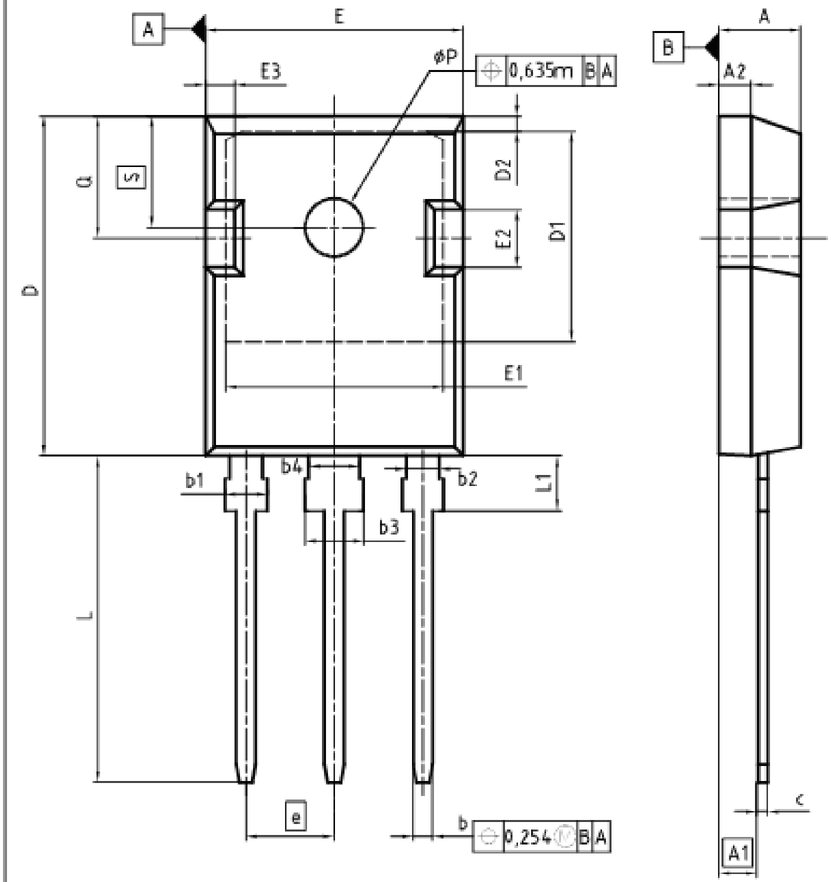

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.27	2.54	0.089	0.100
A2	1.85	2.16	0.073	0.085
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	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		0.214	
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 5 7.5mm

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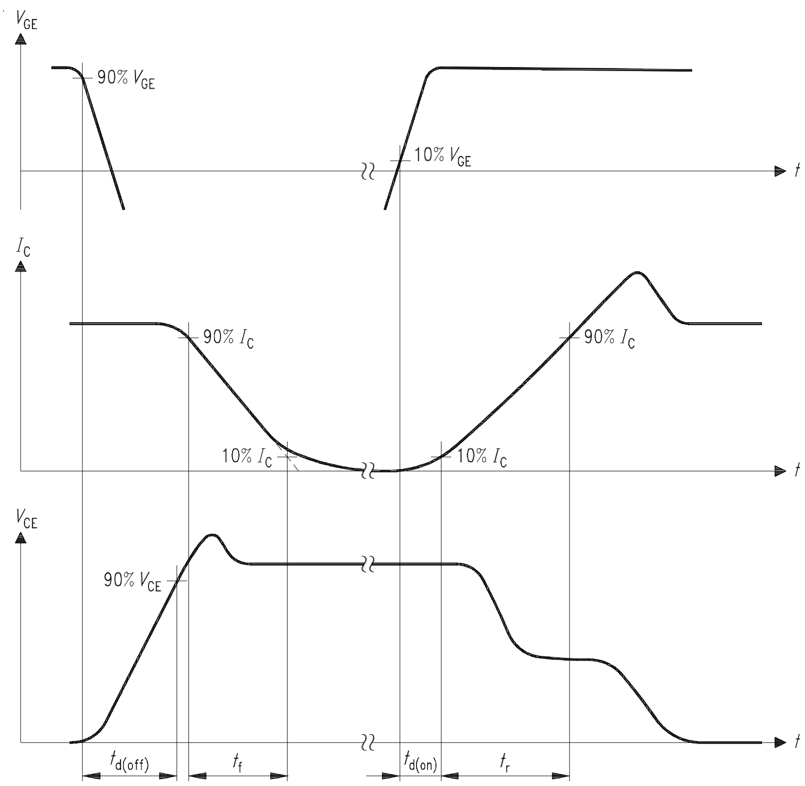
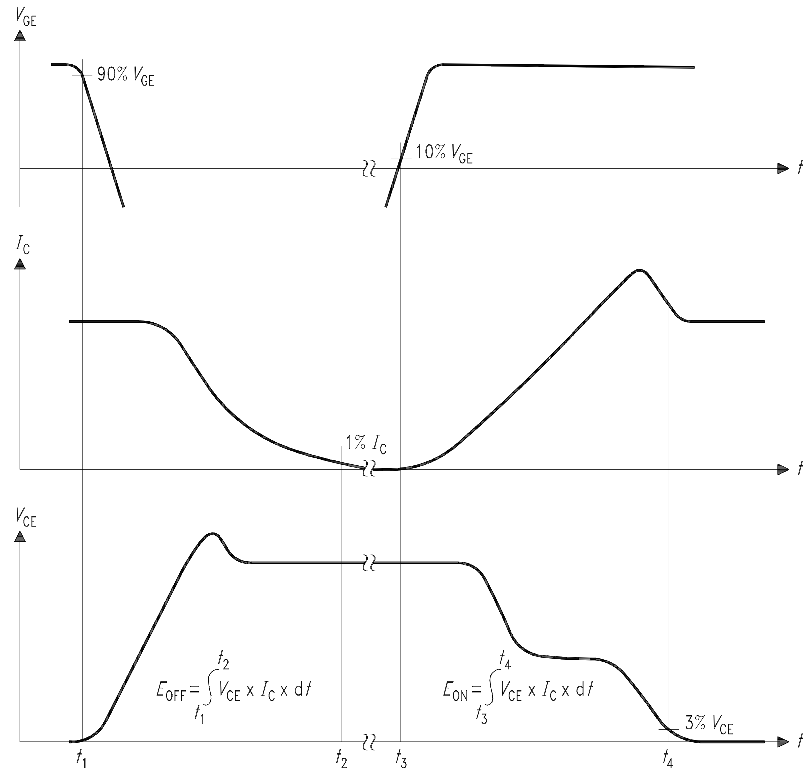


Figure A. Definition of switching times



$$E_{OFF} = \int_{t_1}^{t_2} V_{CE} \times I_C \times dt \qquad E_{ON} = \int_{t_3}^{t_4} V_{CE} \times I_C \times dt$$

Figure B. Definition of switching losses

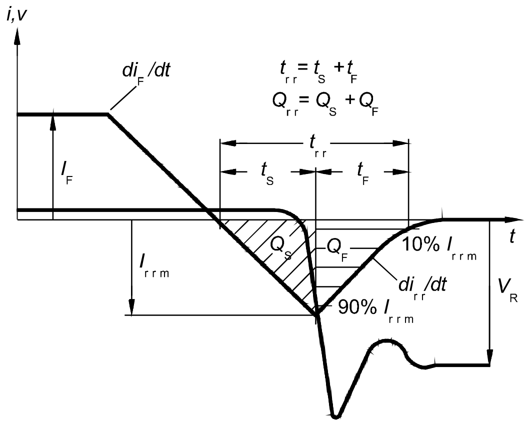


Figure C. Definition of diodes switching characteristics

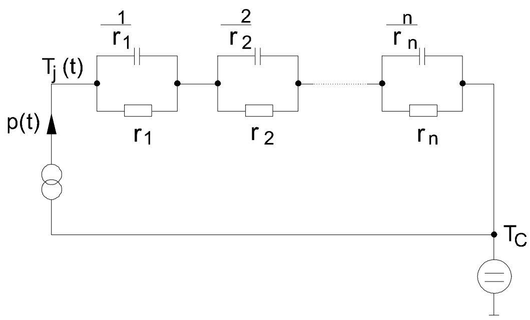


Figure D. Thermal equivalent circuit

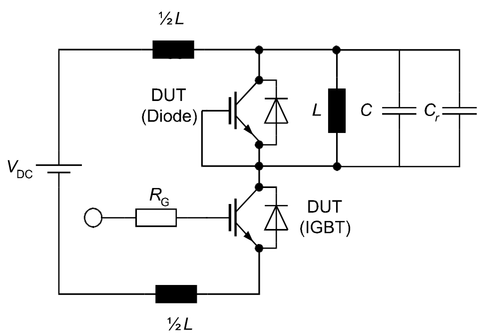


Figure E. Dynamic test circuit
Leakage inductance L= 180nH,
Stray capacitor C_σ = 40pF,
Relief capacitor C_r = 1nF
(only for ZVT switching)

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