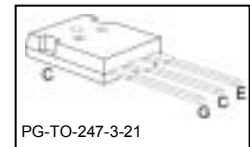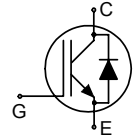# IHW30N60T

Soft Switching Series

Low Loss DuoPack : IGBT in TrenchStop® technology with optimised diode

Features:
- Very low $V_{CE(sat)}$ 1.5 V (typ.)
- Maximum Junction Temperature 175 °C
- Short circuit withstand time – 5µs
- TrenchStop® and Fieldstop technology for 600 V applications offers :
  - - very tight parameter distribution
  - - high ruggedness, temperature stable behavior
  - - low $V_{CE(sat)}$
- 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/

PG-TO-247-3-21

Applications:
- Inductive Cooking
- Soft Switching Applications

Type	V_{CE}	I_C	$V_{CE(sat),Tj=25°C}$	$T_{j,max}$	Marking	Package
IHW30N60T	600V	30A	1.5V	175°C	H30T60	PG-TO-247-3-21

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	600	V
DC collector current, limited by T_{jmax}	I_C		A
T_C = 25°C		60	
T_C = 100°C		30	
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	90	
Turn off safe operating area ($V_{CE} \leq$ 600V, $T_j \leq$ 175°C)	-	90	
Diode forward current	I_F		
T_C = 25°C		23	
T_C = 100°C		13	
Diode pulsed current, t_p limited by T_{jmax}	I_{Fpuls}	30	
Gate-emitter voltage	V_{GE}	±20	V
Transient Gate-emitter voltage (t_p < 5 ms)		±25	
Short circuit withstand time[2]	t_{SC}	5	µs
V_{GE} = 15V, $V_{CC} \leq$ 400V, $T_j \leq$ 150°C			
Power dissipation T_C = 25°C	P_{tot}	187	W
Operating junction temperature	T_j	-40...+175	°C
Storage temperature	T_{stg}	-55...+175	
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}		0.8	K/W
Diode thermal resistance, junction – case	R_{thJCD}		1.1	
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	$V_{(BR)CES}$	$V_{GE}=0V$, $I_C=0.5mA$	600	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE} = 15V, $I_C=30A$				
		$T_j=25°C$	-	1.5	2	
		$T_j=175°C$	-	1.9	-	
Diode forward voltage	V_F	$V_{GE}=0V$, $I_F=10A$				
		$T_j=25°C$	-	1.1	1.3	
		$T_j=150°C$	-	1.0	-	
		$T_j=175°C$	-	1.0	-	
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C=0.43mA$, $V_{CE}=V_{GE}$	4.1	4.9	5.7	
Zero gate voltage collector current	I_{CES}	$V_{CE}=600V$, $V_{GE}=0V$				µA
		$T_j=25°C$	-	-	40	
		$T_j=175°C$	-	-	1000	
Gate-emitter leakage current	I_{GES}	$V_{CE}=0V, V_{GE}=20V$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE}=20V$, $I_C=30A$	-	16.7	-	S
Integrated gate resistor	R_{Gint}			-		Ω

Dynamic Characteristic

Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
Input capacitance	C_{iss}	$V_{CE}=25V$,	-	1630	-	pF
Output capacitance	C_{oss}	$V_{GE}=0V$,	-	108	-	
Reverse transfer capacitance	C_{rss}	$f=1MHz$	-	50	-	
Gate charge	Q_{Gate}	$V_{CC}=480V$, $I_C=30A$ $V_{GE}=15V$	-	167	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13	-	nH
Short circuit collector current[1]	$I_{C(SC)}$	$V_{GE}=15V, t_{SC}\leq5\mu s$ V_{CC} = 400V, T_j = 150°C	-	275	-	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,	-	23	-	ns
Rise time	t_r	V_{CC}=400V, I_C=30A,	-	21	-	
Turn-off delay time	$t_{d(off)}$	V_{GE}=0/15V,	-	254	-	
Fall time	t_f	R_G=10.6 Ω,	-	46	-	
Turn-on energy	E_{on}	$L_\sigma{}^{1)}$=136nH,	-	-	-	mJ
Turn-off energy	E_{off}	$C_\sigma{}^{1)}$=39pF	-	0.77	-	
Total switching energy	E_{ts}		-	0.77	-	

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,	-	24	-	ns
Rise time	t_r	V_{CC}=400V, I_C=30A,	-	26	-	
Turn-off delay time	$t_{d(off)}$	V_{GE}=0/15V,	-	292	-	
Fall time	t_f	R_G= 10.6 Ω	-	90	-	
Turn-on energy	E_{on}	$L_\sigma{}^{1)}$=136nH,	-	-	-	mJ
Turn-off energy	E_{off}	$C_\sigma{}^{1)}$=39pF	-	1.1	-	
Total switching energy	E_{ts}		-	1.1	-	

[1] Leakage inductance L_σ and Stray capacity C_σ due to dynamic test circuit in Figure E.
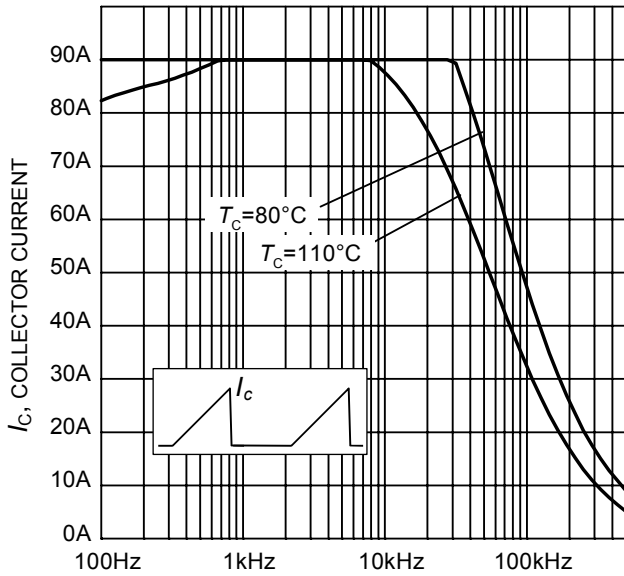
Figure 1. Collector current as a function of switching frequency for triangular current (E_{on} = 0, hard turn-off)
($T_j \leq 175°C$, D = 0.5, V_{CE} = 400V, V_{GE} = 0/+15V, R_G = 10Ω)
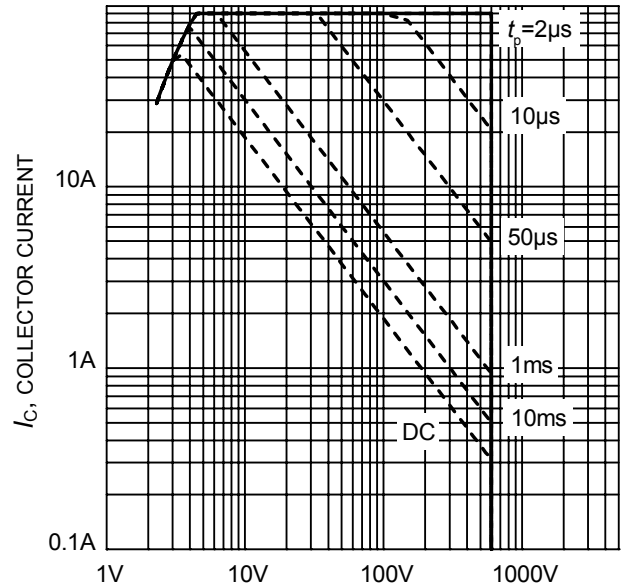
Figure 2. Safe operating area
(D = 0, T_C = 25°C, $T_j \leq 175°C$; V_{GE}=15V)
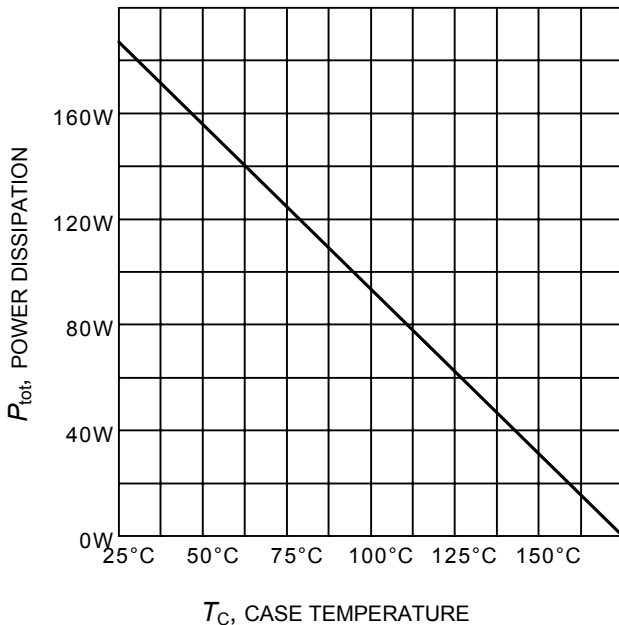
Figure 3. Power dissipation as a function of case temperature
($T_j \leq 175°C$)
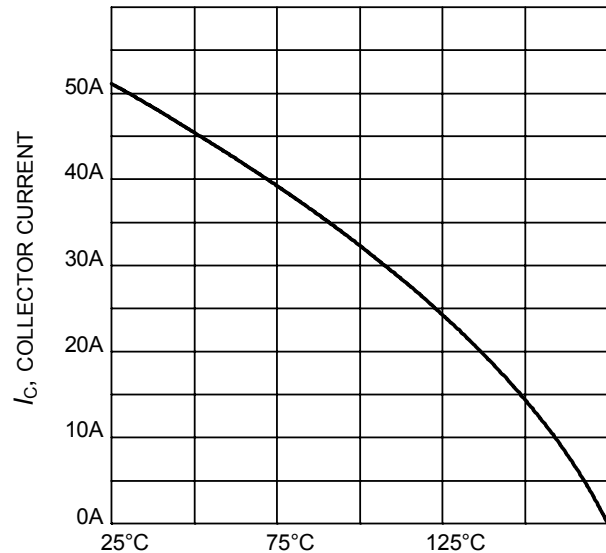
Figure 4. Collector current as a function of case temperature
($V_{GE} \geq 15V$, $T_j \leq 175°C$)
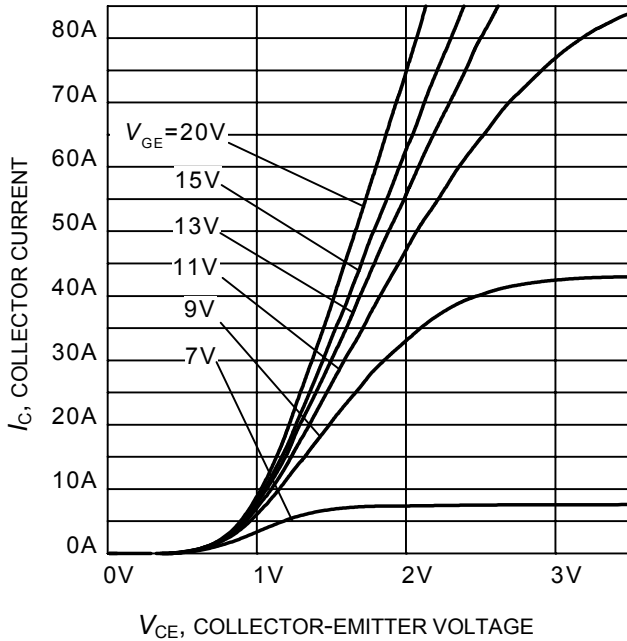
Figure 5. Typical output characteristic
(T_j = 25°C)
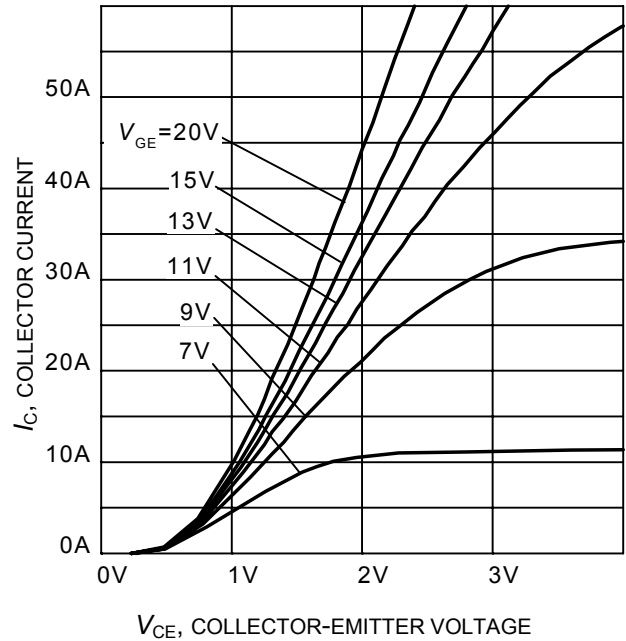
Figure 6. Typical output characteristic
(T_j = 175°C)
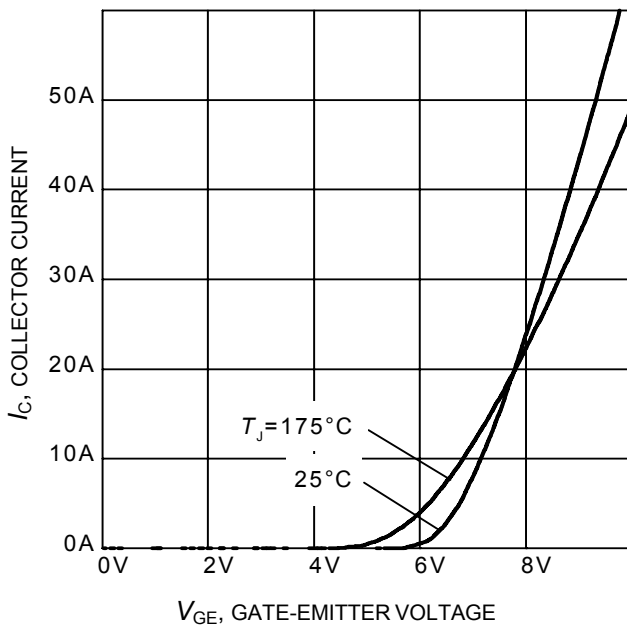
Figure 7. Typical transfer characteristic
(V_CE=10V)
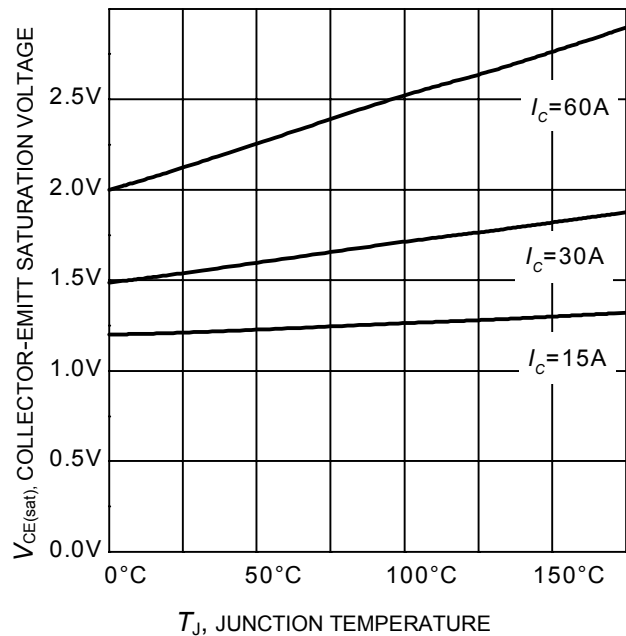
Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_GE = 15V)
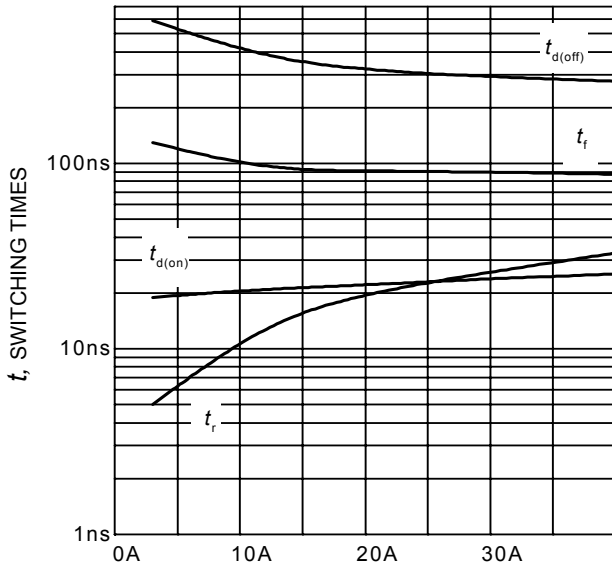
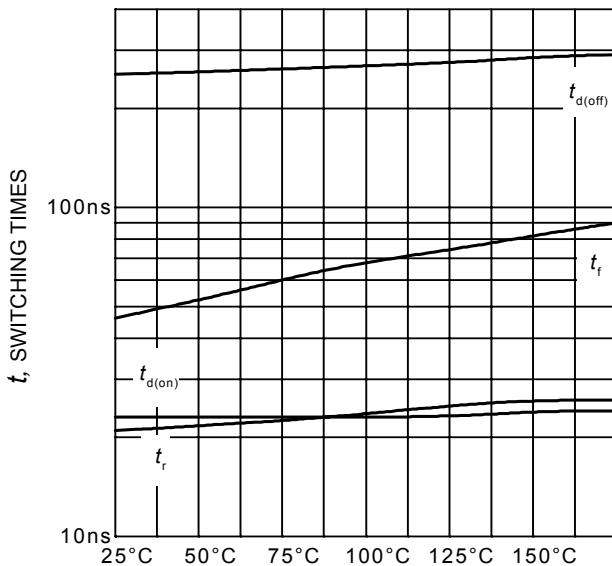**Figure 9.** **Typical switching times as a function of collector current** (inductive load, T_J=175°C, V_{CE} = 400V, V_{GE} = 0/15V, R_G = 10Ω, Dynamic test circuit in Figure E)
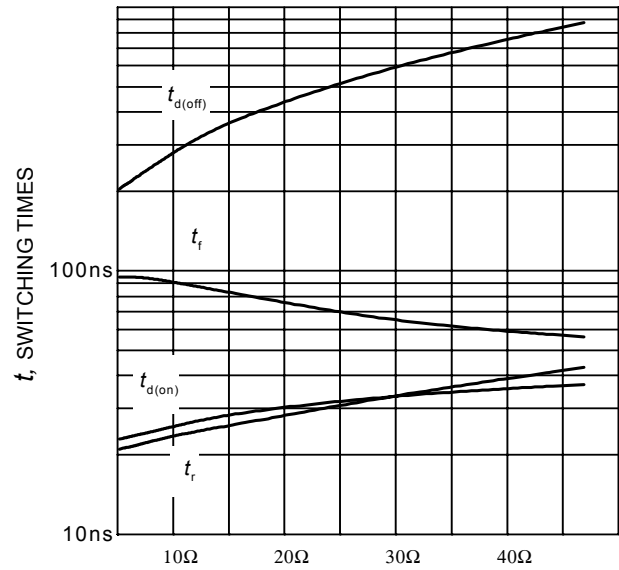
Figure 10. **Typical switching times as a function of gate resistor** (inductive load, T_J = 175°C, V_{CE}= 400V, V_{GE} = 0/15V, I_C = 30A, Dynamic test circuit in Figure E)

Figure 11. **Typical switching times as a function of junction temperature** (inductive load, V_{CE} = 400V, V_{GE} = 0/15V, I_C = 30A, R_G=10Ω, Dynamic test circuit in Figure E)
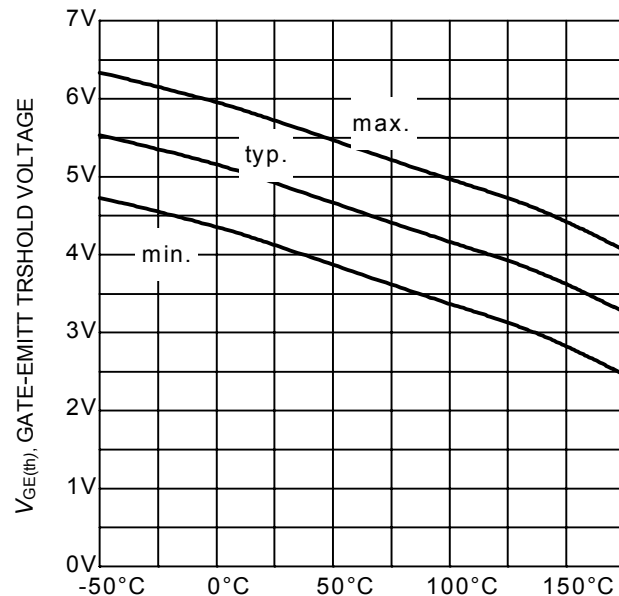
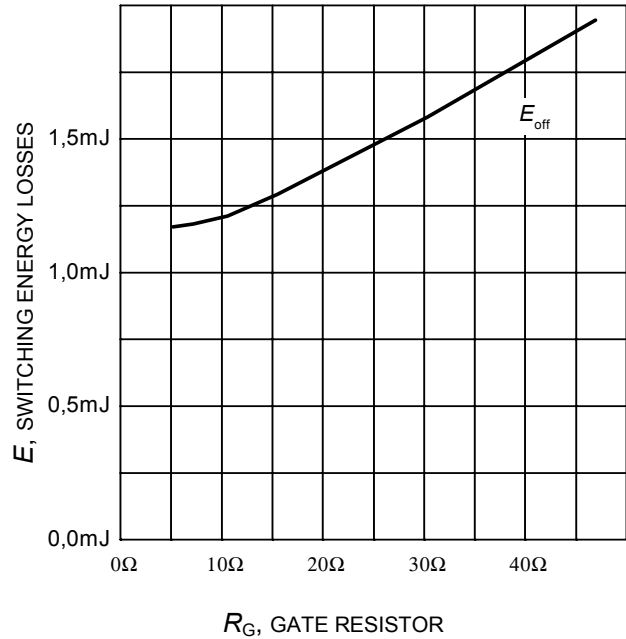**Figure 12.** **Gate-emitter threshold voltage as a function of junction temperature** (I_C = 0.43mA)

Soft Switching Series
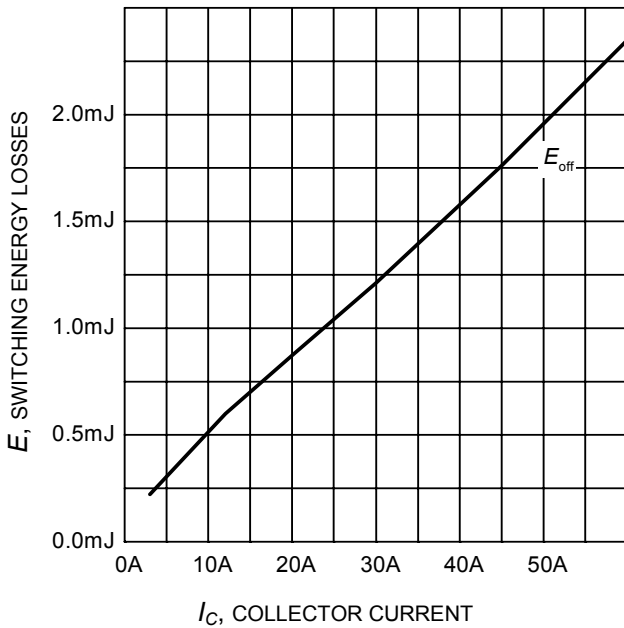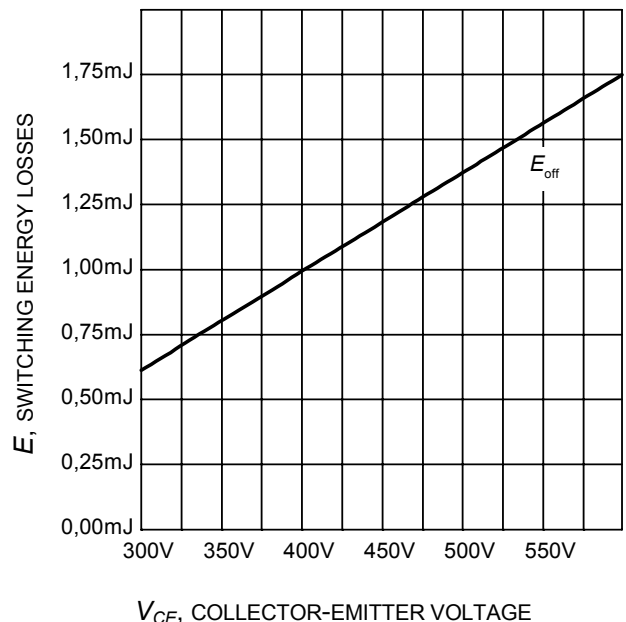

Figure 13. Typical switching energy losses as a function of collector current (inductive load, T_J = 175°C, V_{CE} = 400V, V_{GE} = 0/15V, R_G = 10Ω, Dynamic test circuit in Figure E)


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 = 30A, Dynamic test circuit in Figure E)
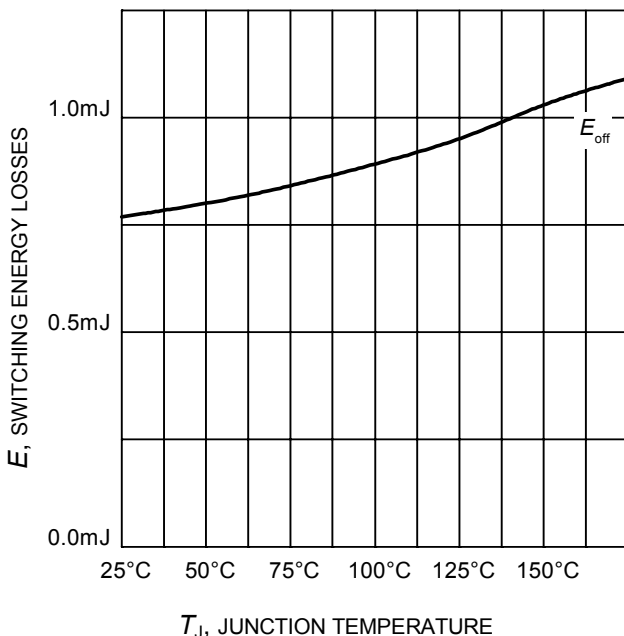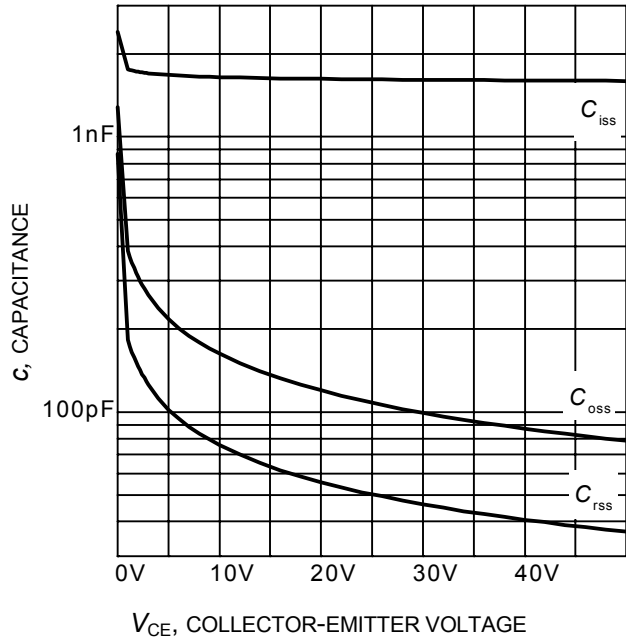

Figure 15. Typical switching energy losses as a function of junction temperature (inductive load, V_{CE} = 400V, V_{GE} = 0/15V, I_C = 30A, R_G = 10Ω, Dynamic test circuit in Figure E)
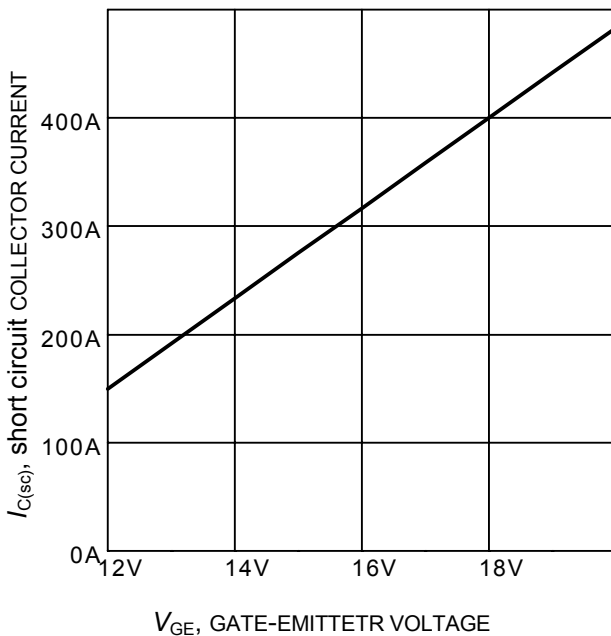

Figure 16. Typical switching energy losses as a function of collector emitter voltage (inductive load, T_J = 175°C, V_{GE} = 0/15V, I_C = 30A, R_G = 10Ω, Dynamic test circuit in Figure E)
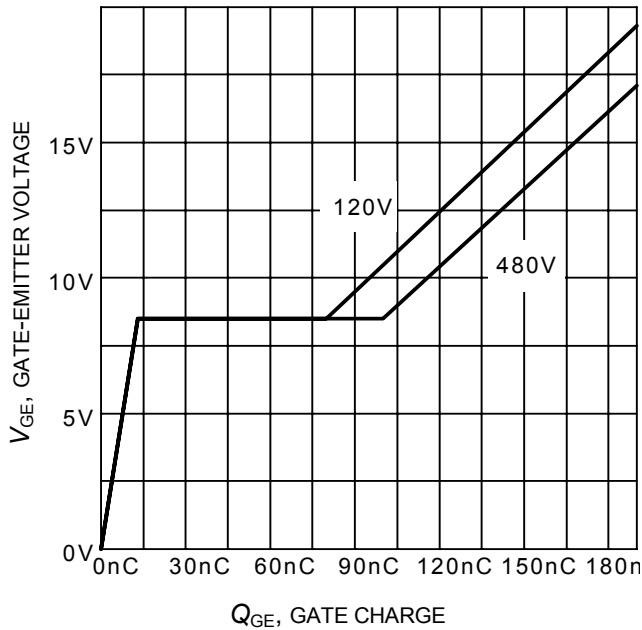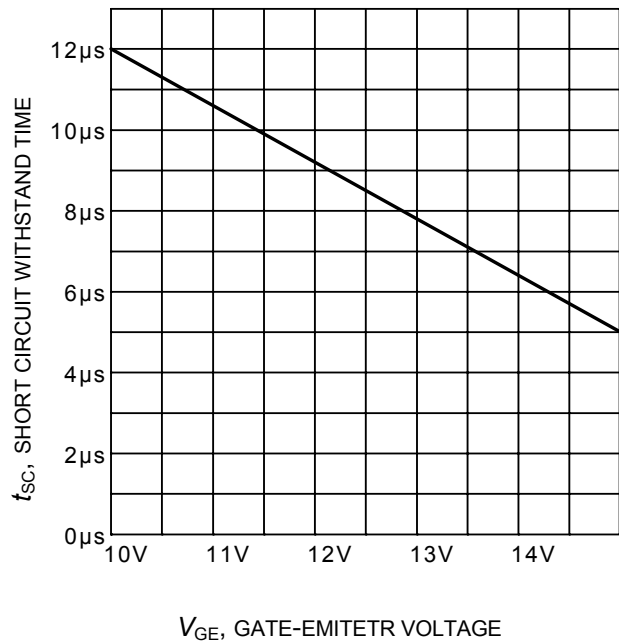
Figure 17. Typical gate charge
(I_C=30 A)

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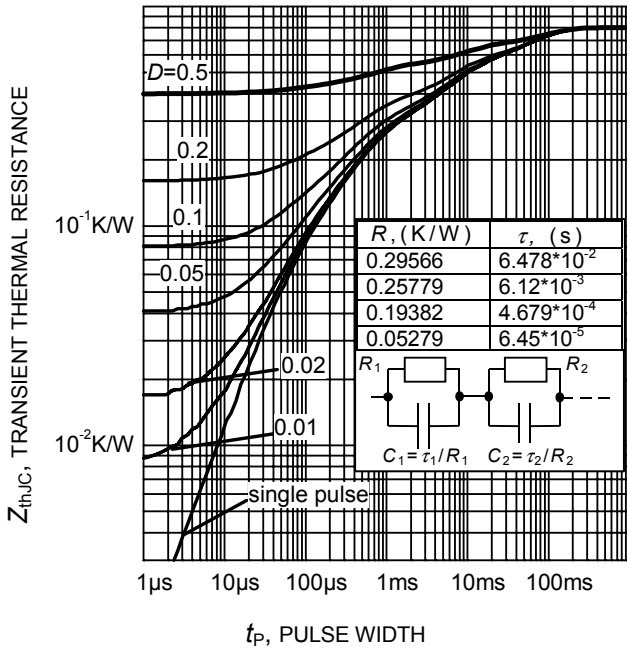

Figure 19. Typical short circuit collector current as a function of gate-emitter voltage
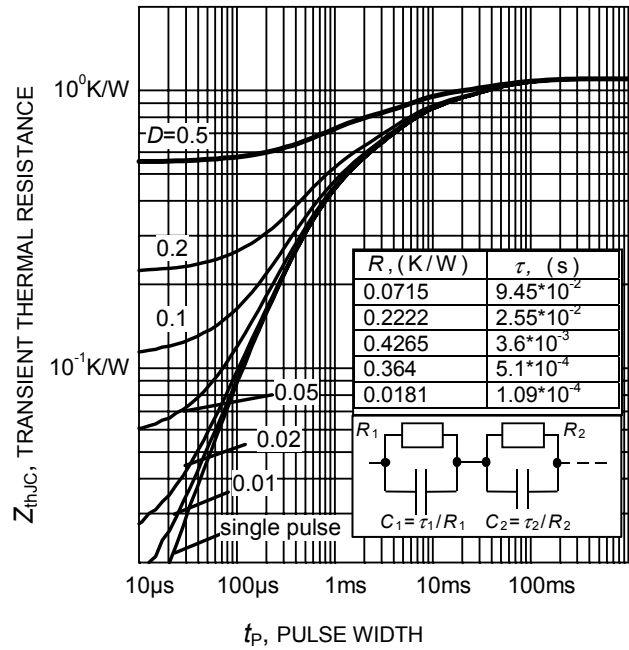($V_{CE} \leq 400V$, $T_j \leq 150°C$)

Figure 20. Short circuit withstand time as a function of gate-emitter voltage
(V_{CE}=600V, start at T_J=25°C, T_{Jmax}<150°C)

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

Embedded table (Figure 21):

R, (K/W)	τ, (s)
0.29566	$6.478*10^{-2}$
0.25779	$6.12*10^{-3}$
0.19382	$4.679*10^{-4}$
0.05279	$6.45*10^{-5}$

$C_1 = \tau_1/R_1$ $C_2 = \tau_2/R_2$

Figure 22. Diode transient thermal impedance as a function of pulse width
$(D=t_P/T)$

Embedded table (Figure 22):

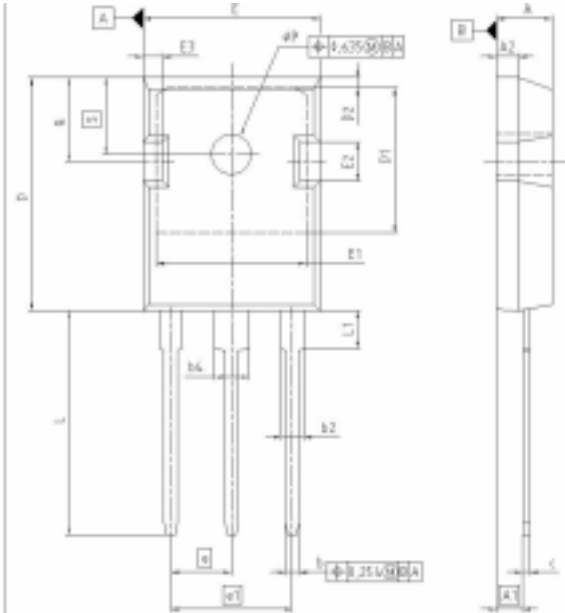| R, (K/W)	τ, (s)
0.0715	$9.45*10^{-2}$
0.2222	$2.55*10^{-2}$
0.4265	$3.6*10^{-3}$
0.364	$5.1*10^{-4}$
0.0181	$1.09*10^{-4}$

$C_1 = \tau_1/R_1$ $C_2 = \tau_2/R_2$
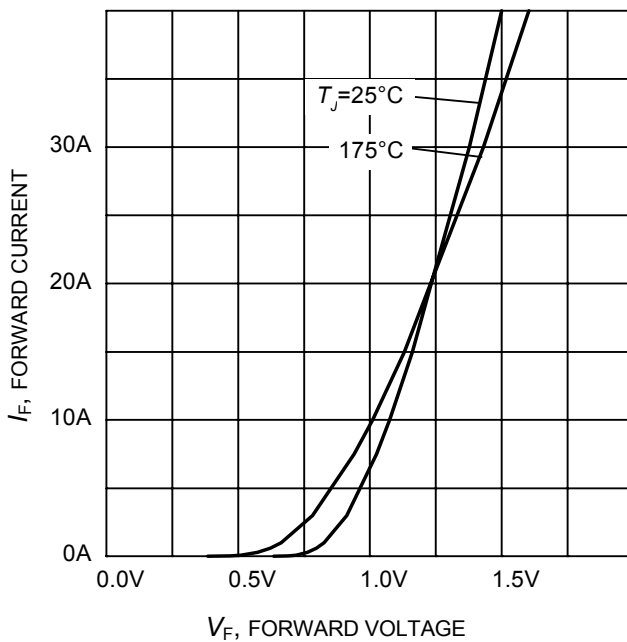
**Figure 23. Typical diode forward current as a function of forward voltage**
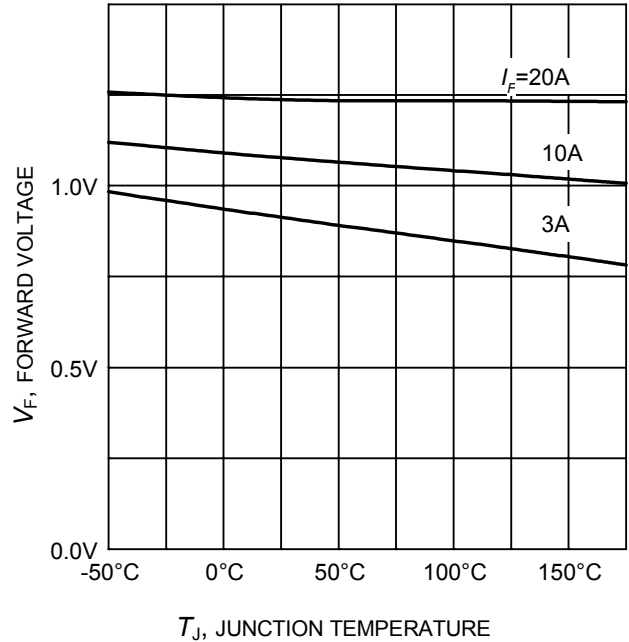
Figure 24. Typical diode forward voltage as a function of junction temperature
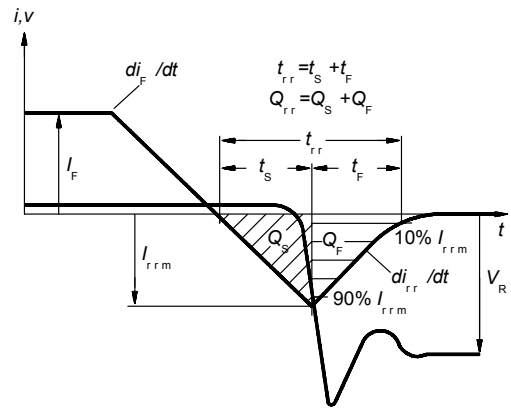
PG-TO247-3-21

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.903	5.157	0.193	0.203
A1	2.275	2.527	0.092	0.096
A2	1.953	2.107	0.076	0.081
b	1.073	1.327	0.047	0.052
b2	1.901	2.386	0.075	0.094
b4	2.870	3.454	0.113	0.136
c	0.549	0.752	0.024	0.030
D	20.823	21.077	0.820	0.830
D1	17.323	17.831	0.682	0.702
D2	1.063	1.317	0.042	0.052
E	15.773	16.027	0.621	0.631
E1	13.893	14.147	0.547	0.557
E2	3.683	3.937	0.145	0.155
E3	1.683	1.937	0.066	0.076
e	5.450		0.215	
e1	10.900		0.430	
N	3		3	
L	20.053	20.307	0.789	0.799
L1	4.188	4.472	0.164	0.176
øP	3.558	3.661	0.140	0.144
Q	5.493	5.747	0.216	0.226
S	6.043	6.297	0.238	0.248
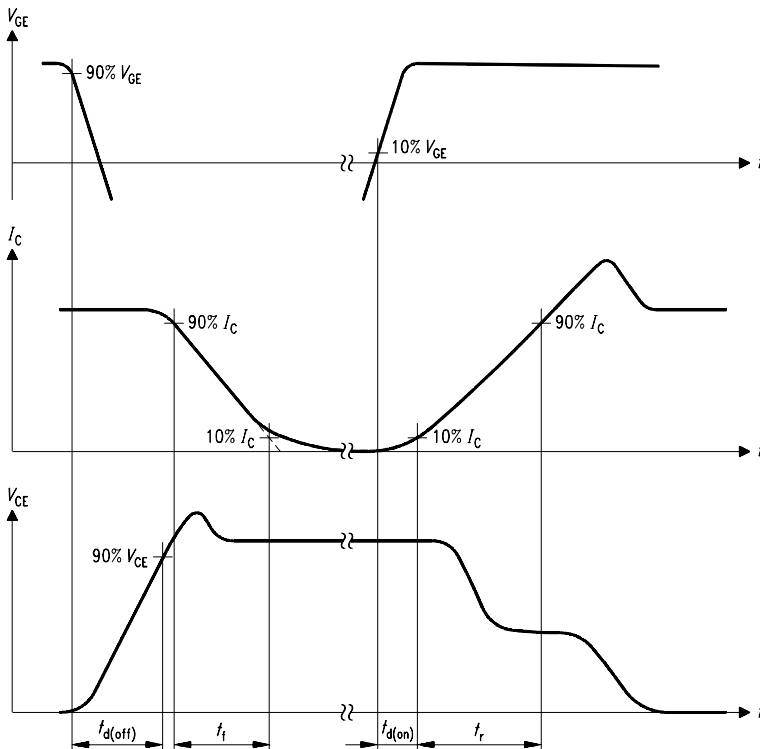
Figure A. Definition of switching times

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

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

Figure B. Definition of switching losses

$t_{rr} = t_S + t_F$

$Q_{rr} = Q_S + Q_F$
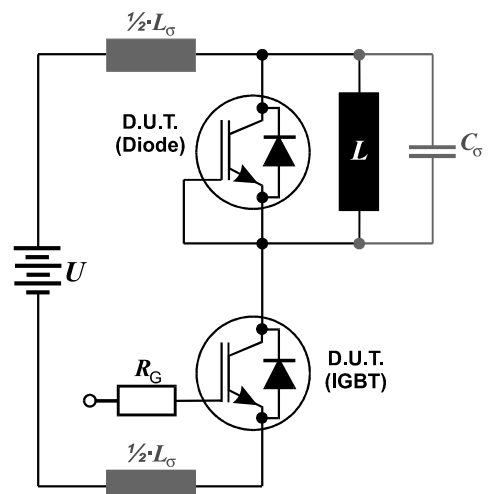
Figure C. Definition of diodes switching characteristics
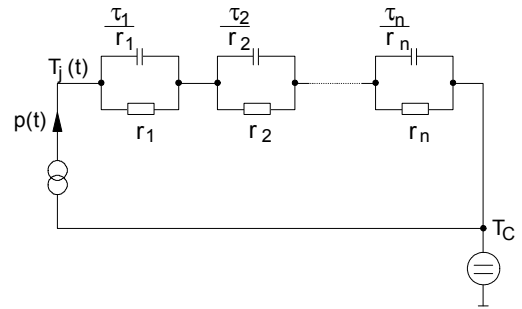
Figure D. Thermal equivalent circuit

Figure E. Dynamic test circuit

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