Aug. 2023

SemiHow
Know-How for Semiconductor

HIA20N140IH-DA

1400V N-Channel Trench Field Stop IGBT

Features

- Very Low $V_{CE(sat)}$
- Extremely low switching loss
- Excellent stability and uniformity
- 1400V Breakdown voltage
- Maximum Junction temperature, $T_{J(max)}$=175℃

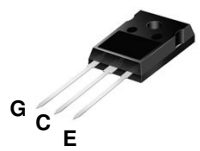
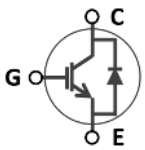
Application

- Induction Cooking
- Microwave Ovens

Key Parameters

Parameter	Value	Unit
V_{CES}	1400	V
I_C	20	A
$V_{CE(sat)}$	1.50	V
E_{off}	0.95	mJ

Package & Internal Circuit

TO-247	SYMBOL
	

Absolute Maximum Ratings

T_C=25℃ unless otherwise specified

Symbol	Parameter	Value	Unit
V_{CES}	Collector-Emitter Voltage	1400	V
V_{GE}	Gate-Emitter Voltage	±20	V
I_C	Collector Current (@ T_C = 25 ℃)	40	A
	Collector Current (@ T_C = 100 ℃)	20	A
I_{CM}	Pulsed Collector Current (Note. 1)	200	A
I_F	Diode Continuous Forward Current (@ T_C = 25 ℃)	40	A
	Diode Continuous Forward Current (@ T_C = 100 ℃)	20	A
I_{FM}	Diode Maximum Forward Current	60	A
P_D	Power Dissipation (@ T_C = 25 ℃)	300	W
	Power Dissipation (@ T_C = 100 ℃)	150	W
T_J	Maximum Operating Junction Temperature	175	℃
T_{STG}	Storage Temperature Range	-55 to +175	℃

Thermal Resistance Characteristics

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	IGBT Thermal Resistance, Junction-to-Case, Max.	0.50	℃/W
$R_{\theta JC}$	Diode Thermal Resistance, Junction-to-Case, Max.	2.0	℃/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient , Max.	40	℃/W

Notes : 1. Repetitive Rating, Pulse width limited by maximum junction temperature (Tj<175℃, t_p<3㎲)

Electrical Characteristics T_J=25°C unless otherwise specified

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Static Characteristics						
BV_{CES}	Collector-Emitter Breakdown Voltage	V_{GE} = 0 V, I_C = 250 μA	1,400	-	-	V
I_{CES}	Zero Gate Voltage Collector Current	V_{CE} = 1400 V, V_{GE} = 0 T_j=25 ℃ T_j=175 ℃	 - -	 - -	 100 2000	μA
I_{GES}	Gate Leakage Current	V_{GE} = ±20 V, V_{CE} = 0 V	-	-	±100	nA
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	V_{CE} = V_{GE} , I_C = 250 μA	3.6	4.4	5.2	V
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage	V_{GE} = 15 V, I_C = 10 A, T_j=25 ℃ T_j=150 ℃	 - -	 1.28 1.32	 - -	V
		V_{GE} = 15 V, I_C = 20 A, T_j=25 ℃ T_j=150 ℃	 - -	 1.50 1.65	 1.80 -	
V_{FEC}	Diode Forward Voltage	V_{GE} = 0 V, I_F = 10 A, T_j=25 ℃ T_j=150 ℃	 - -	 1.10 1.05	 - -	V
		V_{GE} = 0 V, I_F = 20 A, T_j=25 ℃ T_j=150 ℃	 - -	 1.30 1.30	 1.70 -	
g_{fs}	Transconductance	V_{CE} = 15 V, I_C = 20 A	-	32	-	S
Dynamic Characteristics						
C_{ies}	Input Capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1.0 MHz	-	4,100	-	pF
C_{oes}	Output Capacitance		-	54	-	pF
C_{res}	Reverse Transfer Capacitance		-	21	-	pF
Q_g	Total Gate Charge	V_{CE} = 700 V, I_C = 20 A, V_{GE} = 15 V	-	132	-	nC
Q_{ge}	Gate-Emitter Charge		-	19	-	nC
Q_{gc}	Gate-Collector Charge		-	35	-	nC

Electrical Characteristics T_J=25°C unless otherwise specified

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Switching Characteristics						
$t_{d(off)}$	Turn-Off Delay Time	V_{CE} = 600 V, I_C = 10 A, R_G = 10 Ω, V_{GE} = 15 V / 0 V T_J = 25℃ (Note. 2)	-	260	-	ns
t_f	Turn-Off Fall Time		-	55	-	ns
E_{off}	Turn-Off Energy Loss		-	0.43	-	mJ
$t_{d(off)}$	Turn-Off Delay Time	V_{CE} = 600 V, I_C = 10 A, R_G = 10 Ω, V_{GE} = 15 V / 0V T_J = 150℃ (Note. 2)	-	375	-	ns
t_f	Turn-Off Fall Time		-	212	-	ns
E_{off}	Turn-Off Energy Loss		-	0.90	-	mJ
$t_{d(off)}$	Turn-Off Delay Time	V_{CE} = 600 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V / 0 V T_J = 25℃ (Note. 2)	-	245	-	ns
t_f	Turn-Off Fall Time		-	102	-	ns
E_{off}	Turn-Off Energy Loss		-	0.95	-	mJ
$t_{d(off)}$	Turn-Off Delay Time	V_{CE} = 600 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V / 0V T_J = 150℃ (Note. 2)	-	300	-	ns
t_f	Turn-Off Fall Time		-	240	-	ns
E_{off}	Turn-Off Energy Loss		-	1.65	-	mJ

Notes : 2. Include tail current

IGBT Static Characteristics Figure.

Figure.1 Saturation Voltage characteristics ,Junction Temperature(T_J) 25℃

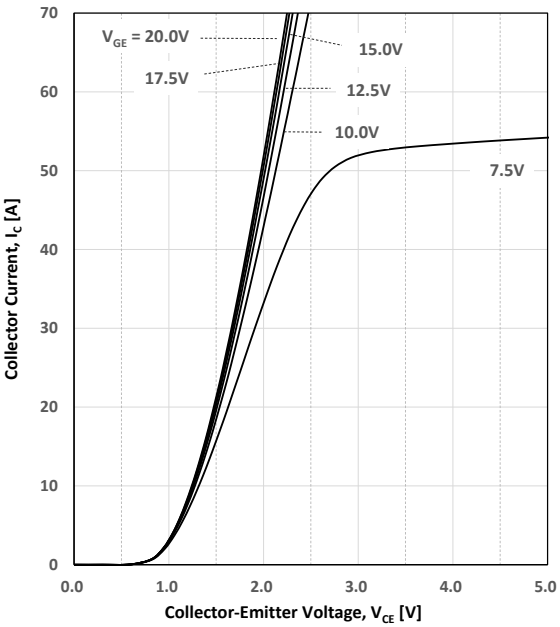


Figure.2 Saturation Voltage characteristics ,Junction Temperature(T_J) 150℃

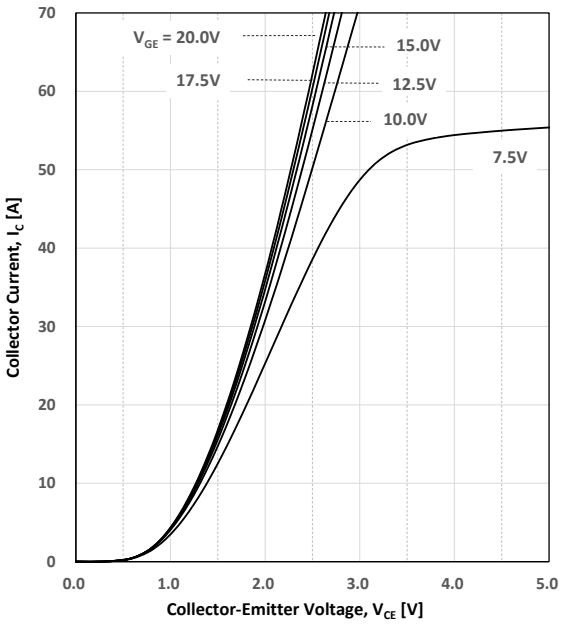


Figure.3 Saturation Voltage characteristics as Junction Temperature, V_{GE}=15V

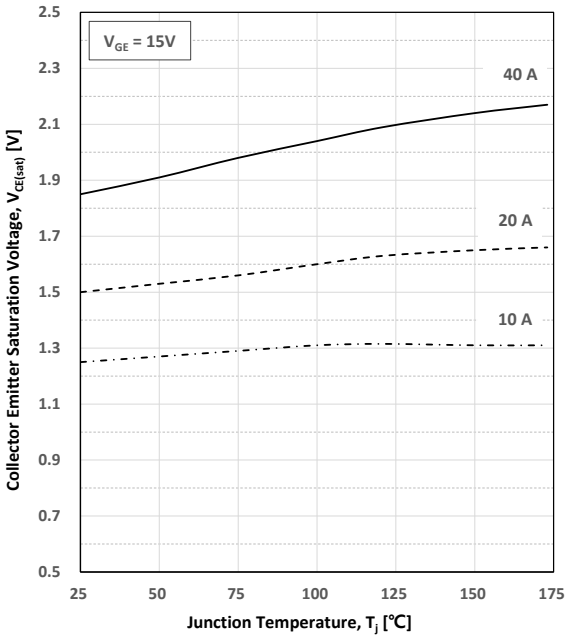


Figure.4 Transconductance characteristics as Junction Temperature, V_{CE}=15V

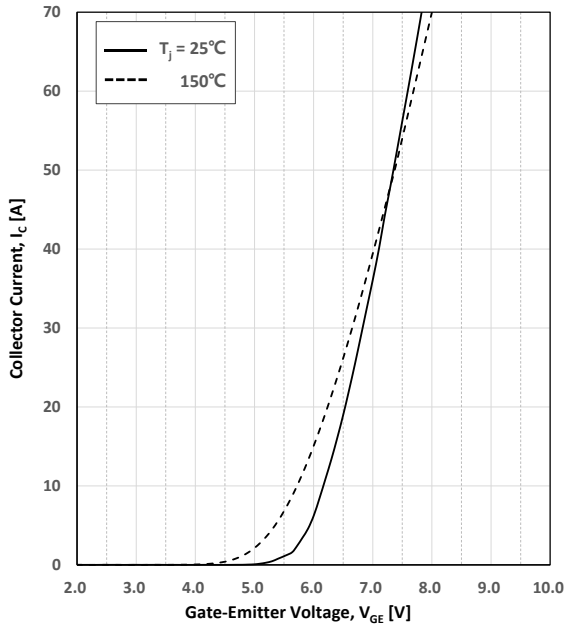


Figure.5 Threshold Voltage characteristics as Junction Temperature

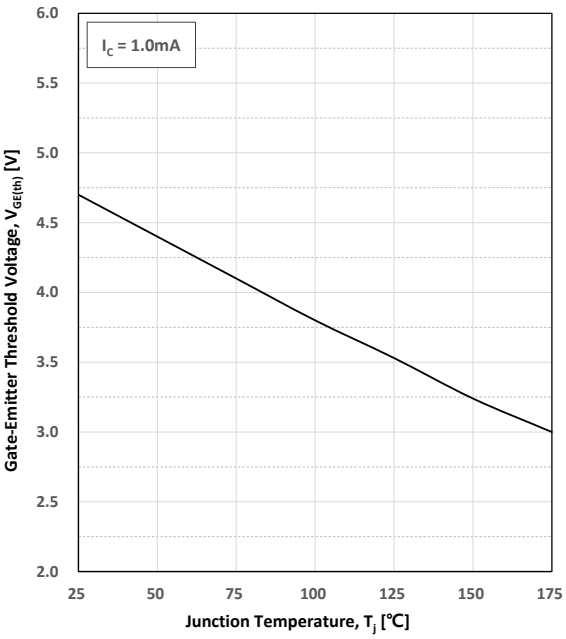
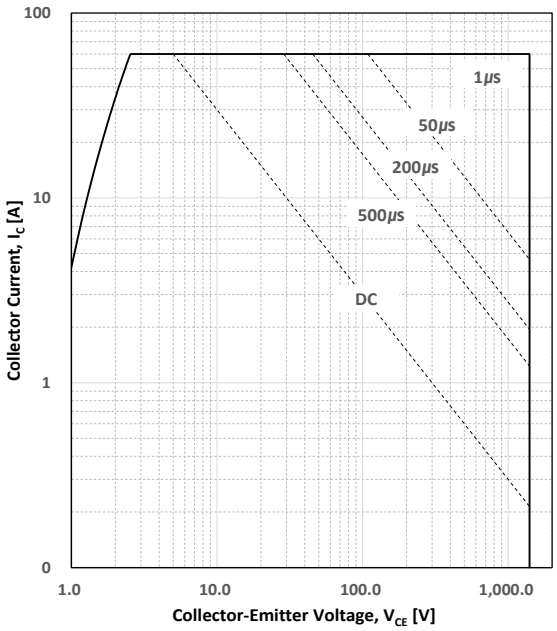


Figure.6 Forward Bias Safe Operating Area (T_C=25℃, T_J≤175℃, V_{GE}=15V, t_p=1μs, D=0)



IGBT Dynamic Characteristics Figure.

Figure.7 Capacitance characteristics (f=1MHz)

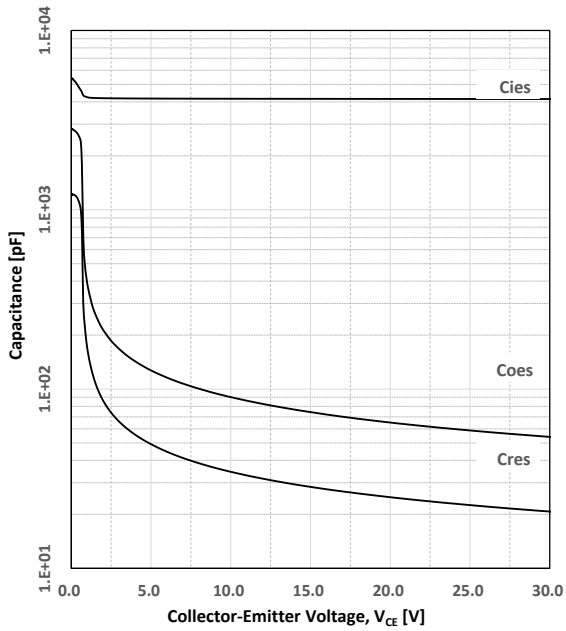
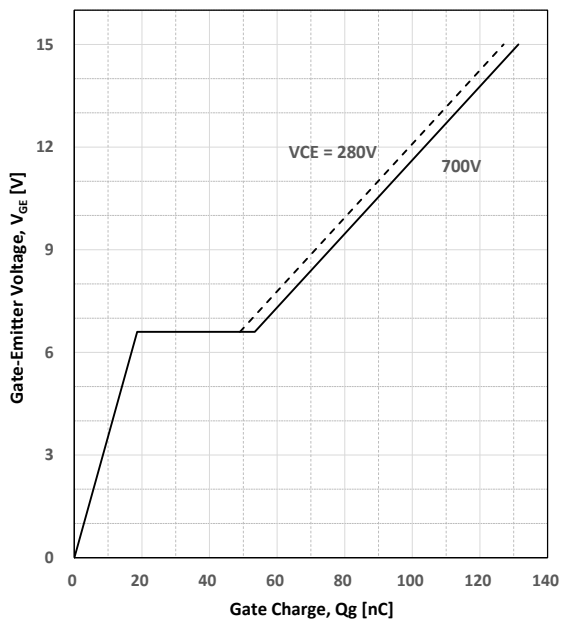


Figure.8 Gate Charge characteristics (I_C=20A)



IGBT Switching Characteristics Figure.

Figure.9 Switching Times as Gate Resistance
(V_{CE}=600V, I_C=20A, V_{GE}=15V, T_J=25℃)

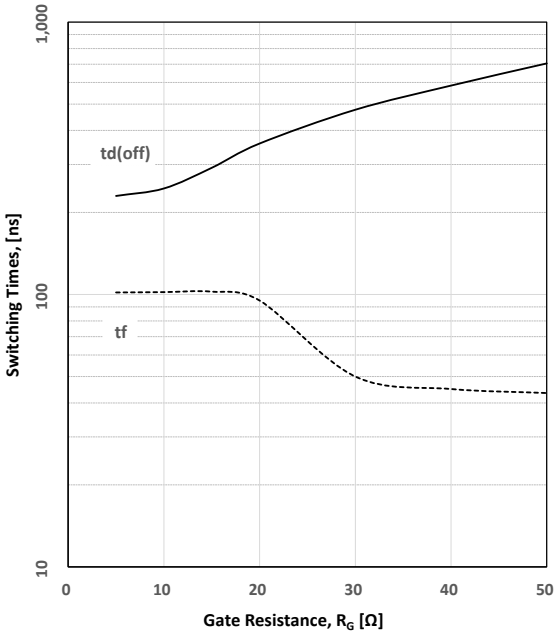


Figure.10 Switching Loss as Gate Resistance
(V_{CE}=600V, I_C=20A, V_{GE}=15V, T_J=25℃)

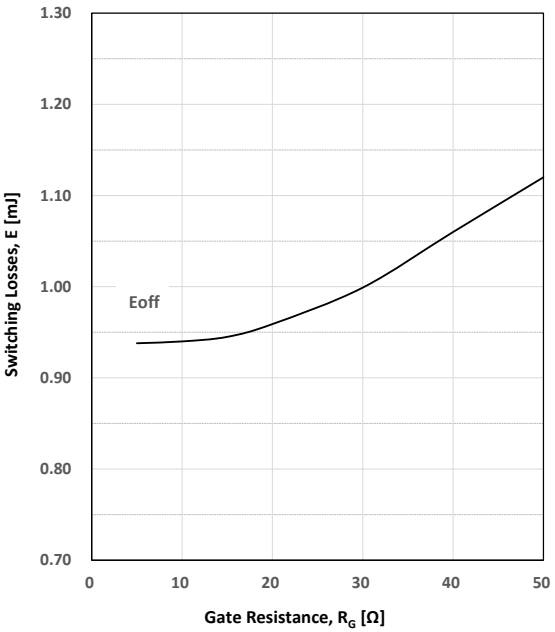


Figure.11 Switching Times as Collector Current
(V_{CE}=600V, V_{GE}=15V, Rg=10Ω, T_J=25℃)

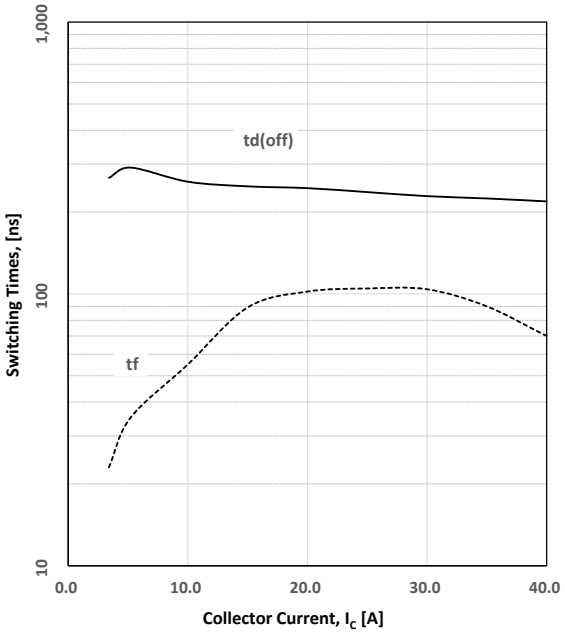


Figure.12 Switching Loss as Collector Current
(V_{CE}=600V, V_{GE}=15V, Rg=10Ω, T_J=25℃)

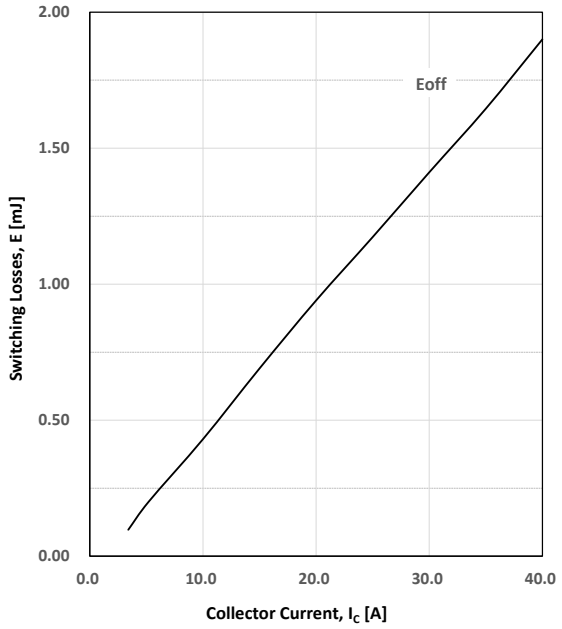


Figure.13 Switching Times as Collector Voltage
(I_C=20A, V_{GE}=15V, Rg=10Ω, T_J=25℃)

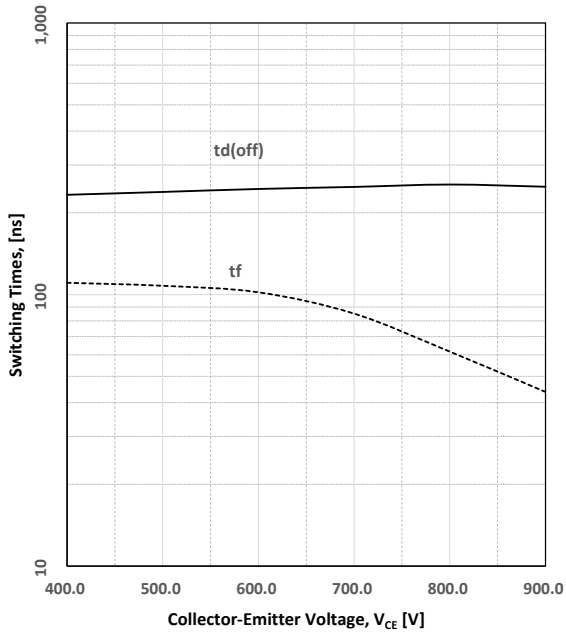


Figure.14 Switching Loss as Collector Voltage
(I_C=20A, V_{GE}=15V, Rg=10Ω, T_J=25℃)

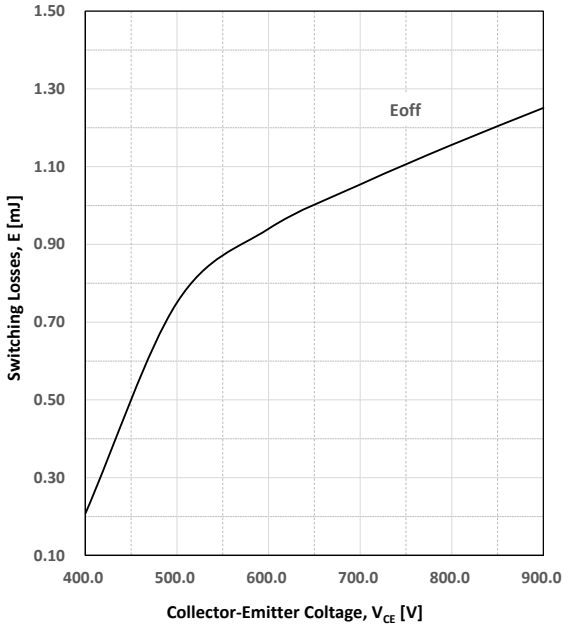


Figure.15 Switching Times as Gate Resistance
(V_{CE}=600V, I_C=20A, V_{GE}=15V, T_J=150℃)

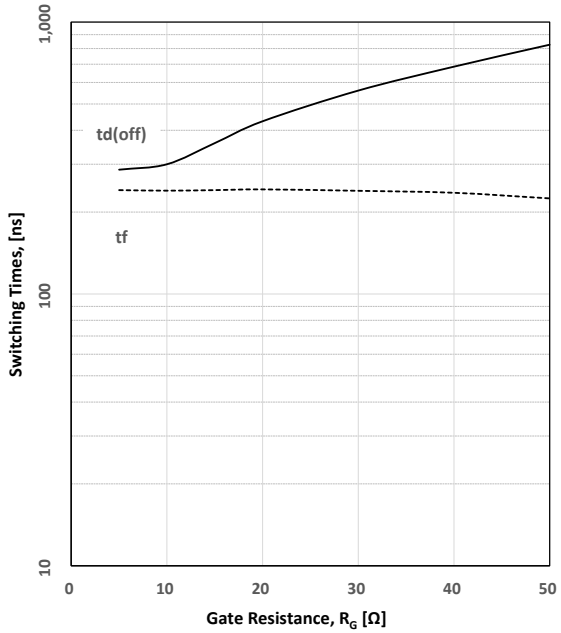


Figure.16 Switching Loss as Gate Resistance
(V_{CE}=600V, I_C=20A, V_{GE}=15V, T_J=150℃)

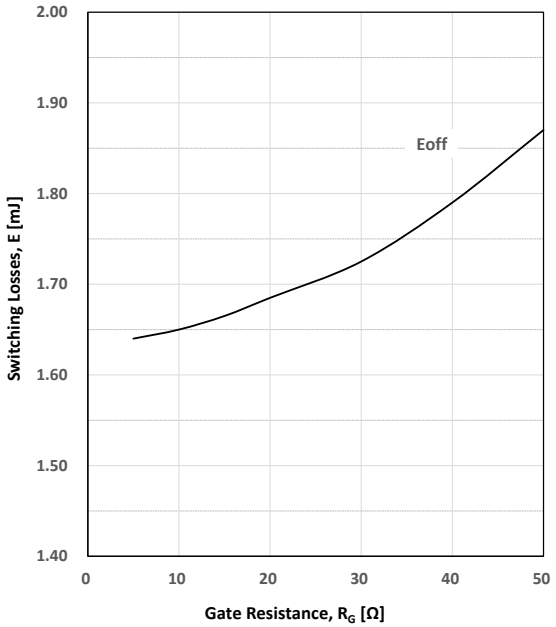


Figure.17 Switching Times as Collector Current
(V_{CE}=600V, V_{GE}=15V, Rg=10Ω, T_J=150℃)

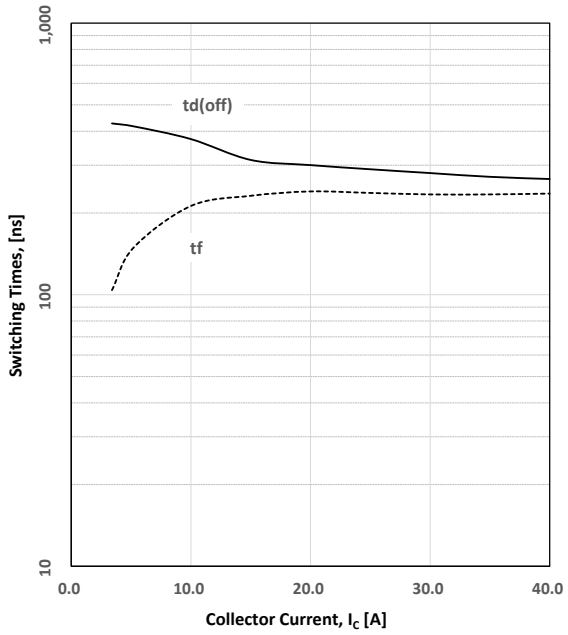


Figure.18 Switching Loss as Collector Current
(V_{CE}=600V, V_{GE}=15V, Rg=10Ω, T_J=150℃)

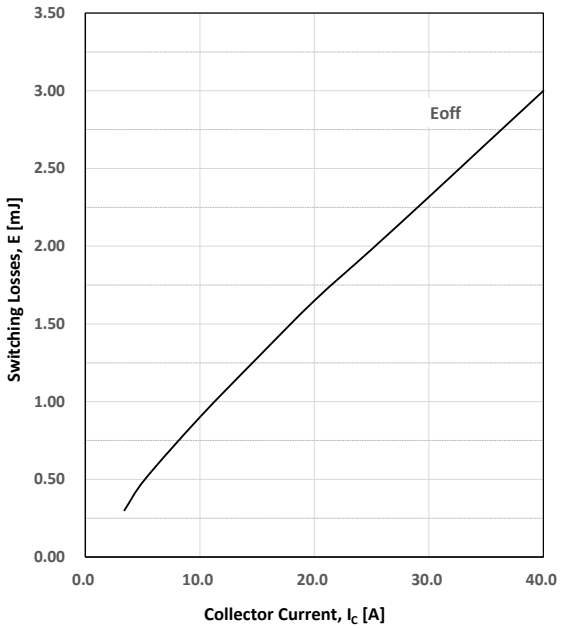


Figure.19 Switching Times as Collector Voltage
(I_C=20A, V_{GE}=15V, Rg=10Ω, T_J=150℃)

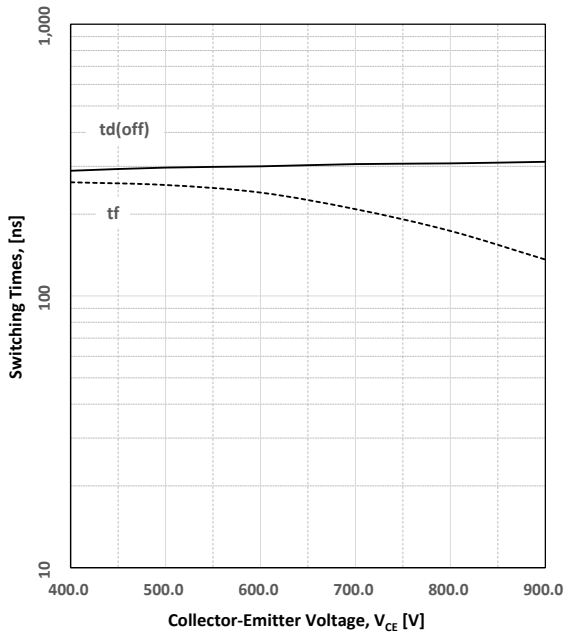


Figure.20 Switching Loss as Collector Voltage
(I_C=20A, V_{GE}=15V, Rg=10Ω, T_J=150℃)

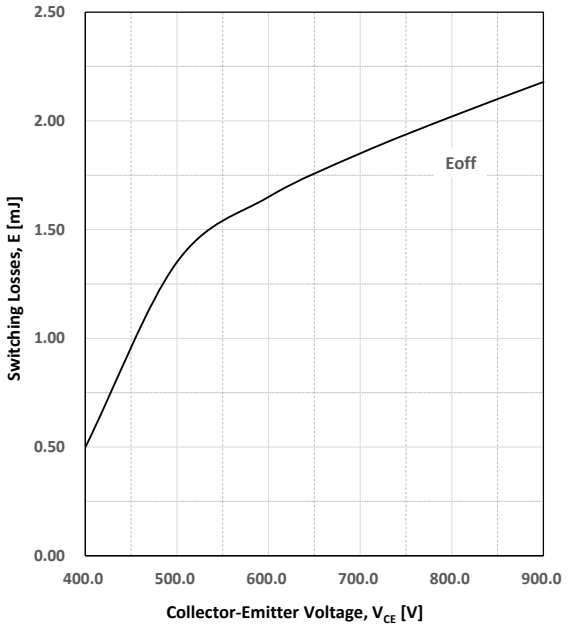


Figure.21 Switching Times as Junction Temp.
(V_{CE}=600V, I_C=20A, V_{GE}=15V, Rg=10Ω)

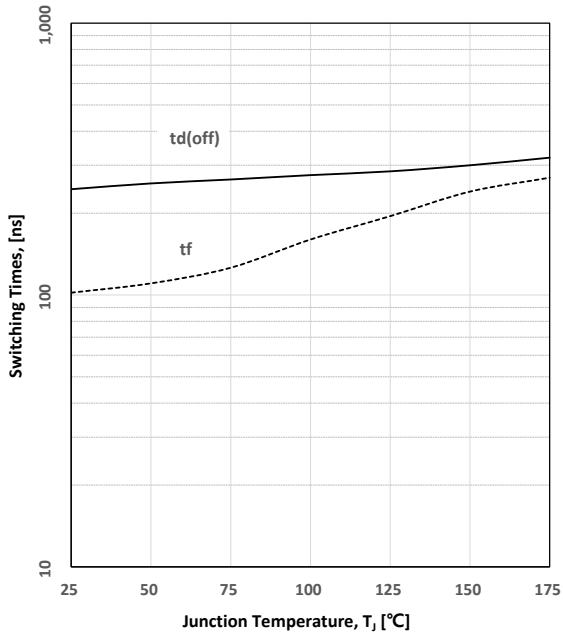
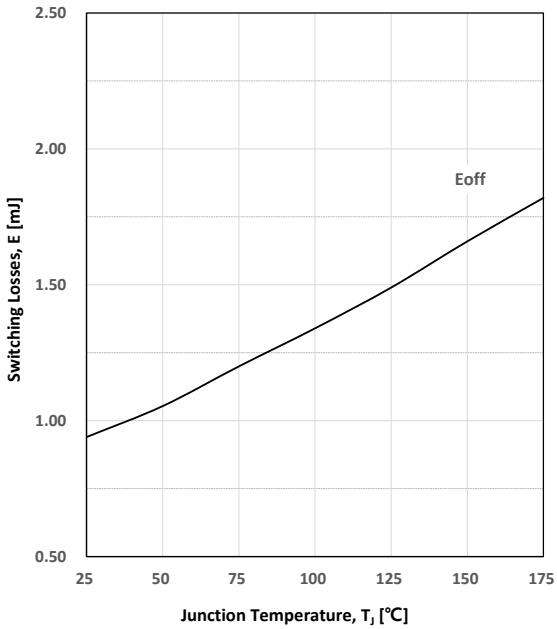
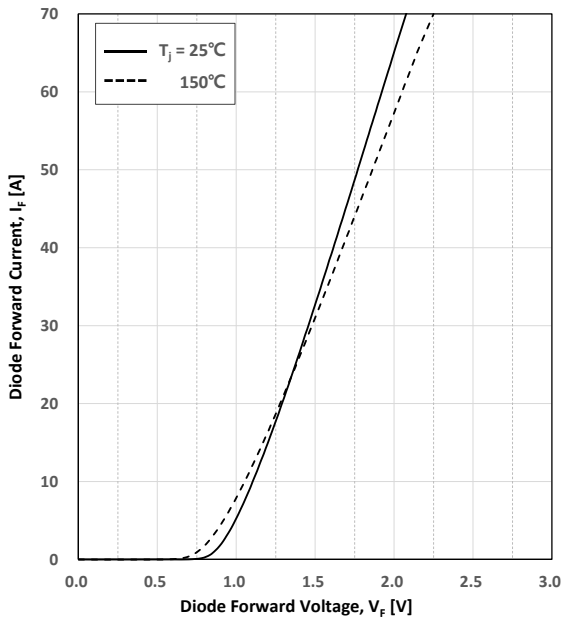


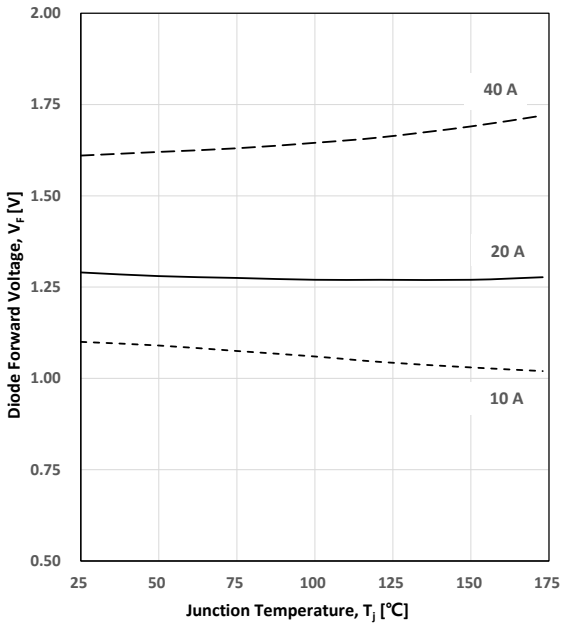
Figure.22 Switching Loss as Junction Temp.
(V_{CE}=600V, I_C=20A, V_{GE}=15V, Rg=10Ω)



Diode Static Characteristics Figure.

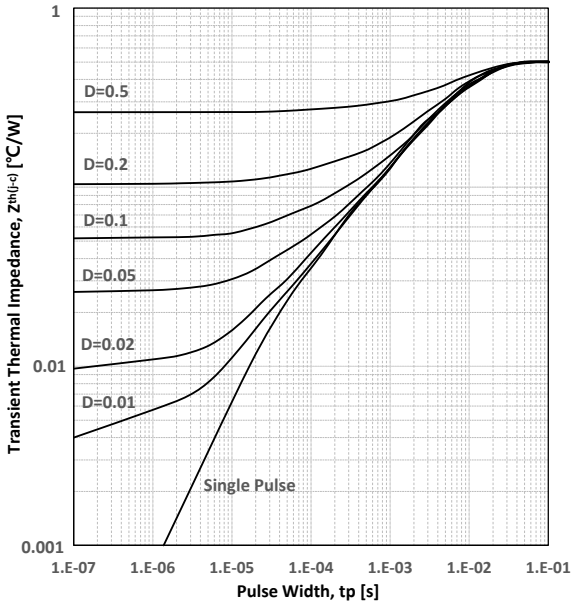
Figure.23 Diode Forward current characteristics as Junction Temperature and Forward current



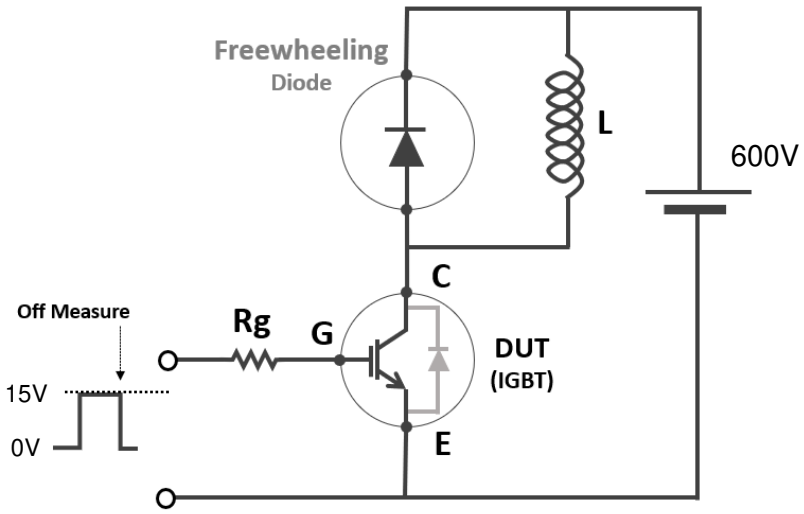


Transient Thermal Impedance Figure.

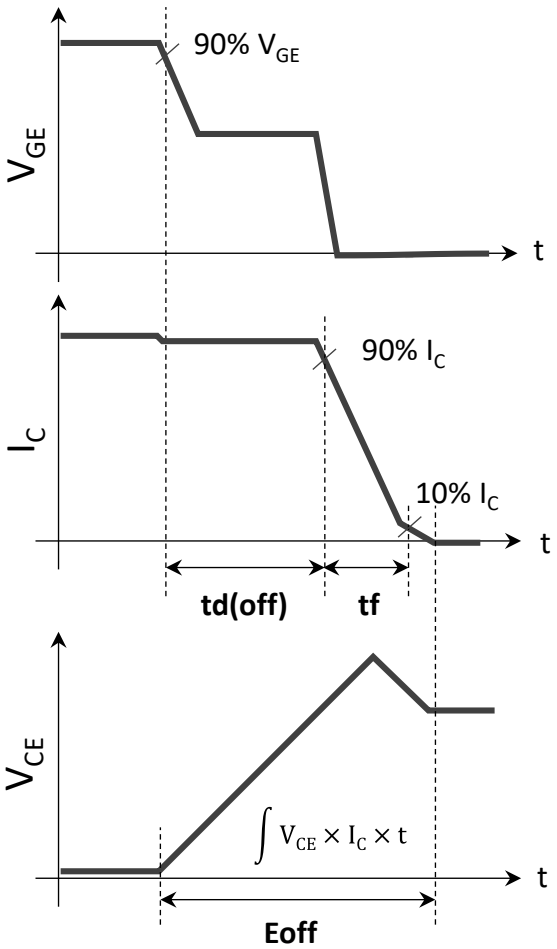
Figure.24 IGBT Transient Thermal Impedance



Ref. 1) Switching off Test Circuit



Ref. 2) Definition of switching off time and loss



Package Dimension : TO-247