

# FGW40N120VD

Discrete IGBT

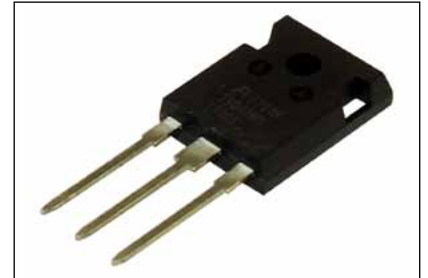
## Discrete IGBT (High-Speed V series) 1200V / 40A

### ■ Features

- Low power loss
- Low switching surge and noise
- High reliability, high ruggedness (RBSOA, SCSOA etc.)

### ■ Applications

- Inverter for Motor drive
- AC and DC Servo drive amplifier
- Uninterruptible power supply



### ■ Maximum Ratings and Characteristics

#### ● Absolute Maximum Ratings (at T<sub>c</sub>=25°C unless otherwise specified)

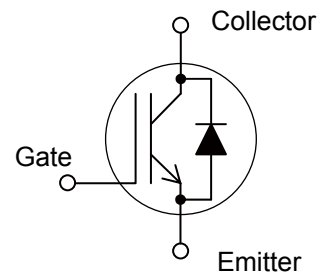
Items	Symbols	Characteristics	Units	Remarks
Collector-Emitter voltage	V <sub>CEs</sub>	1200	V	
Gate-Emitter voltage	V <sub>GES</sub>	±20	V	
DC Collector Current	I <sub>C@25</sub>	63	A	T <sub>c</sub> =25°C, T <sub>j</sub> =150°C
	I <sub>C@100</sub>	40	A	T <sub>c</sub> =100°C, T <sub>j</sub> =150°C
Pulsed Collector Current	I <sub>CP</sub>	80	A	Note *1
Turn-Off Safe Operating Area	-	80	A	V <sub>CE</sub> ≤1200V, T <sub>j</sub> ≤175°C
Diode Forward Current	I <sub>F@25</sub>	58	A	
	I <sub>F@100</sub>	30	A	
Diode Pulsed Current	I <sub>FP</sub>	80	A	Note *1
Short Circuit Withstand Time	t <sub>sc</sub>	10	μs	V <sub>CE</sub> ≤640V, V <sub>GE</sub> =15V T <sub>j</sub> ≤150°C
IGBT Max. Power Dissipation	P <sub>D_IGBT</sub>	340	W	T <sub>c</sub> =25°C
FWD Max. Power Dissipation	P <sub>D_FWD</sub>	220	W	T <sub>c</sub> =25°C
Operating Junction Temperature	T <sub>j</sub>	-40~+175	°C	
Storage Temperature	T <sub>stg</sub>	-55~+175	°C	

Note \*1 : Pulse width limited by T<sub>jmax</sub>.

#### ● Electrical characteristics (at T<sub>j</sub>= 25°C unless otherwise specified)

Items	Symbols	Conditions	Characteristics			Unit
			min.	typ.	max.	
Collector-Emitter Breakdown Voltage	V <sub>BR(ICES)</sub>	I <sub>c</sub> = 50μA, V <sub>GE</sub> = 0V	1200	-	-	V
Zero Gate Voltage Collector Current	I <sub>CEs</sub>	V <sub>CE</sub> = 1200V, V <sub>GE</sub> = 0V	-	-	250	μA
		T <sub>j</sub> =25°C	-	-	2	mA
		T <sub>j</sub> =175°C	-	-	200	nA
Gate-Emitter Leakage Current	I <sub>GES</sub>	V <sub>CE</sub> = 0V, V <sub>GE</sub> = ±20V	-	-	7.0	V
Gate-Emitter Threshold Voltage	V <sub>GE(th)</sub>	V <sub>CE</sub> = +20V, I <sub>c</sub> = 40mA	6.0	6.5	7.0	V
Collector-Emitter Saturation Voltage	V <sub>CE(sat)</sub>	V <sub>GE</sub> = +15V, I <sub>c</sub> = 40A	-	1.85	2.4	V
		T <sub>j</sub> =25°C	-	2.4	-	
		T <sub>j</sub> =175°C	-	-	-	
Input Capacitance	C <sub>ies</sub>	V <sub>CE</sub> =25V	-	2230	-	pF
Output Capacitance	C <sub>oes</sub>	V <sub>GE</sub> =0V	-	135	-	
Reverse Transfer Capacitance	C <sub>res</sub>	f=1MHz	-	105	-	
Gate Charge	Q <sub>G</sub>	V <sub>CC</sub> = 600V I <sub>c</sub> = 40A V <sub>GE</sub> = 15V	-	320	-	nC
Turn-On Delay Time	t <sub>d(on)</sub>	T <sub>j</sub> = 25°C	-	38	-	ns
Rise Time	t <sub>r</sub>	V <sub>CC</sub> = 600V	-	75	-	
Turn-Off Delay Time	t <sub>d(off)</sub>	I <sub>c</sub> = 40A	-	310	-	
Fall Time	t <sub>f</sub>	V <sub>GE</sub> = 15V	-	55	-	
Turn-On Energy	E <sub>on</sub>	R <sub>G</sub> = 10Ω	-	4.3	-	mJ
Turn-Off Energy	E <sub>off</sub>	L = 500μH Energy loss include "tail" and FWD reverse recovery.	-	2.2	-	
Turn-On Delay Time	t <sub>d(on)</sub>	T <sub>j</sub> = 175°C	-	38	-	ns
Rise Time	t <sub>r</sub>	V <sub>CC</sub> = 600V	-	68	-	
Turn-Off Delay Time	t <sub>d(off)</sub>	I <sub>c</sub> = 40A	-	360	-	
Fall Time	t <sub>f</sub>	V <sub>GE</sub> = 15V	-	85	-	
Turn-On Energy	E <sub>on</sub>	R <sub>G</sub> = 10Ω	-	6.5	-	mJ
Turn-Off Energy	E <sub>off</sub>	L = 500μH Energy loss include "tail" and FWD reverse recovery.	-	3.8	-	
Forward Voltage Drop	V <sub>F</sub>	I <sub>F</sub> =30A	-	1.7	2.21	V
		T <sub>j</sub> =25°C	-	1.8	-	V
		T <sub>j</sub> =175°C	-	-	-	
Diode Reverse Recovery Time	t <sub>rr1</sub>	V <sub>CC</sub> =30V I <sub>F</sub> = 3.0A -di/dt=200A/μs	-	79	103	ns
Diode Reverse Recovery Time	t <sub>rr2</sub>	V <sub>CC</sub> =600V I <sub>F</sub> =30A	-	0.33	-	μs
Diode Reverse Recovery Charge	Q <sub>rr</sub>	-di <sub>F</sub> /dt=200A/μs T <sub>j</sub> =25°C	-	1.45	-	μC

### ■ Equivalent circuit



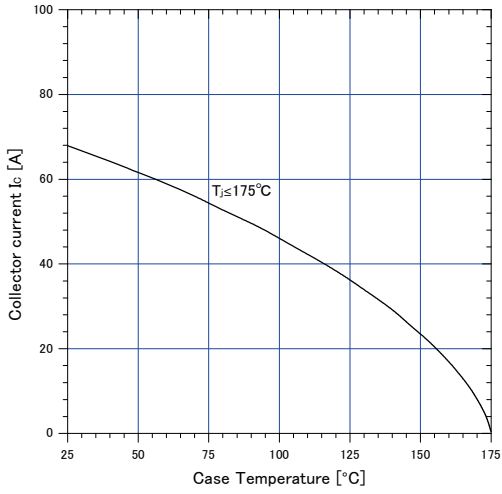
Items	Symbols	Conditions	Characteristics			Unit
			min.	typ.	max.	
Diode Reverse Recovery Time	$t_{rr2}$	$V_{CC}=600V$ $I_F=30A$	-	0.75	-	$\mu s$
Diode Reverse Recovery Charge	$Q_{rr}$	$-di_F/dt=200A/\mu s$ $T_j=175^\circ C$	-	4.30	-	$\mu C$

● Thermal resistance

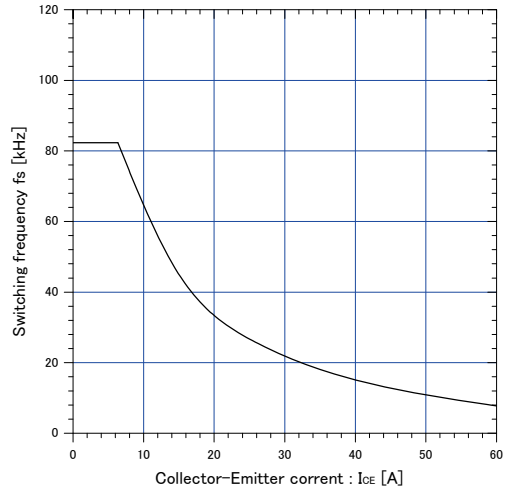
Items	Symbols	Characteristics			Unit
		min.	typ.	max.	
Thermal Resistance, Junction-Ambient	$R_{th(j-a)}$	-	-	50	$^\circ C/W$
Thermal Resistance, IGBT Junction to Case	$R_{th(j-c)}_{IGBT}$	-	-	0.439	
Thermal Resistance, FWD Junction to Case	$R_{th(j-c)}_{FWD}$	-	-	0.676	

■ Characteristics (Representative)

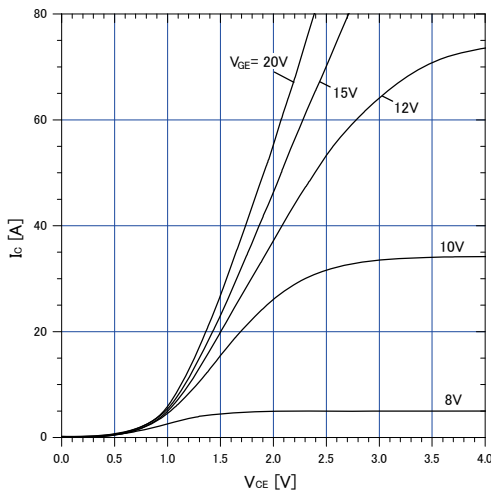
Graph.1  
DC Collector Current vs  $T_c$   
 $V_{GE} \geq +15V, T_j \leq 175^\circ C$



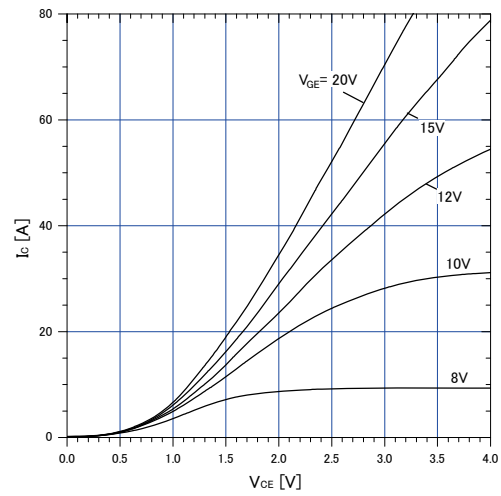
Graph.2  
Collector Current vs. switching frequency  
 $V_{GE} = +15V, T_c \leq 175^\circ C, V_{CE} = 600V, D = 0.5, R_g = 10\Omega, T_c = 100^\circ C$



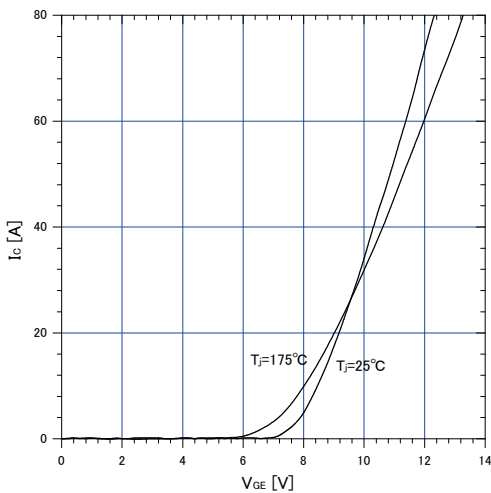
Graph.3  
Typical Output Characteristics ( $V_{CE} - I_c$ )  
 $T_j = 25^\circ C$



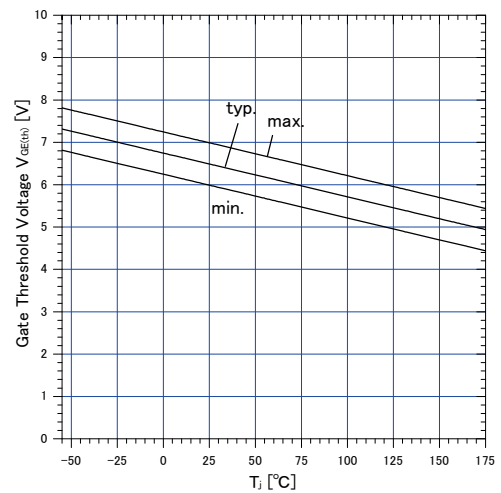
Graph.4  
Typical Output Characteristics ( $V_{CE} - I_c$ )  
 $T_j = 175^\circ C$



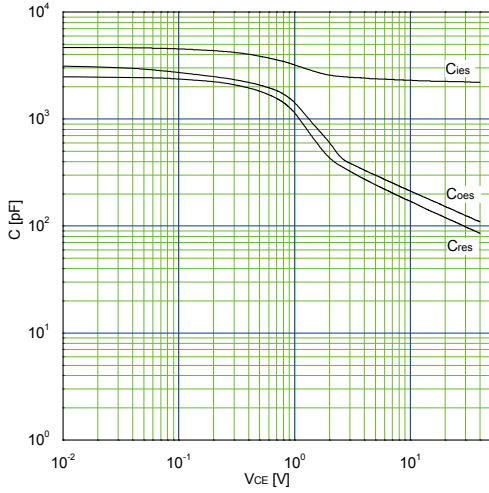
Graph.5  
Typical Transfer Characteristics  
 $V_{GE} = +15V$



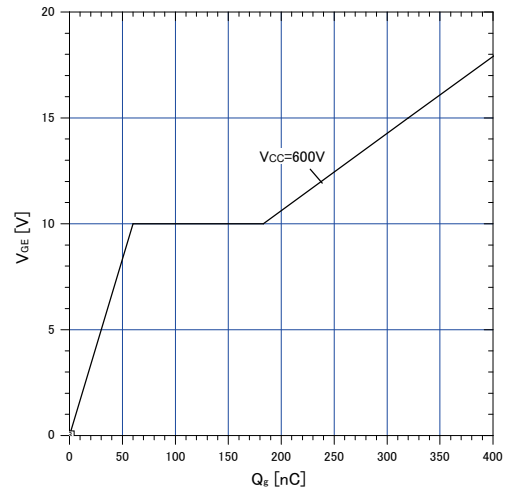
Graph.6  
Gate Threshold Voltage vs.  $T_j$   
 $I_c = 40mA, V_{CE} = 20V$



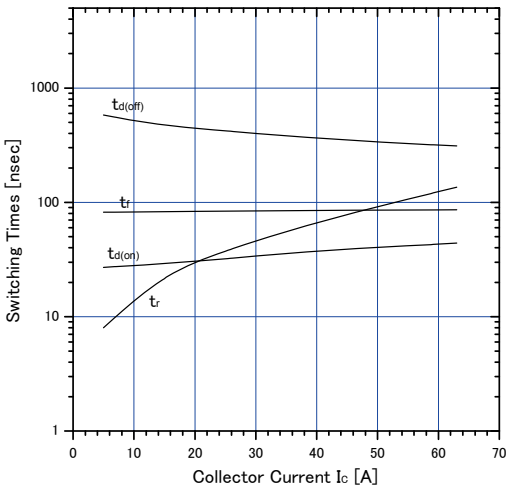
Graph.7  
Typical Capacitance  
 $V_{GE}=0V, f=1MHz, T_j=25^\circ C$



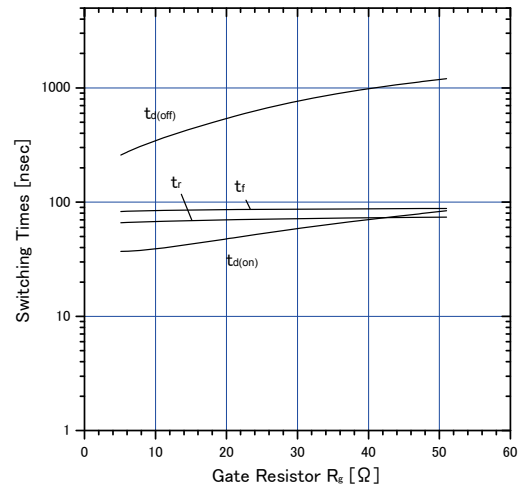
Graph.8  
Typical Gate Charge  
 $V_{CC}=600V, I_c=40A, T_j=25^\circ C$



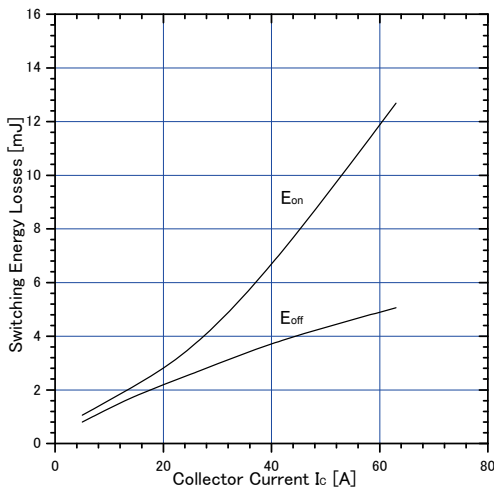
Graph.9  
Typical switching time vs.  $I_c$   
 $T_j=175^\circ C, V_{CC}=600V, L=500\mu H$   
 $V_{GE}=15V, R_G=10\Omega$



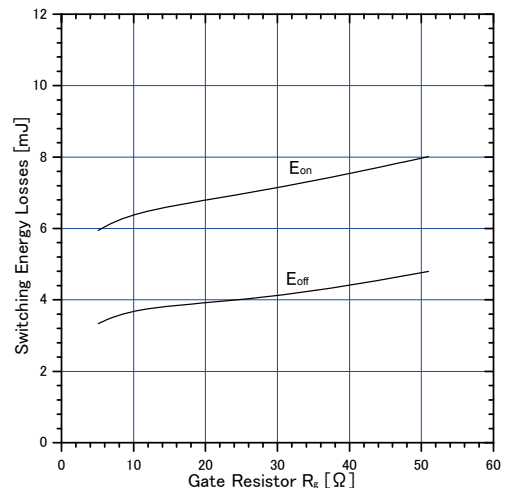
Graph.10  
Typical switching time vs.  $R_G$   
 $T_j=175^\circ C, V_{CC}=600V, I_c=40A, L=500\mu H$   
 $V_{GE}=15V$



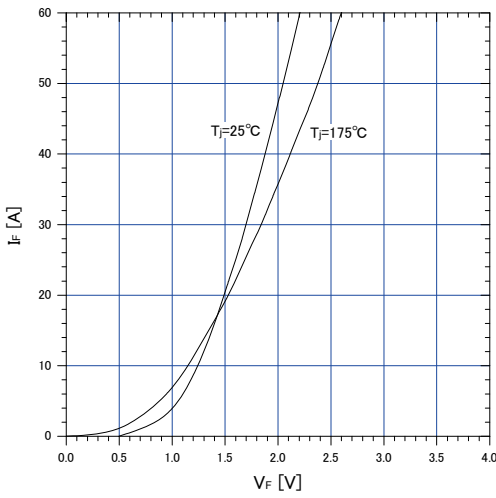
Graph.11  
Typical switching losses vs.  $I_c$   
 $T_j=175^\circ C, V_{CC}=600V, L=500\mu H$   
 $V_{GE}=15V, R_G=10\Omega$



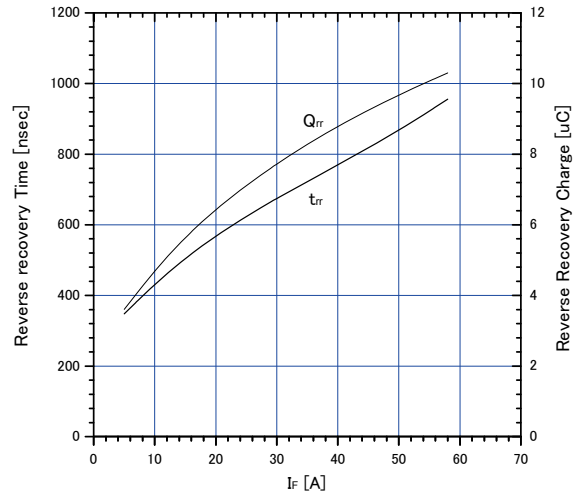
Graph.12  
Typical switching losses vs.  $R_G$   
 $T_j=175^\circ C, V_{CC}=600V, I_c=40A, L=500\mu H$   
 $V_{GE}=15V$



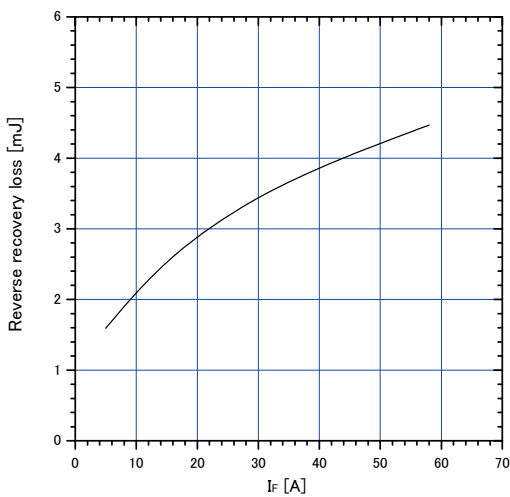
Graph.13  
FWD Forward voltage drop ( $V_F-I_F$ )



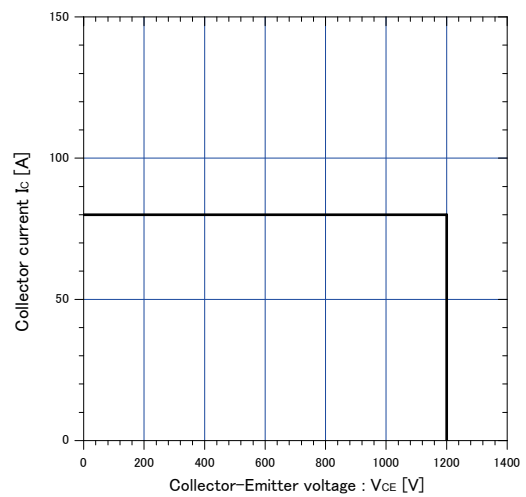
Graph.14  
Typical reverse recovery characteristics vs.  $I_F$   
 $T_J=175^\circ\text{C}$ ,  $V_{CC}=600\text{V}$ ,  $L=500\mu\text{H}$ ,  
 $V_{GE}=15\text{V}$ ,  $R_G=10\Omega$



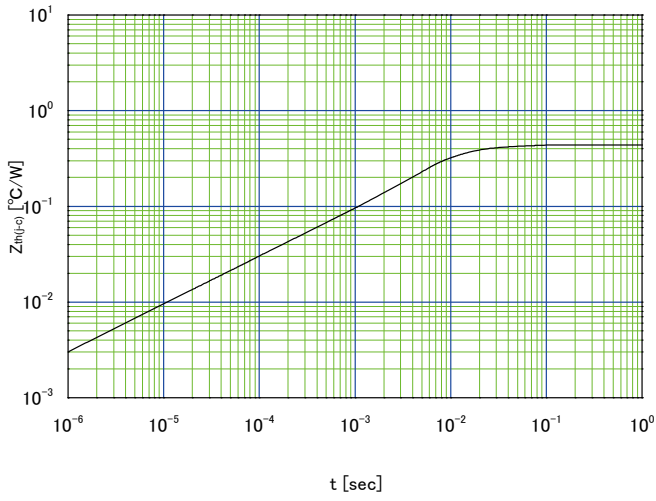
Graph.15  
Typical reverse recovery loss vs.  $I_F$   
 $T_J=175^\circ\text{C}$ ,  $V_{CC}=600\text{V}$ ,  $L=500\mu\text{H}$   
 $V_{GE}=15\text{V}$ ,  $R_G=10\Omega$



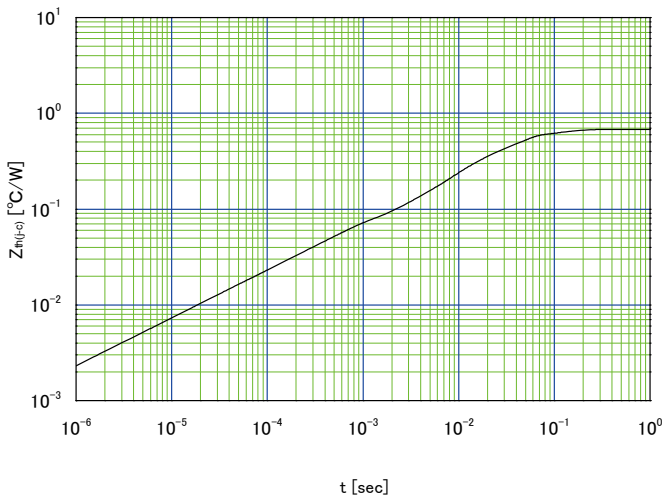
Graph.16  
Reverse biased Safe Operating Area  
 $T_J \leq 175^\circ\text{C}$ ,  $V_{GE}=+15\text{V}/0\text{V}$ ,  $R_G=10\Omega$



Graph.17  
Transient thermal resistance of IGBT

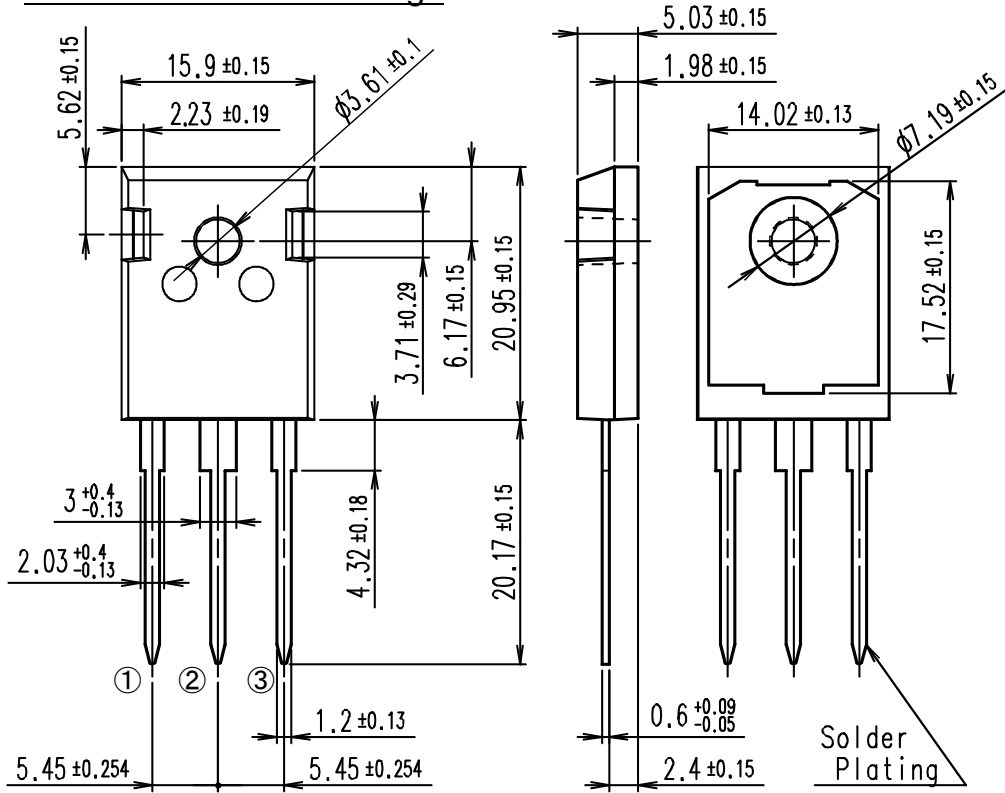


Graph.18  
Transient thermal resistance of FWD



■ Outline Drawings, mm

Outview : TO-247 Package



CONNECTION

- ① GATE
- ② COLLECTOR
- ③ EMITTER

DIMENSIONS ARE IN MILLIMETERS.

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