

# FGW50N60HD

Discrete IGBT

## Discrete IGBT (High-Speed V series)

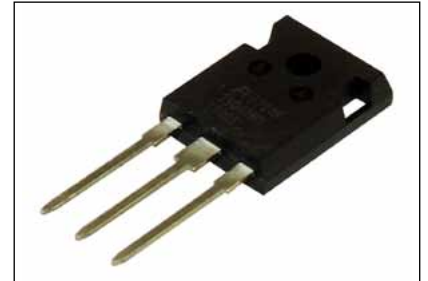
### 600V / 50A

#### ■ Features

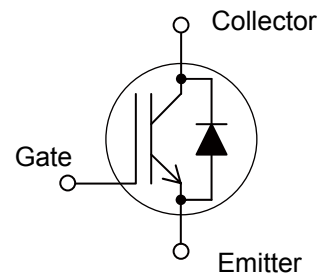
- Low power loss
- Low switching surge and noise
- High reliability, high ruggedness (RBSOA, SCSOA etc.)

#### ■ Applications

- Uninterruptible power supply
- Power conditioner
- Power factor correction circuit



#### ■ Equivalent circuit



#### ■ Maximum Ratings and Characteristics

##### ● Absolute Maximum Ratings (at $T_c=25^\circ\text{C}$ unless otherwise specified)

Items	Symbols	Characteristics	Units	Remarks
Collector-Emitter Voltage	$V_{CES}$	600	V	
Gate-Emitter Voltage	$V_{GES}$	$\pm 20$	V	
DC Collector Current	$I_{C@25}$	95	A	$T_c=25^\circ\text{C}, T_j=150^\circ\text{C}$
	$I_{C@100}$	50	A	$T_c=100^\circ\text{C}, T_j=150^\circ\text{C}$
Pulsed Collector Current	$I_{CP}$	150	A	Note *1
Turn-Off Safe Operating Area	-	150	A	$V_{CE} \leq 600\text{V}, T_j \leq 175^\circ\text{C}$
Diode Forward Current	$I_{F@25}$	43	A	
	$I_{F@100}$	25	A	
Diode Pulsed Current	$I_{FP}$	150	A	Note *1
Short Circuit Withstand Time	$t_{SC}$	5	$\mu\text{s}$	$V_{CC} \leq 300\text{V}, V_{GE} = 12\text{V}$ $T_j \leq 150^\circ\text{C}$
IGBT Max. Power Dissipation	$P_{D\_IGBT}$	360	W	$T_c=25^\circ\text{C}$
FWD Max. Power Dissipation	$P_{D\_FWD}$	125	W	$T_c=25^\circ\text{C}$
Operating Junction Temperature	$T_j$	$-40 \sim +175$	$^\circ\text{C}$	
Storage Temperature	$T_{stg}$	$-55 \sim +175$	$^\circ\text{C}$	

Note \*1 : Pulse width limited by  $T_{jmax}$ .

##### ● Electrical characteristics (at $T_j=25^\circ\text{C}$ unless otherwise specified)

Items	Symbols	Conditions	Characteristics			Units
			min.	typ.	max.	
Collector-Emitter Breakdown Voltage	$V_{(BR)CES}$	$I_c = 250\mu\text{A}, V_{GE} = 0\text{V}$	600	-	-	V
Zero Gate Voltage Collector Current	$I_{CES}$	$V_{CE} = 600\text{V}, V_{GE} = 0\text{V}$	-	-	250	$\mu\text{A}$
		$T_j=25^\circ\text{C}$	-	-	10	$\text{mA}$
		$T_j=175^\circ\text{C}$	-	-	200	$\text{nA}$
Gate-Emitter Leakage Current	$I_{GES}$	$V_{CE} = 0\text{V}, V_{GE} = \pm 20\text{V}$	-	-	200	$\text{nA}$
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	$V_{CE} = +20\text{V}, I_c = 50\text{mA}$	4.0	5.0	6.0	V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = +15\text{V}, I_c = 50\text{A}$	-	1.50	1.95	V
		$T_j=25^\circ\text{C}$	-	1.80	-	
		$T_j=175^\circ\text{C}$	-	-	-	
Input Capacitance	$C_{ies}$	$V_{CE}=25\text{V}$	-	4320	-	pF
Output Capacitance	$C_{oes}$	$V_{GE}=0\text{V}$	-	210	-	
Reverse Transfer Capacitance	$C_{res}$	$f=1\text{MHz}$	-	160	-	
Gate Charge	$Q_G$	$V_{CC} = 400\text{V}$ $I_c = 50\text{A}$ $V_{GE} = 15\text{V}$	-	305	-	nC
Turn-On Delay Time	$t_{d(on)}$	$T_j = 25^\circ\text{C}$	-	35	-	ns
Rise Time	$t_r$	$V_{CC} = 400\text{V}$	-	75	-	
Turn-Off Delay Time	$t_{d(off)}$	$I_c = 50\text{A}$	-	310	-	
Fall Time	$t_f$	$V_{GE} = 15\text{V}$	-	60	-	
Turn-On Energy	$E_{on}$	$R_G = 10\Omega$ $L = 500\mu\text{H}$	-	1.4	-	mJ
Turn-Off Energy	$E_{off}$	Energy loss include "tail" and FWD reverse recovery.	-	1.7	-	
Turn-On Delay Time	$t_{d(on)}$	$T_j = 175^\circ\text{C}$	-	40	-	ns
Rise Time	$t_r$	$V_{CC} = 400\text{V}$	-	85	-	
Turn-Off Delay Time	$t_{d(off)}$	$I_c = 50\text{A}$	-	335	-	
Fall Time	$t_f$	$V_{GE} = 15\text{V}$	-	72	-	
Turn-On Energy	$E_{on}$	$R_G = 10\Omega$ $L = 500\mu\text{H}$	-	2.4	-	mJ
Turn-Off Energy	$E_{off}$	Energy loss include "tail" and FWD reverse recovery.	-	2.2	-	

● FWD Characteristics

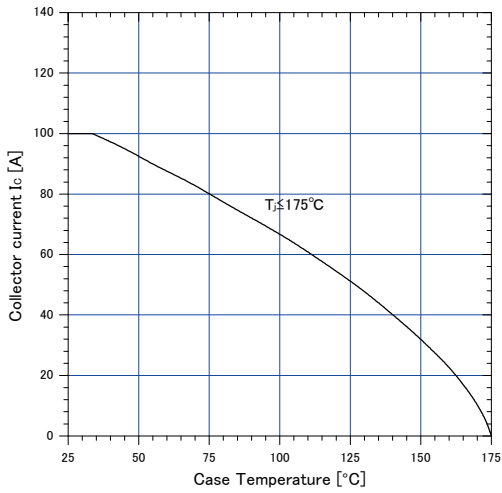
Description	Symbol	Conditions	Characteristics			Unit	
			min.	typ.	max.		
Forward Voltage Drop	$V_F$	$I_F=25A$	$T_j=25^{\circ}C$	-	2.0	2.6	V
			$T_j=175^{\circ}C$	-	1.4	-	V
Diode Reverse Recovery Time	$t_{rr1}$	$V_{CC}=30V, I_F = 2.5A$ $-di/dt=200A/\mu s$	-	25	33	ns	
Diode Reverse Recovery Time	$t_{rr2}$	$V_{CC}=400V$ $I_F=25A$	-	0.04	-	$\mu s$	
Diode Reverse Recovery Charge	$Q_{rr}$	$-di_F/dt=200A/\mu s$ $T_j=25^{\circ}C$	-	0.08	-	$\mu C$	
Diode Reverse Recovery Time	$t_{rr2}$	$V_{CC}=400V$ $I_F=25A$	-	0.16	-	$\mu s$	
Diode Reverse Recovery Charge	$Q_{rr}$	$-di_F/dt=200A/\mu s$ $T_j=175^{\circ}C$	-	0.75	-	$\mu C$	

● Thermal resistance characteristics

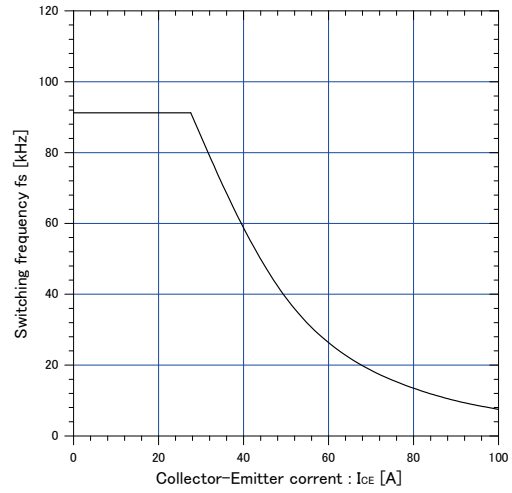
Items	Symbols	Conditions	Characteristics			Units
			min.	typ.	max.	
Thermal Resistance, Junction-Ambient	$R_{th(j-a)}$	-	-	-	50	$^{\circ}C/W$
Thermal Resistance, IGBT Junction to Case	$R_{th(j-c)}_{IGBT}$	-	-	-	0.417	
Thermal Resistance, FWD Junction to Case	$R_{th(j-c)}_{FWD}$	-	-	-	1.191	

■ Characteristics (Representative)

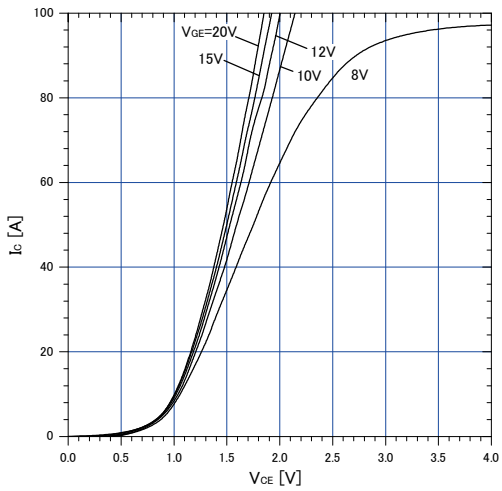
Graph.1  
DC Collector Current vs  $T_c$   
 $V_{GE} \geq +15V, T_c \leq 175^\circ C$



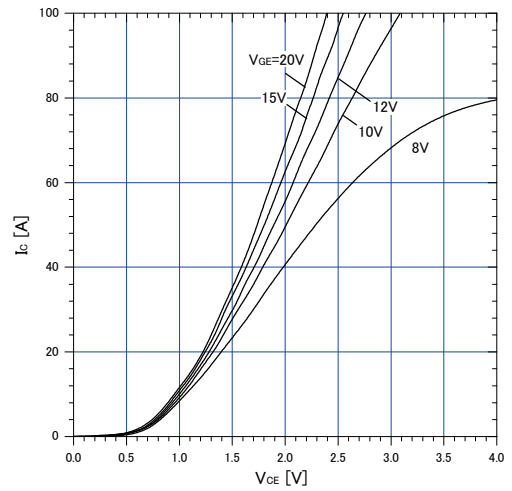
Graph.2  
Collector Current vs. switching frequency  
 $V_{GE} = +15V, T_c \leq 175^\circ C, V_{CE} = 400V, D = 0.5, R_G = 10\Omega, T_c = 100^\circ C$



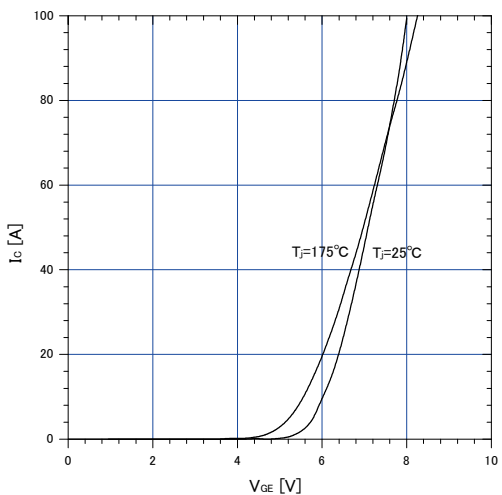
Graph.3  
Typical Output Characteristics ( $V_{CE}-I_c$ )  
 $T_j = 25^\circ C$



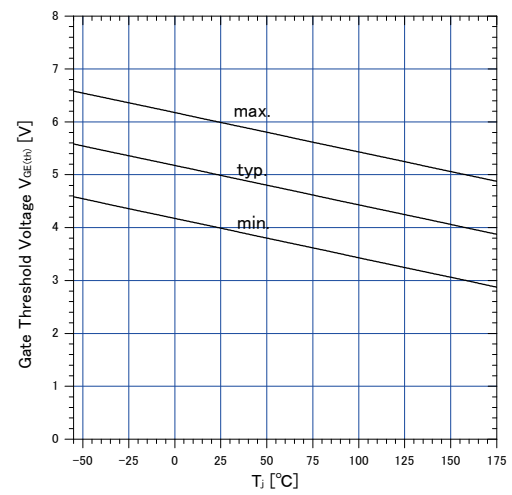
Graph.4  
Typical Output Characteristics ( $V_{CE}-I_c$ )  
 $T_j = 175^\circ C$



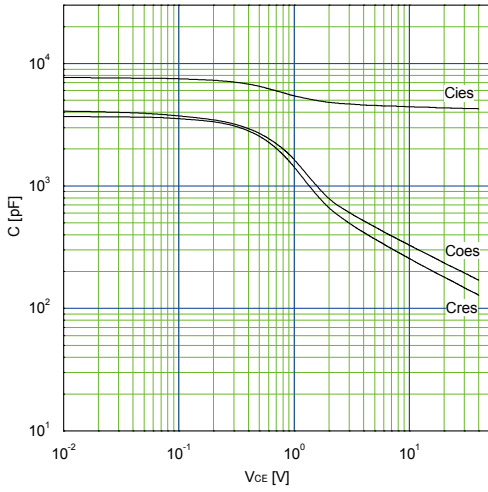
Graph.5  
Typical Transfer Characteristics  
 $V_{GE} = +15V$



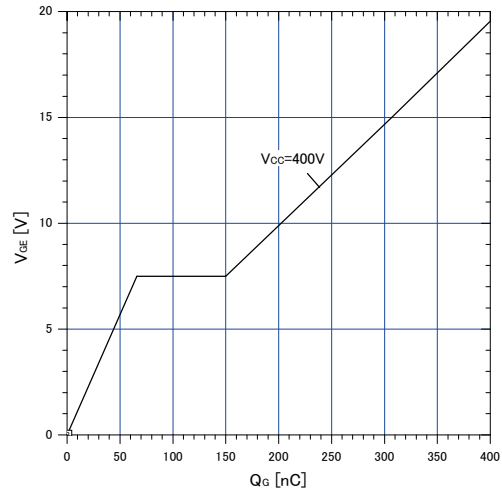
Graph.6  
Gate Threshold Voltage vs.  $T_j$   
 $I_c = 50mA, V_{CE} = 20V$



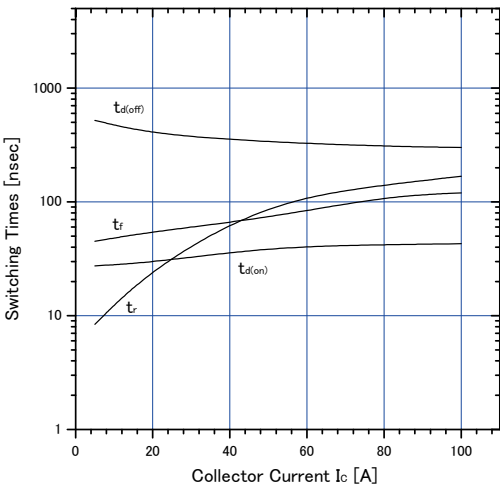
Graph.7  
Typical Capacitance  
 $V_{GE}=0V, f=1MHz, T_j=25^\circ C$



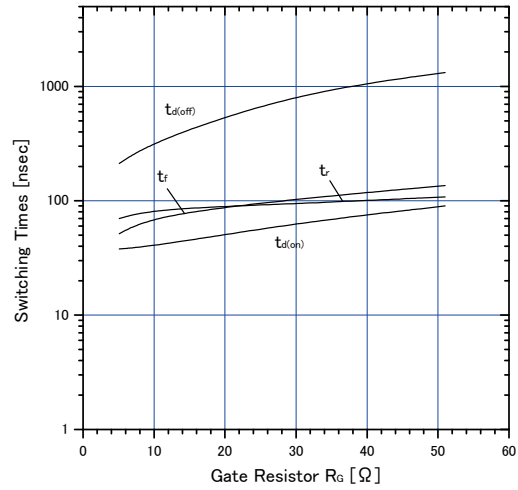
Graph.8  
Typical Gate Charge  
 $V_{CC}=400V, I_c=50A, T_j=25^\circ C$



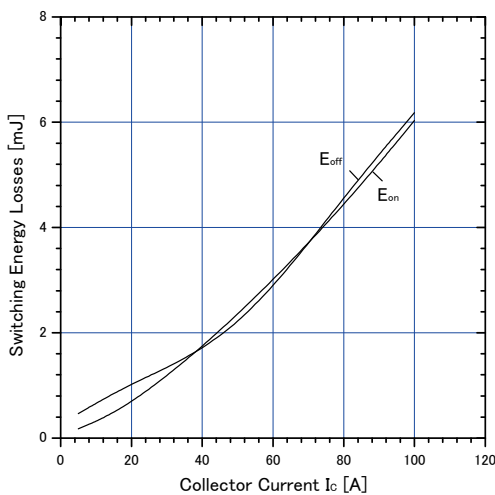
Graph.9  
Typical switching time vs.  $I_c$   
 $T_j=175^\circ C, V_{CC}=400V, L=500\mu H$   
 $V_{GE}=15V, R_G=10\Omega$



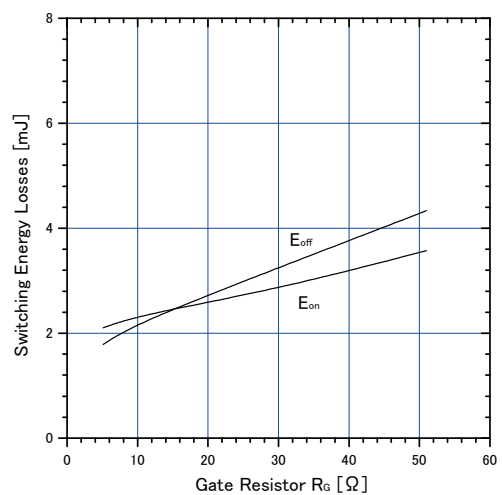
Graph.10  
Typical switching time vs.  $R_G$   
 $T_j=175^\circ C, V_{CC}=400V, I_c=50A, L=500\mu H$   
 $V_{GE}=15V$



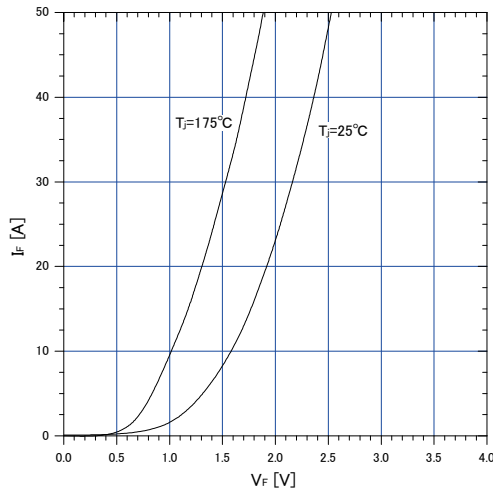
Graph.11  
Typical switching losses vs.  $I_c$   
 $T_j=175^\circ C, V_{CC}=400V, L=500\mu H$   
 $V_{GE}=15V, R_G=10\Omega$



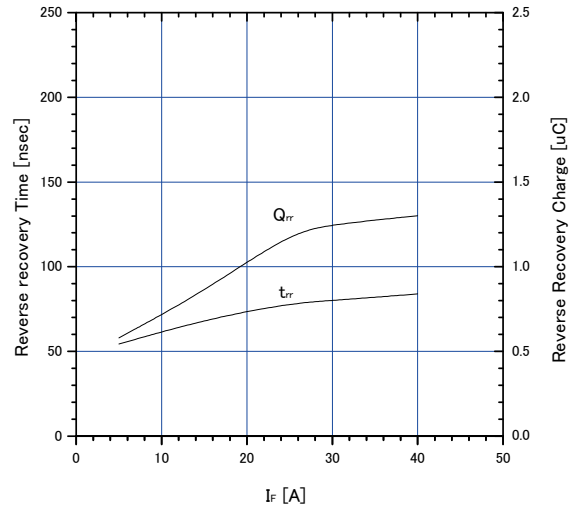
Graph.12  
Typical switching losses vs.  $R_G$   
 $T_j=175^\circ C, V_{CC}=400V, I_c=50A, L=500\mu H$   
 $V_{GE}=15V$



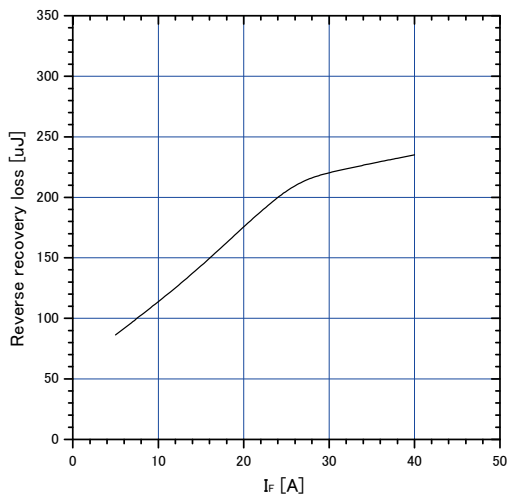
Graph.13  
FWD Forward voltage drop ( $V_F-I_F$ )



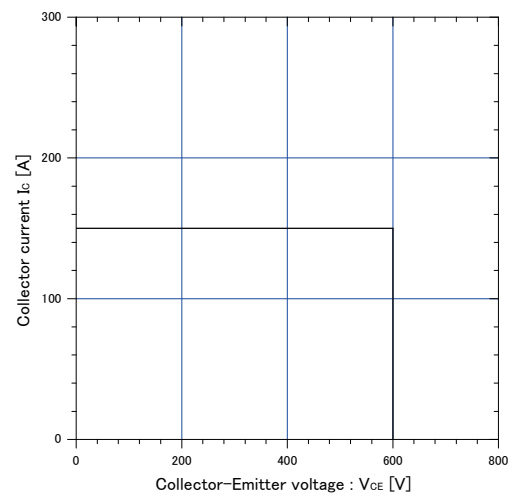
Graph.14  
Typical reverse recovery characteristics vs.  $I_F$   
 $T_J=175^\circ\text{C}$ ,  $V_{CC}=400\text{V}$ ,  $L=500\mu\text{H}$   
 $V_{GE}=15\text{V}$ ,  $R_G=10\Omega$



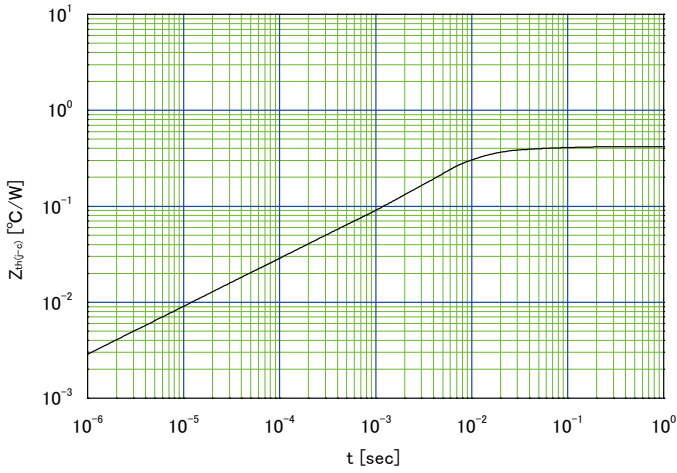
Graph.15  
Typical reverse recovery loss vs.  $I_F$   
 $T_J=175^\circ\text{C}$ ,  $V_{CC}=400\text{V}$ ,  $L=500\mu\text{H}$   
 $V_{GE}=15\text{V}$ ,  $R_G=10\Omega$



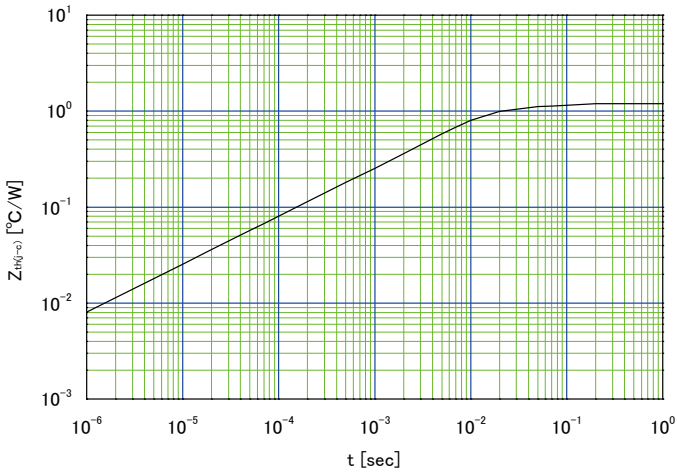
Graph.16  
Reverse biased Safe Operating Area  
 $T_J \leq 175^\circ\text{C}$ ,  $V_{GE}=+15\text{V}/0\text{V}$ ,  $R_G=10\Omega$



Graph.17  
Transient thermal resistance of IGBT

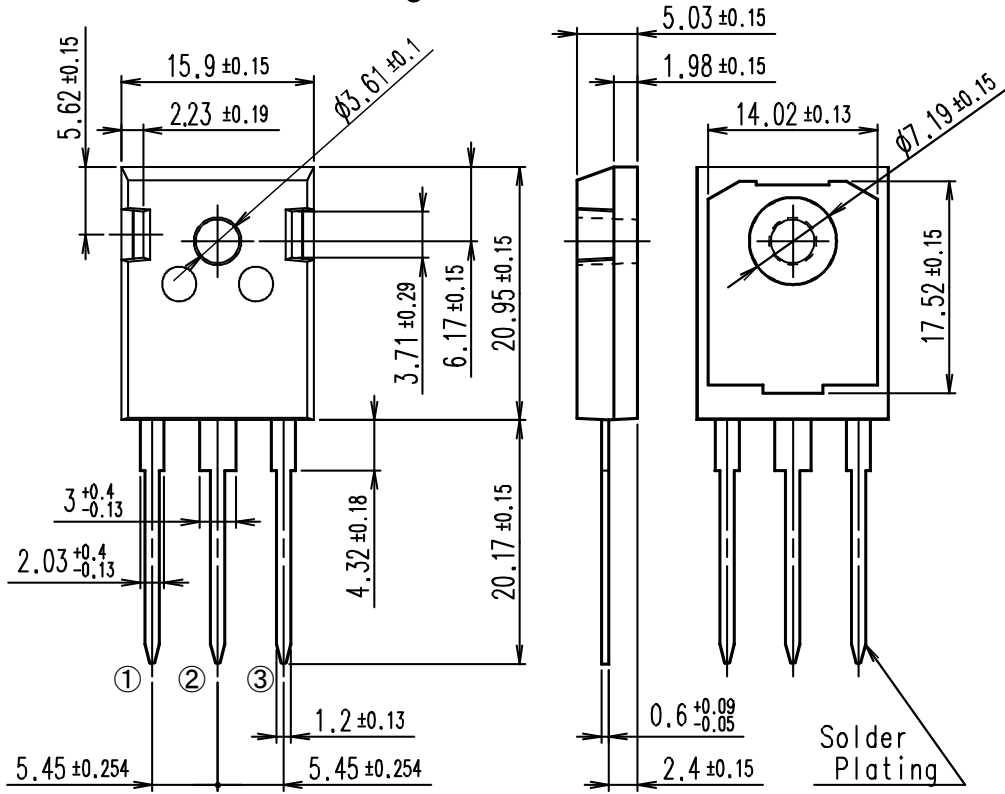


Graph.18  
Transient thermal resistance of FWD



■ Outline Drawings, mm

Outview : TO-247 Package



CONNECTION

- ① GATE
- ② COLLECTOR
- ③ EMITTER

DIMENSIONS ARE IN MILLIMETERS.

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