

# FGW40N120WE

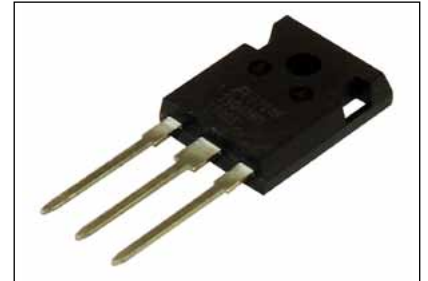
## Discrete IGBT (High-Speed W series) 1200V / 40A

### Features

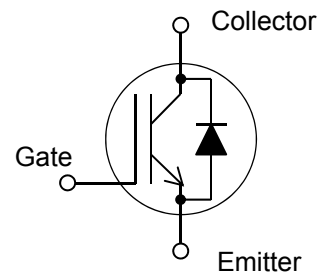
- Low power loss
- Low switching surge and noise
- High reliability, high ruggedness (RBSOA, SCSOA etc.)

### Applications

- Uninterruptible power supply
- PV Power conditioner
- Inverter welding machine



### Equivalent circuit



### Maximum Ratings and Characteristics

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

Items	Symbol	Characteristics	Unit	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>	65	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>	160	A	Note *1
Turn-Off Safe Operating Area	-	160	A	V <sub>CE</sub> ≤1200V, T <sub>J</sub> ≤175°C
Diode Forward Current	I <sub>F@25</sub>	60	A	
	I <sub>F@100</sub>	40	A	
Diode Pulsed Current	I <sub>FP</sub>	160	A	Note *1
Short Circuit Withstand Time	t <sub>SC</sub>	5	μs	V <sub>CC</sub> ≤600V, V <sub>GE</sub> =15V T <sub>J</sub> ≤150°C
IGBT Max. Power Dissipation	P <sub>D_IGBT</sub>	430	W	T <sub>C</sub> =25°C
FWD Max. Power Dissipation	P <sub>D_FWD</sub>	190	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) Static Characteristics

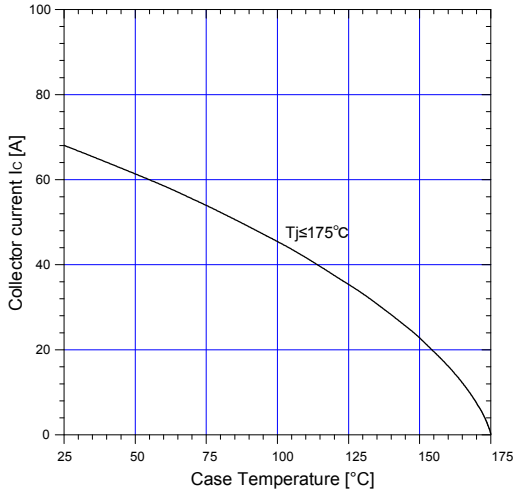
Description	Symbol	Conditions	min.	typ.	max.	Unit	
Zero Gate Voltage Collector Current	I <sub>CES</sub>	V <sub>CE</sub> = 1200V, V <sub>GE</sub> = 0V	T <sub>J</sub> =25°C	-	-	250	μA
			T <sub>J</sub> =175°C	-	-	2	mA
Gate-Emitter Leakage Current	I <sub>GES</sub>	V <sub>CE</sub> = 0V, V <sub>GE</sub> = ±20V	-	-	200	nA	
Gate-Emitter Threshold Voltage	V <sub>GE(th)</sub>	V <sub>CE</sub> = 20V, I <sub>C</sub> = 40mA	5.0	6.0	7.0	V	
Collector-Emitter Saturation Voltage	V <sub>CE(sat)</sub>	V <sub>GE</sub> = 15V, I <sub>C</sub> = 40A	T <sub>J</sub> =25°C	-	2.0	2.6	V
			T <sub>J</sub> =175°C	-	2.6	-	
Input Capacitance	C <sub>ies</sub>	V <sub>CE</sub> =25V	-	2500	-	pF	
Output Capacitance	C <sub>oes</sub>	V <sub>GE</sub> =0V	-	110	-		
Reverse Transfer Capacitance	C <sub>res</sub>	f=1MHz	-	34	-		
Gate Charge	Q <sub>G</sub>	V <sub>CC</sub> = 400V I <sub>C</sub> = 40A V <sub>GE</sub> = 15V	-	120	-	nC	
Turn-On Delay Time	t <sub>d(on)</sub>	T <sub>J</sub> = 25°C	-	36	-	ns	
Rise Time	t <sub>r</sub>	V <sub>CC</sub> = 600V	-	66	-		
Turn-Off Delay Time	t <sub>d(off)</sub>	I <sub>C</sub> = 40A	-	178	-		
Fall Time	t <sub>f</sub>	V <sub>GE</sub> = 15V	-	40	-		
Turn-On Energy	E <sub>on</sub>	R <sub>G</sub> = 10Ω	-	3.0	-	mJ	
Turn-Off Energy	E <sub>off</sub>	L = 500μH Energy loss include "tail" and FWD (FDRW30S120J) reverse recovery.	-	1.6	-		
Turn-On Delay Time	t <sub>d(on)</sub>	T <sub>J</sub> = 175°C	-	36	-	ns	
Rise Time	t <sub>r</sub>	V <sub>CC</sub> = 600V	-	58	-		
Turn-Off Delay Time	t <sub>d(off)</sub>	I <sub>C</sub> = 40A	-	220	-		
Fall Time	t <sub>f</sub>	V <sub>GE</sub> = 15V	-	56	-		
Turn-On Energy	E <sub>on</sub>	R <sub>G</sub> = 10Ω	-	4.8	-	mJ	
Turn-Off Energy	E <sub>off</sub>	L = 500μH Energy loss include "tail" and FWD (FDRW30S120J) reverse recovery.	-	2.4	-		
Forward Voltage Drop	V <sub>F</sub>	I <sub>F</sub> =40A	T <sub>J</sub> =25°C	-	2.40	3.36	V
			T <sub>J</sub> =175°C	-	2.10	-	V
Diode Reverse Recovery Time	t <sub>rr</sub>	V <sub>CC</sub> =600V I <sub>F</sub> = 40A	-	0.45	-	ns	
Diode Reverse Recovery Charge	Q <sub>rr</sub>	-di/dt=600A/μs T <sub>J</sub> =25°C	-	2.20	-	μC	
Diode Reverse Recovery Time	t <sub>rr</sub>	V <sub>CC</sub> =600V I <sub>F</sub> =40A	-	0.85	-	μs	
Diode Reverse Recovery Charge	Q <sub>rr</sub>	-di <sub>r</sub> /dt=600A/μs T <sub>J</sub> =175°C	-	7.10	-	μC	

## ● Thermal Resistance

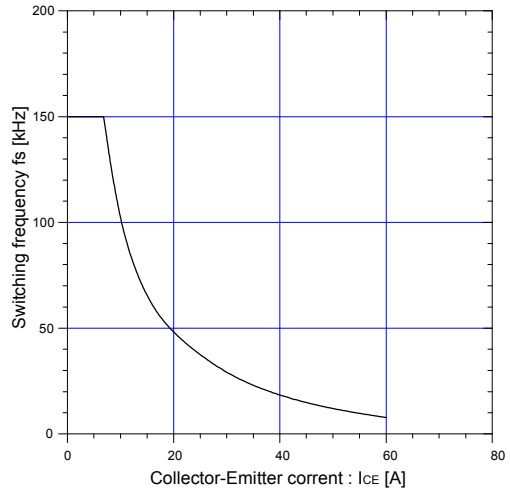
Description	Symbol	min.	typ.	max.	Unit
Thermal Resistance, Junction-Ambient	$R_{th(j-a)}$	-	-	50	°C/W
Thermal Resistance, IGBT Junction to Case	$R_{th(j-c)}_{IGBT}$	-	-	0.347	°C/W
Thermal Resistance, FWD Junction to Case	$R_{th(j-c)}_{FWD}$	-	-	0.781	°C/W

**Characteristics (Representative)**

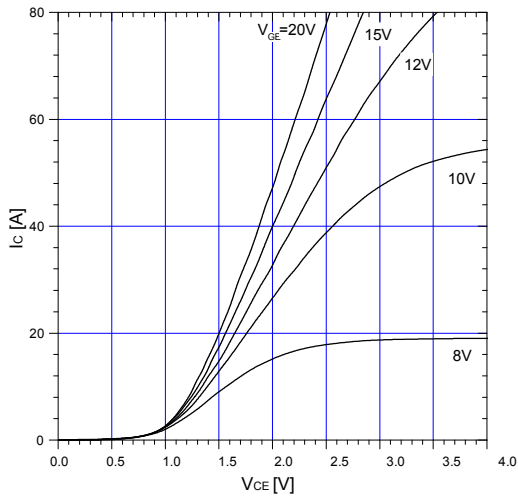
Graph.1  
DC Collector Current vs Tc  
 $V_{GE} \geq +15V, T_j \leq 175^\circ C$



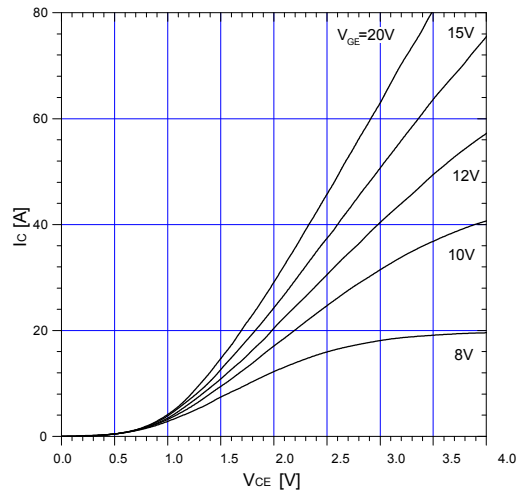
Graph.2  
Collector Current vs. switching frequency  
 $V_{GE} = +15V, T_c \leq 175^\circ C, V_{CC} = 600V, D = 0.5, R_G = 10\Omega, T_c = 100^\circ C$



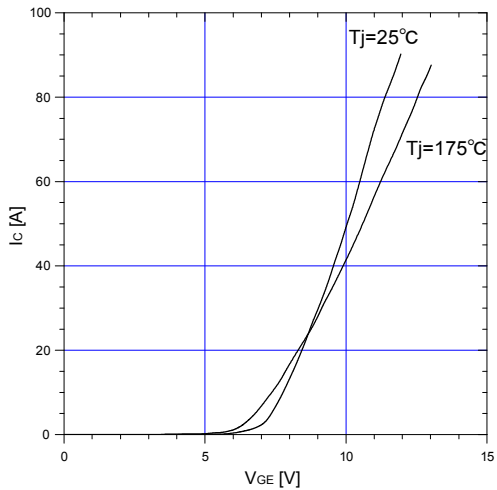
Graph.3  
Typical Output Characteristics ( $V_{CE}-I_c$ )  
 $T_j = 25^\circ C$



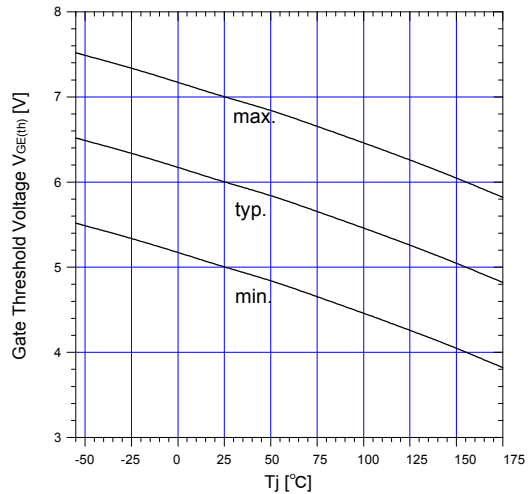
Graph.4  
Typical Output Characteristics ( $V_{CE}-I_c$ )  
 $T_j = 175^\circ C$



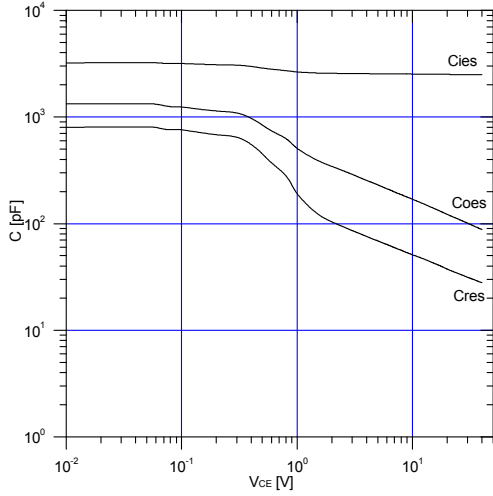
Graph.5  
Typical Transfer Characteristics  
 $V_{CE} = 15V$



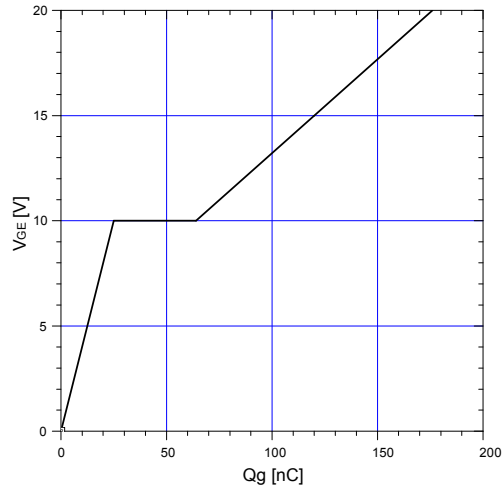
Graph.6  
Gate Threshold Voltage vs. Tj  
 $I_C = 40mA, V_{CE} = 20V$



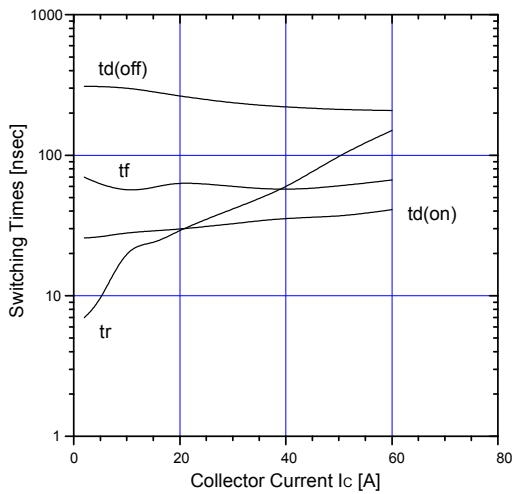
Graph.7  
Typical Capacitance  
 $V_{GE}=0V, f=1MHz, T_j=25^{\circ}C$



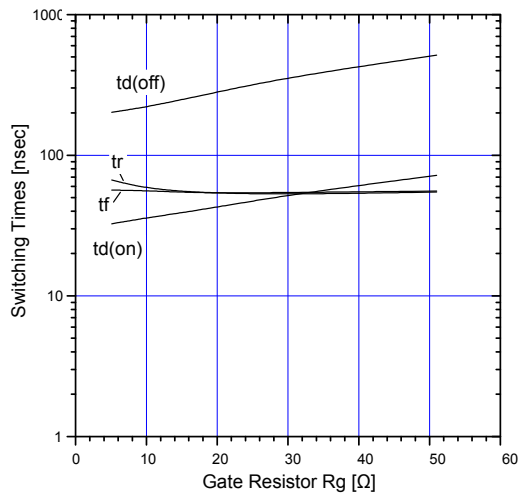
Graph.8  
Typical Gate Charge  
 $V_{cc}=600V, I_c=40A, T_j=25^{\circ}C$



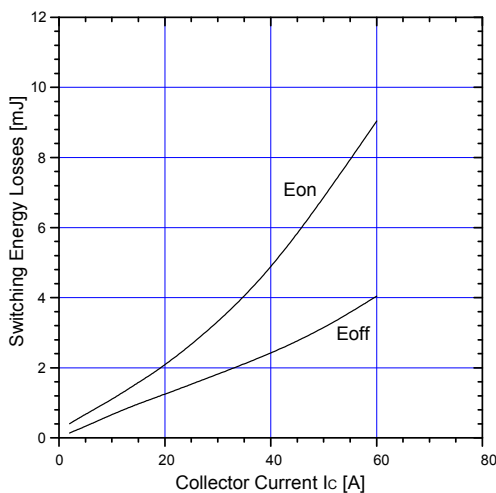
Graph.9  
Typical switching time vs. Ic  
 $T_j=175^{\circ}C, V_{cc}=600V, L=500\mu H$   
 $V_{GE}=15V, R_G=10\Omega$



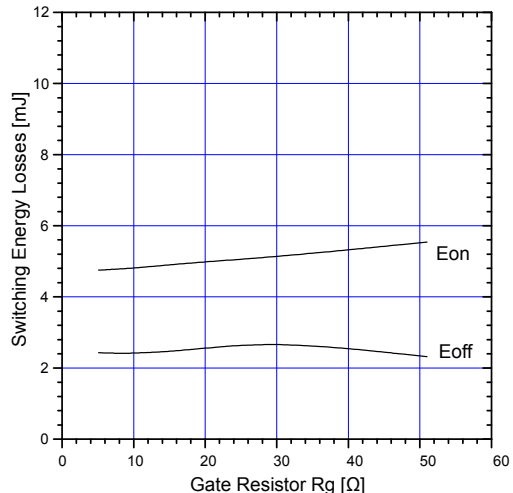
Graph.10  
Typical switching time vs. Rg  
 $T_j=175^{\circ}C, V_{cc}=600V, I_c=40A, L=500\mu H$   
 $V_{GE}=15V$



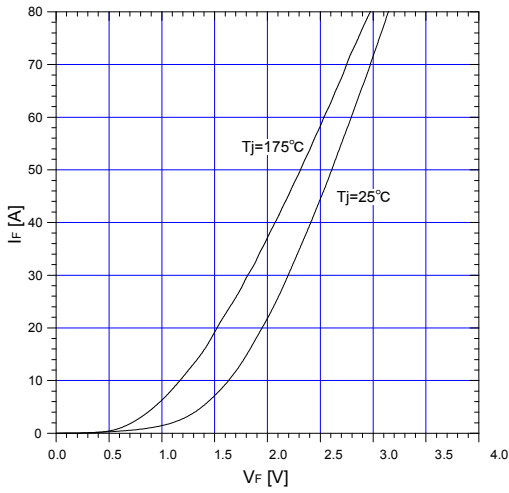
Graph.11  
Typical switching losses vs. Ic  
 $T_j=175^{\circ}C, V_{cc}=600V, L=500\mu H$   
 $V_{GE}=15V, R_G=10\Omega$



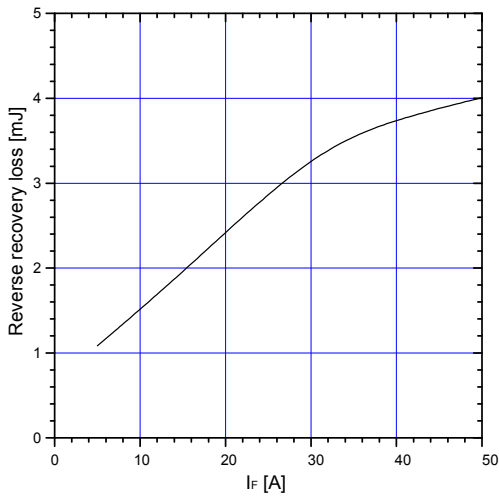
Graph.12  
Typical switching losses vs. Rg  
 $T_j=175^{\circ}C, V_{cc}=600V, I_c=40A, L=500\mu H$   
 $V_{GE}=15V$



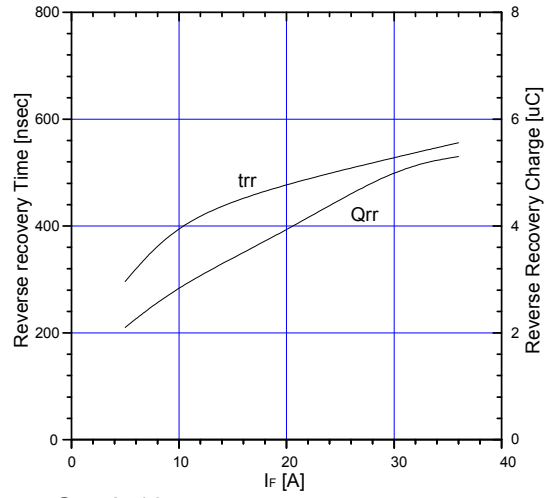
Graph.13  
FWD Forward voltage drop ( $V_F$ - $I_F$ )



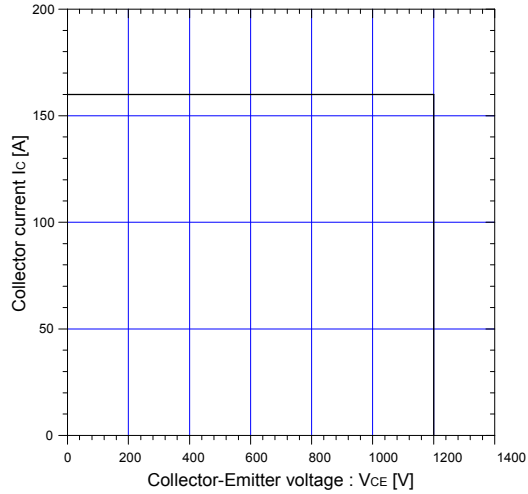
Graph.15  
Typical reverse recovery loss vs.  $I_F$   
 $T_j=175^\circ\text{C}, V_{cc}=600\text{V}, L=500\mu\text{H}$   
 $V_{GE}=15\text{V}, R_G=10\Omega$



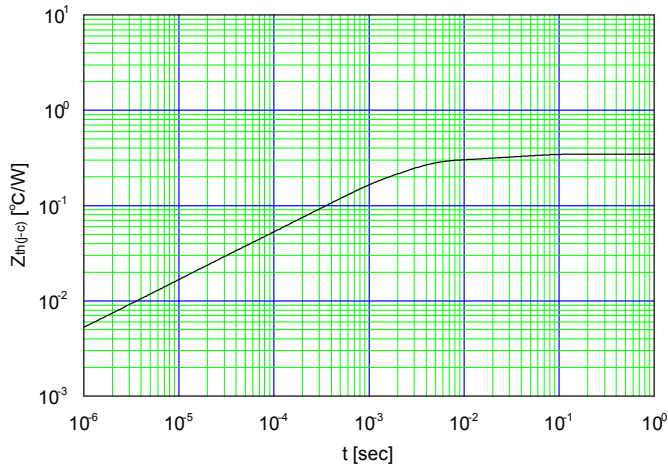
Graph.14  
Typical reverse recovery characteristics vs.  $I_F$   
 $T_j=175^\circ\text{C}, V_{cc}=600\text{V}, L=500\mu\text{H}$   
 $V_{GE}=15\text{V}, R_G=10\Omega$



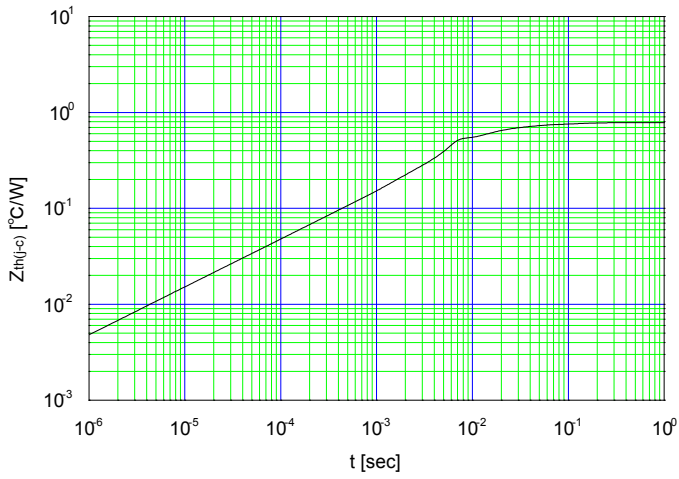
Graph.16  
Reverse biased Safe Operating Area  
 $T_j \leq 175^\circ\text{C}, V_{GE}=+15\text{V}/0\text{V}, R_G=10\Omega$



Graph.17  
Transient thermal resistance of IGBT

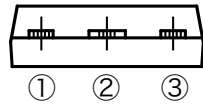
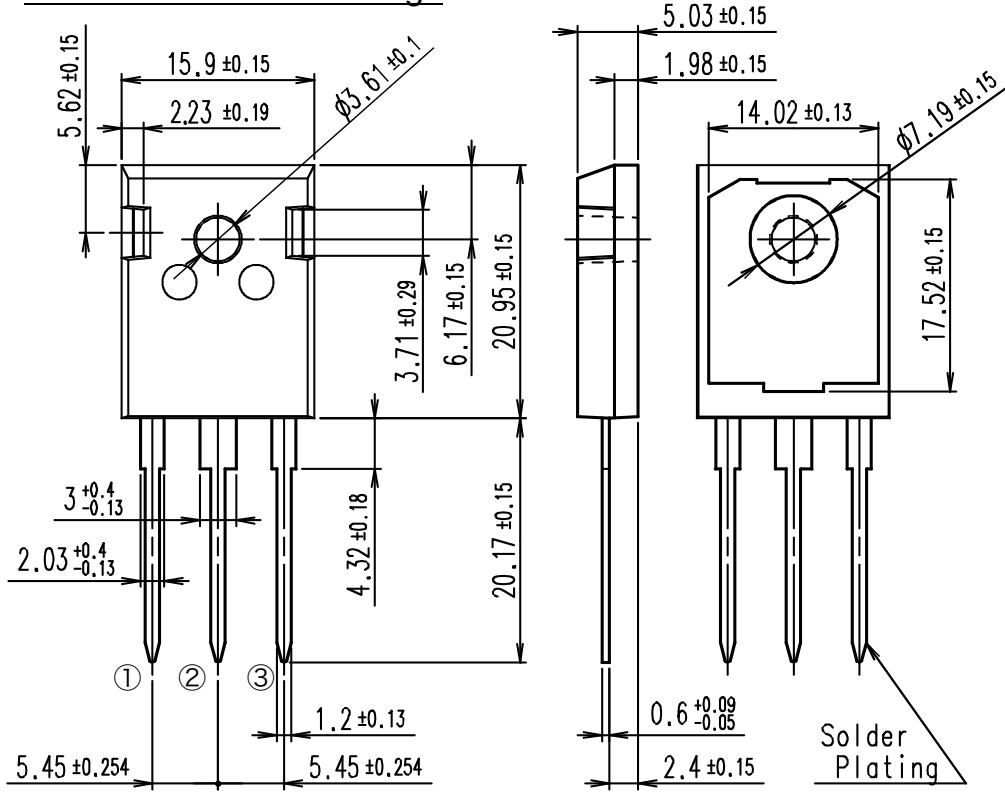


Graph.18  
Transient thermal resistance of FWD



■ Outline Drawings, mm

Outview : TO-247 Package



CONNECTION

- ① GATE
- ② COLLECTOR
- ③ EMITTER

DIMENSIONS ARE IN MILLIMETERS.

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