

FGW40N120WE

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Discrete IGBT

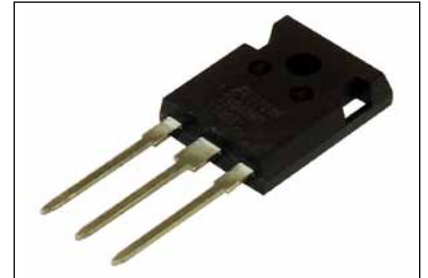
Discrete IGBT (High-Speed W series) 1200V / 40A

■ 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



■ Maximum Ratings and Characteristics

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

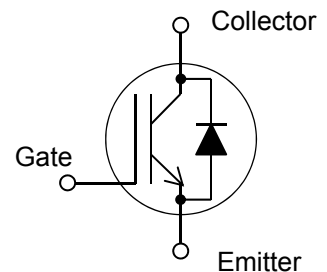
Items	Symbol	Characteristics	Unit	Remarks
Collector-Emitter voltage	V_{CES}	1200	V	
Gate-Emitter voltage	V_{GES}	± 20	V	
DC Collector Current	$I_{C@25}$	65	A	$T_C=25^{\circ}\text{C}$, $T_J=150^{\circ}\text{C}$
	$I_{C@100}$	40	A	$T_C=100^{\circ}\text{C}$, $T_J=150^{\circ}\text{C}$
Pulsed Collector Current	I_{CP}	160	A	Note *1
Turn-Off Safe Operating Area	-	160	A	$V_{CE} \leq 1200\text{V}$, $T_J \leq 175^{\circ}\text{C}$
Diode Forward Current	$I_{F@25}$	60	A	
	$I_{F@100}$	40	A	
Diode Pulsed Current	I_{FP}	160	A	Note *1
Short Circuit Withstand Time	t_{SC}	5	μs	$V_{CC} \leq 600\text{V}$, $V_{GE} = 15\text{V}$ $T_J \leq 150^{\circ}\text{C}$
IGBT Max. Power Dissipation	P_{D_IGBT}	430	W	$T_C=25^{\circ}\text{C}$
FWD Max. Power Dissipation	P_{D_FWD}	190	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) Static Characteristics

Description	Symbol	Conditions	min.	typ.	max.	Unit
Zero Gate Voltage Collector Current	I_{CES}	$V_{CE} = 1200\text{V}$, $V_{GE} = 0\text{V}$	-	-	250	μA
		$T_J=175^{\circ}\text{C}$	-	-	2	mA
Gate-Emitter Leakage Current	I_{GES}	$V_{CE} = 0\text{V}$, $V_{GE} = \pm 20\text{V}$	-	-	200	nA
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	$V_{CE} = 20\text{V}$, $I_C = 40\text{mA}$	5.0	6.0	7.0	V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 15\text{V}$, $I_C = 40\text{A}$	-	2.0	2.6	V
		$T_J=175^{\circ}\text{C}$	-	2.6	-	
Input Capacitance	C_{ies}	$V_{CE}=25\text{V}$	-	2500	-	pF
Output Capacitance	C_{oes}	$V_{GE}=0\text{V}$	-	110	-	
Reverse Transfer Capacitance	C_{res}	$f=1\text{MHz}$	-	34	-	
Gate Charge	Q_G	$V_{CC} = 400\text{V}$ $I_C = 40\text{A}$ $V_{GE} = 15\text{V}$	-	120	-	nC
Turn-On Delay Time	$t_{d(on)}$	$T_J = 25^{\circ}\text{C}$	-	36	-	ns
Rise Time	t_r	$V_{CC} = 600\text{V}$	-	66	-	
Turn-Off Delay Time	$t_{d(off)}$	$I_C = 40\text{A}$	-	178	-	
Fall Time	t_f	$V_{GE} = 15\text{V}$	-	40	-	
Turn-On Energy	E_{on}	$R_G = 10\Omega$	-	3.0	-	mJ
Turn-Off Energy	E_{off}	$L = 500\mu\text{H}$ Energy loss include "tail" and FWD (FDRW30S120J) reverse recovery.	-	1.6	-	
Turn-On Delay Time	$t_{d(on)}$	$T_J = 175^{\circ}\text{C}$	-	36	-	ns
Rise Time	t_r	$V_{CC} = 600\text{V}$	-	58	-	
Turn-Off Delay Time	$t_{d(off)}$	$I_C = 40\text{A}$	-	220	-	
Fall Time	t_f	$V_{GE} = 15\text{V}$	-	56	-	
Turn-On Energy	E_{on}	$R_G = 10\Omega$	-	4.8	-	mJ
Turn-Off Energy	E_{off}	$L = 500\mu\text{H}$ Energy loss include "tail" and FWD (FDRW30S120J) reverse recovery.	-	2.4	-	
Forward Voltage Drop	V_F	$I_F=40\text{A}$	-	2.40	3.36	V
		$T_J=175^{\circ}\text{C}$	-	2.10	-	V
Diode Reverse Recovery Time	t_{rr}	$V_{CC}=600\text{V}$	-	0.45	-	ns
Diode Reverse Recovery Charge	Q_{rr}	$I_F = 40\text{A}$ $-di/dt=600\text{A}/\mu\text{s}$ $T_J=25^{\circ}\text{C}$	-	2.20	-	μC
Diode Reverse Recovery Time	t_{rr}	$V_{CC}=600\text{V}$	-	0.85	-	μs
Diode Reverse Recovery Charge	Q_{rr}	$I_F=40\text{A}$ $-di/dt=600\text{A}/\mu\text{s}$ $T_J=175^{\circ}\text{C}$	-	7.10	-	μC

■ Equivalent circuit

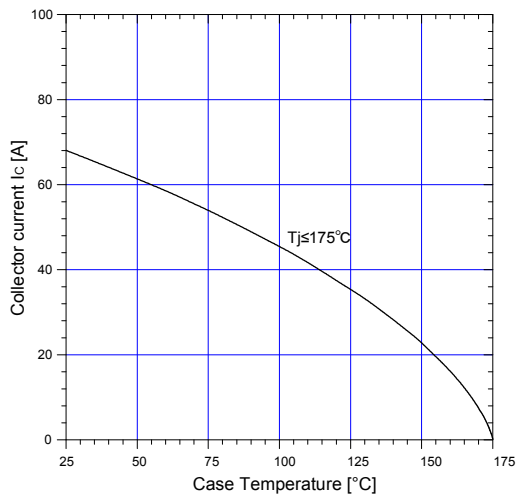


● Thermal Resistance

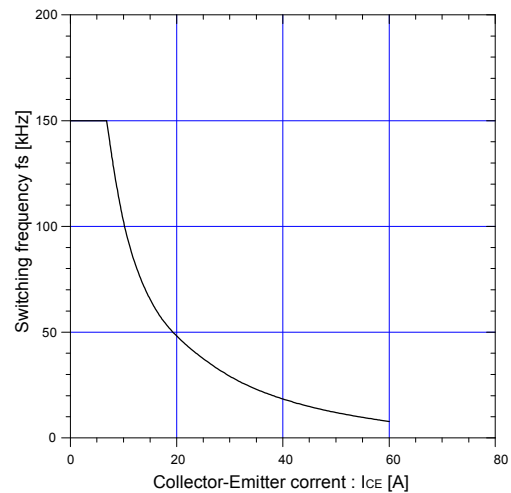
Description	Symbol	min.	typ.	max.	Unit
Thermal Resistance, Junction-Ambient	$R_{th(j-a)}$	-	-	50	°C/W
Thermal Resistance, IGBT Junction to Case	$R_{th(j-c)}_{IGBT}$	-	-	0.347	°C/W
Thermal Resistance, FWD Junction to Case	$R_{th(j-c)}_{FWD}$	-	-	0.781	°C/W

■ Characteristics (Representative)

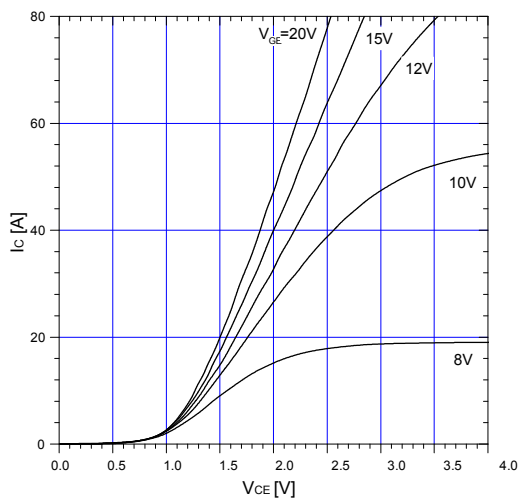
Graph.1
DC Collector Current vs Tc
 $V_{GE} \geq +15V, T_j \leq 175^\circ C$



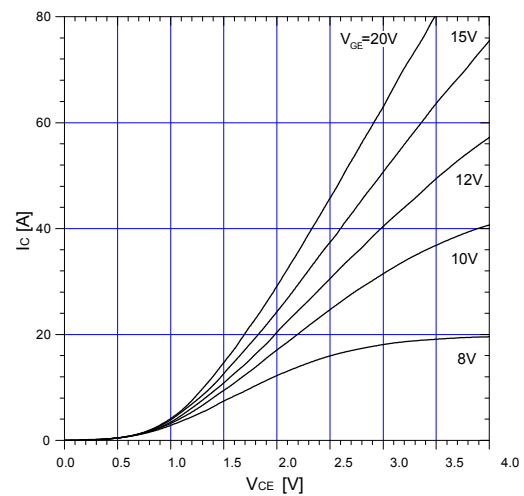
Graph.2
Collector Current vs. switching frequency
 $V_{GE} = +15V, T_c \leq 175^\circ C, V_{CC} = 600V, D = 0.5,$
 $R_G = 10\Omega, T_c = 100^\circ C$



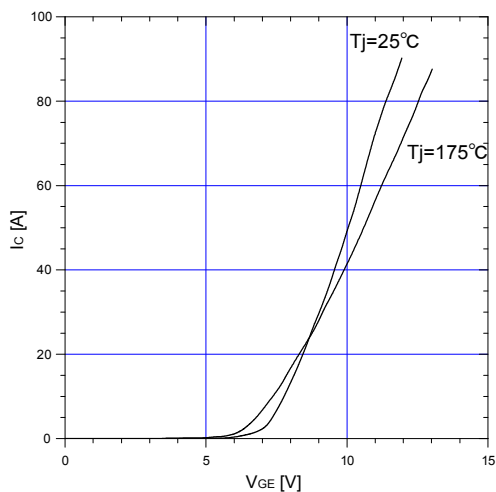
Graph.3
Typical Output Characteristics ($V_{CE}-I_C$)
 $T_j = 25^\circ C$



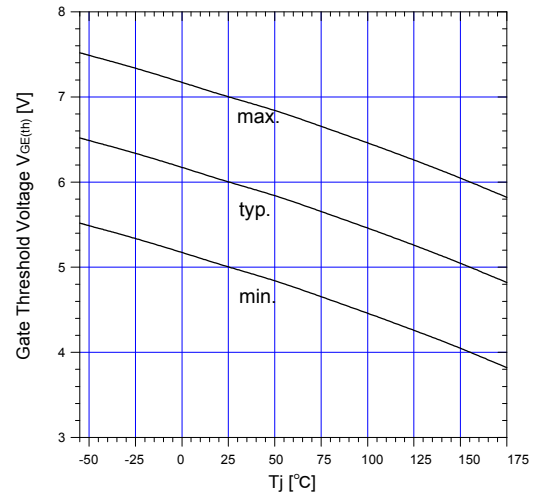
Graph.4
Typical Output Characteristics ($V_{CE}-I_C$)
 $T_j = 175^\circ C$



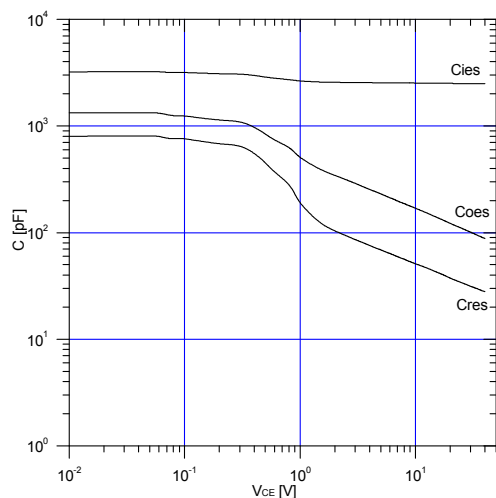
Graph.5
Typical Transfer Characteristics
 $V_{CE} = 15V$



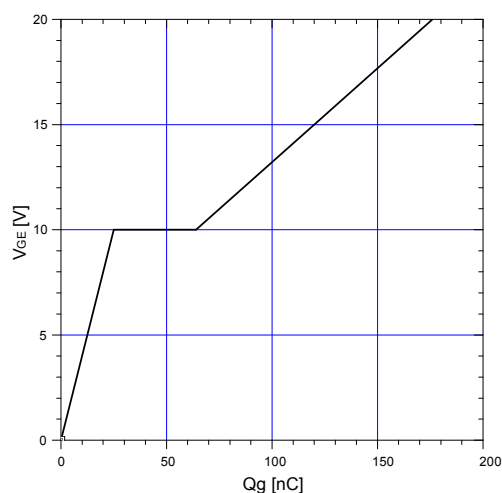
Graph.6
Gate Threshold Voltage vs. T_j
 $I_C = 40mA, V_{CE} = 20V$



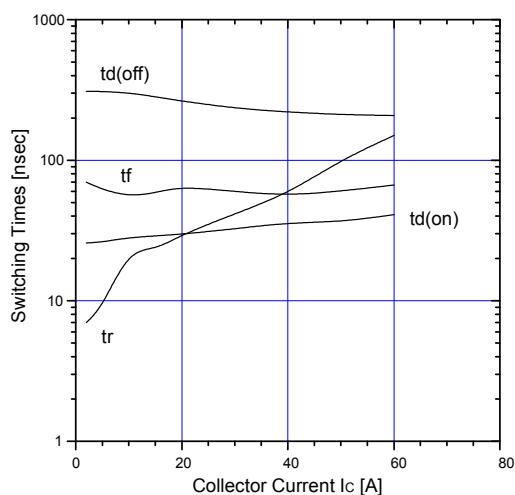
Graph.7
Typical Capacitance
 $V_{GE}=0V, f=1MHz, T_J=25^{\circ}C$



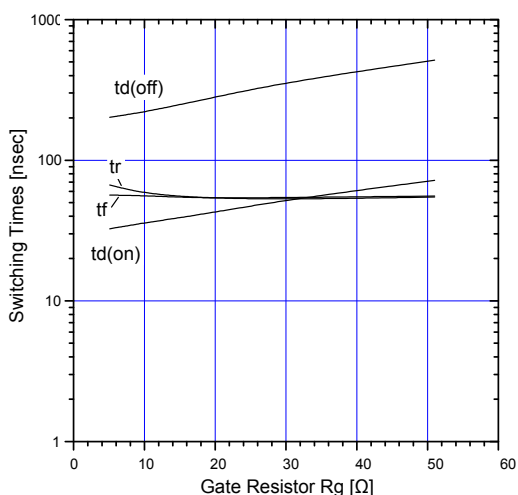
Graph.8
Typical Gate Charge
 $V_{CC}=600V, I_C=40A, T_J=25^{\circ}C$



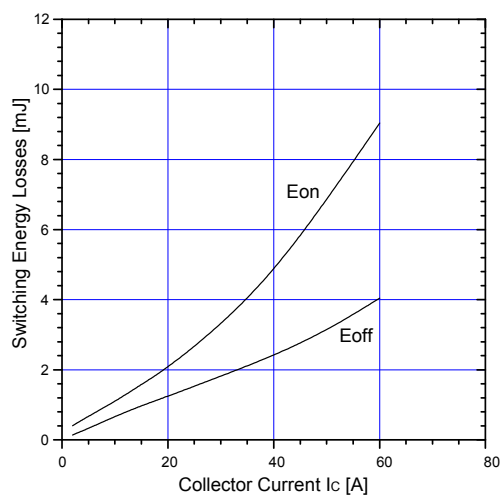
Graph.9
Typical switching time vs. Ic
 $T_J=175^{\circ}C, V_{CC}=600V, L=500\mu H$
 $V_{GE}=15V, R_G=10\Omega$



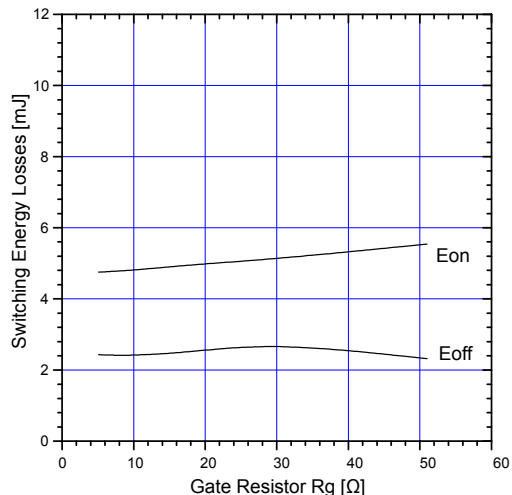
Graph.10
Typical switching time vs. Rg
 $T_J=175^{\circ}C, V_{CC}=600V, I_C=40A, L=500\mu H$
 $V_{GE}=15V$



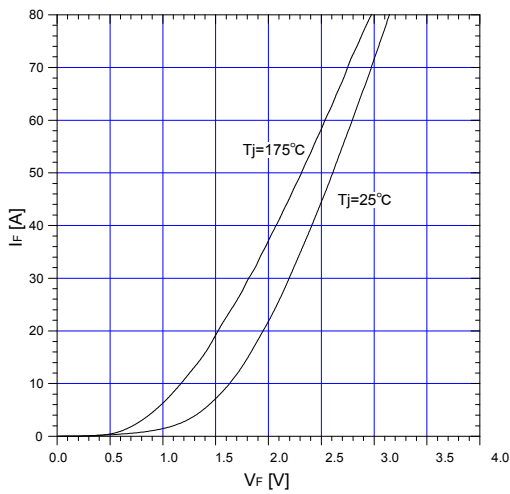
Graph.11
Typical switching losses vs. Ic
 $T_J=175^{\circ}C, V_{CC}=600V, L=500\mu H$
 $V_{GE}=15V, R_G=10\Omega$



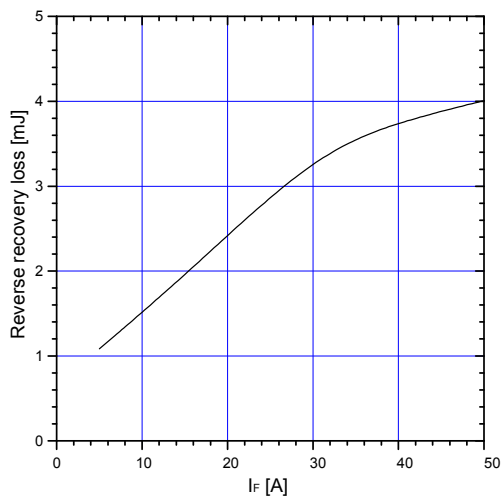
Graph.12
Typical switching losses vs. Rg
 $T_J=175^{\circ}C, V_{CC}=600V, I_C=40A, L=500\mu H$
 $V_{GE}=15V$



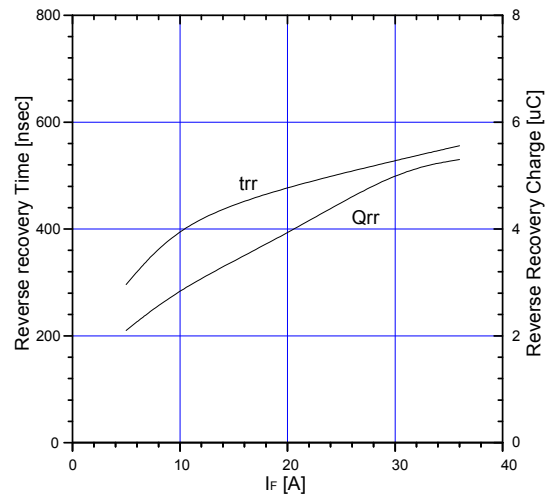
Graph.13
FWD Forward voltage drop (V_F-I_F)



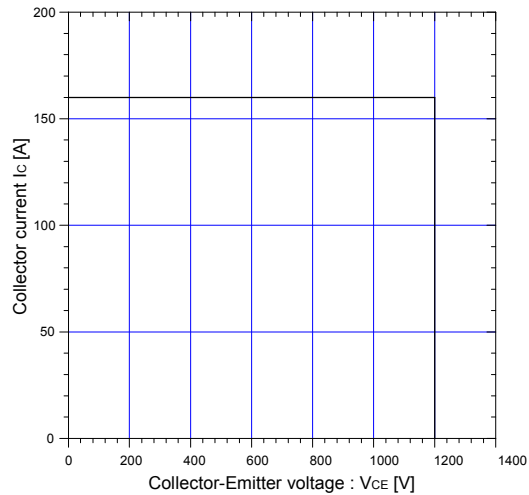
Graph.15
Typical reverse recovery loss vs. I_F
 $T_J = 175^\circ\text{C}$, $V_{CC} = 600\text{V}$, $L = 500\mu\text{H}$
 $V_{GE} = 15\text{V}$, $R_G = 10\Omega$



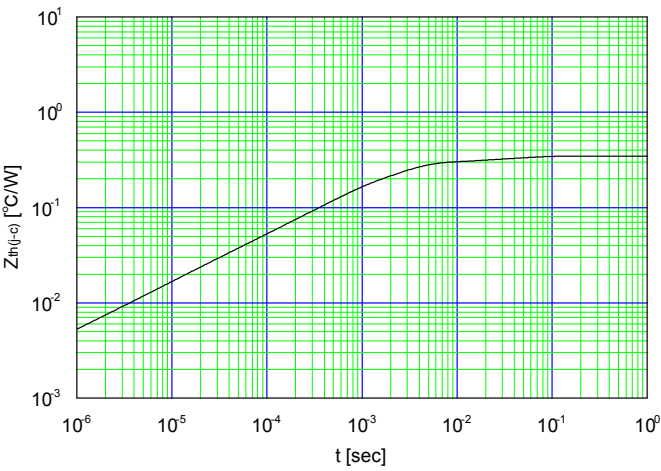
Graph.14
Typical reverse recovery characteristics vs. I_F
 $T_J = 175^\circ\text{C}$, $V_{CC} = 600\text{V}$, $L = 500\mu\text{H}$
 $V_{GE} = 15\text{V}$, $R_G = 10\Omega$



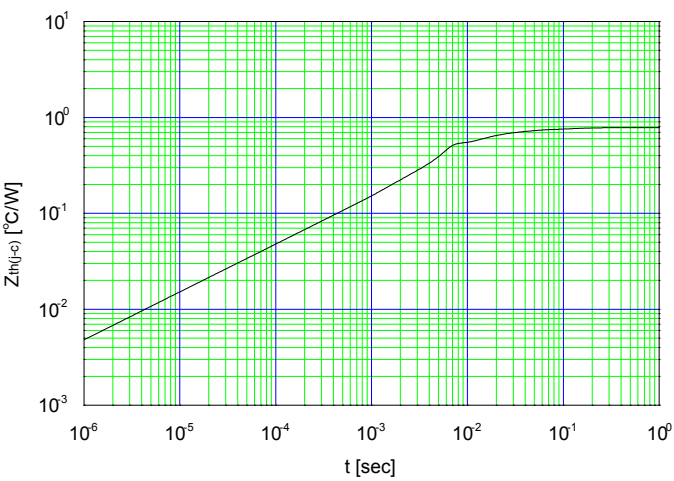
Graph.16
Reverse biased Safe Operating Area
 $T_J \leq 175^\circ\text{C}$, $V_{GE} = +15\text{V}/0\text{V}$, $R_G = 10\Omega$



Graph.17
Transient thermal resistance of IGBT

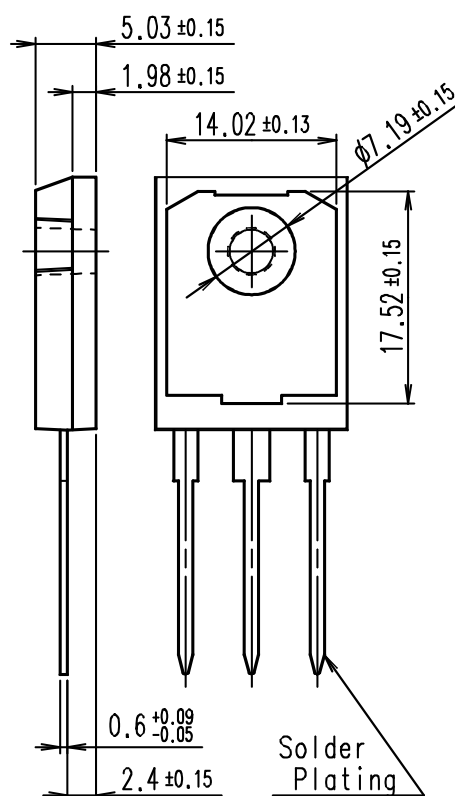
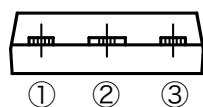
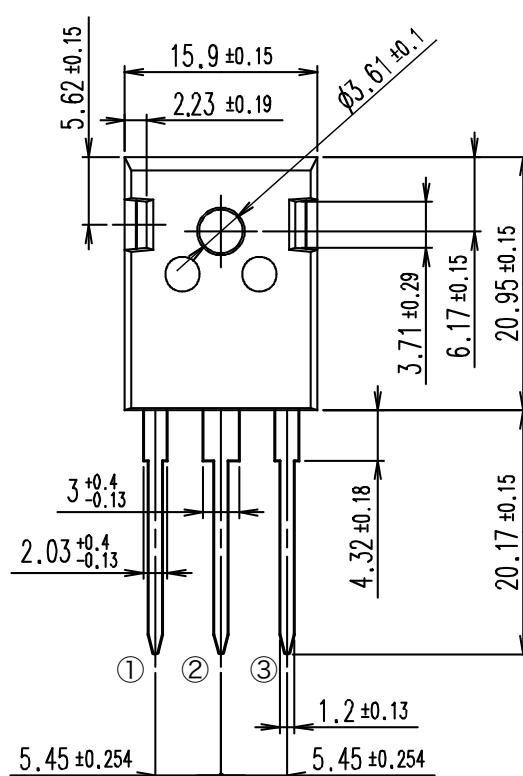


Graph.18
Transient thermal resistance of FWD



■ Outline Drawings, mm

Outview : TO-247 Package



CONNECTION

① GATE

② COLLECTOR

③ EMITTER

DIMENSIONS ARE IN MILLIMETERS.

WARNING

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IGBT Modules

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