

FGW40N120WD

Discrete IGBT

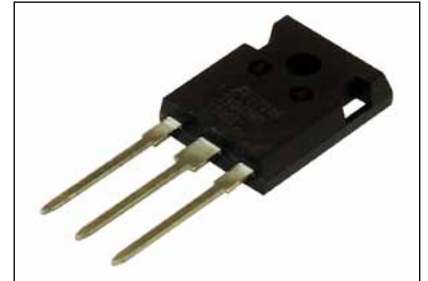
Discrete IGBT (High-Speed W series) 1200V / 40A

■ 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 $T_c=25^\circ\text{C}$ unless otherwise specified)

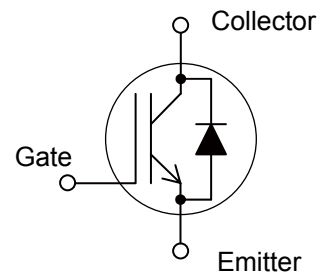
Items	Symbols	Characteristics	Units	Remarks
Collector-Emitter voltage	V_{CES}	1200	V	
Gate-Emitter voltage	V_{GES}	± 20	V	
DC Collector Current	$I_{C@25}$	65	A	$T_c=25^\circ\text{C}$, $T_j=150^\circ\text{C}$
	$I_{C@100}$	40	A	$T_c=100^\circ\text{C}$, $T_j=150^\circ\text{C}$
Pulsed Collector Current	I_{CP}	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	$I_{F@25}$	36	A	
	$I_{F@100}$	20	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}	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)

Description	Symbols	Conditions	Characteristics			Unit
			min.	typ.	max.	
Zero Gate Voltage Collector Current	I_{CES}	$V_{CE} = 1200\text{V}$, $V_{GE} = 0\text{V}$	$T_j=25^\circ\text{C}$	-	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	$V_{CE(sat)}$	$V_{GE} = 15\text{V}$, $I_C = 40\text{A}$	$T_j=25^\circ\text{C}$	1.4	2.0	2.6
			$T_j=175^\circ\text{C}$	-	2.6	-
Input Capacitance	C_{ies}	$V_{CE}=25\text{V}$	1250	2500	3750	pF
Output Capacitance	C_{oes}	$V_{GE}=0\text{V}$	55	110	165	
Reverse Transfer Capacitance	C_{res}	$f=1\text{MHz}$	17	34	51	
Gate Charge	Q_G	$V_{CC} = 400\text{V}$ $I_C = 40\text{A}$ $V_{GE} = 15\text{V}$	60	120	180	nC
Turn-On Delay Time	$t_{d(on)}$	$T_j = 25^\circ\text{C}$	16	32	48	ns
Rise Time	t_r	$V_{CC} = 600\text{V}$	27	54	81	
Turn-Off Delay Time	$t_{d(off)}$	$I_C = 40\text{A}$	89	178	267	
Fall Time	t_f	$V_{GE} = 15\text{V}$	20	40	60	
Turn-On Energy	E_{on}	$R_G = 10\Omega$ $L = 500\mu\text{H}$	1.4	2.8	4.2	
Turn-Off Energy	E_{off}	Energy loss include "tail" and FWD (FDRW20S120J) reverse recovery.	0.8	1.6	2.4	mJ
Turn-On Delay Time	$t_{d(on)}$	$T_j = 150^\circ\text{C}$	16	32	48	ns
Rise Time	t_r	$V_{CC} = 600\text{V}$	24	48	72	
Turn-Off Delay Time	$t_{d(off)}$	$I_C = 40\text{A}$	110	220	330	
Fall Time	t_f	$V_{GE} = 15\text{V}$	28	56	84	
Turn-On Energy	E_{on}	$R_G = 10\Omega$ $L = 500\mu\text{H}$	2.3	4.6	6.9	
Turn-Off Energy	E_{off}	Energy loss include "tail" and FWD (FDRW20S120J) reverse recovery.	1.2	2.4	3.6	mJ
Forward Voltage Drop	V_F	$I_F=20\text{A}$	$T_j=25^\circ\text{C}$	1.3	2.2	2.8
			$T_j=175^\circ\text{C}$	1.0	1.8	2.6
Diode Reverse Recovery Time	t_{rr1}	$V_{CC}=30\text{V}$ $I_F = 3.0\text{A}$ $-di/dt=200\text{A}/\mu\text{s}$	21	42	55	ns
Diode Reverse Recovery Time	t_{rr2}	$V_{CC}=600\text{V}$ $I_F=20\text{A}$	0.15	0.38	0.61	μs
Diode Reverse Recovery Charge	Q_{rr}	$-di/dt=200\text{A}/\mu\text{s}$ $T_j=25^\circ\text{C}$	0.38	0.95	1.52	μC

■ Equivalent circuit



Description	Symbols	Conditions	Characteristics			Unit
			min.	typ.	max.	
Diode Reverse Recovery Time	t_{rr2}	$V_{CC}=600V$ $I_F=20A$	0.26	0.66	1.06	μs
Diode Reverse Recovery Charge	Q_{rr}	$-di_F/dt=200A/\mu s$ $T_J=175^\circ C$	1.8	4.5	7.2	μC

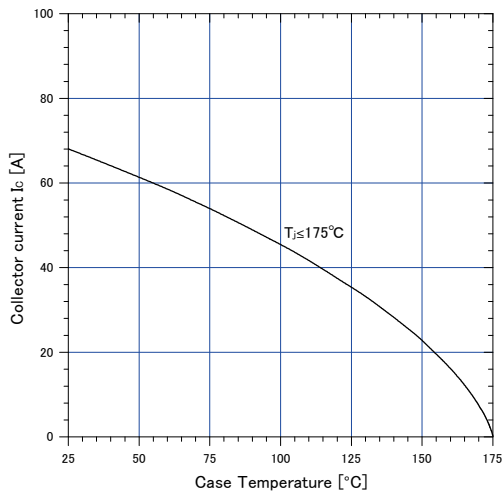
● Thermal resistance

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	$R_{th(j-c)}_{IGBT}$	-	-	0.417	
Thermal Resistance, FWD Junction to Case	$R_{th(j-c)}_{FWD}$	-	-	1.191	

■ Characteristics (Representative)

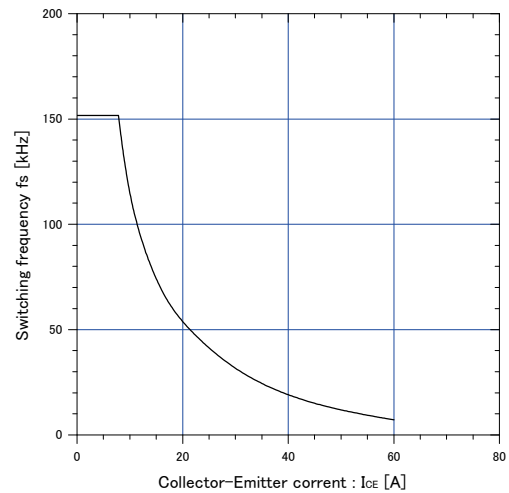
Graph.1

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



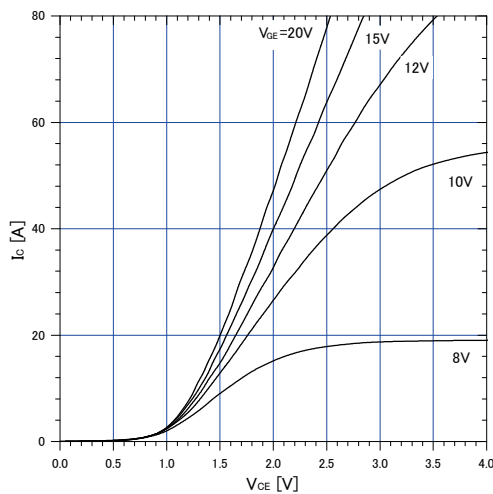
Graph.2

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



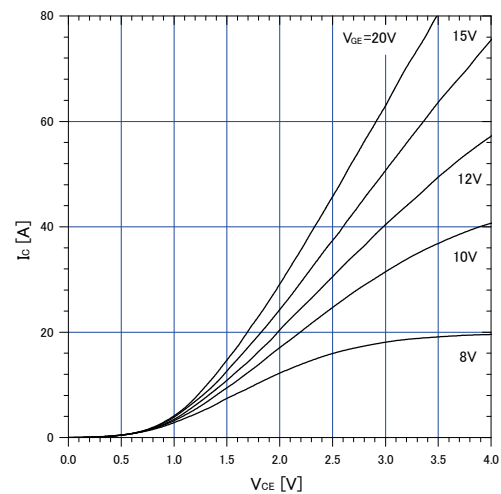
Graph.3

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



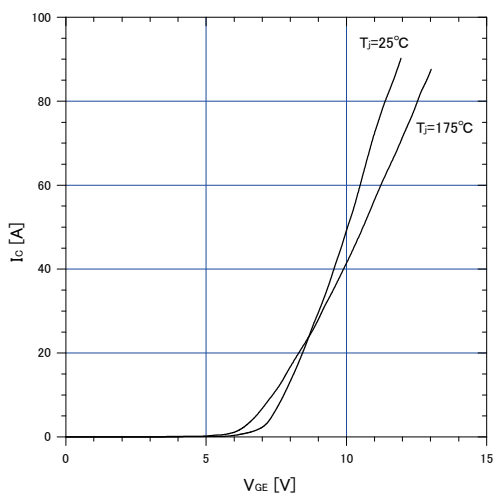
Graph.4

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



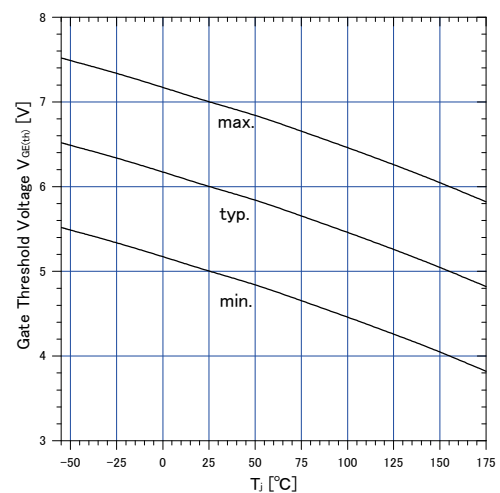
Graph.5

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

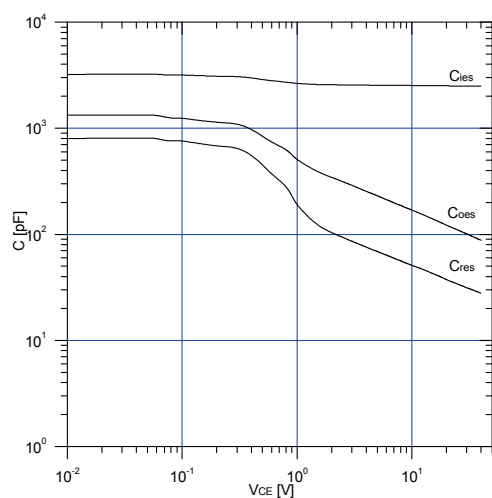


Graph.6

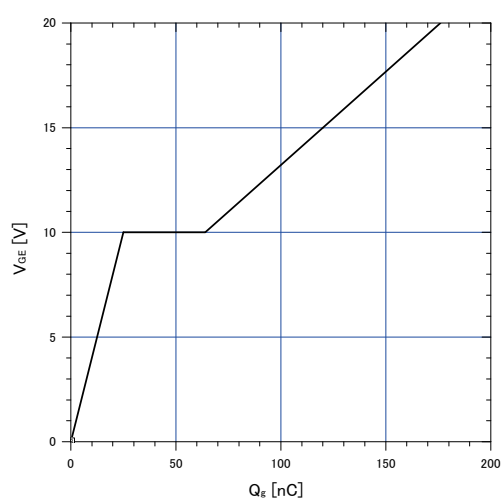
Gate Threshold Voltage vs. T_j
 $I_c = 40mA$, $V_{CE} = 20V$



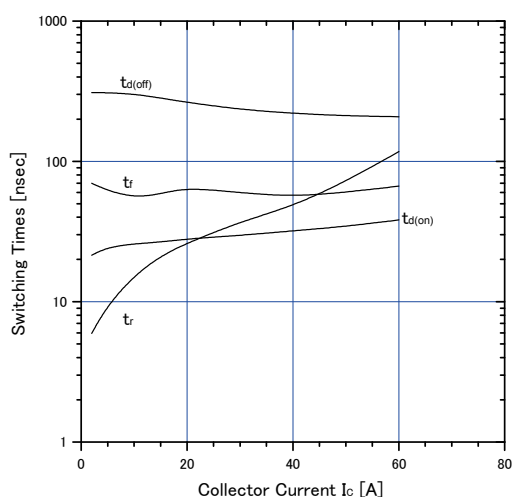
Graph.7
Typical Capacitance
 $V_{GE}=0V$, $f=1MHz$, $T_J=25^\circ C$



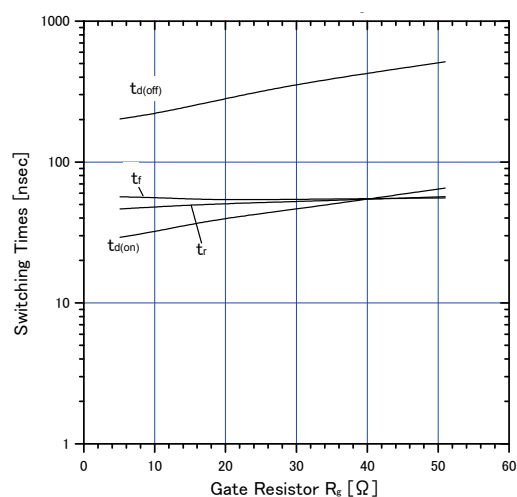
Graph.8
Typical Gate Charge
 $V_{CC}=600V$, $I_C=40A$, $T_J=25^\circ C$



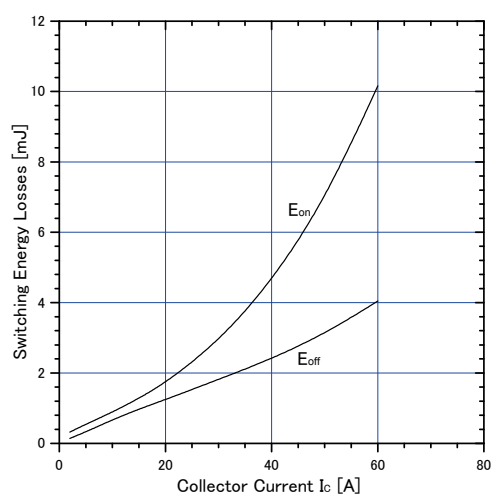
Graph.9
Typical switching time vs. I_C
 $T_J=175^\circ C$, $V_{CC}=600V$, $L=500\mu H$
 $V_{GE}=15V$, $R_G=10\Omega$



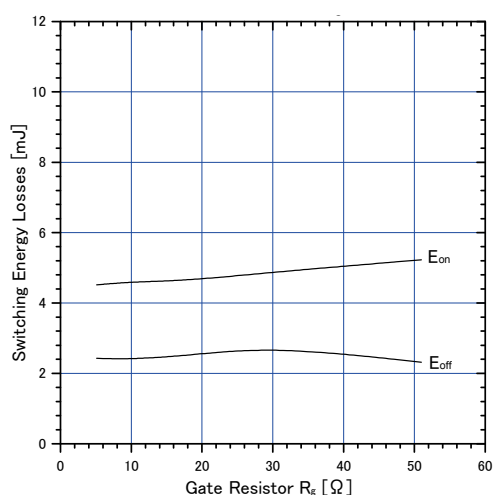
Graph.10
Typical switching time vs. R_G
 $T_J=175^\circ C$, $V_{CC}=600V$, $I_C=40A$, $L=500\mu H$
 $V_{GE}=15V$



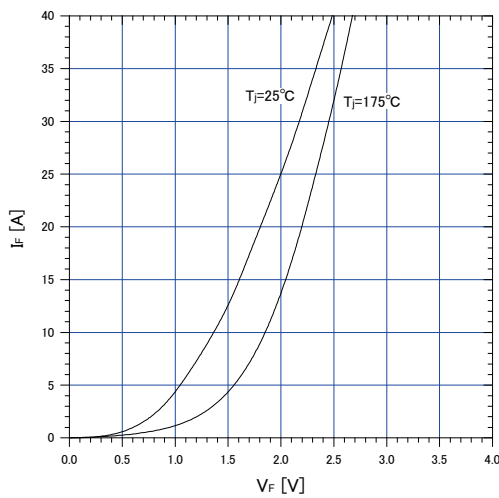
Graph.11
Typical switching losses vs. I_C
 $T_J=175^\circ C$, $V_{CC}=600V$, $L=500\mu H$
 $V_{GE}=15V$, $R_G=10\Omega$



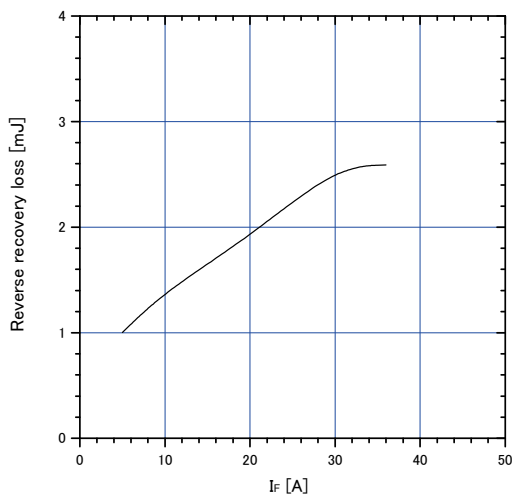
Graph.12
Typical switching losses vs. R_G
 $T_J=175^\circ C$, $V_{CC}=600V$, $I_C=40A$, $L=500\mu H$
 $V_{GE}=15V$



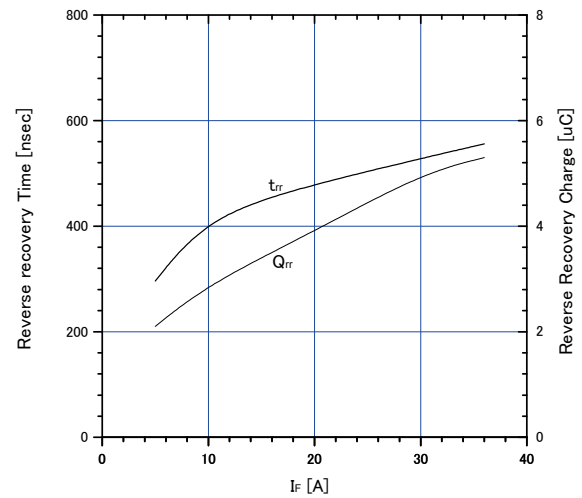
Graph.13
FWD Forward voltage drop (V_F - I_F)



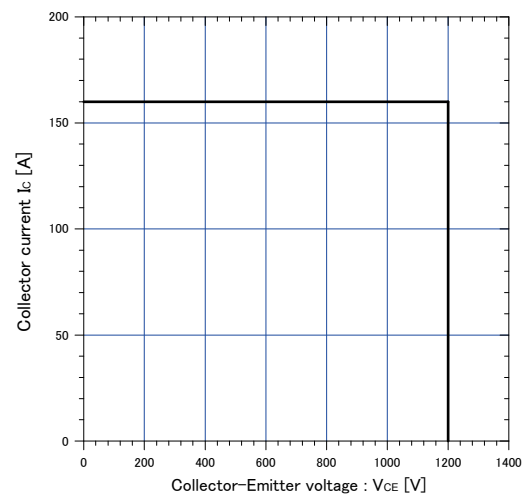
Graph.15
Typical reverse recovery loss vs. I_F
 $T_J = 175^\circ\text{C}$, $V_{CC} = 600\text{V}$, $L = 500\mu\text{H}$
 $V_{GE} = 15\text{V}$, $R_G = 10\Omega$



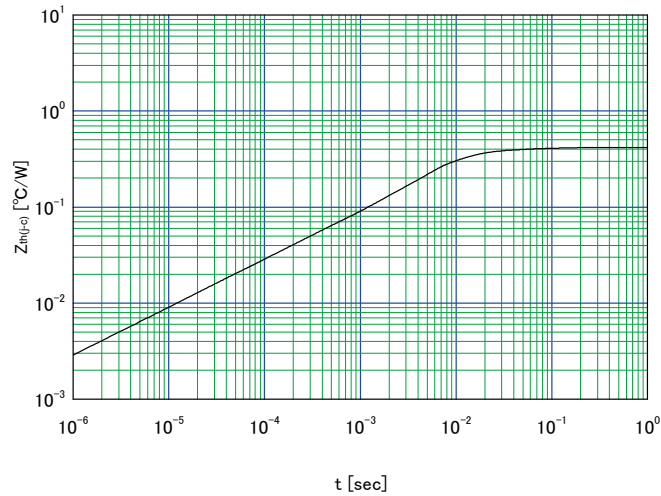
Graph.14
Typical reverse recovery characteristics vs. I_F
 $T_J = 175^\circ\text{C}$, $V_{CC} = 600\text{V}$, $L = 500\mu\text{H}$,
 $V_{GE} = 15\text{V}$, $R_G = 10\Omega$



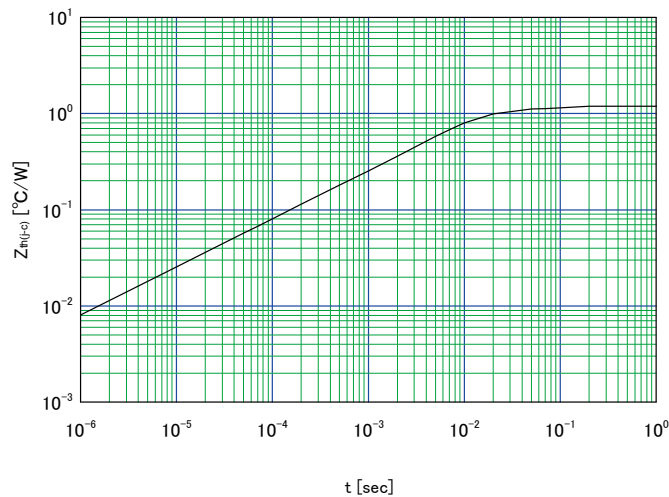
Graph.16
Reverse biased Safe Operating Area
 $T_J \leq 175^\circ\text{C}$, $V_{GE} = +15\text{V}/0\text{V}$, $R_G = 10\Omega$



Graph.17
Transient thermal resistance of IGBT

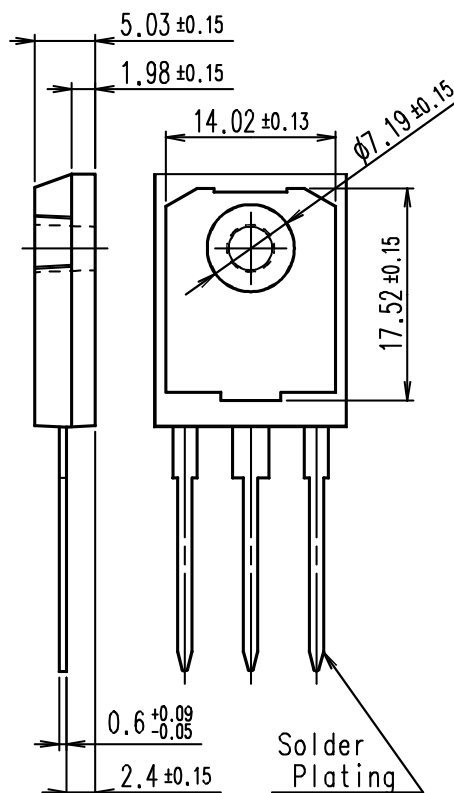
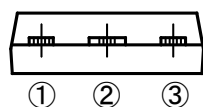
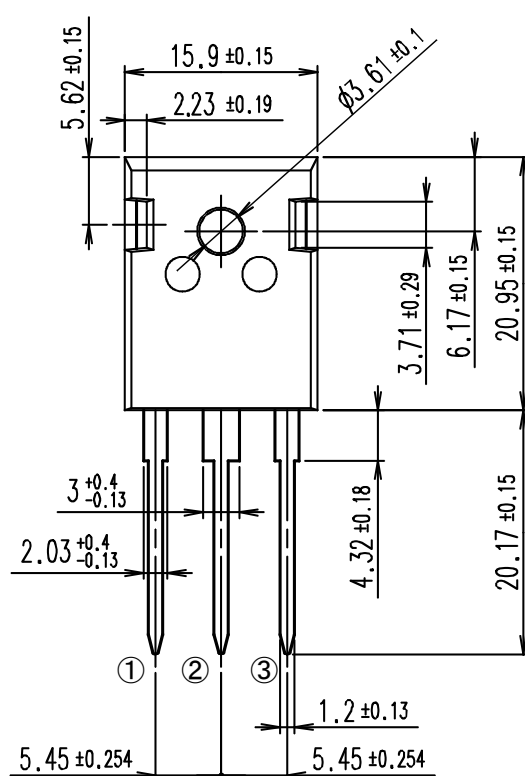


Graph.18
Transient thermal resistance of FWD



■ Outline Drawings, mm

Outview : TO-247 Package



CONNECTION

- ① GATE
- ② COLLECTOR
- ③ EMITTER

DIMENSIONS ARE IN MILLIMETERS.

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IGBT Modules

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