

FGW40N120VD

Discrete IGBT

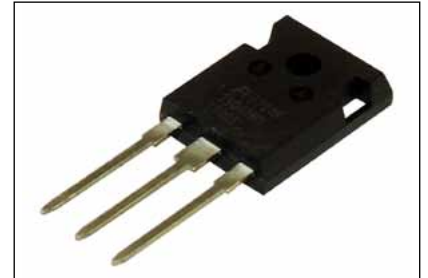
Discrete IGBT (High-Speed V series) 1200V / 40A

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

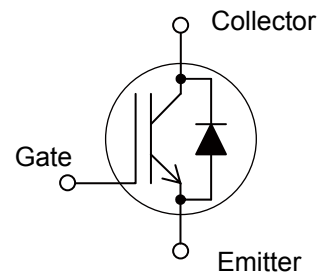
Items	Symbols	Characteristics	Units	Remarks
Collector-Emitter voltage	V_{CES}	1200	V	
Gate-Emitter voltage	V_{GES}	± 20	V	
DC Collector Current	$I_{C@25}$	63	A	$T_c=25^\circ\text{C}$, $T_j=150^\circ\text{C}$
	$I_{C@100}$	40	A	$T_c=100^\circ\text{C}$, $T_j=150^\circ\text{C}$
Pulsed Collector Current	I_{CP}	80	A	Note *1
Turn-Off Safe Operating Area	-	80	A	$V_{CE} \leq 1200\text{V}$, $T_j \leq 175^\circ\text{C}$
Diode Forward Current	$I_{F@25}$	58	A	
	$I_{F@100}$	30	A	
Diode Pulsed Current	I_{FP}	80	A	Note *1
Short Circuit Withstand Time	t_{SC}	10	μs	$V_{CC} \leq 640\text{V}$, $V_{GE} = 15\text{V}$ $T_j \leq 150^\circ\text{C}$
IGBT Max. Power Dissipation	P_{D_IGBT}	340	W	$T_c=25^\circ\text{C}$
FWD Max. Power Dissipation	P_{D_FWD}	220	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			Unit
			min.	typ.	max.	
Collector-Emitter Breakdown Voltage	$V_{(BR)CES}$	$I_C = 50\mu\text{A}$, $V_{GE} = 0\text{V}$	1200	-	-	V
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	$V_{GE(th)}$	$V_{CE} = +20\text{V}$, $I_C = 40\text{mA}$	6.0	6.5	7.0	V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = +15\text{V}$, $I_C = 40\text{A}$	-	1.85	2.4	V
		$T_j=175^\circ\text{C}$		2.4	-	
Input Capacitance	C_{ies}	$V_{CE}=25\text{V}$	-	2230	-	pF
Output Capacitance	C_{oes}	$V_{GE}=0\text{V}$	-	135	-	
Reverse Transfer Capacitance	C_{res}	$f=1\text{MHz}$	-	105	-	
Gate Charge	Q_G	$V_{CC} = 600\text{V}$ $I_C = 40\text{A}$ $V_{GE} = 15\text{V}$	-	320	-	nC
Turn-On Delay Time	$t_{d(on)}$	$T_j = 25^\circ\text{C}$	-	38	-	ns
Rise Time	t_r	$V_{CC} = 600\text{V}$	-	75	-	
Turn-Off Delay Time	$t_{d(off)}$	$I_C = 40\text{A}$	-	310	-	
Fall Time	t_f	$V_{GE} = 15\text{V}$	-	55	-	
Turn-On Energy	E_{on}	$R_G = 10\Omega$	-	4.3	-	mJ
Turn-Off Energy	E_{off}	$L = 500\mu\text{H}$ Energy loss include "tail" and FWD reverse recovery.	-	2.2	-	
Turn-On Delay Time	$t_{d(on)}$	$T_j = 175^\circ\text{C}$	-	38	-	ns
Rise Time	t_r	$V_{CC} = 600\text{V}$	-	68	-	
Turn-Off Delay Time	$t_{d(off)}$	$I_C = 40\text{A}$	-	360	-	
Fall Time	t_f	$V_{GE} = 15\text{V}$	-	85	-	
Turn-On Energy	E_{on}	$R_G = 10\Omega$	-	6.5	-	mJ
Turn-Off Energy	E_{off}	$L = 500\mu\text{H}$ Energy loss include "tail" and FWD reverse recovery.	-	3.8	-	
Forward Voltage Drop	V_F	$I_F=30\text{A}$	-	1.7	2.21	V
		$T_j=175^\circ\text{C}$	-	1.8	-	V
Diode Reverse Recovery Time	t_{rr1}	$V_{CC}=30\text{V}$ $I_F = 3.0\text{A}$ $-di/dt=200\text{A}/\mu\text{s}$	-	79	103	ns
Diode Reverse Recovery Time	t_{rr2}	$V_{CC}=600\text{V}$ $I_F=30\text{A}$ $-di/dt=200\text{A}/\mu\text{s}$	-	0.33	-	μs
Diode Reverse Recovery Charge	Q_{rr}	$T_j=25^\circ\text{C}$	-	1.45	-	μC

■ Equivalent circuit



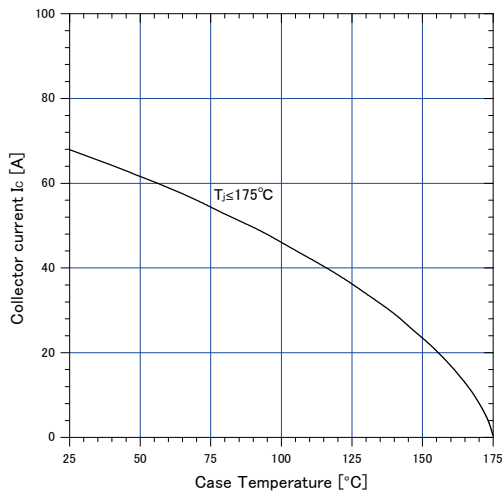
Items	Symbols	Conditions	Characteristics			Unit
			min.	typ.	max.	
Diode Reverse Recovery Time	t_{rr2}	$V_{CC}=600V$ $I_F=30A$	-	0.75	-	μs
Diode Reverse Recovery Charge	Q_{rr}	$-di_F/dt=200A/\mu s$ $T_J=175^{\circ}C$	-	4.30	-	μC

● Thermal resistance

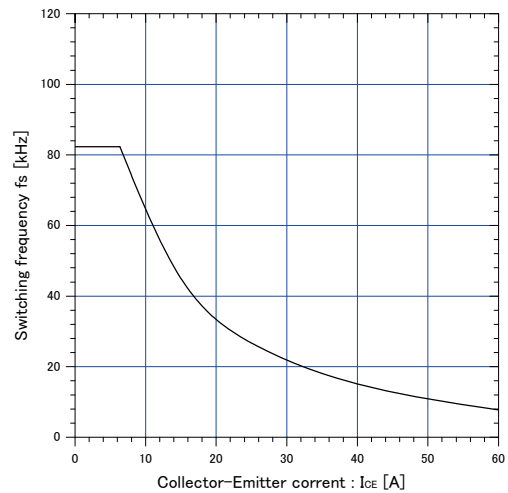
Items	Symbols	Characteristics			Unit
		min.	typ.	max.	
Thermal Resistance, Junction-Ambient	$R_{th(j-a)}$	-	-	50	$^{\circ}C/W$
Thermal Resistance, IGBT Junction to Case	$R_{th(j-c)}_{IGBT}$	-	-	0.439	
Thermal Resistance, FWD Junction to Case	$R_{th(j-c)}_{FWD}$	-	-	0.676	

■ Characteristics (Representative)

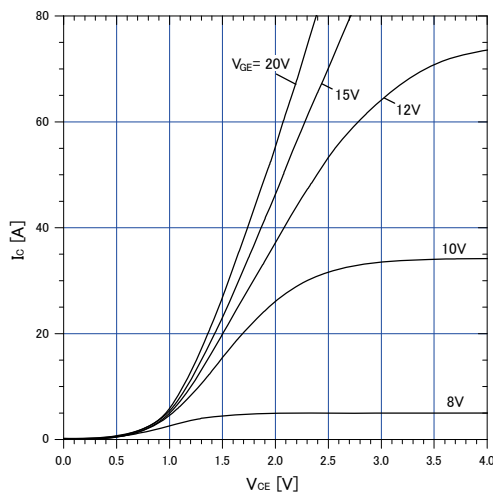
Graph.1
DC Collector Current vs T_c
 $V_{GE} \geq +15V$, $T_J \leq 175^\circ C$



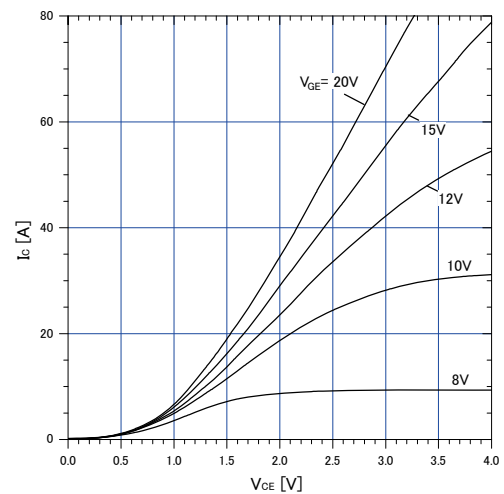
Graph.2
Collector Current vs. switching frequency
 $V_{GE} = +15V$, $T_c \leq 175^\circ C$, $V_{CE} = 600V$, $D = 0.5$,
 $R_g = 10\Omega$, $T_c = 100^\circ C$



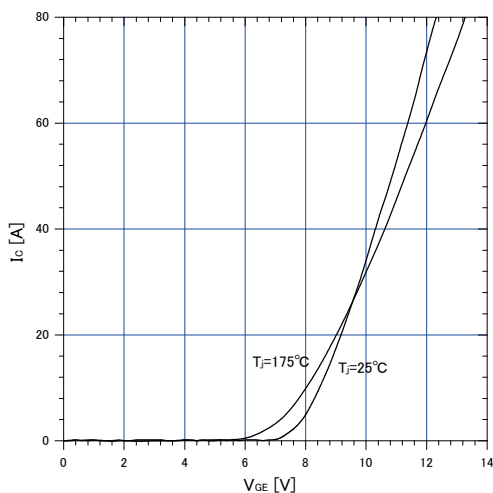
Graph.3
Typical Output Characteristics ($V_{CE} - I_C$)
 $T_J = 25^\circ C$



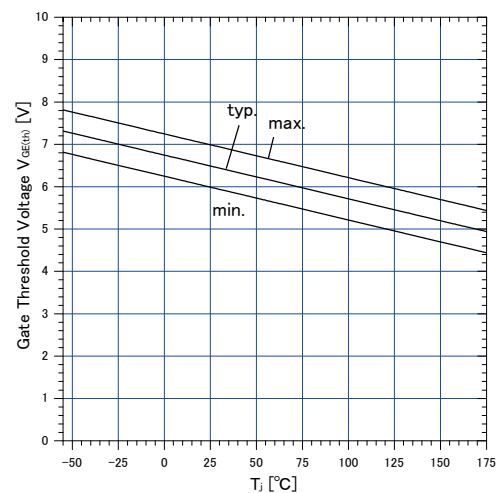
Graph.4
Typical Output Characteristics ($V_{CE} - I_C$)
 $T_J = 175^\circ C$



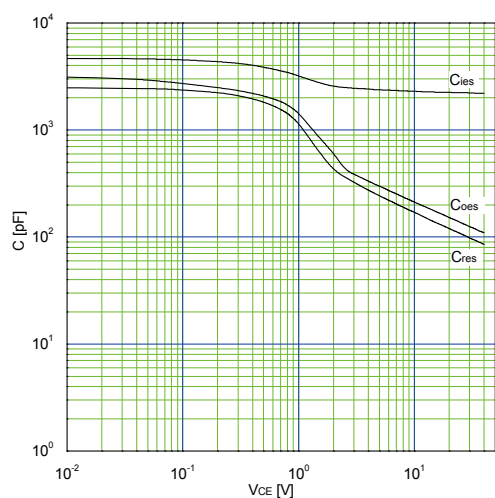
Graph.5
Typical Transfer Characteristics
 $V_{GE} = +15V$



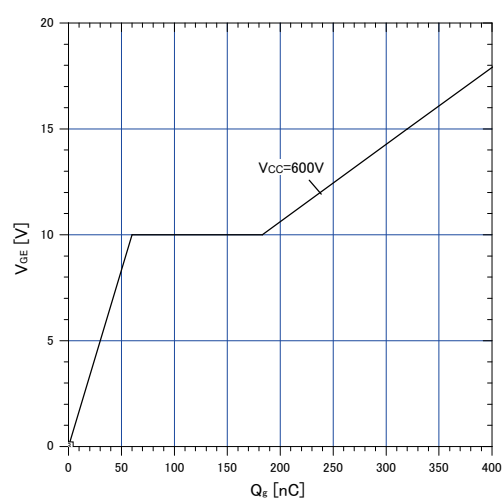
Graph.6
Gate Threshold Voltage vs. T_J
 $I_C = 40mA$, $V_{CE} = 20V$



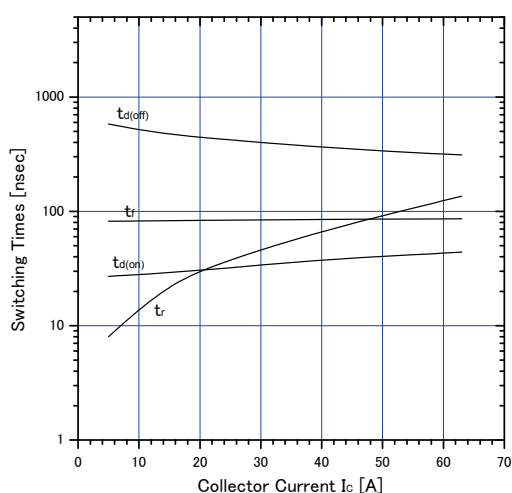
Graph.7
Typical Capacitance
 $V_{GE}=0V$, $f=1MHz$, $T_J=25^\circ C$



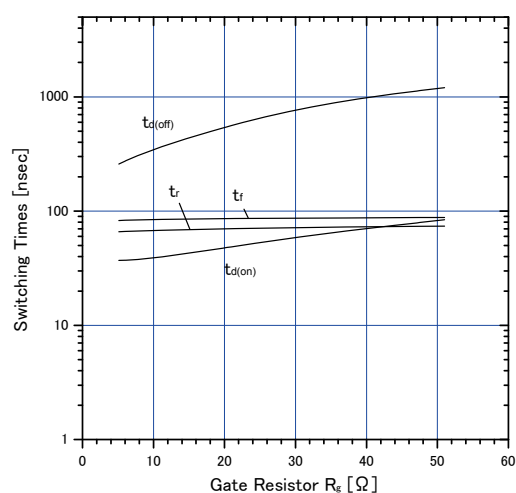
Graph.8
Typical Gate Charge
 $V_{CC}=600V$, $I_C=40A$, $T_J=25^\circ C$



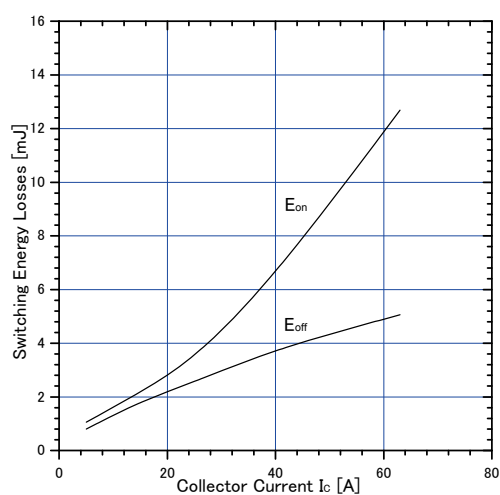
Graph.9
Typical switching time vs. I_C
 $T_J=175^\circ C$, $V_{CC}=600V$, $L=500\mu H$
 $V_{GE}=15V$, $R_G=10\Omega$



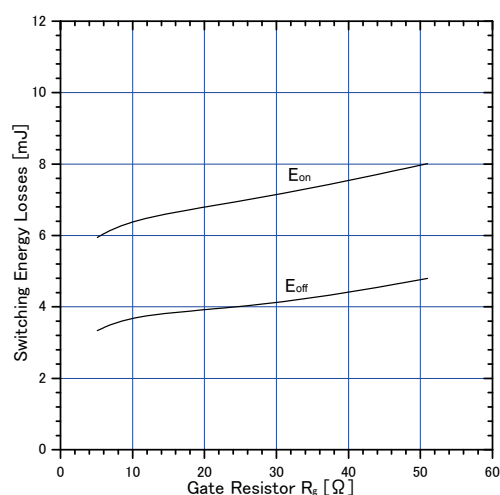
Graph.10
Typical switching time vs. R_G
 $T_J=175^\circ C$, $V_{CC}=600V$, $I_C=40A$, $L=500\mu H$
 $V_{GE}=15V$



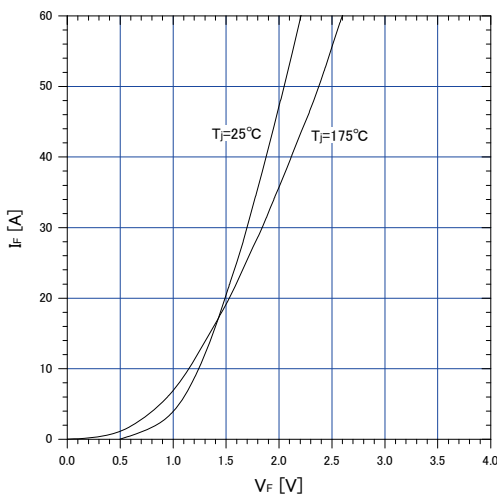
Graph.11
Typical switching losses vs. I_C
 $T_J=175^\circ C$, $V_{CC}=600V$, $L=500\mu H$
 $V_{GE}=15V$, $R_G=10\Omega$



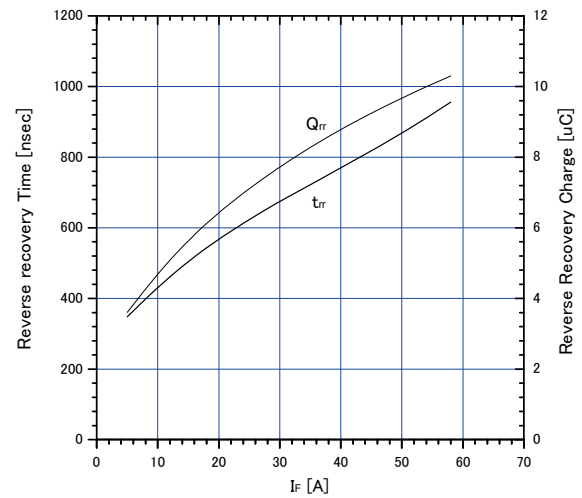
Graph.12
Typical switching losses vs. R_G
 $T_J=175^\circ C$, $V_{CC}=600V$, $I_C=40A$, $L=500\mu H$
 $V_{GE}=15V$



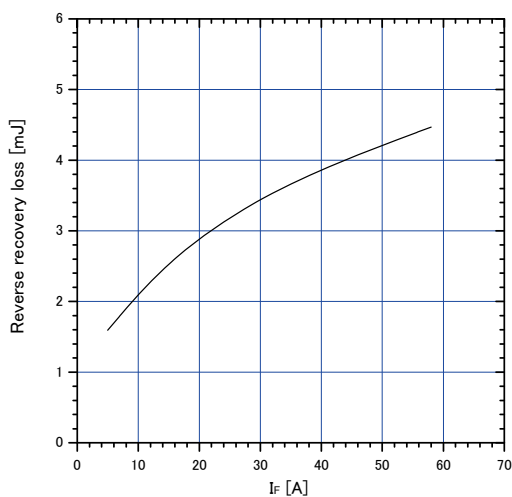
Graph.13
FWD Forward voltage drop (V_F - I_F)



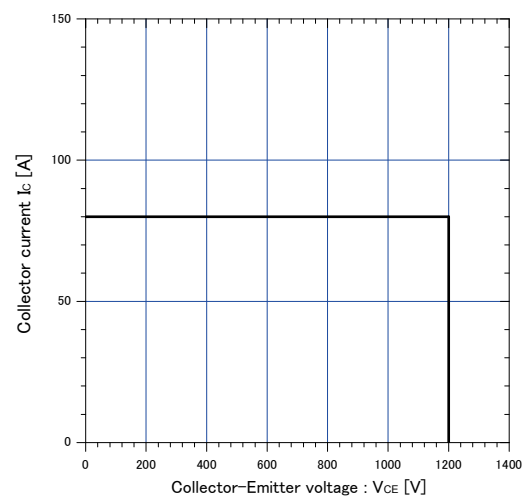
Graph.14
Typical reverse recovery characteristics vs. I_F
 $T_J = 175^\circ\text{C}$, $V_{CC} = 600\text{V}$, $L = 500\mu\text{H}$,
 $V_{GE} = 15\text{V}$, $R_G = 10\Omega$



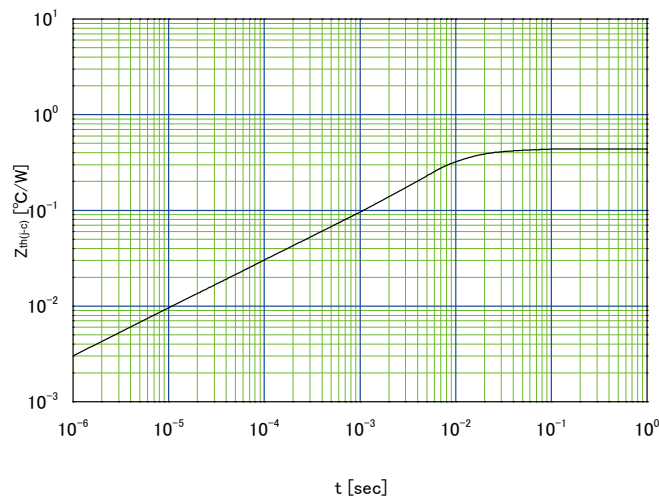
Graph.15
Typical reverse recovery loss vs. I_F
 $T_J = 175^\circ\text{C}$, $V_{CC} = 600\text{V}$, $L = 500\mu\text{H}$
 $V_{GE} = 15\text{V}$, $R_G = 10\Omega$



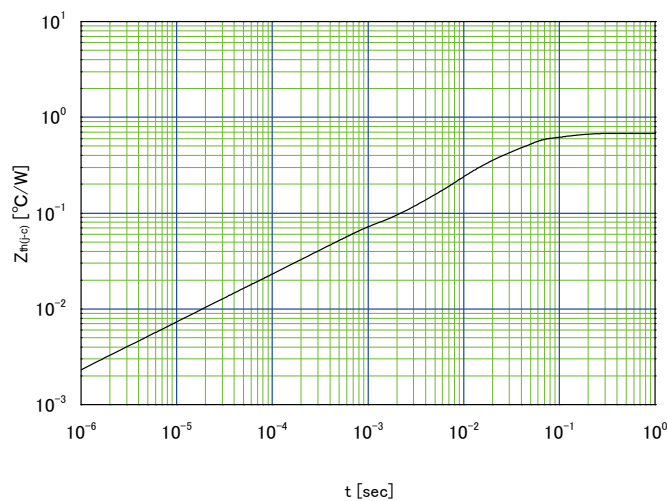
Graph.16
Reverse biased Safe Operating Area
 $T_J \leq 175^\circ\text{C}$, $V_{GE} = +15\text{V}/0\text{V}$, $R_G = 10\Omega$



Graph.17
Transient thermal resistance of IGBT

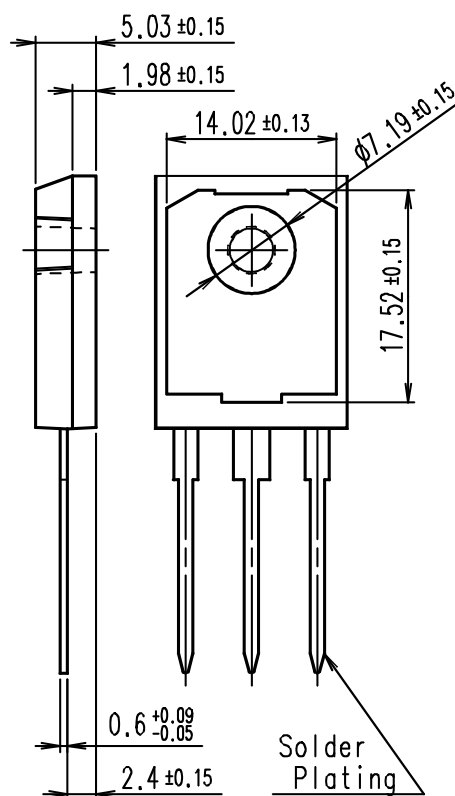
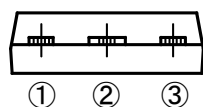
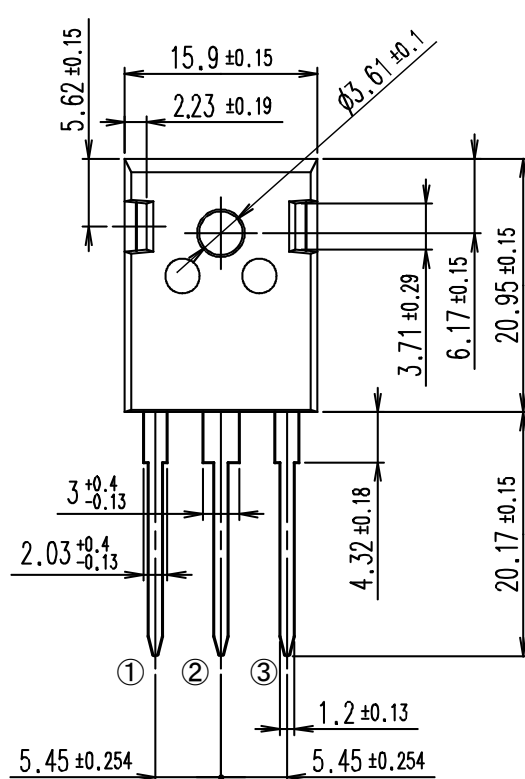


Graph.18
Transient thermal resistance of FWD



■ Outline Drawings, mm

Outview : TO-247 Package



CONNECTION

① GATE

② COLLECTOR

③ EMITTER

DIMENSIONS ARE IN MILLIMETERS.

WARNING

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• Machine tools	• Audiovisual equipment	• Electrical home appliances	• Personal equipment
			• Industrial robots etc.
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• Traffic-signal control equipment	• Gas leakage detectors with an auto-shut-off feature
• Emergency equipment for responding to disasters and anti-burglary devices	• Safety devices
• Medical equipment	
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• Submarine repeater equipment		
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