

FGW40XS65C

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Discrete IGBT

Discrete IGBT (XS-series)

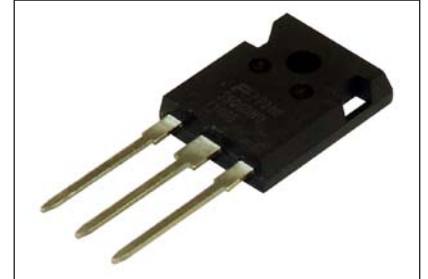
650V / 40A

Features

- Low power loss
- Low switching surge and noise
- High reliability, high ruggedness

Applications

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



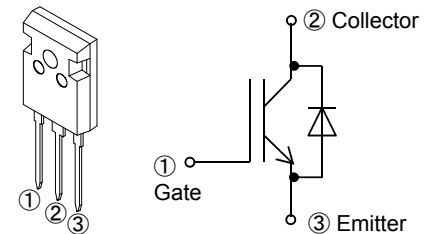
Maximum Ratings and Characteristics

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

Parameter	Symbol	Value	Unit	Remarks
Collector-Emitter Voltage	V_{CES}	650	V	
Gate-Emitter Voltage	V_{GES}	± 20	V	
Transient Gate-Emitter Voltage		± 30	V	$t_p < 1 \mu\text{s}$
DC Collector Current	$I_{C@25}$	61	A	$T_c = 25^\circ\text{C}$
	$I_{C@100}$	40	A	$T_c = 100^\circ\text{C}$
Pulsed Collector Current	I_{CP}	160	A	Note *1
Turn-Off Safe Operating Area	-	160	A	$V_{CE} \leq 650 \text{ V}$ $T_{vj} \leq 175^\circ\text{C}$
Diode Forward Current	$I_F@25$	64	A	
	$I_F@100$	40	A	
Diode Pulsed Current	I_{FP}	160	A	Note *1
IGBT Max. Power Dissipation	P_{tot_IGBT}	234	W	$T_c = 25^\circ\text{C}$
FWD Max. Power Dissipation	P_{tot_FWD}	174	W	$T_c = 25^\circ\text{C}$
Operating Junction Temperature	T_{vj}	$-40 \sim +175$	$^\circ\text{C}$	
Storage Temperature	T_{stg}	$-55 \sim +175$	$^\circ\text{C}$	

Note *1 : Pulse width limited by $T_{vj \text{ max.}}$

Equivalent circuit



TO-247-P/TO-247-P2

Electrical Characteristics at $T_{vj} = 25^\circ\text{C}$ (unless otherwise specified)

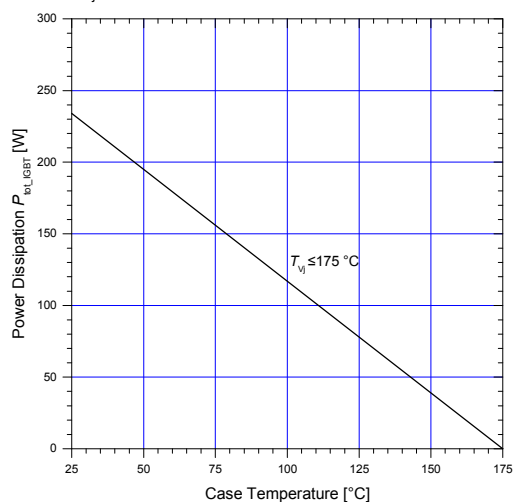
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Zero Gate Voltage Collector Current	I_{CES}	$V_{CE} = 650 \text{ V}$ $V_{GE} = 0 \text{ V}$	-	-	250	μA
Gate-Emitter Leakage Current	I_{GES}	$V_{CE} = 0 \text{ V}$ $V_{GE} = \pm 20 \text{ V}$	-	-	200	nA
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	$V_{CE} = 20 \text{ V}$ $I_C = 40 \text{ mA}$	3.4	4.0	4.6	V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 15 \text{ V}$ $I_C = 40 \text{ A}$	-	1.35	1.70	V
Input Capacitance	C_{ies}	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	-	3400	-	pF
Output Capacitance	C_{oes}	$V_{CE} = 0 \text{ V}$ $f = 1 \text{ MHz}$	-	78	-	pF
Reverse Transfer Capacitance	C_{res}	$f = 1 \text{ MHz}$	-	34	-	pF
Gate Charge	Q_G	$V_{CC} = 520 \text{ V}$ $I_C = 40 \text{ A}$ $V_{GE} = 15 \text{ V}$	-	160	-	nC
Turn-On Delay Time	$t_{d(on)}$	$T_{vj} = 25^\circ\text{C}$	-	28	-	ns
Rise Time	t_r	$V_{CC} = 400 \text{ V}$ $I_C = 20 \text{ A}$	-	16	-	ns
Turn-Off Delay Time	$t_{d(off)}$	$V_{GE} = 15 \text{ V}$ $R_G = 10 \Omega$	-	200	-	ns
Fall Time	t_f	$V_{GE} = 15 \text{ V}$ $R_G = 10 \Omega$	-	15	-	ns
Turn-On Energy	E_{on}	Energy loss include "tail" and FWD reverse recovery.	-	0.40	-	mJ
Turn-Off Energy	E_{off}	Energy loss include "tail" and FWD reverse recovery.	-	0.30	-	mJ
Turn-On Delay Time	$t_{d(on)}$	$T_{vj} = 150^\circ\text{C}$	-	28	-	ns
Rise Time	t_r	$V_{CC} = 400 \text{ V}$ $I_C = 20 \text{ A}$	-	22	-	ns
Turn-Off Delay Time	$t_{d(off)}$	$V_{GE} = 15 \text{ V}$ $R_G = 10 \Omega$	-	240	-	ns
Fall Time	t_f	$V_{GE} = 15 \text{ V}$ $R_G = 10 \Omega$	-	22	-	ns
Turn-On Energy	E_{on}	Energy loss include "tail" and FWD reverse recovery.	-	0.58	-	mJ
Turn-Off Energy	E_{off}	Energy loss include "tail" and FWD reverse recovery.	-	0.48	-	mJ
Forward Voltage Drop	V_F	$I_F = 40 \text{ A}$	-	1.70	2.15	V
Diode Reverse Recovery Time	t_{rr}	$V_{CC} = 400 \text{ V}$ $I_F = 20 \text{ A}$ $-di_F/dt = 1200 \text{ A}/\mu\text{s}$ $T_{vj} = 25^\circ\text{C}$	-	1.78	-	V
Diode Reverse Recovery Charge	Q_{rr}	$V_{CC} = 400 \text{ V}$ $I_F = 20 \text{ A}$ $-di_F/dt = 1000 \text{ A}/\mu\text{s}$ $T_{vj} = 150^\circ\text{C}$	-	84	-	ns
Diode Reverse Recovery Time	t_{rr}	$V_{CC} = 400 \text{ V}$ $I_F = 20 \text{ A}$ $-di_F/dt = 1000 \text{ A}/\mu\text{s}$ $T_{vj} = 150^\circ\text{C}$	-	0.90	-	μC
Diode Reverse Recovery Charge	Q_{rr}	$V_{CC} = 400 \text{ V}$ $I_F = 20 \text{ A}$ $-di_F/dt = 1000 \text{ A}/\mu\text{s}$ $T_{vj} = 150^\circ\text{C}$	-	126	-	ns
Diode Reverse Recovery Charge	Q_{rr}	$V_{CC} = 400 \text{ V}$ $I_F = 20 \text{ A}$ $-di_F/dt = 1000 \text{ A}/\mu\text{s}$ $T_{vj} = 150^\circ\text{C}$	-	1.4	-	μC

● Thermal Resistance

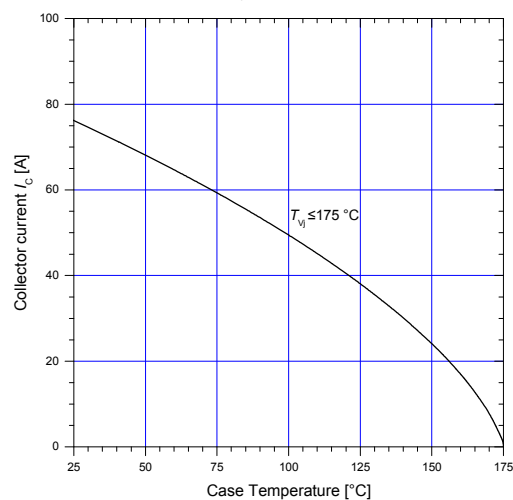
Parameter	Symbol	Min.	Typ.	Max.	Unit
Thermal Resistance, Junction-Ambient	$R_{th(j-a)}$	-	-	50	°C/W
Thermal Resistance, IGBT Junction to Case	$R_{th(j-c)}_{IGBT}$	-	-	0.642	°C/W
Thermal Resistance, FWD Junction to Case	$R_{th(j-c)}_{FWD}$	-	-	0.86	°C/W

■ Characteristics (Representative)

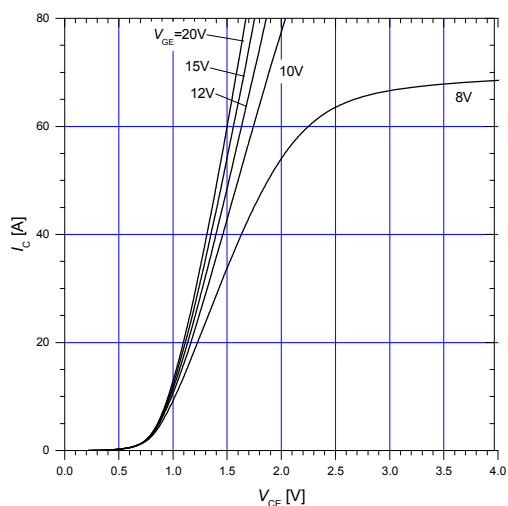
Graph 1
IGBT Power Dissipation vs T_c
 $T_{vj} \leq 175^\circ\text{C}$



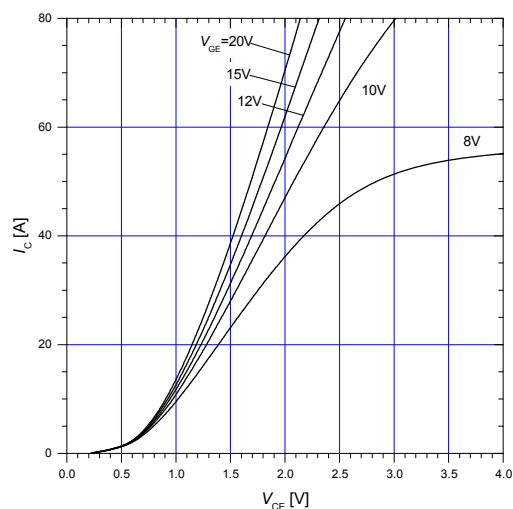
Graph 2
DC Collector Current vs T_c
 $V_{GE} \geq +15\text{ V}$, $T_{vj} \leq 175^\circ\text{C}$



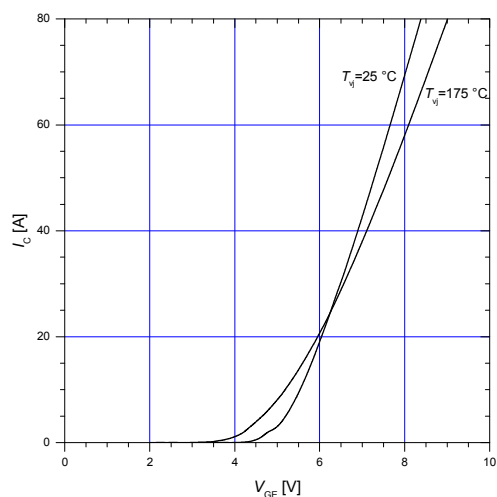
Graph 3
Typical output characteristics
 $T_{vj} = 25^\circ\text{C}$



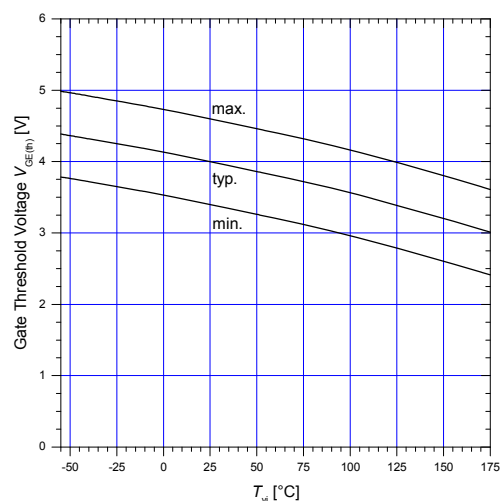
Graph 4
Typical output characteristics
 $T_{vj} = 175^\circ\text{C}$



Graph 5
Typical transfer characteristics
 $V_{CE} = 20\text{ V}$

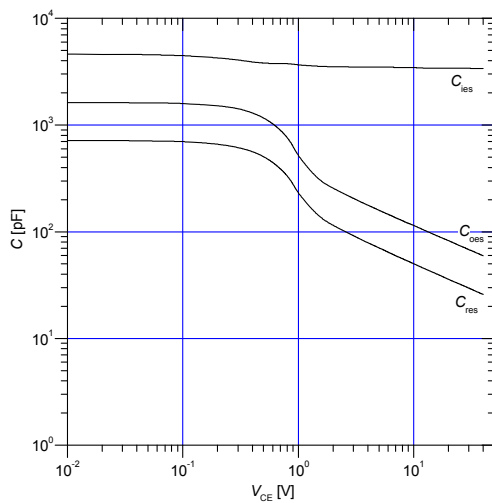


Graph 6
Gate threshold voltage
 $I_c = 40\text{ mA}$, $V_{CE} = 20\text{ V}$



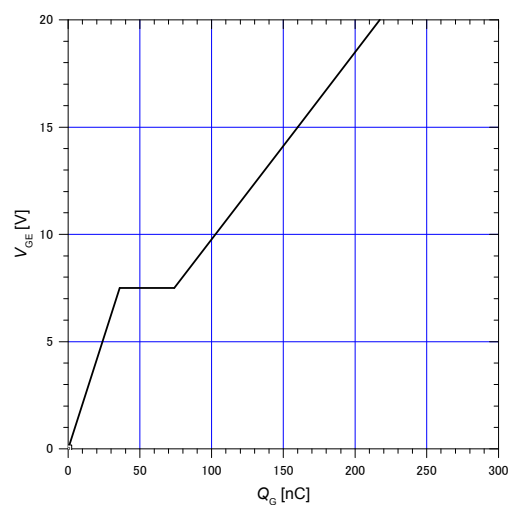
Graph 7
Typical capacitance

$V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$



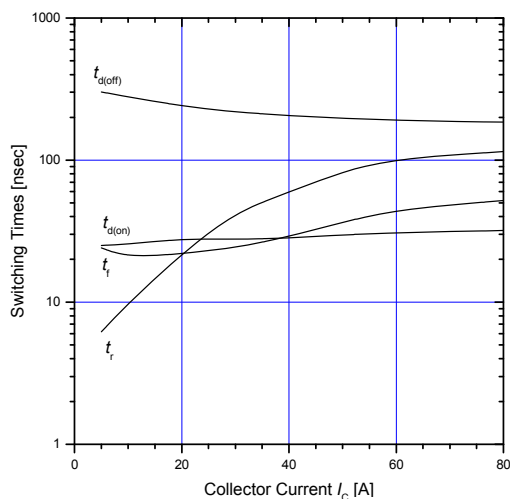
Graph 8
Typical gate charge

$I_C = 40\text{ A}$, $V_{CC} = 520\text{ V}$, $T_{vj} = 25\text{ }^\circ\text{C}$



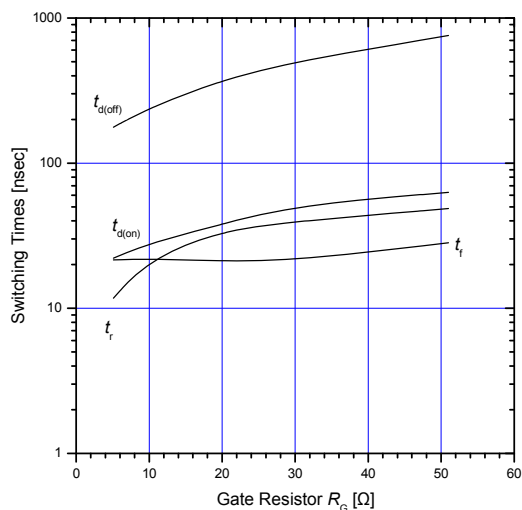
Graph 9
Typical switching times vs. I_C

$V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $R_G = 10\text{ }\Omega$, $T_{vj} = 150\text{ }^\circ\text{C}$



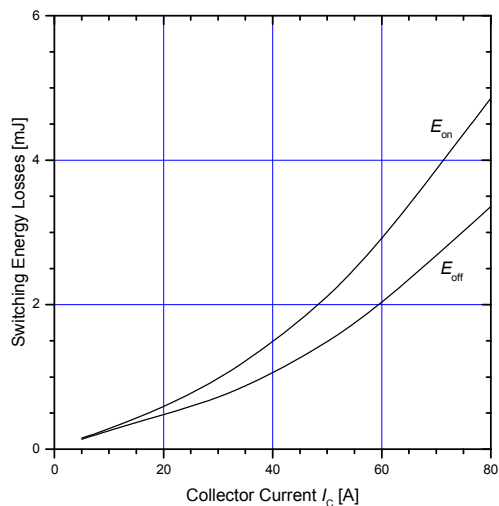
Graph 10
Typical switching times vs. R_G

$V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 20\text{ A}$, $T_{vj} = 150\text{ }^\circ\text{C}$



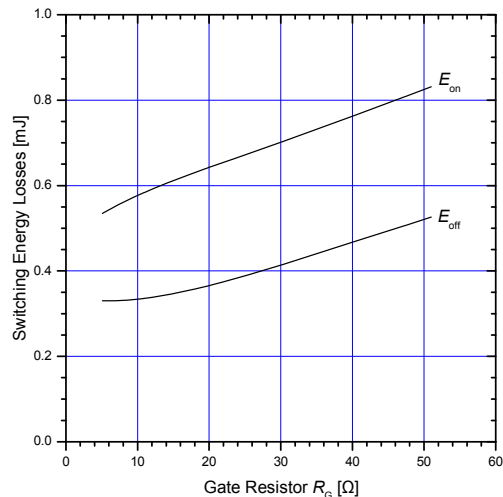
Graph 11
Typical switching losses vs. I_C

$V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $R_G = 10\text{ }\Omega$, $T_{vj} = 150\text{ }^\circ\text{C}$

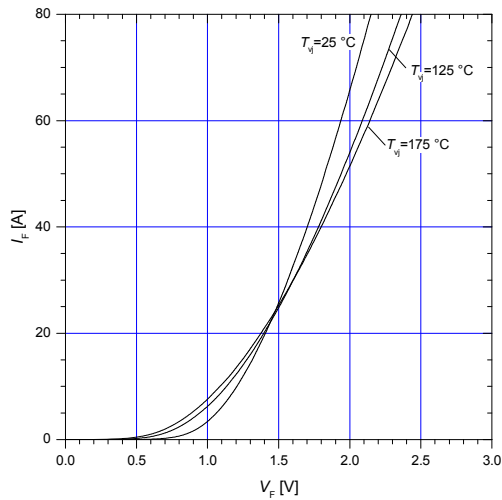


Graph 12
Typical switching losses vs. R_G

$V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 20\text{ A}$, $T_{vj} = 150\text{ }^\circ\text{C}$

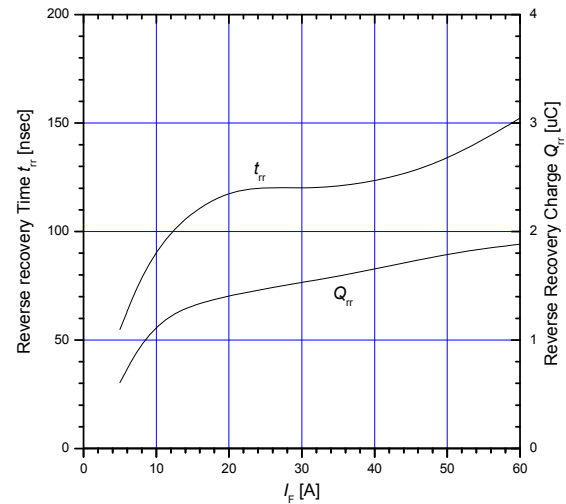


Graph 13
Typical forward characteristics of FWD



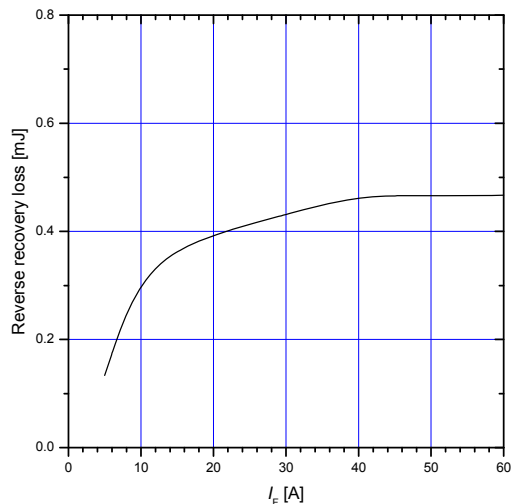
Graph 14
Typical reverse recovery characteristics vs. I_F

$V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $R_G = 10\text{ }\Omega$, $T_{vj} = 150\text{ °C}$



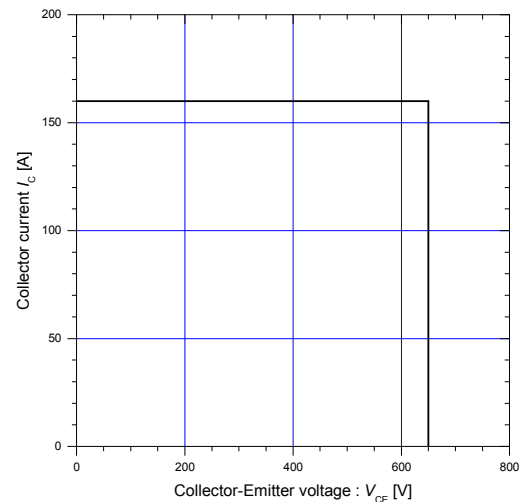
Graph 15
Typical reverse recovery loss vs. I_F

$V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $R_G = 10\text{ }\Omega$, $T_{vj} = 150\text{ °C}$

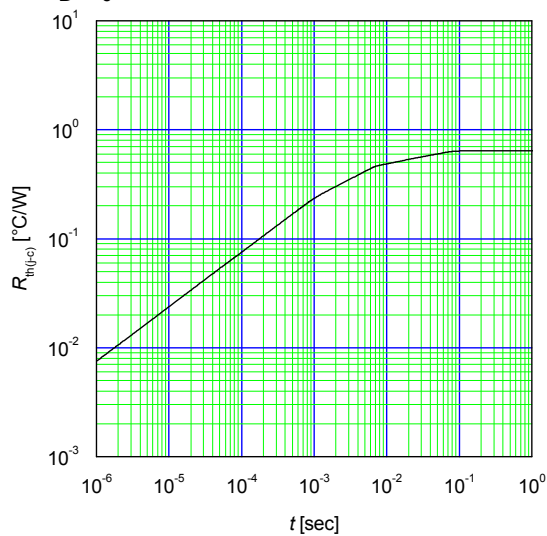


Graph 16
Reverse biased safe operating area

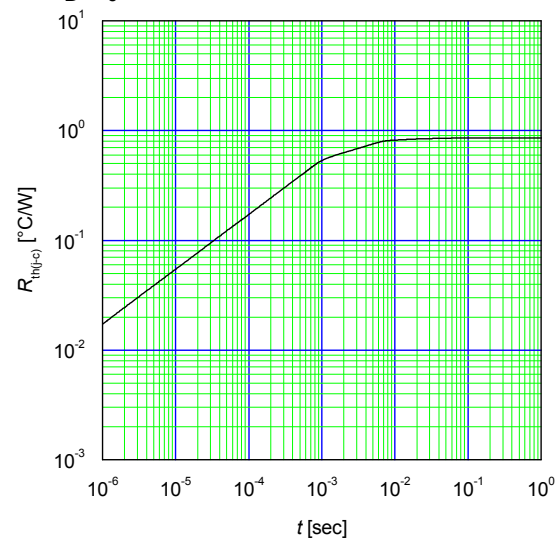
$V_{GE} = 15\text{ V} / 0\text{ V}$, $R_G = 10\text{ }\Omega$, $T_{vj} \leq 175\text{ °C}$



Graph 17
Transient Thermal Impedance of IGBT
 $D = 0$

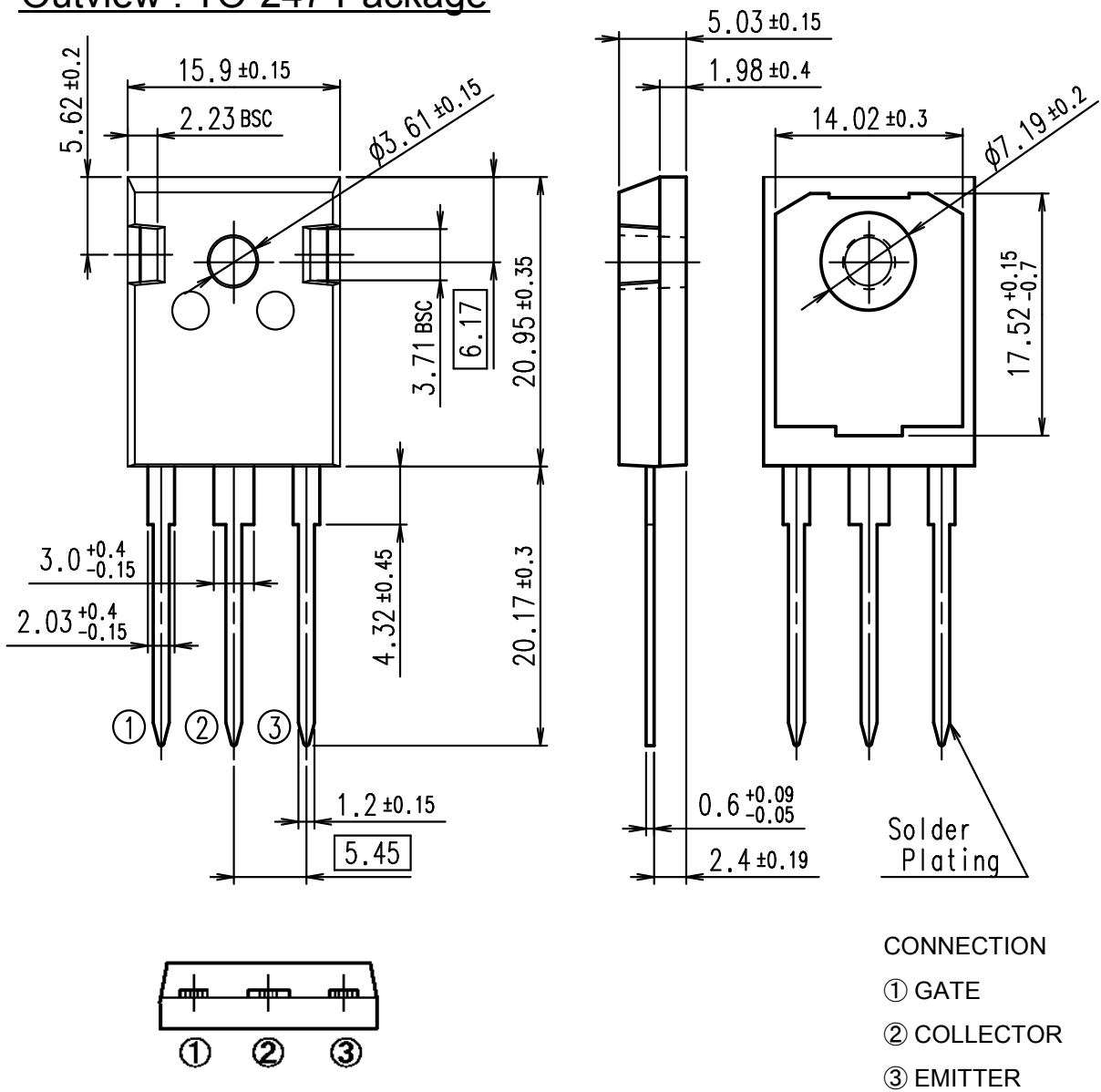


Graph 18
Transient Thermal Impedance of FWD
 $D = 0$



Outline Drawings, mm

Outview : TO-247 Package



DIMENSIONS ARE IN MILLIMETERS.

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IGBT Modules

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