

# FGW50N65WE

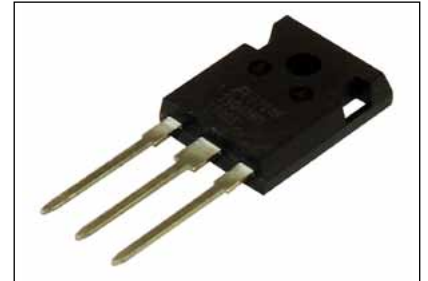
## Discrete IGBT (High-Speed W series) 650V / 50A

### Features

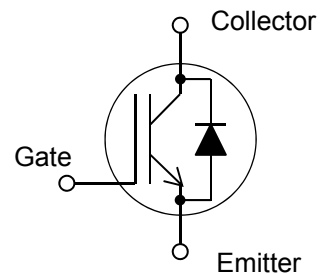
- Low power loss
- Low switching surge and noise
- High reliability, high ruggedness (RBSOA, SCSOA etc.)

### Applications

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



### Equivalent circuit



### Maximum Ratings and Characteristics

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

Items	Symbols	Characteristics	Unit	Remarks
Collector-Emitter Voltage	$V_{CES}$	650	V	
Gate-Emitter Voltage	$V_{GES}$	$\pm 20$	V	
Transient Gate-Emitter Voltage		$\pm 30$		
DC Collector Current	$I_C@25$	70	A	$T_c=25^\circ\text{C}$
	$I_C@100$	50	A	$T_c=100^\circ\text{C}$
Pulsed Collector Current	$I_{CP}$	200	A	Note *1
Turn-Off Safe Operating Area	-	200	A	$V_{CE} \leq 650\text{V}$ $T_j \leq 175^\circ\text{C}$
Diode Forward Current	$I_F@25$	73	A	
	$I_F@100$	50	A	
Diode Pulsed Current	$I_{FP}$	200	A	Note *1
IGBT Max. Power Dissipation	$P_{D\_IGBT}$	330	W	$T_c=25^\circ\text{C}$
FWD Max. Power Dissipation	$P_{D\_FWD}$	170	W	$T_c=25^\circ\text{C}$
Operating Junction Temperature	$T_j$	-40 ~ +175	$^\circ\text{C}$	
Storage Temperature	$T_{stg}$	-55 ~ +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

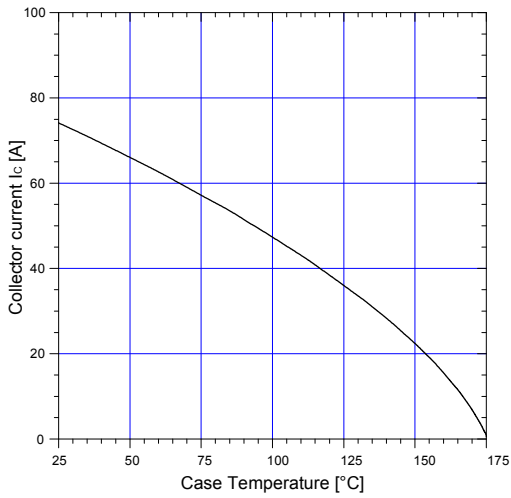
Description	Symbol	Conditions	min.	typ.	max.	Unit
Zero Gate Voltage Collector Current	$I_{CES}$	$V_{CE} = 650\text{V}, V_{GE} = 0\text{V}$	-	-	250	$\mu\text{A}$
Gate-Emitter Leakage Current	$I_{GES}$	$V_{CE} = 0\text{V}, V_{GE} = \pm 20\text{V}$	-	-	200	nA
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	$V_{CE} = 20\text{V}, I_C = 50\text{mA}$	3.0	4.0	5.0	V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 15\text{V}, I_C = 50\text{A}$	-	1.80	2.20	V
Input Capacitance	$C_{ies}$	$V_{CE}=25\text{V}$	-	3650	-	pF
Output Capacitance	$C_{oes}$	$V_{GE}=0\text{V}$	-	105	-	
Reverse Transfer Capacitance	$C_{res}$	$f=1\text{MHz}$	-	80	-	
Gate Charge	$Q_G$	$V_{CC} = 520\text{V}$ $I_C = 50\text{A}$ $V_{GE} = 15\text{V}$	-	215	-	nC
Turn-On Delay Time	$t_{d(on)}$	$T_j = 25^\circ\text{C}, V_{CC} = 400\text{V}$ $I_C = 25\text{A}, V_{GE} = 15\text{V}$ $R_G = 10\Omega, L = 500\mu\text{H}$ Energy loss include "tail" and FWD reverse recovery.	-	27	-	ns
Rise Time	$t_r$		-	36	-	
Turn-Off Delay Time	$t_{d(off)}$		-	240	-	
Fall Time	$t_f$		-	60	-	
Turn-On Energy	$E_{on}$	$T_j = 150^\circ\text{C}, V_{CC} = 400\text{V}$ $I_C = 25\text{A}, V_{GE} = 15\text{V}$ $R_G = 10\Omega, L = 500\mu\text{H}$ Energy loss include "tail" and FWD reverse recovery.	-	0.42	-	mJ
Turn-Off Energy	$E_{off}$		-	0.46	-	
Turn-On Delay Time	$t_{d(on)}$		-	27	-	
Rise Time	$t_r$		-	36	-	
Turn-Off Delay Time	$t_{d(off)}$	$T_j = 150^\circ\text{C}, V_{CC} = 400\text{V}$ $I_C = 25\text{A}, V_{GE} = 15\text{V}$ $R_G = 10\Omega, L = 500\mu\text{H}$ Energy loss include "tail" and FWD reverse recovery.	-	265	-	ns
Fall Time	$t_f$		-	54	-	
Turn-On Energy	$E_{on}$		-	0.78	-	
Turn-Off Energy	$E_{off}$		-	0.54	-	
Forward Voltage Drop	$V_F$	$I_F=50\text{A}$	-	2.5	3.2	V
			-	1.9	-	V
			-	1.7	-	V
Diode Reverse Recovery Time	$t_{rr}$	$V_{CC}=400\text{V}, I_F=25\text{A}$	-	115	-	ns
Diode Reverse Recovery Charge	$Q_{rr}$	$-di_F/dt=500\text{A}/\mu\text{s}, T_j=25^\circ\text{C}$	-	0.35	-	$\mu\text{C}$
Diode Reverse Recovery Time	$t_{rr}$	$V_{CC}=400\text{V}, I_F=25\text{A}$	-	140	-	ns
Diode Reverse Recovery Charge	$Q_{rr}$	$-di_F/dt=500\text{A}/\mu\text{s}, T_j=150^\circ\text{C}$	-	1.10	-	$\mu\text{C}$

## ● Thermal Resistance

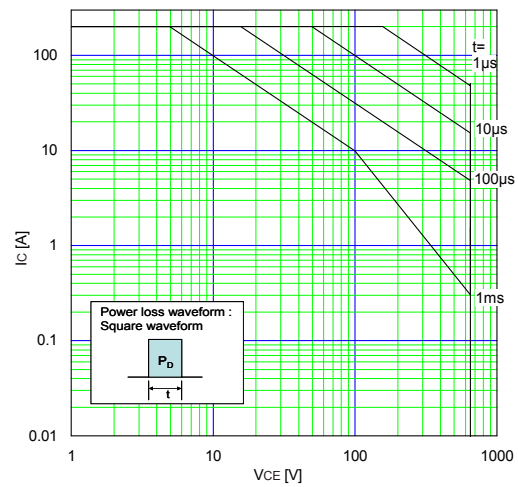
Description	Symbol	min.	typ.	max.	Unit
Thermal Resistance, Junction-Ambient	$R_{th(j-a)}$	-	-	50	°C/W
Thermal Resistance, IGBT Junction to Case	$R_{th(j-c)}_{IGBT}$	-	-	0.448	°C/W
Thermal Resistance, FWD Junction to Case	$R_{th(j-c)}_{FWD}$	-	-	0.862	°C/W

**Characteristics (Representative)**

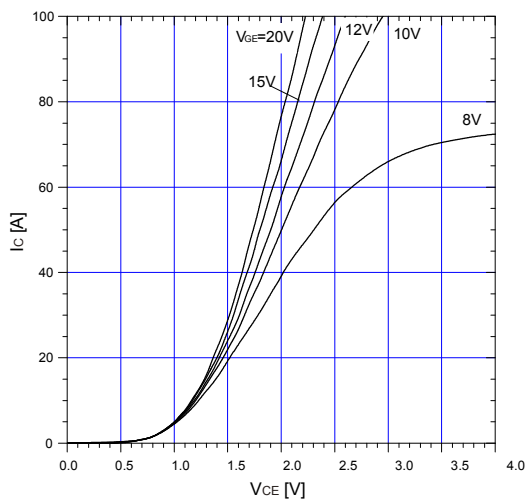
Graph.1  
DC Collector Current vs Tc  
 $V_{GE} \geq +15V, T_j \leq 175^\circ C$



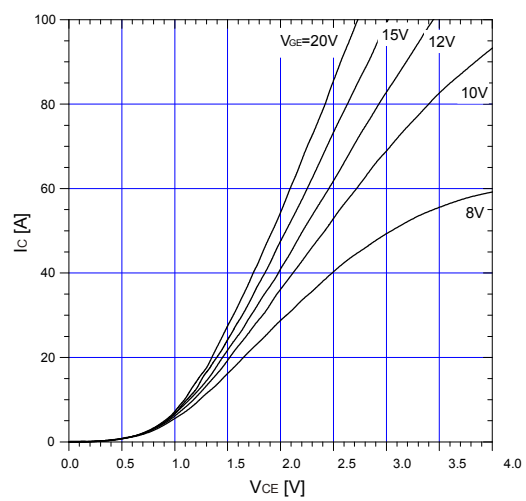
Graph.2  
SOA  
Duty=0(Single pulse), Tc=25°C



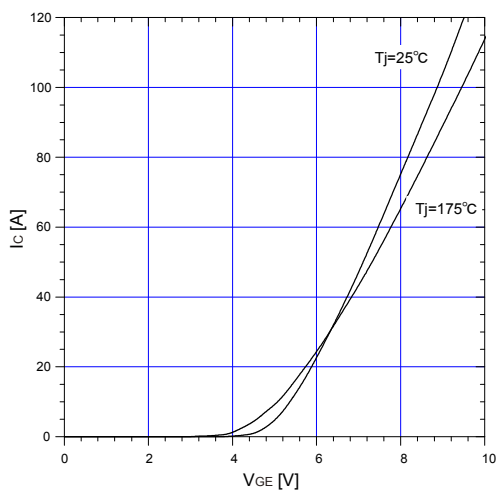
Graph.3  
Typical Output Characteristics ( $V_{CE}-I_c$ )  
Tj=25°C



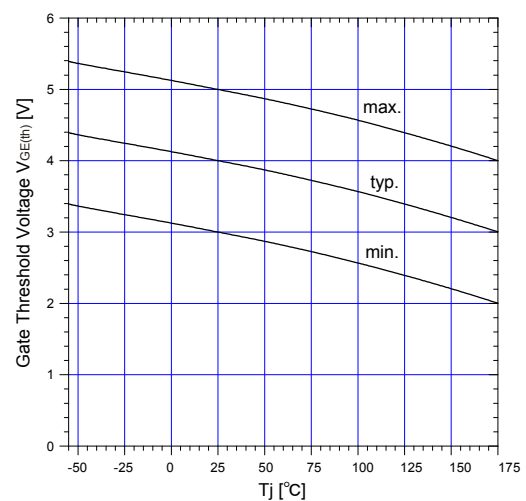
Graph.4  
Typical Output Characteristics ( $V_{CE}-I_c$ )  
Tj=175°C



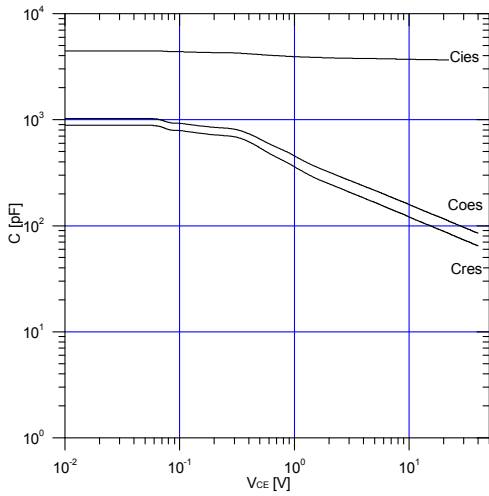
Graph.5  
Typical Transfer Characteristics  
 $V_{CE}=10V$



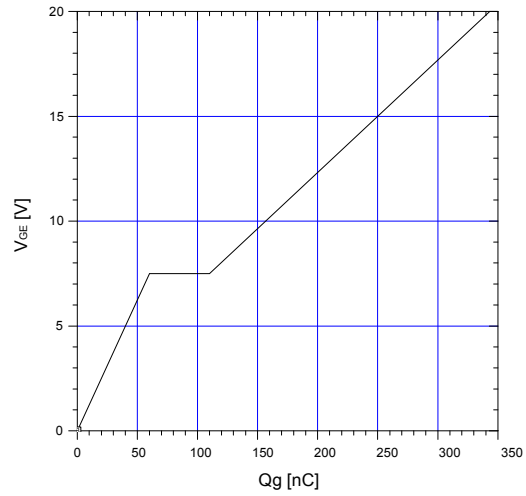
Graph.6  
Gate Threshold Voltage vs. Tj  
 $I_c=50mA, V_{CE}=20V$



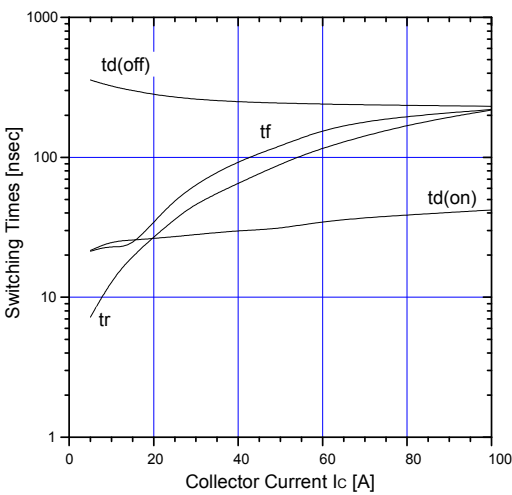
Graph.7  
Typical Capacitance  
 $V_{GE}=0V, f=1MHz, T_j=25^\circ C$



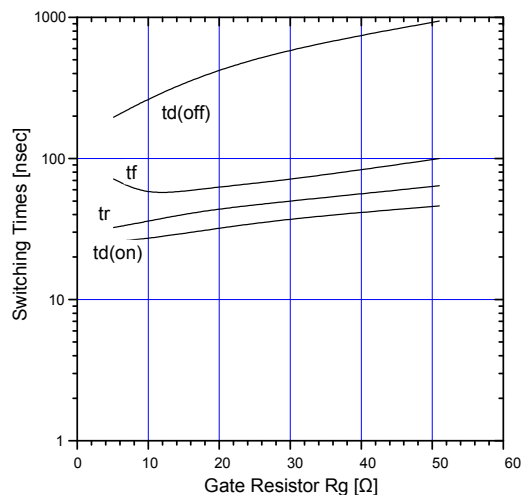
Graph.8  
Typical Gate Charge  
 $V_{cc}=520V, I_c=50A, T_j=25^\circ C$



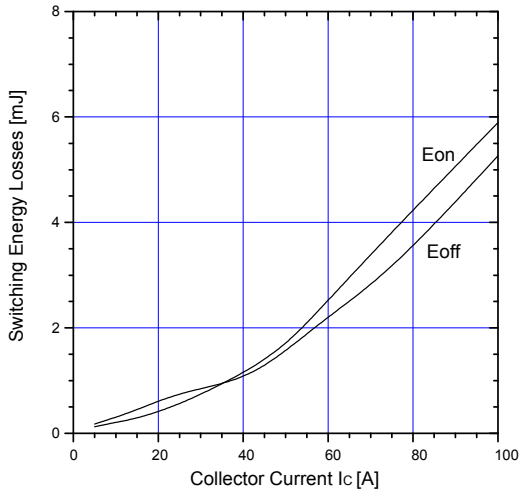
Graph.9  
Typical switching time vs. Ic  
 $T_j=150^\circ C, V_{cc}=400V, L=500\mu H$   
 $V_{GE}=15V, R_G=10\Omega$



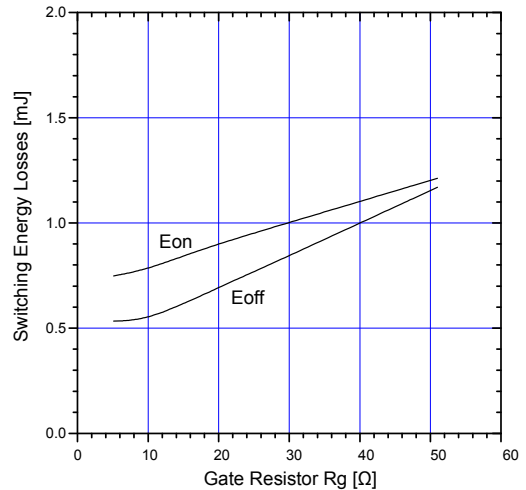
Graph.10  
Typical switching time vs. Rg  
 $T_j=150^\circ C, V_{cc}=400V, I_c=25A, L=500\mu H$   
 $V_{GE}=15V$



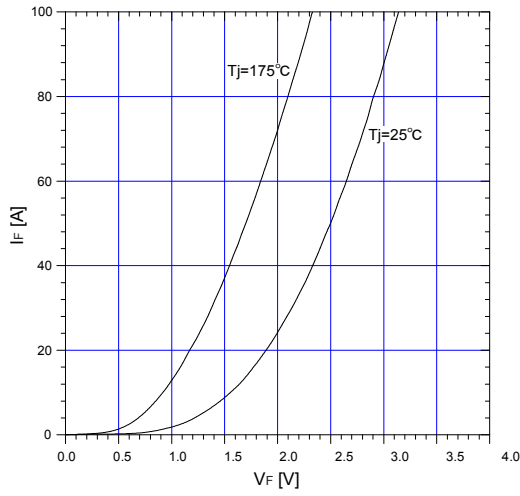
Graph.11  
Typical switching losses vs. Ic  
 $T_j=150^\circ C, V_{cc}=400V, L=500\mu H$   
 $V_{GE}=15V, R_G=10\Omega$



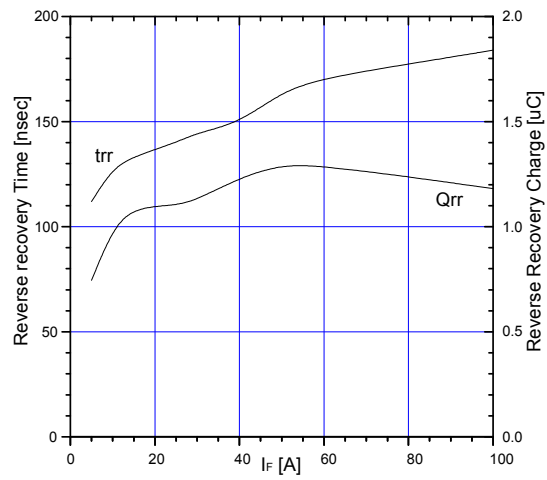
Graph.12  
Typical switching losses vs. Rg  
 $T_j=150^\circ C, V_{cc}=400V, I_c=25A, L=500\mu H$   
 $V_{GE}=15V$



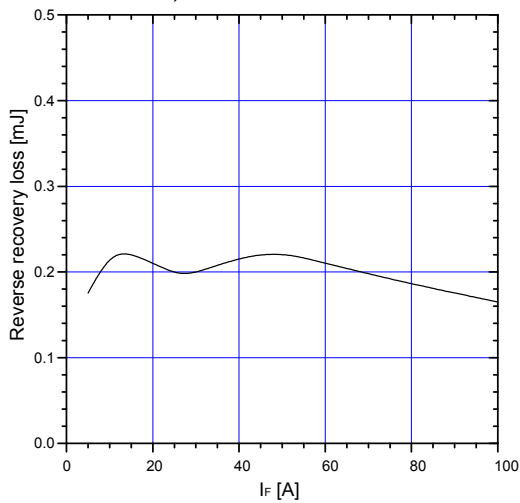
Graph.13  
FWD Forward voltage drop ( $V_F$ - $I_F$ )



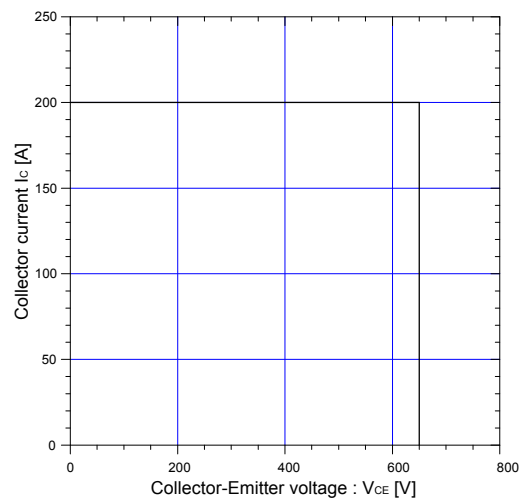
Graph.14  
Typical reverse recovery characteristics vs.  $I_F$   
 $T_j=150^\circ\text{C}$ ,  $V_{CC}=400\text{V}$ ,  $L=500\mu\text{H}$   
 $V_{GE}=15\text{V}$ ,  $R_G=10\Omega$



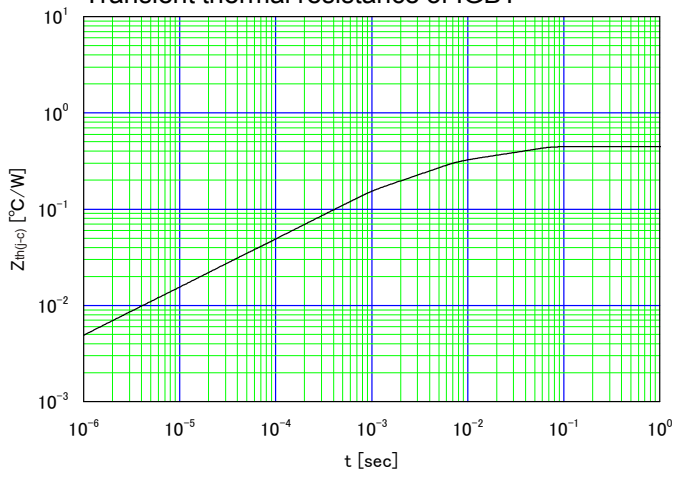
Graph.15  
Typical reverse recovery loss vs.  $I_F$   
 $T_j=150^\circ\text{C}$ ,  $V_{CC}=400\text{V}$ ,  $L=500\mu\text{H}$   
 $V_{GE}=15\text{V}$ ,  $R_G=10\Omega$



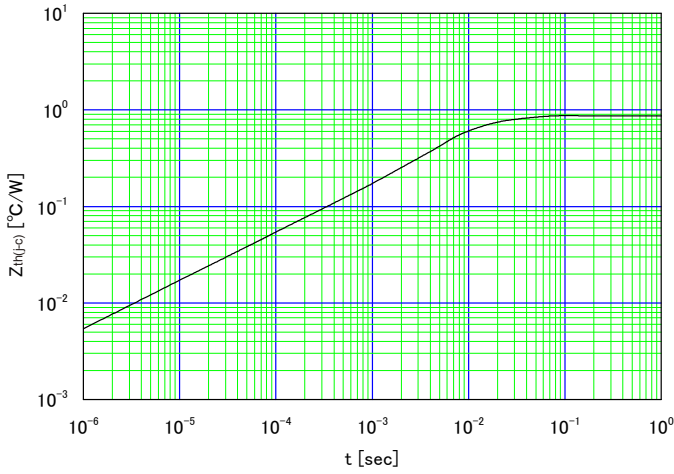
Graph.16  
Reverse biased Safe Operating Area  
 $T_j \leq 175^\circ\text{C}$ ,  $V_{GE}=+15\text{V}/0\text{V}$ ,  $R_G=10\Omega$



Graph.17  
Transient thermal resistance of IGBT

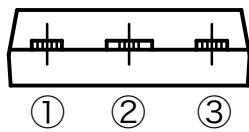
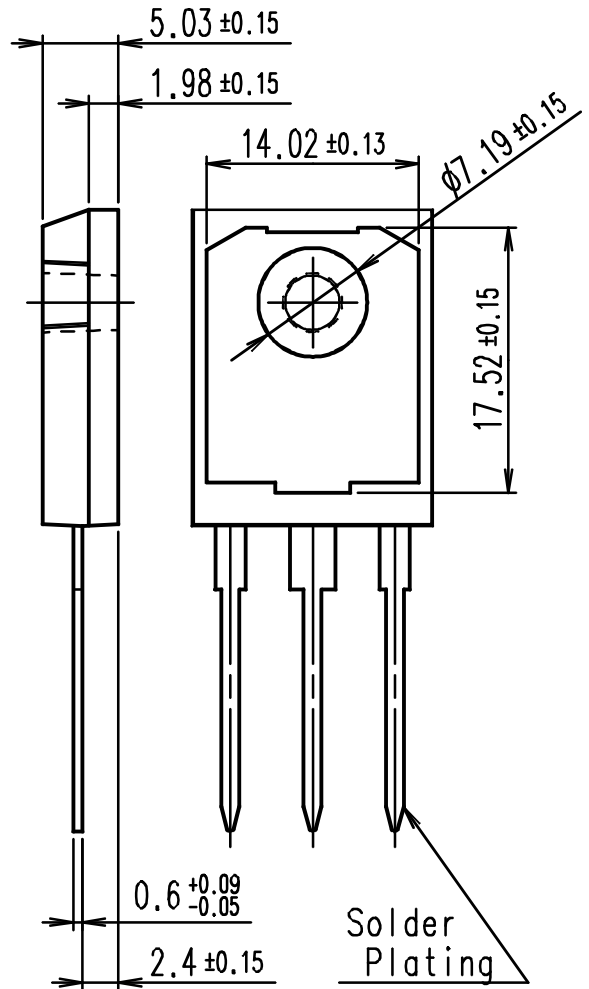
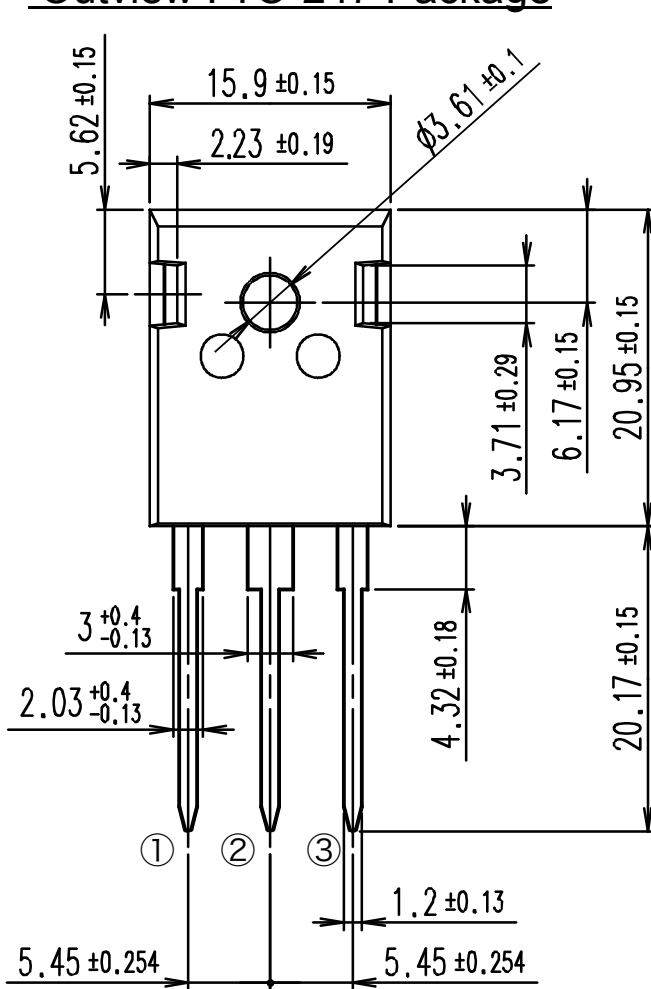


Graph.18  
Transient thermal resistance of FWD



■ Outline Drawings, mm

Overview : TO-247 Package



CONNECTION

- ① GATE
- ② COLLECTOR
- ③ EMITTER

DIMENSIONS ARE IN MILLIMETERS.

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