

FGW35N60HD

Discrete IGBT

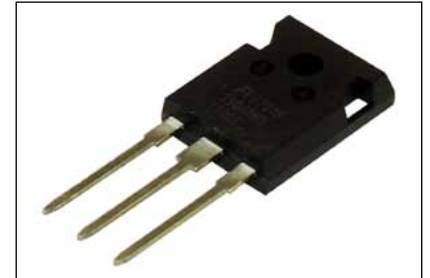
Discrete IGBT (High-Speed V series) 600V / 35A

■ Features

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

■ Applications

- Uninterruptible power supply
- Power conditioner
- Power factor correction circuit



■ Maximum Ratings and Characteristics

● Absolute Maximum Ratings (at T_c=25°C unless otherwise specified)

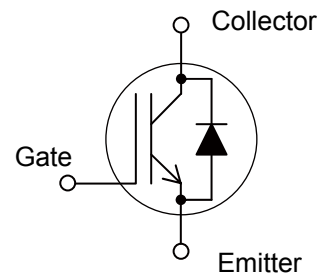
Items	Symbols	Characteristics	Units	Remarks
Collector-Emitter Voltage	V _{CEs}	600	V	
Gate-Emitter Voltage	V _{GES}	±20	V	
DC Collector Current	I _{C@25}	64	A	T _c =25°C, T _j =150°C
	I _{C@100}	35	A	T _c =100°C, T _j =150°C
Pulsed Collector Current	I _{CP}	105	A	Note *1
Turn-Off Safe Operating Area	-	105	A	V _{CE} ≤600V, T _j ≤175°C
Diode Forward Current	I _{F@25}	30	A	
	I _{F@100}	15	A	
Diode Pulsed Current	I _{FP}	105	A	Note *1
Short Circuit Withstand Time	t _{SC}	5	μs	V _{CC} ≤300V, V _{GE} =12V T _j ≤150°C
IGBT Max. Power Dissipation	P _{D,IGBT}	230	W	T _c =25°C
FWD Max. Power Dissipation	P _{D,FWD}	80	W	T _c =25°C
Operating Junction Temperature	T _j	-40 ~ +175	°C	
Storage Temperature	T _{stg}	-55 ~ +175	°C	

Note *1 : Pulse width limited by T_{jmax}.

● Electrical characteristics (at T_j= 25°C unless otherwise specified)

Items	Symbols	Conditions	Characteristics			Units	
			min.	typ.	max.		
Collector-Emitter Breakdown Voltage	V _{(BR)CES}	I _c = 250μA, V _{GE} = 0V	600	-	-	V	
Zero Gate Voltage Collector Current	I _{CES}	V _{CE} = 600V, V _{GE} = 0V	T _j =25°C	-	-	250	μA
			T _j =175°C	-	-	10	mA
Gate-Emitter Leakage Current	I _{GES}	V _{CE} = 0V, V _{GE} = ±20V	-	-	200	nA	
Gate-Emitter Threshold Voltage	V _{GE(th)}	V _{CE} = +20V, I _c = 35mA	4.0	5.0	6.0	V	
Collector-Emitter Saturation Voltage	V _{CE(sat)}	V _{GE} = +15V, I _c = 35A	T _j =25°C	-	1.50	1.95	V
			T _j =175°C	-	1.80	-	
Input Capacitance	C _{ies}	V _{CE} =25V	-	2800	-	pF	
Output Capacitance	C _{oes}	V _{GE} =0V	-	140	-		
Reverse Transfer Capacitance	C _{res}	f=1MHz	-	100	-		
Gate Charge	Q _G	V _{CC} = 400V I _c = 35A V _{GE} = 15V	-	210	-	nC	
Turn-On Delay Time	t _{d(on)}	T _j = 25°C V _{CC} = 400V I _c = 35A V _{GE} = 15V	-	32	-	ns	
Rise Time	t _r		-	60	-		
Turn-Off Delay Time	t _{d(off)}		-	200	-		
Fall Time	t _f		-	40	-		
Turn-On Energy	E _{on}		R _{GE} = 10Ω	-	0.90		-
Turn-Off Energy	E _{off}	L = 500μH Energy loss include "tail" and FWD reverse recovery.	-	0.85	-	mJ	
Turn-On Delay Time	t _{d(on)}	T _j = 175°C V _{CC} = 400V I _c = 35A V _{GE} = 15V	-	33	-	ns	
Rise Time	t _r		-	60	-		
Turn-Off Delay Time	t _{d(off)}		-	225	-		
Fall Time	t _f		-	50	-		
Turn-On Energy	E _{on}		R _{GE} = 10Ω	-	1.40		-
Turn-Off Energy	E _{off}	L = 500μH Energy loss include "tail" and FWD reverse recovery.	-	1.25	-	mJ	

■ Equivalent circuit



● FWD Characteristics

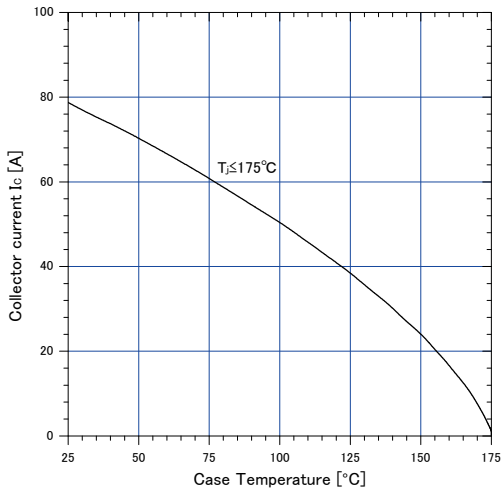
Description	Symbol	Conditions	Characteristics			Unit	
			min.	typ.	max.		
Forward Voltage Drop	V_F	$I_F=15A$	$T_J=25^{\circ}C$	-	2.0	2.6	V
			$T_J=175^{\circ}C$	-	1.4	-	V
Diode Reverse Recovery Time	t_{rr1}	$V_{CC}=30V, I_F = 1.5A$ $-di/dt=200A/\mu s$	-	24	31	ns	
Diode Reverse Recovery Time	t_{rr2}	$V_{CC}=400V$ $I_F=15A$	-	0.03	-	μs	
Diode Reverse Recovery Charge	Q_{rr}	$-di_F/dt=200A/\mu s$ $T_J=25^{\circ}C$	-	0.06	-	μC	
Diode Reverse Recovery Time	t_{rr2}	$V_{CC}=400V$ $I_F=15A$	-	0.15	-	μs	
Diode Reverse Recovery Charge	Q_{rr}	$-di_F/dt=200A/\mu s$ $T_J=175^{\circ}C$	-	0.65	-	μC	

● Thermal resistance characteristics

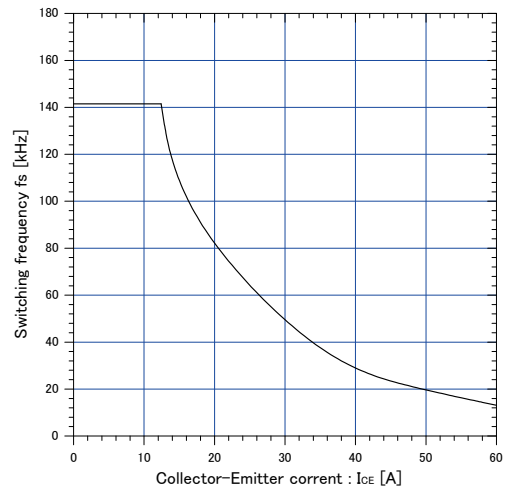
Items	Symbols	Conditions	Characteristics			Units
			min.	typ.	max.	
Thermal Resistance, Junction-Ambient	$R_{th(j-a)}$	-	-	-	50	$^{\circ}C/W$
Thermal Resistance, IGBT Junction to Case	$R_{th(j-c)}_{IGBT}$	-	-	-	0.641	
Thermal Resistance, FWD Junction to Case	$R_{th(j-c)}_{FWD}$	-	-	-	1.786	

■ Characteristics (Representative)

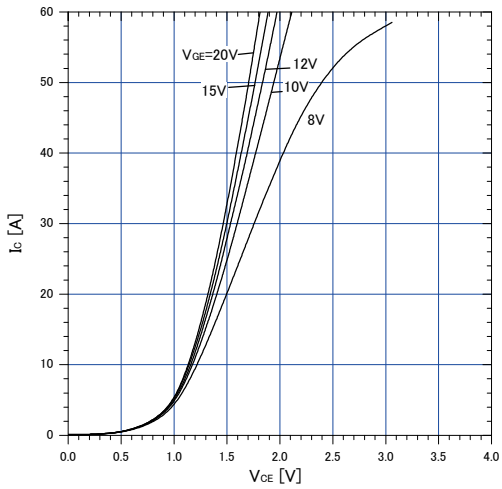
Graph.1
DC Collector Current vs T_c
 $V_{GE} \geq +15V, T_c \leq 175^\circ C$



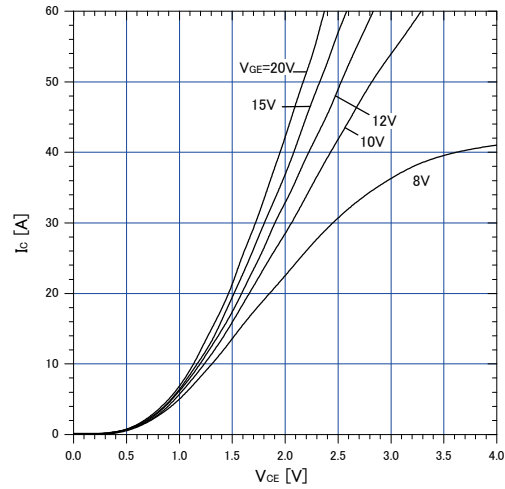
Graph.2
Collector Current vs. switching frequency
 $V_{GE} = +15V, T_c \leq 175^\circ C, V_{CE} = 400V, D = 0.5, R_G = 10\Omega, T_c = 100^\circ C$



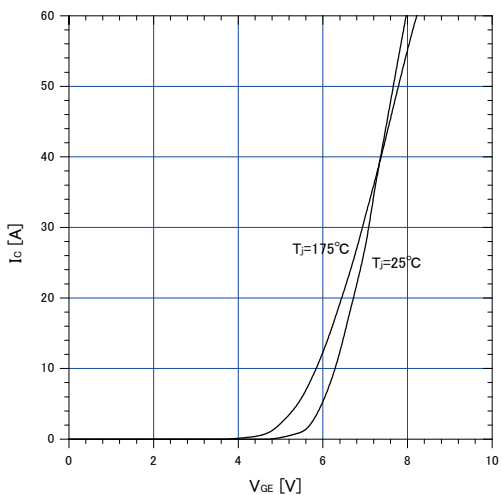
Graph.3
Typical Output Characteristics ($V_{CE}-I_c$)
 $T_j = 25^\circ C$



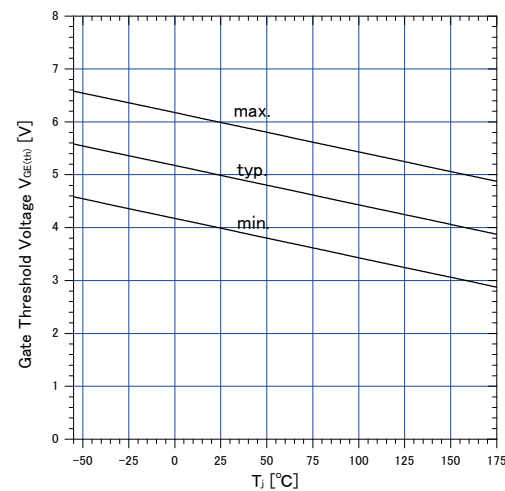
Graph.4
Typical Output Characteristics ($V_{CE}-I_c$)
 $T_j = 175^\circ C$



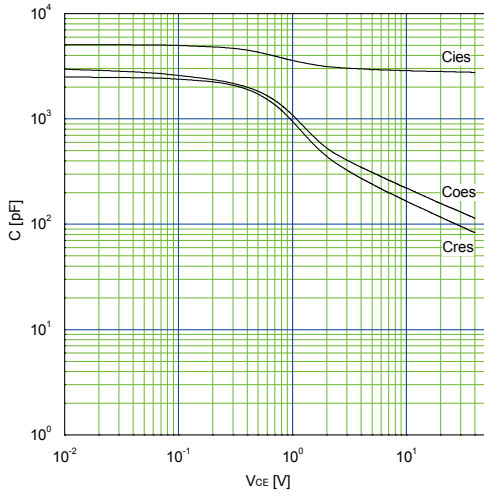
Graph.5
Typical Transfer Characteristics
 $V_{GE} = +15V$



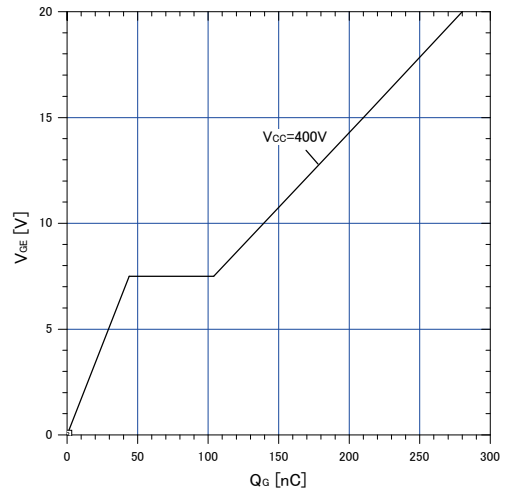
Graph.6
Gate Threshold Voltage vs. T_j
 $I_c = 35mA, V_{CE} = 20V$



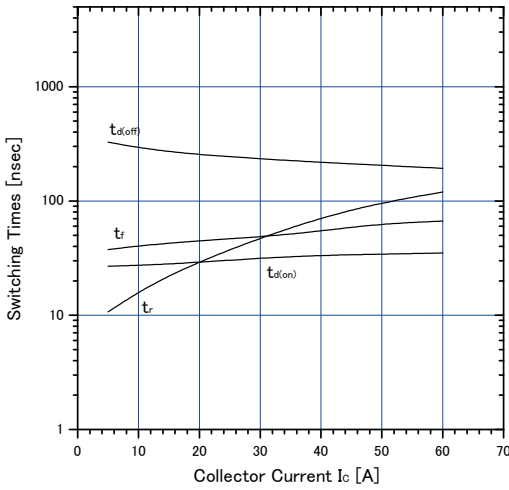
Graph.7
Typical Capacitance
 $V_{GE}=0V, f=1MHz, T_j=25^{\circ}C$



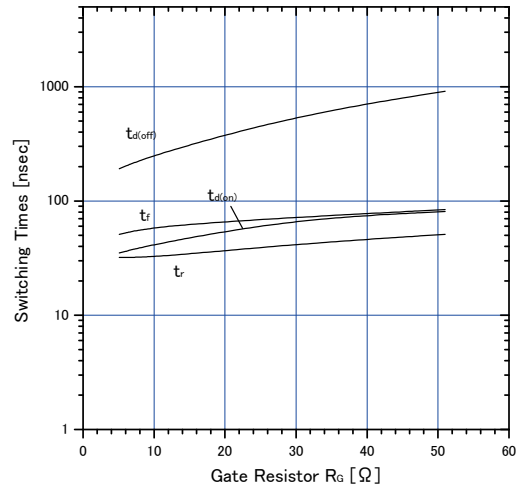
Graph.8
Typical Gate Charge
 $V_{CC}=400V, I_c=35A, T_j=25^{\circ}C$



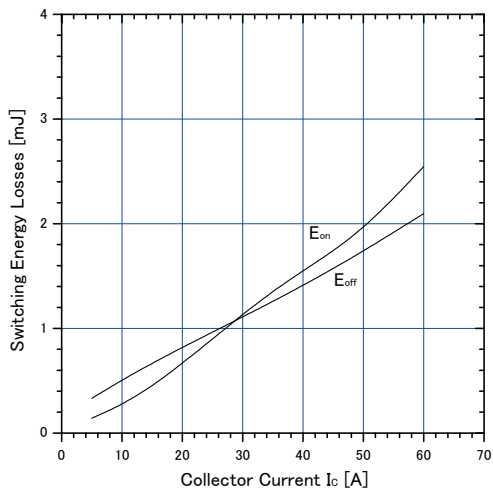
Graph.9
Typical switching time vs. I_c
 $T_j=175^{\circ}C, V_{CC}=400V, L=500\mu H$
 $V_{GE}=15V, R_G=10\Omega$



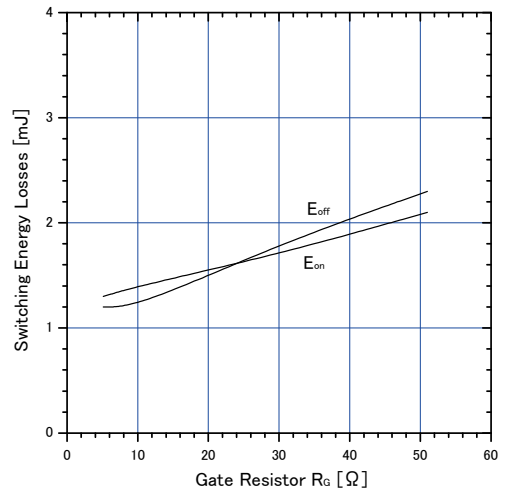
Graph.10
Typical switching time vs. R_G
 $T_j=175^{\circ}C, V_{CC}=400V, I_c=35A, L=500\mu H$
 $V_{GE}=15V$



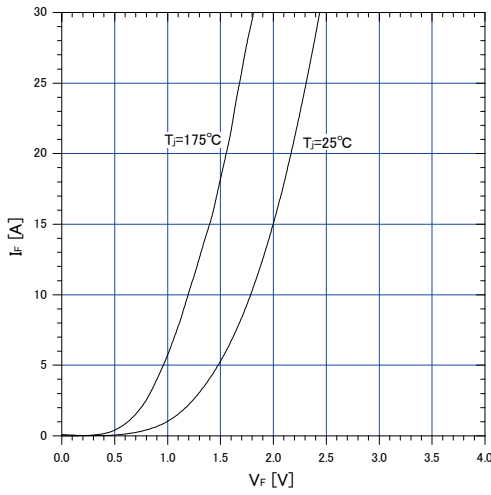
Graph.11
Typical switching losses vs. I_c
 $T_j=175^{\circ}C, V_{CC}=400V, L=500\mu H$
 $V_{GE}=15V, R_G=10\Omega$



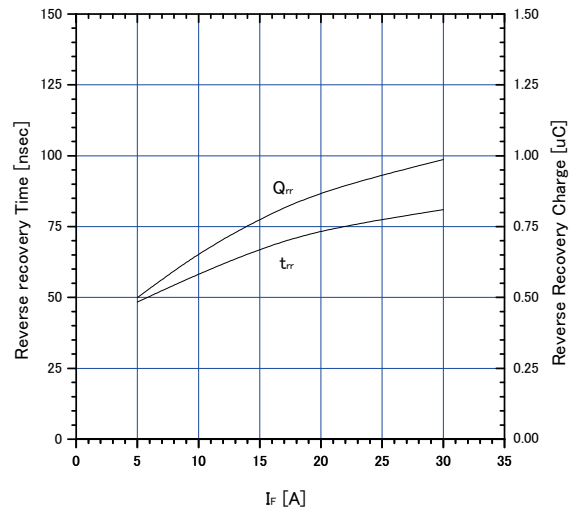
Graph.12
Typical switching losses vs. R_G
 $T_j=175^{\circ}C, V_{CC}=400V, I_c=35A, L=500\mu H$
 $V_{GE}=15V$



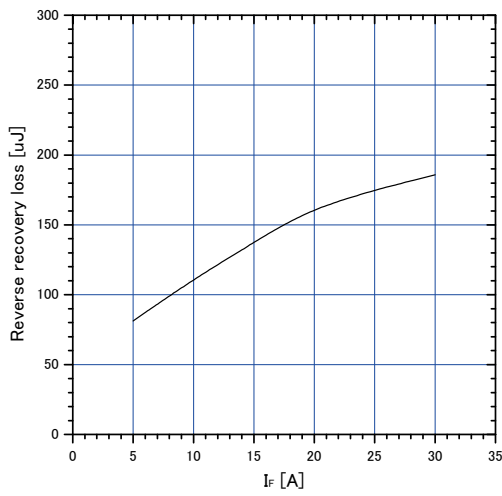
Graph.13
FWD Forward voltage drop (V_F-I_F)



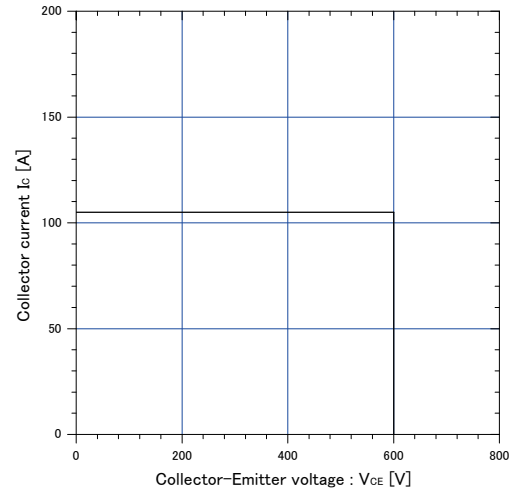
Graph.14
Typical reverse recovery characteristics vs. I_F
 $T_j=175^\circ\text{C}$, $V_{CC}=400\text{V}$, $L=500\mu\text{H}$
 $V_{GE}=15\text{V}$, $R_G=10\Omega$



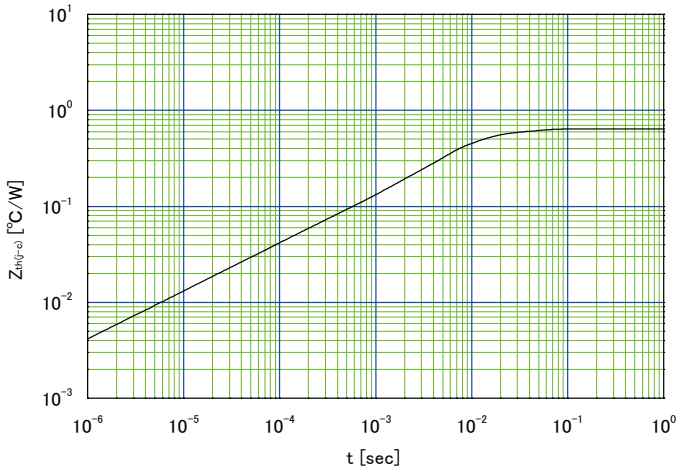
Graph.15
Typical reverse recovery loss vs. I_F
 $T_j=175^\circ\text{C}$, $V_{CC}=400\text{V}$, $L=500\mu\text{H}$
 $V_{GE}=15\text{V}$, $R_G=10\Omega$



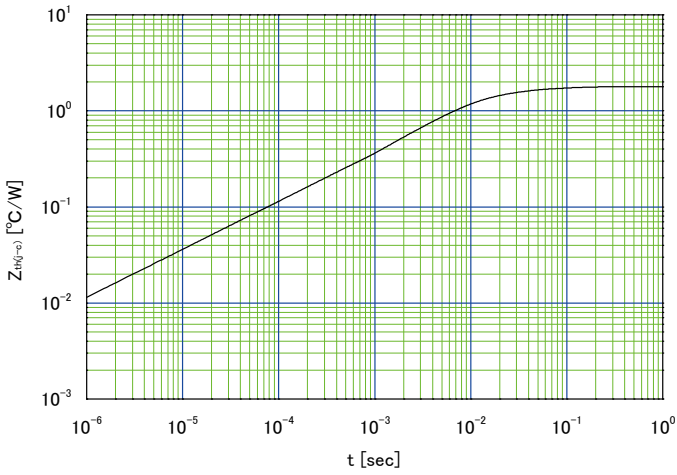
Graph.16
Reverse biased Safe Operating Area
 $T_j \leq 175^\circ\text{C}$, $V_{GE}=+15\text{V}/0\text{V}$, $R_G=10\Omega$



Graph.17
Transient thermal resistance of IGBT

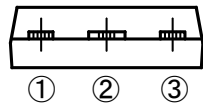
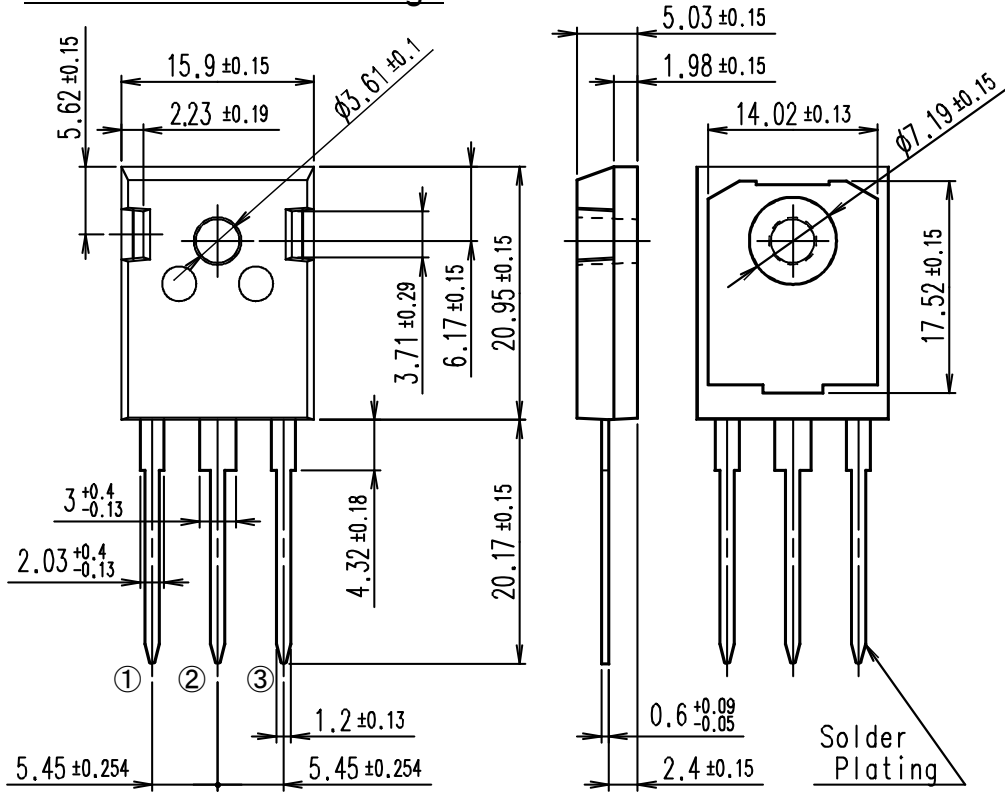


Graph.18
Transient thermal resistance of FWD



■ Outline Drawings, mm

Outview : TO-247 Package



CONNECTION

- ① GATE
- ② COLLECTOR
- ③ EMITTER

DIMENSIONS ARE IN MILLIMETERS.

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