

FGW35N60HD

Discrete IGBT

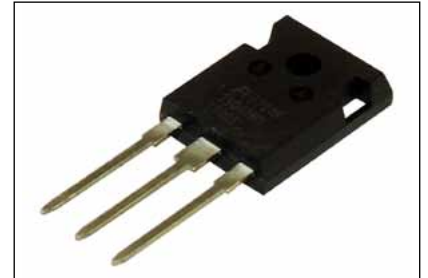
Discrete IGBT (High-Speed V series) 600V / 35A

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

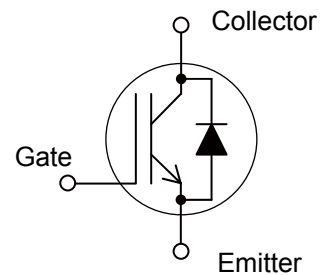
Items	Symbols	Characteristics	Units	Remarks
Collector-Emitter Voltage	V_{CES}	600	V	
Gate-Emitter Voltage	V_{GES}	± 20	V	
DC Collector Current	$I_{C@25}$	64	A	$T_c=25^\circ\text{C}, T_j=150^\circ\text{C}$
	$I_{C@100}$	35	A	$T_c=100^\circ\text{C}, T_j=150^\circ\text{C}$
Pulsed Collector Current	I_{CP}	105	A	Note *1
Turn-Off Safe Operating Area	-	105	A	$V_{CE} \leq 600\text{V}, T_j \leq 175^\circ\text{C}$
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	$V_{CC} \leq 300\text{V}, V_{GE} = 12\text{V}$ $T_j \leq 150^\circ\text{C}$
IGBT Max. Power Dissipation	P_{D_IGBT}	230	W	$T_c=25^\circ\text{C}$
FWD Max. Power Dissipation	P_{D_FWD}	80	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			Units
			min.	typ.	max.	
Collector-Emitter Breakdown Voltage	$V_{(BR)CES}$	$I_C = 250\mu\text{A}, V_{GE} = 0\text{V}$	600	-	-	V
Zero Gate Voltage Collector Current	I_{CES}	$V_{CE} = 600\text{V}, V_{GE} = 0\text{V}$	-	-	250	μA
Gate-Emitter Leakage Current	I_{GES}	$V_{CE} = 0\text{V}, V_{GE} = \pm 20\text{V}$	-	-	10	nA
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	$V_{CE} = +20\text{V}, I_C = 35\text{mA}$	4.0	5.0	6.0	V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = +15\text{V}, I_C = 35\text{A}$	-	1.50	1.95	V
Input Capacitance	C_{ies}	$V_{CE}=25\text{V}$	-	2800	-	pF
Output Capacitance	C_{oes}	$V_{GE}=0\text{V}$	-	140	-	pF
Reverse Transfer Capacitance	C_{res}	$f=1\text{MHz}$	-	100	-	pF
Gate Charge	Q_G	$V_{CC} = 400\text{V}$ $I_C = 35\text{A}$ $V_{GE} = 15\text{V}$	-	210	-	nC
Turn-On Delay Time	$t_{d(on)}$	$T_j = 25^\circ\text{C}$	-	32	-	ns
Rise Time	t_r	$V_{CC} = 400\text{V}$	-	60	-	ns
Turn-Off Delay Time	$t_{d(off)}$	$I_C = 35\text{A}$	-	200	-	ns
Fall Time	t_f	$V_{GE} = 15\text{V}$	-	40	-	ns
Turn-On Energy	E_{on}	$R_G = 10\Omega$ $L = 500\mu\text{H}$	-	0.90	-	mJ
Turn-Off Energy	E_{off}	Energy loss include "tail" and FWD reverse recovery.	-	0.85	-	mJ
Turn-On Delay Time	$t_{d(on)}$	$T_j = 175^\circ\text{C}$	-	33	-	ns
Rise Time	t_r	$V_{CC} = 400\text{V}$	-	60	-	ns
Turn-Off Delay Time	$t_{d(off)}$	$I_C = 35\text{A}$	-	225	-	ns
Fall Time	t_f	$V_{GE} = 15\text{V}$	-	50	-	ns
Turn-On Energy	E_{on}	$R_G = 10\Omega$ $L = 500\mu\text{H}$	-	1.40	-	mJ
Turn-Off Energy	E_{off}	Energy loss include "tail" and FWD reverse recovery.	-	1.25	-	mJ

■ Equivalent circuit



● FWD Characteristics

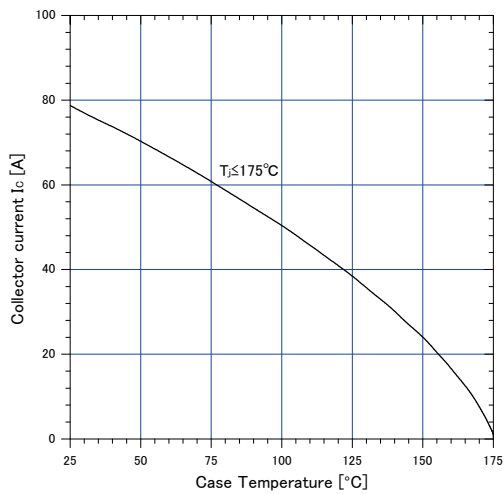
Description	Symbol	Conditions	Characteristics			Unit
			min.	typ.	max.	
Forward Voltage Drop	V_F	$I_F=15A$	-	2.0	2.6	V
		$T_J=25^{\circ}C$ $T_J=175^{\circ}C$	-	1.4	-	V
Diode Reverse Recovery Time	t_{rr1}	$V_{CC}=30V, I_F=1.5A$ $-di/dt=200A/\mu s$	-	24	31	ns
Diode Reverse Recovery Time	t_{rr2}	$V_{CC}=400V$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

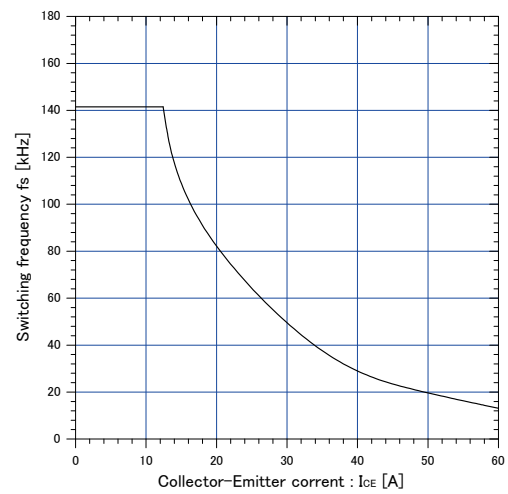
■ Characteristics (Representative)

Graph.1

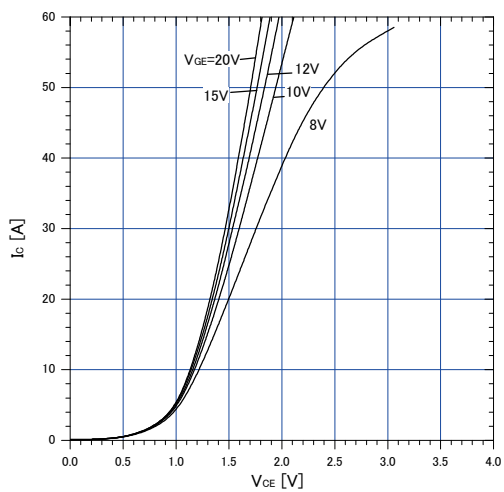
DC Collector Current vs T_c $V_{GE} \geq +15V$, $T_c \leq 175^\circ C$ 

Graph.2

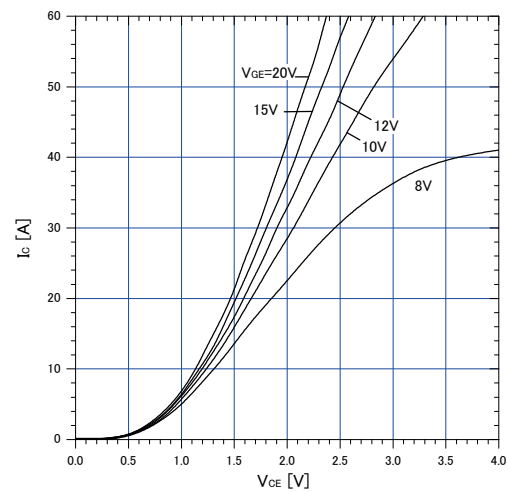
Collector Current vs. switching frequency

 $V_{GE} = +15V$, $T_c \leq 175^\circ C$, $V_{CE} = 400V$, $D = 0.5$, $R_G = 10\Omega$, $T_c = 100^\circ C$ 

Graph.3

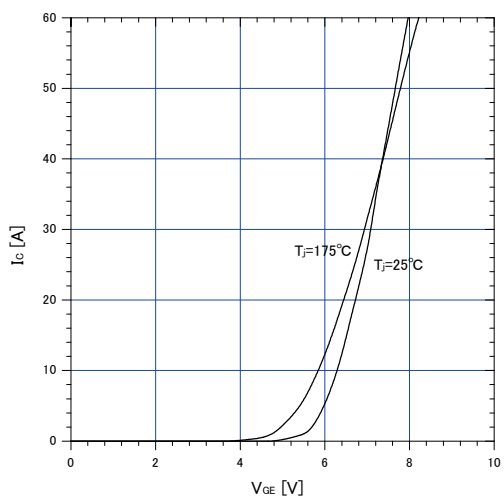
Typical Output Characteristics ($V_{CE} - I_c$) $T_j = 25^\circ C$ 

Graph.4

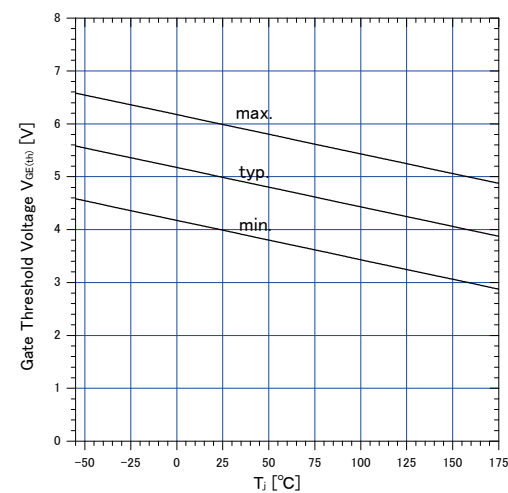
Typical Output Characteristics ($V_{CE} - I_c$) $T_j = 175^\circ C$ 

Graph.5

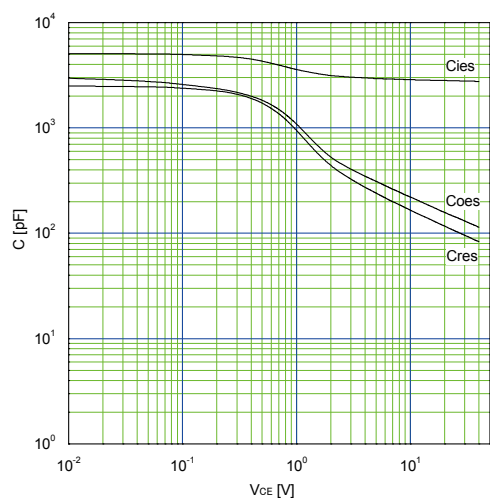
Typical Transfer Characteristics

 $V_{GE} = +15V$ 

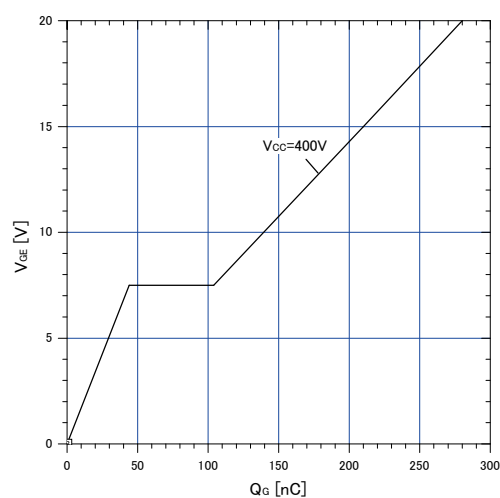
Graph.6

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

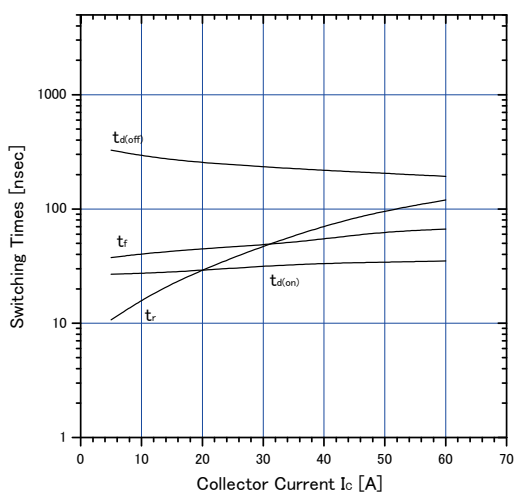
Graph.7
Typical Capacitance
 $V_{GE}=0V, f=1MHz, T_J=25^{\circ}C$



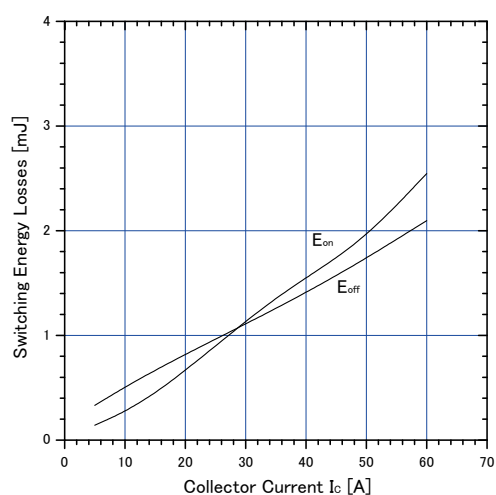
Graph.8
Typical Gate Charge
 $V_{CC}=400V, I_C=35A, T_J=25^{\circ}C$



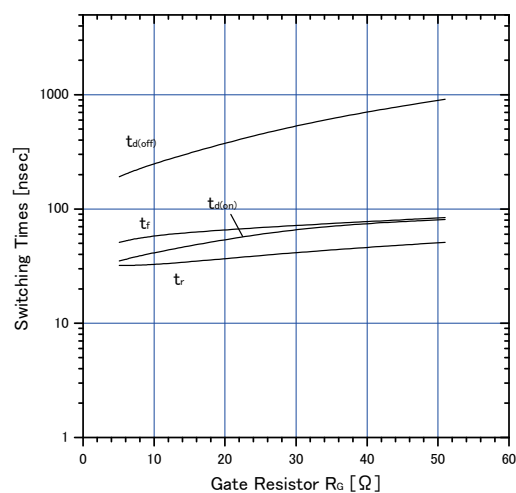
Graph.9
Typical switching time vs. I_C
 $T_J=175^{\circ}C, V_{CC}=400V, L=500\mu H$
 $V_{GE}=15V, R_G=10\Omega$



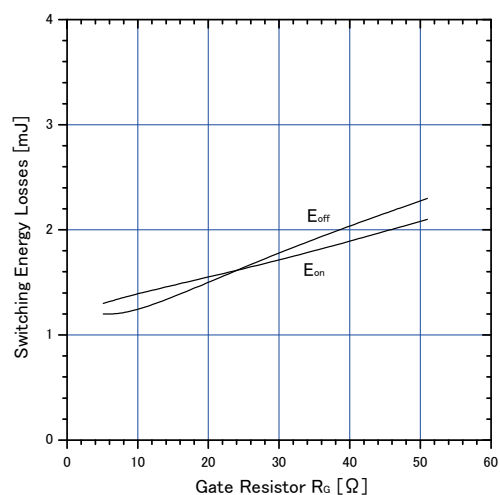
Graph.11
Typical switching losses vs. I_C
 $T_J=175^{\circ}C, V_{CC}=400V, L=500\mu H$
 $V_{GE}=15V, R_G=10\Omega$



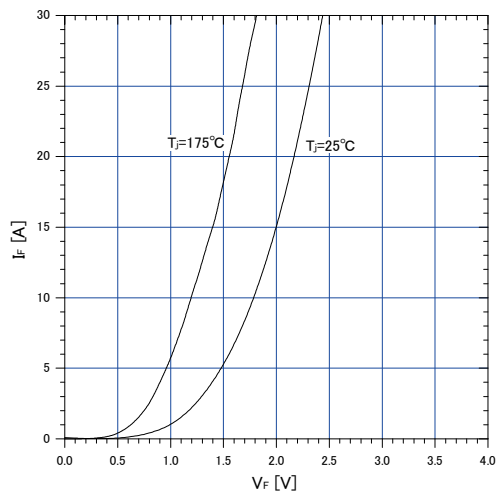
Graph.10
Typical switching time vs. R_G
 $T_J=175^{\circ}C, V_{CC}=400V, I_C=35A, L=500\mu H$
 $V_{GE}=15V$



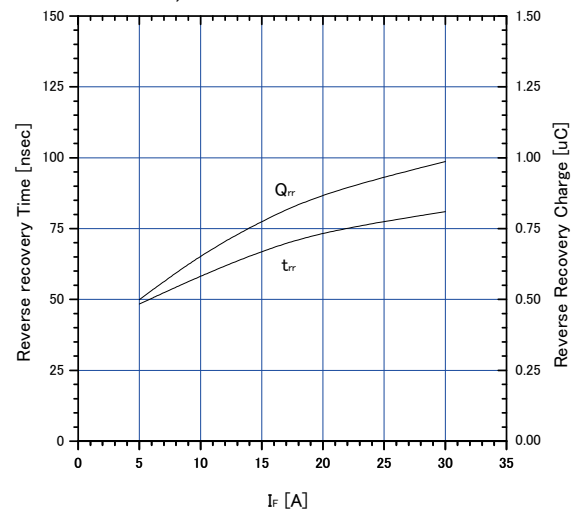
Graph.12
Typical switching losses vs. R_G
 $T_J=175^{\circ}C, V_{CC}=400V, I_C=35A, L=500\mu H$
 $V_{GE}=15V$



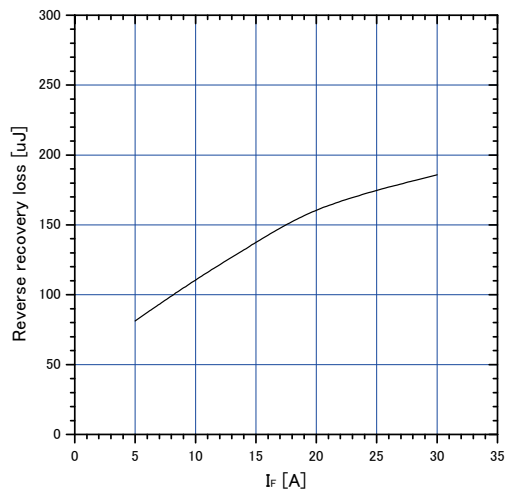
Graph.13
FWD Forward voltage drop (V_F-I_F)



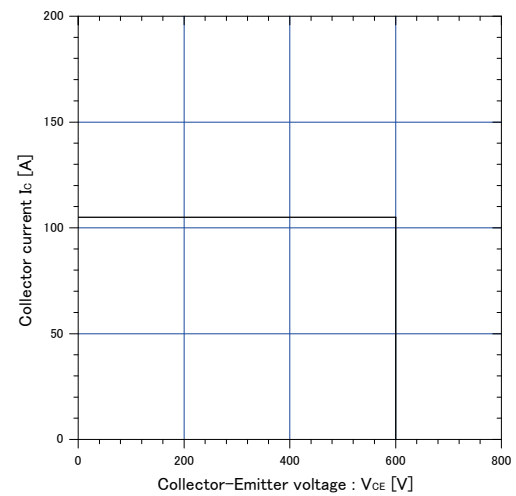
Graph.14
Typical reverse recovery characteristics vs. I_F
 $T_J=175^\circ\text{C}$, $V_{CC}=400\text{V}$, $L=500\mu\text{H}$
 $V_{GE}=15\text{V}$, $R_G=10\Omega$



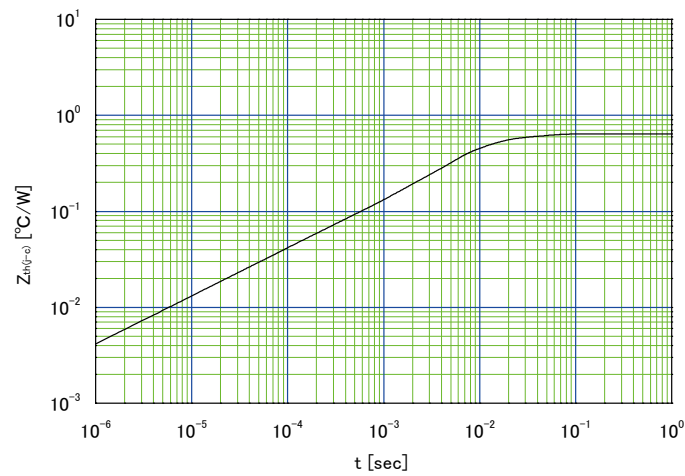
Graph.15
Typical reverse recovery loss vs. I_F
 $T_J=175^\circ\text{C}$, $V_{CC}=400\text{V}$, $L=500\mu\text{H}$
 $V_{GE}=15\text{V}$, $R_G=10\Omega$



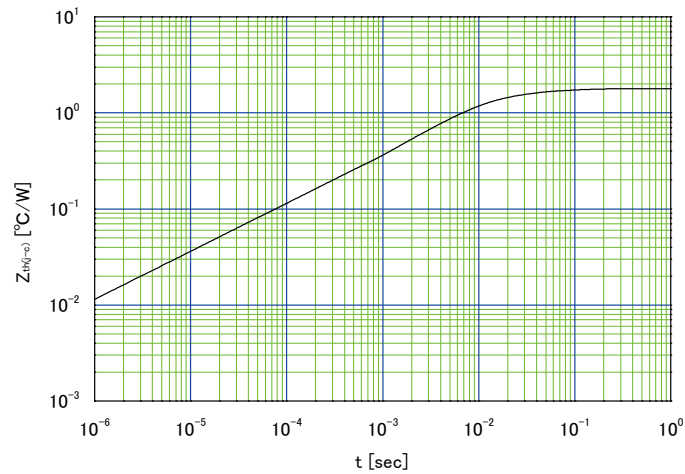
Graph.16
Reverse biased Safe Operating Area
 $T_J \leq 175^\circ\text{C}$, $V_{GE}=+15\text{V}/0\text{V}$, $R_G=10\Omega$



Graph.17
Transient thermal resistance of IGBT

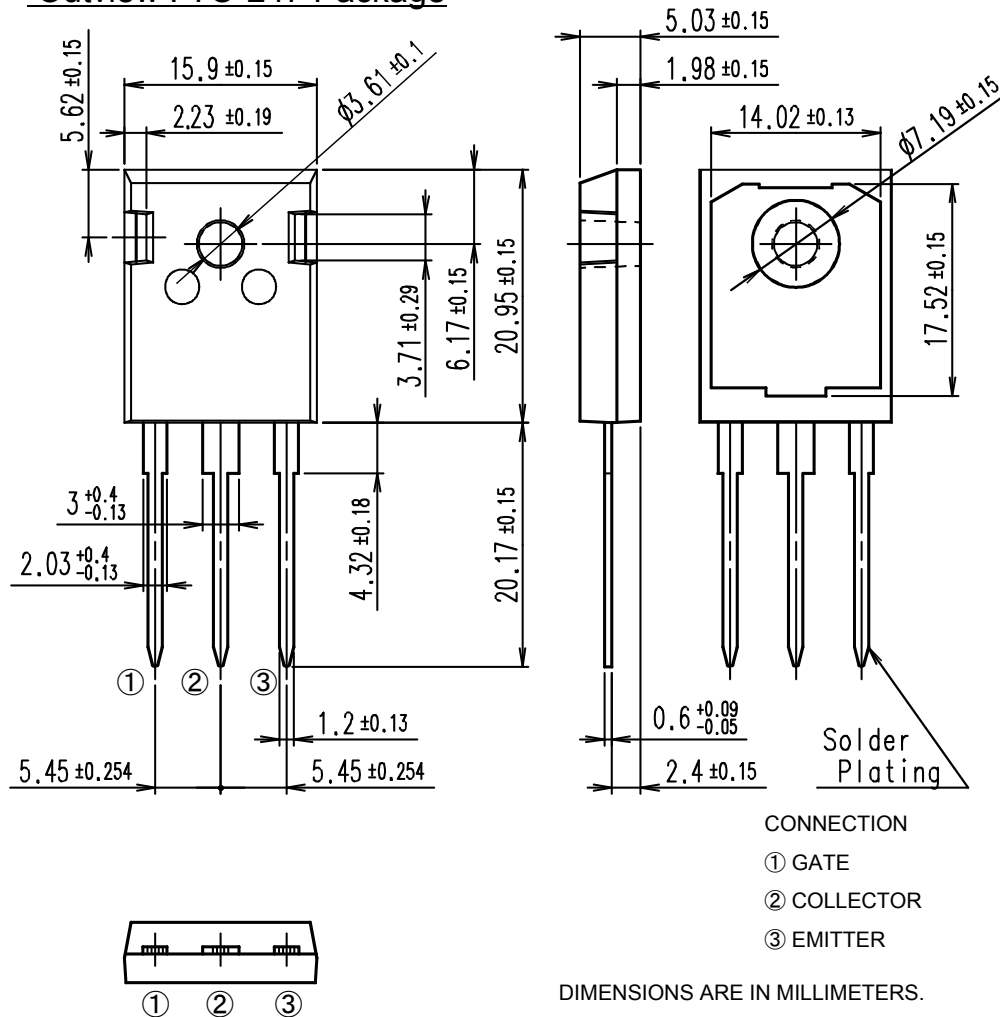


Graph.18
Transient thermal resistance of FWD



■ Outline Drawings, mm

Outview : TO-247 Package



WARNING

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