

# FGW40XS65

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Discrete IGBT

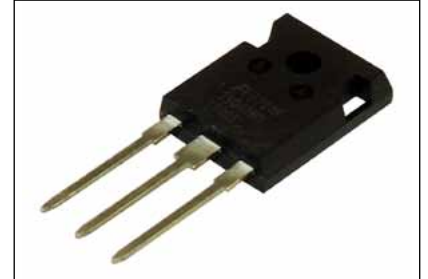
## Discrete IGBT (High-Speed XS-series) 650V / 40A

### ■ Features

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

### ■ Applications

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



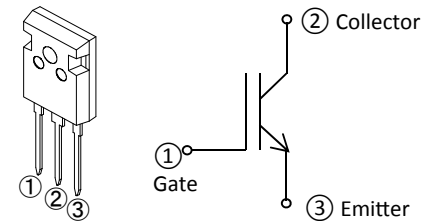
### ■ Maximum Ratings and Characteristics

#### ● 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	$V_{GES}$	$\pm 20$	V	
Transient Gate-Emitter Voltage		$\pm 30$	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	$V_{CE} \leq 650 \text{ V}$ $T_{vj} \leq 175^\circ\text{C}$
Max. Power Dissipation	$P_{tot}$	234	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-P2

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

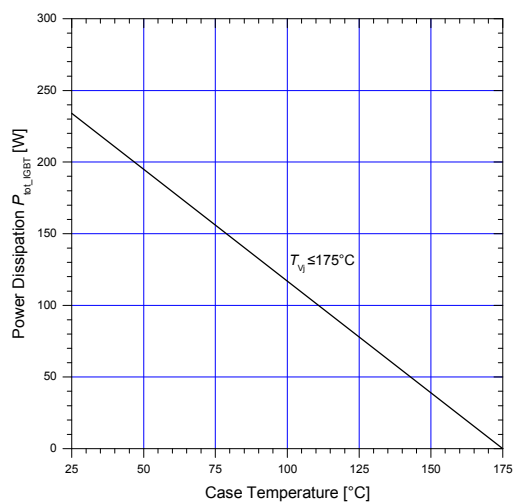
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Zero Gate Voltage Collector Current	$I_{CES}$	$V_{CE} = 650 \text{ V}$ $V_{GE} = 0 \text{ V}$ $T_{vj} = 25^\circ\text{C}$	-	-	250	$\mu\text{A}$
		$T_{vj} = 175^\circ\text{C}$	-	-	2	mA
Gate-Emitter Leakage Current	$I_{GES}$	$V_{CE} = 0 \text{ V}$ $V_{GE} = \pm 20 \text{ V}$	-	-	200	nA
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	$V_{CE} = 20 \text{ V}$ $I_C = 40 \text{ mA}$	3.4	4.0	4.6	V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 15 \text{ V}$ $I_C = 40 \text{ A}$ $T_{vj} = 25^\circ\text{C}$	1.00	1.35	1.70	V
		$T_{vj} = 125^\circ\text{C}$	-	1.50	-	
		$T_{vj} = 175^\circ\text{C}$	-	1.60	-	
Input Capacitance	$C_{ies}$	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	1700	3400	5100	pF
Output Capacitance	$C_{oes}$	$f = 1 \text{ MHz}$	39	78	117	
Reverse Transfer Capacitance	$C_{res}$		17	34	51	
Gate Charge	$Q_G$	$V_{CC} = 520 \text{ V}$ $I_C = 40 \text{ A}$ $V_{GE} = 15 \text{ V}$	80	160	240	nC
Turn-On Delay Time	$t_{d(on)}$	$T_{vj} = 25^\circ\text{C}$	14	28	42	ns
Rise Time	$t_r$	$V_{CC} = 400 \text{ V}$	8	16	24	
Turn-Off Delay Time	$t_{d(off)}$	$I_C = 20 \text{ A}$	100	200	300	
Fall Time	$t_f$	$V_{GE} = 15 \text{ V}$	7.5	15	22.5	
Turn-On Energy	$E_{on}$	$R_G = 10 \Omega$	0.20	0.40	0.60	mJ
Turn-Off Energy	$E_{off}$	Energy loss include "tail" and FWD reverse recovery.	0.15	0.30	0.45	
Turn-On Delay Time	$t_{d(on)}$	$T_{vj} = 150^\circ\text{C}$	14	28	42	ns
Rise Time	$t_r$	$V_{CC} = 400 \text{ V}$	11	22	33	
Turn-Off Delay Time	$t_{d(off)}$	$I_C = 20 \text{ A}$	120	240	360	
Fall Time	$t_f$	$V_{GE} = 15 \text{ V}$	11	22	33	
Turn-On Energy	$E_{on}$	$R_G = 10 \Omega$	0.29	0.58	0.87	mJ
Turn-Off Energy	$E_{off}$	Energy loss include "tail" and FWD reverse recovery.	0.24	0.48	0.72	

## ● Thermal Resistance

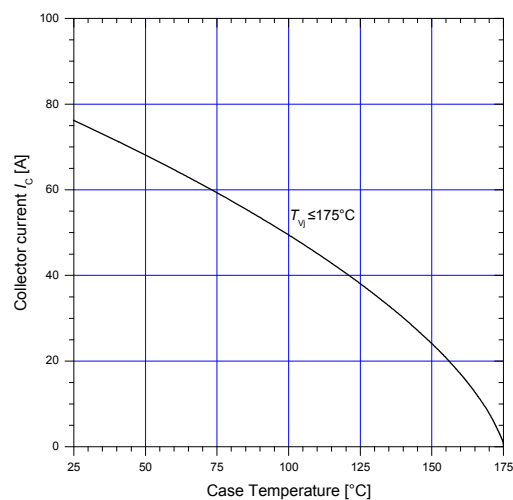
Parameter	Symbol	Min.	Typ.	Max.	Unit
Thermal Resistance, Junction-Ambient	$R_{th(j-a)}$	-	-	50	°C/W
Thermal Resistance, Junction to Case	$R_{th(j-c)}$	-	-	0.642	°C/W

## ■ Characteristics (Representative)

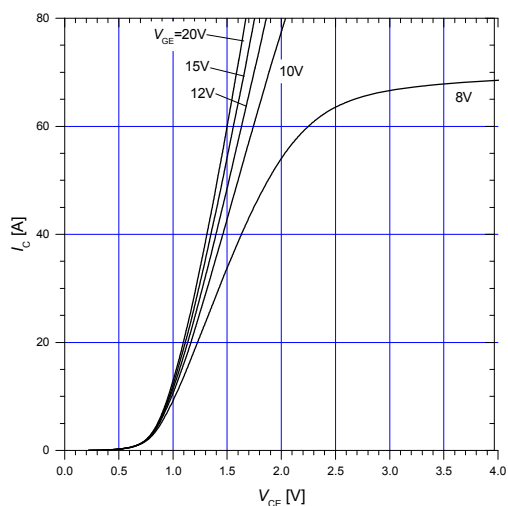
**Graph 1**  
IGBT Power Dissipation vs  $T_c$   
 $T_{vj} \leq 175^\circ\text{C}$



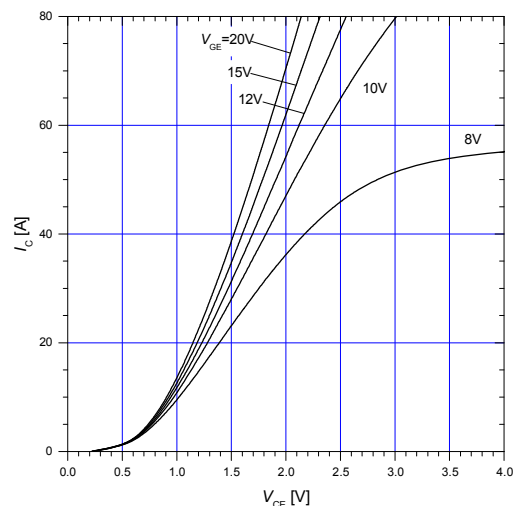
**Graph 2**  
DC Collector Current vs  $T_c$   
 $V_{GE} \geq +15\text{ V}$ ,  $T_{vj} \leq 175^\circ\text{C}$



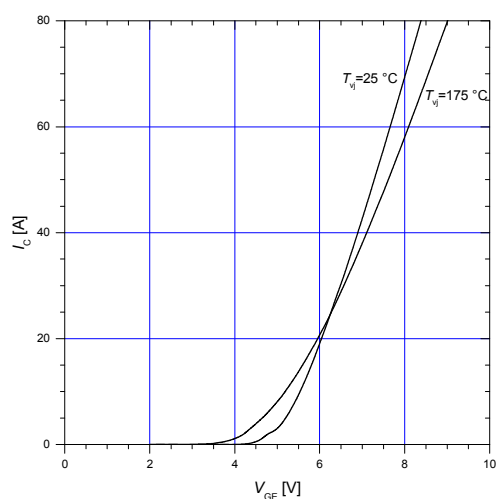
**Graph 3**  
Typical output characteristics  
 $T_{vj} = 25^\circ\text{C}$



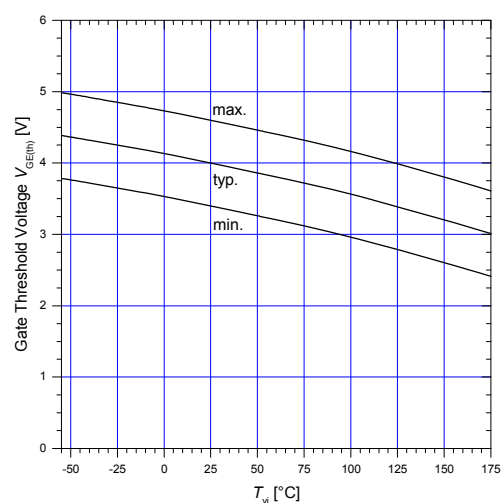
**Graph 4**  
Typical output characteristics  
 $T_{vj} = 175^\circ\text{C}$



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

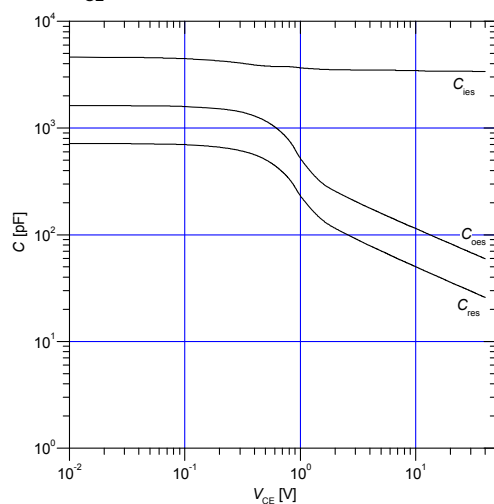


**Graph 6**  
Gate threshold voltage  
 $I_C = 40\text{ mA}$ ,  $V_{CE} = 20\text{ V}$



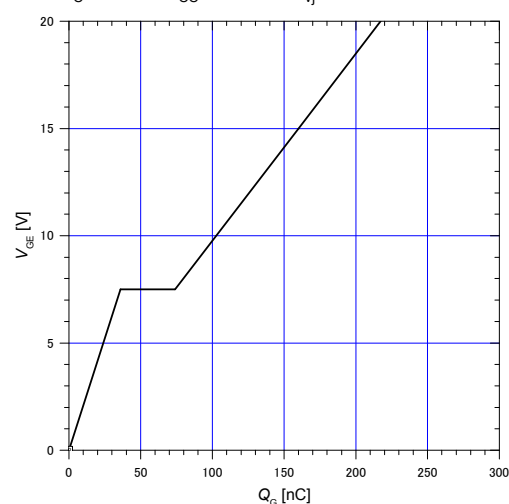
**Graph 7**  
Typical capacitance

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



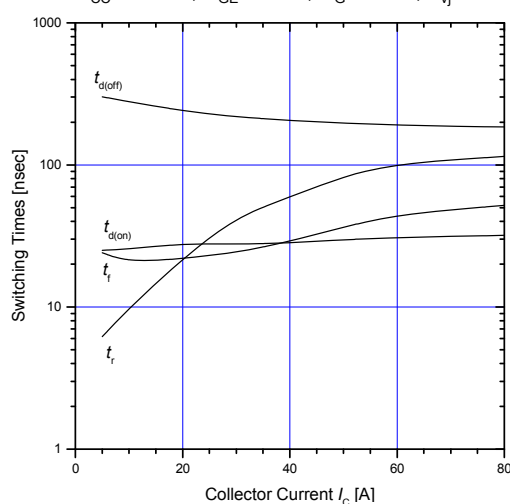
**Graph 8**  
Typical gate charge

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



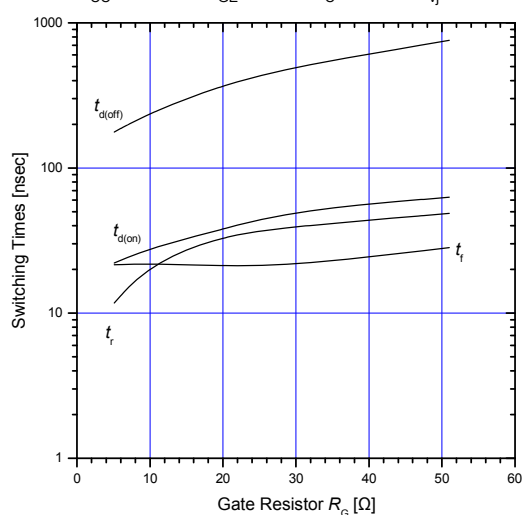
**Graph 9**  
Typical switching times vs.  $I_C$

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



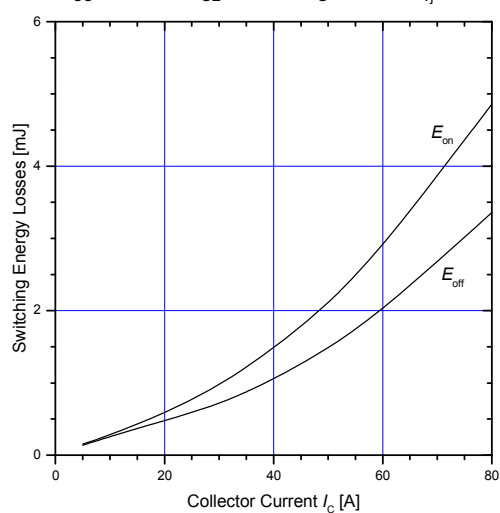
**Graph 10**  
Typical switching times vs.  $R_G$

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



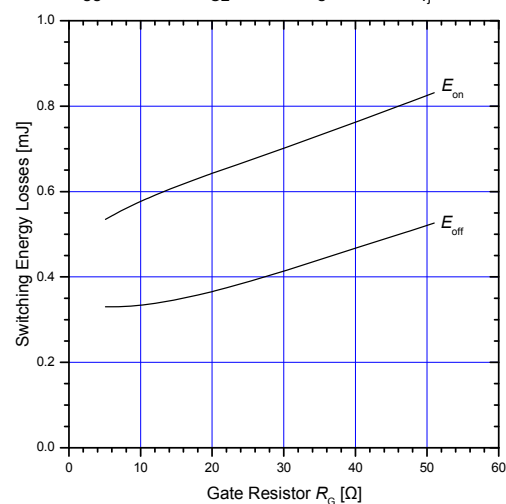
**Graph 11**  
Typical switching losses vs.  $I_C$

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



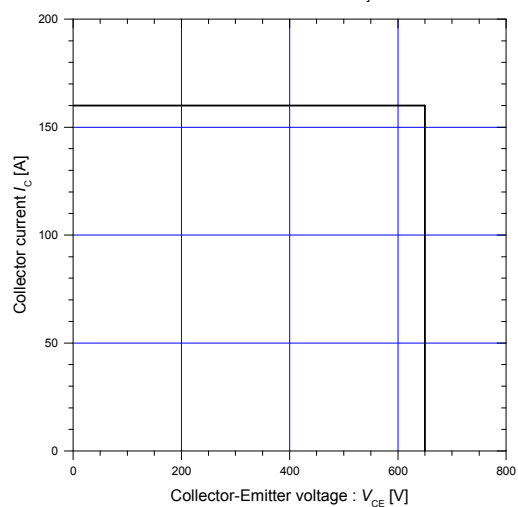
**Graph 12**  
Typical switching losses vs.  $R_G$

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



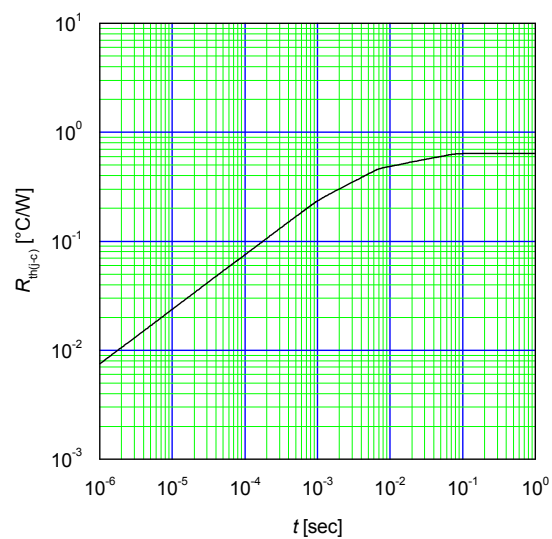
**Graph 13**  
**Reverse biased safe operating area**

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

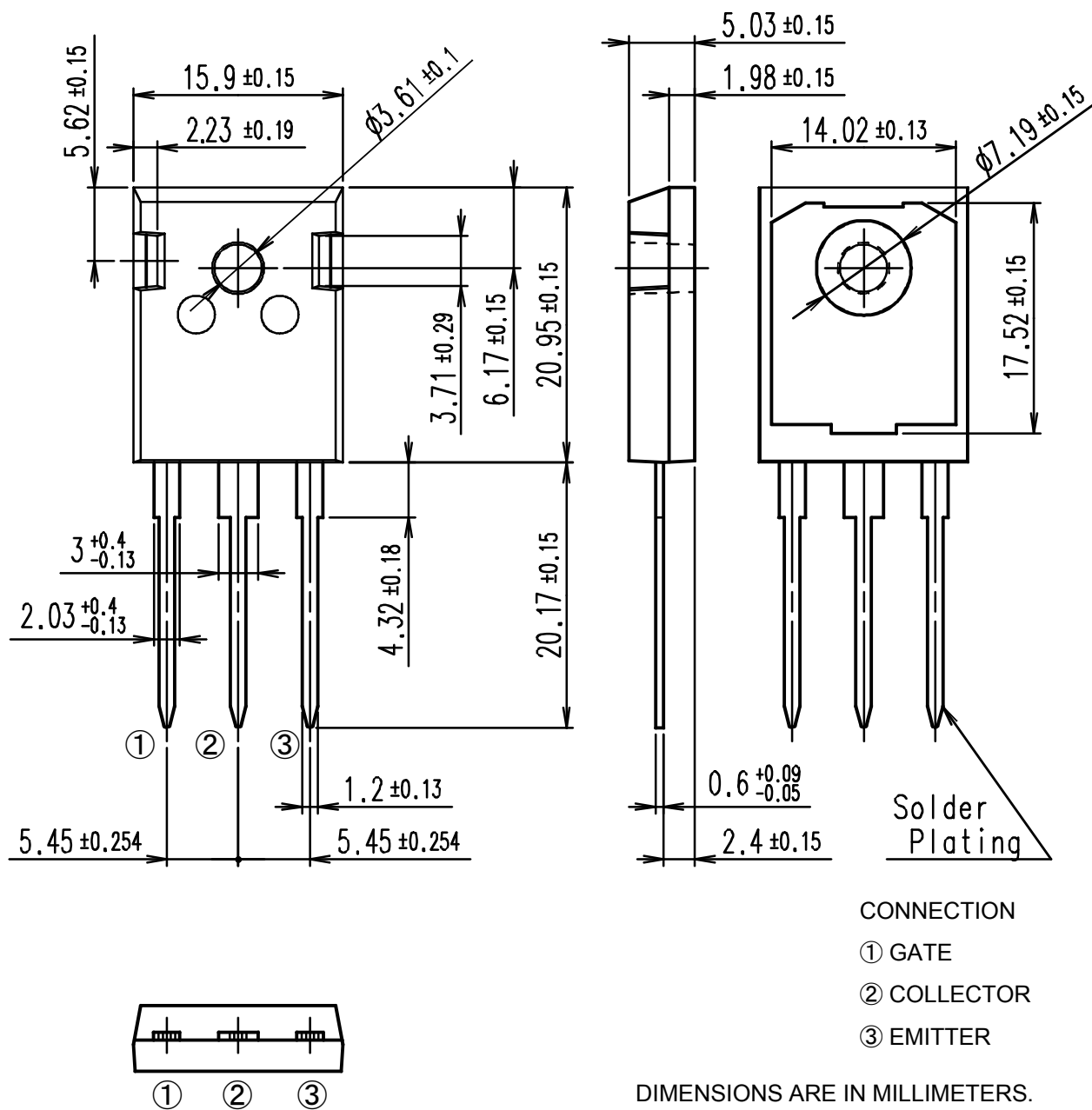


**Graph 14**  
**Transient Thermal Impedance**

$D = 0$



### ■ Outline Drawings, mm



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