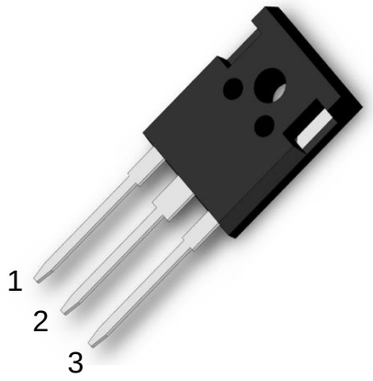
# MM60G3U65B

650V 60A IGBT

December 2019 Version 01 RoHS Compliant

## PRODUCT FEATURES

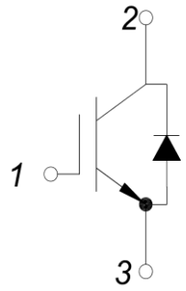
- ☐ 650V IGBT chip in trench FS-technology
- ☐ Low switching losses
- ☐ $V_{CE(sat)}$ with positive temperature coefficient
- ☐ Fast switching and short tail current
- ☐ Free wheeling diodes with fast and soft reverse recovery




## APPLICATIONS

- ☐ High frequency switching application
- ☐ Medical applications
- ☐ Motion/servo control
- ☐ UPS systems

1.Gate
2.Collector
3.Emitter




| Type | $V_{CES}$ | $I_C$ | $V_{CE(sat)}$ $T_J$=25°C | $T_{Jmax}$ | Marking | Package |
|---|---|---|---|---|---|---|
| MM60G3U65B | 650V | 60A | 1.8V | 175°C | MM60G3U65B | TO-247 |

ABSOLUTE MAXIMUM RATINGS($T_C$ *=25°C unless otherwise specified)*

| Symbol | Parameter/Test Conditions | | Values | Unit |
|---|---|---|---|---|
| $V_{CES}$ | Collector Emitter Voltage | $T_J$=25℃ | 650 | V |
| $V_{GES}$ | Gate Emitter Voltage | | ±20 | |
| $I_C$ | DC Collector Current | $T_C$=25℃ | 85 | A |
| | | $T_C$=90℃ | 60 | |
| $I_{Cpuls}$ | Pulsed collector current,tp limited by $T_{Jmax}$ | | 240 | |
| $P_{tot}$ | Power Dissipation Per IGBT | | 300 | W |
| $V_{RRM}$ | Repetitive Reverse Voltage | $T_J$=25℃ | 650 | V |
| $I_{F(AV)}$ | Average Forward Current | $T_C$=25℃ | 60 | A |
| $I_{Fpuls}$ | Diode pulsed current,tp limited by $T_{Jmax}$ | | 240 | |
| $T_{Jmax}$ | Max. Junction Temperature | | 175 | ℃ |
| $T_{Jop}$ | Operating Temperature | | -40~175 | |
| $T_{stg}$ | Storage Temperature | | -55~150 | |
| Torque | to heatsink | Recommended（M3） | 1.1 | Nm |
| Weight | | | 8 | g |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IGBT

ELECTRICAL CHARACTERISTICS *($T_C$=25°C unless otherwise specified)*

| Symbol | Parameter/Test Conditions | | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{GE(th)}$ | Gate Emitter Threshold Voltage | $V_{CE}=V_{GE}$, $I_C$=2.0mA | | 4.0 | 5.0 | 6.0 | V |
| $V_{CE(sat)}$ | Collector Emitter Saturation Voltage | $I_C$=60A, $V_{GE}$=15V, $T_J$=25℃ | | | 1.8 | 2.2 | |
| | | $I_C$=60A, $V_{GE}$=15V, $T_J$=125℃ | | | 2.05 | | |
| | | $I_C$=60A, $V_{GE}$=15V, $T_J$=150℃ | | | 2.2 | | |
| $I_{CES}$ | Collector Leakage Current | $V_{CE}$=650V, $V_{GE}$=0V, $T_J$=25℃ | | | | 100 | μA |
| | | $V_{CE}$=650V, $V_{GE}$=0V, $T_J$=150℃ | | | | 10 | mA |
| $I_{GES}$ | Gate Leakage Current | $V_{CE}$=0V,$V_{GE}$=±20V, $T_J$=25℃ | | -200 | | 200 | nA |
| $Q_g$ | Gate Charge | $V_{CE}$=400V, $I_C$=60A , $V_{GE}$=15V | | | 260 | | nC |
| $C_{ies}$ | Input Capacitance | $V_{CE}$=25V, $V_{GE}$=0V, f =1MHz | | | 4.9 | | nF |
| $C_{res}$ | Reverse Transfer Capacitance | | | | 145 | | pF |
| $t_{d(on)}$ | Turn on Delay Time | $V_{CC}$=400V,$I_C$=60A $R_G$ =7.5Ω, $V_{GE}$=±15V, Inductive Load | $T_J$=25℃ | | 25 | | ns |
| | | | $T_J$=125℃ | | 30 | | ns |
| | | | $T_J$=150℃ | | 30 | | ns |
| $t_r$ | Rise Time | | $T_J$=25℃ | | 28 | | ns |
| | | | $T_J$=125℃ | | 28 | | ns |
| | | | $T_J$=150℃ | | 30 | | ns |
| $t_{d(off)}$ | Turn off Delay Time | $V_{CC}$=400V,$I_C$=60A $R_G$ =7.5Ω, $V_{GE}$=±15V, Inductive Load | $T_J$=25℃ | | 130 | | ns |
| | | | $T_J$=125℃ | | 160 | | ns |
| | | | $T_J$=150℃ | | 170 | | ns |
| $t_f$ | Fall Time | | $T_J$=25℃ | | 38 | | ns |
| | | | $T_J$=125℃ | | 38 | | ns |
| | | | $T_J$=150℃ | | 42 | | ns |
| $E_{on}$ | Turn on Energy | $V_{CC}$=400V,$I_C$=60A $R_G$ =7.5Ω, $V_{GE}$=±15V, Inductive Load | $T_J$=125℃ | | 1.26 | | mJ |
| | | | $T_J$=150℃ | | 1.45 | | mJ |
| $E_{off}$ | Turn off Energy | | $T_J$=125℃ | | 1.04 | | mJ |
| | | | $T_J$=150℃ | | 1.12 | | mJ |
| $R_{thJC}$ | Junction to Case Thermal Resistance （ Per IGBT） | | | | | 0.5 | K /W |

Anti-Parallel Diode

ELECTRICAL CHARACTERISTICS *($T_C$=25°C unless otherwise specified)*

| Symbol | Parameter/Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | $I_F$=60A , $V_{GE}$=0V, $T_J$=25℃ | | 1.9 | 2.4 | V |
| | | $I_F$=60A , $V_{GE}$=0V, $T_J$=125℃ | | 1.7 | | |
| | | $I_F$=60A , $V_{GE}$=0V, $T_J$=150℃ | | 1.65 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$=60A , $V_R$=400V $dI_F/dt$=-2000A/μs $T_J$ =150℃ | | 130 | | ns |
| $I_{RRM}$ | Max. Reverse Recovery Current | | | 51 | | A |
| $Q_{RR}$ | Reverse Recovery Charge | | | 3.5 | | μC |
| $E_{rec}$ | Reverse Recovery Energy | | | 1.1 | | mJ |
| $R_{thJCD}$ | Junction to Case Thermal Resistance （ Per Diode） | | | | 1.05 | K /W |

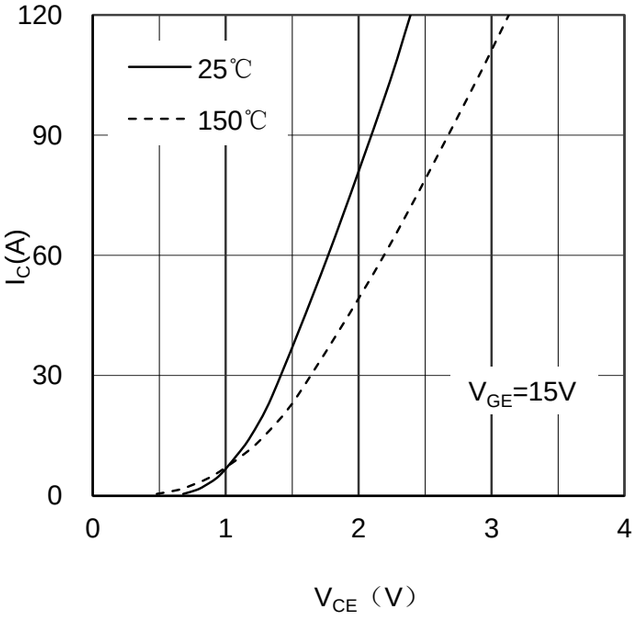



Figure 1. Typical Output Characteristics IGBT

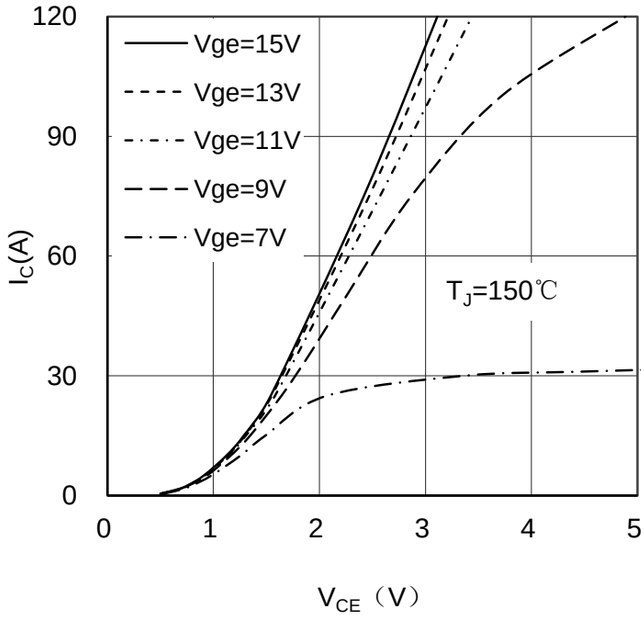



Figure 2. Typical Output Characteristics IGBT

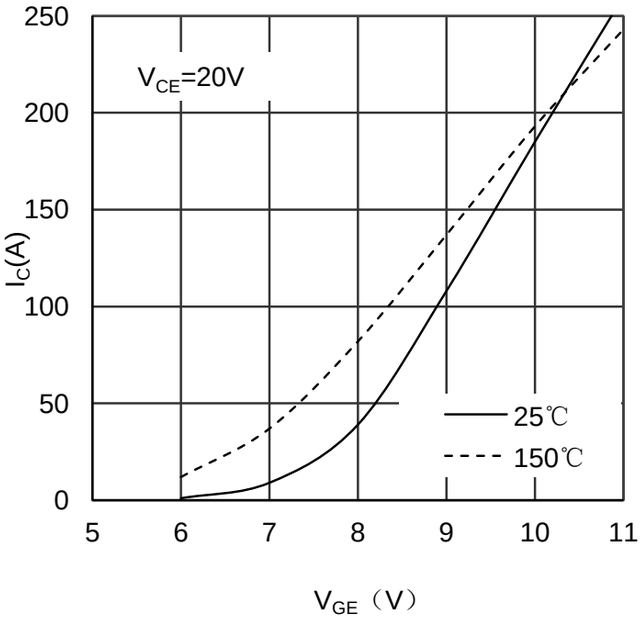



Figure 3. Typical Transfer characteristics IGBT

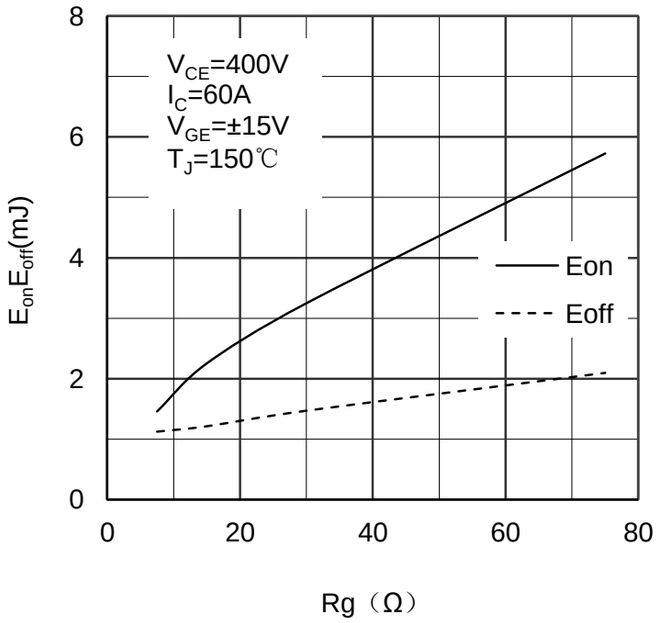



Figure 4. Switching Energy vs Gate Resistor IGBT

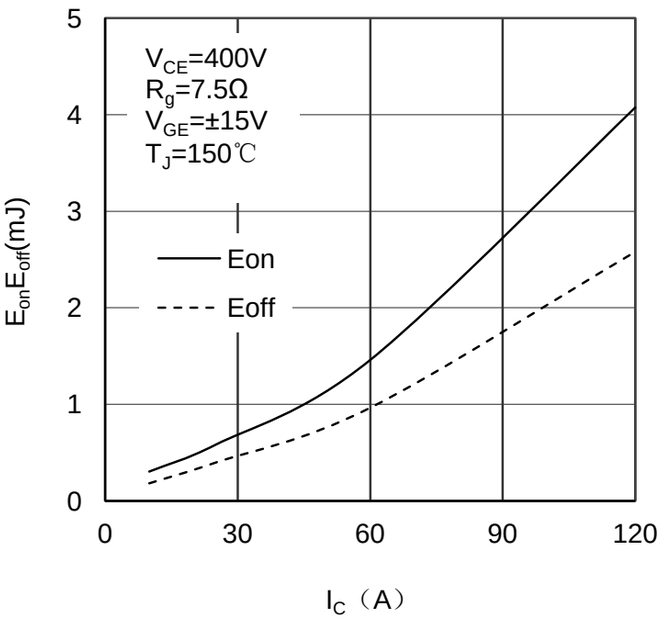



Figure 5. Switching Energy vs Collector Current IGBT

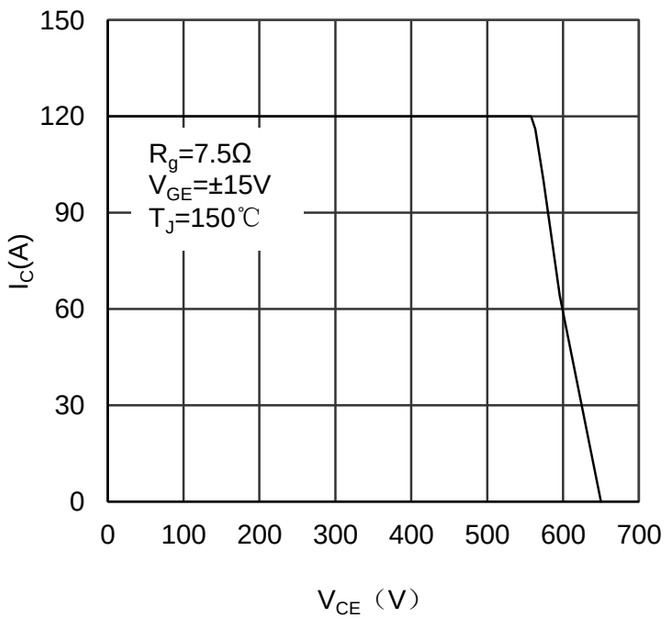



Figure 6. Reverse Biased Safe Operating Area IGBT

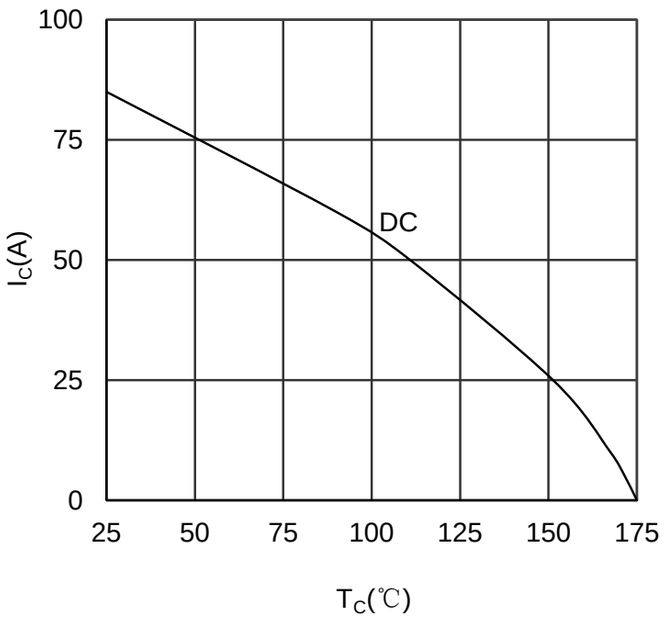



Figure 7. Collector Current vs Case temperature IGBT

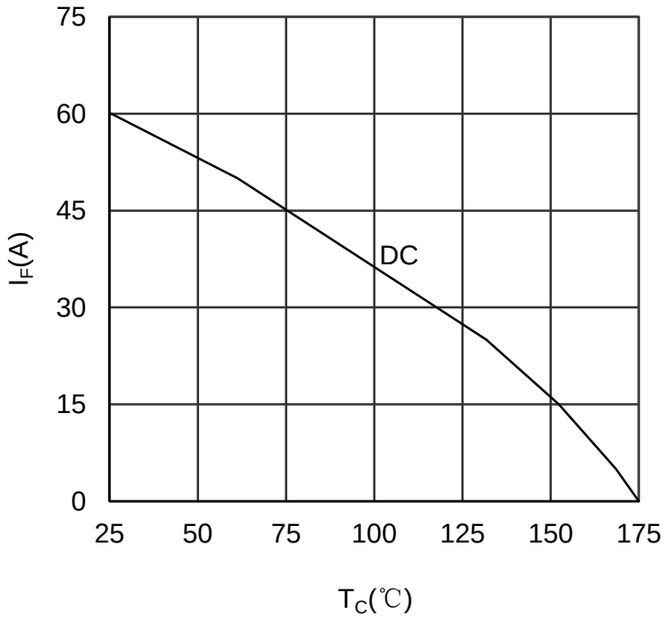



Figure 8. Forward current vs Case temperature Diode

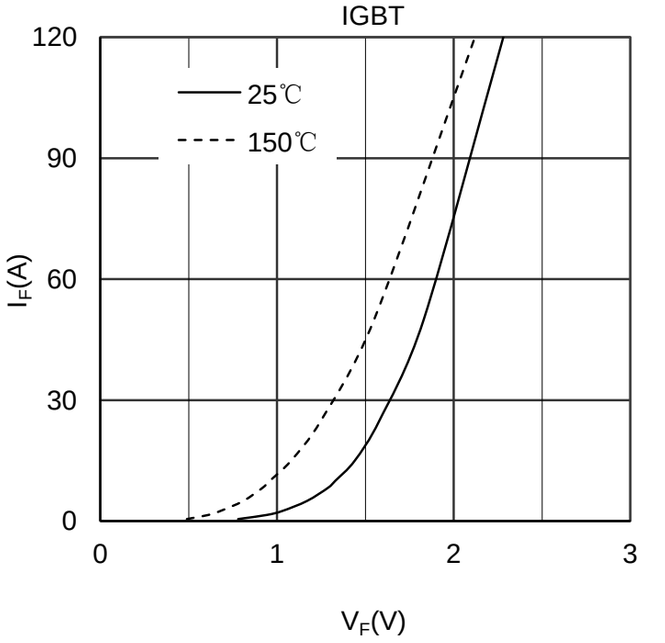



Figure 9. Diode Forward Characteristics Diode

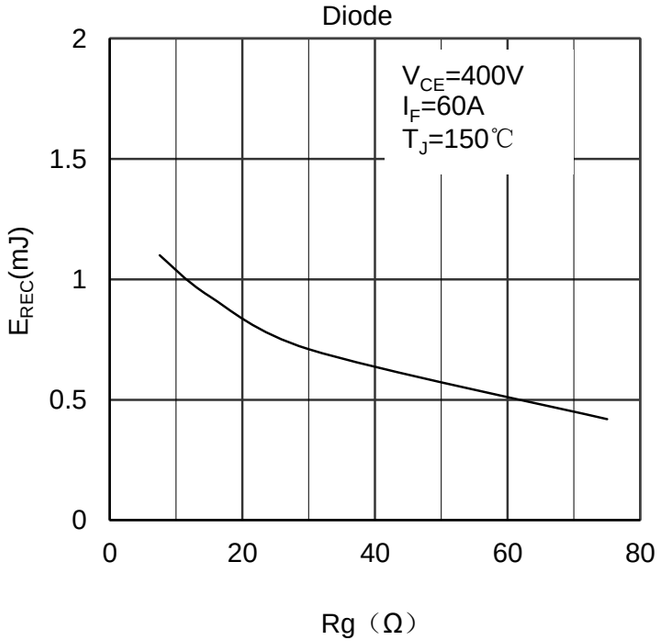



Figure 10. Switching Energy vs Gate Resistor Diode

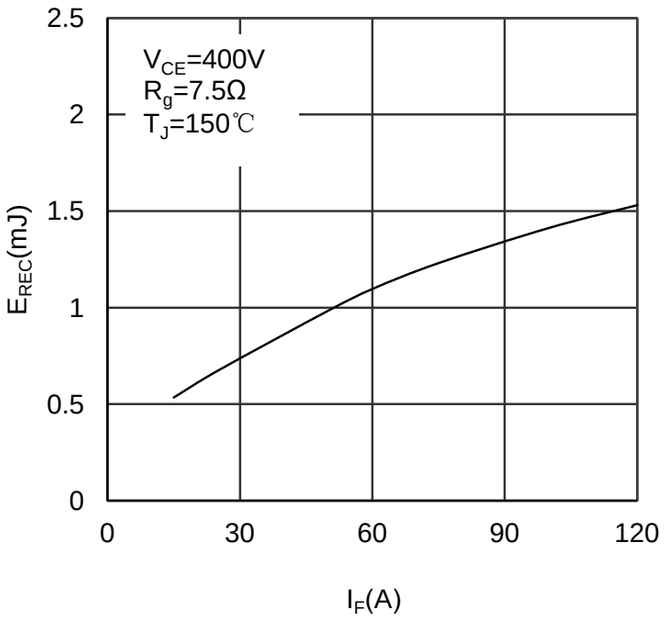



Figure 11. Switching Energy vs Forward Current Diode

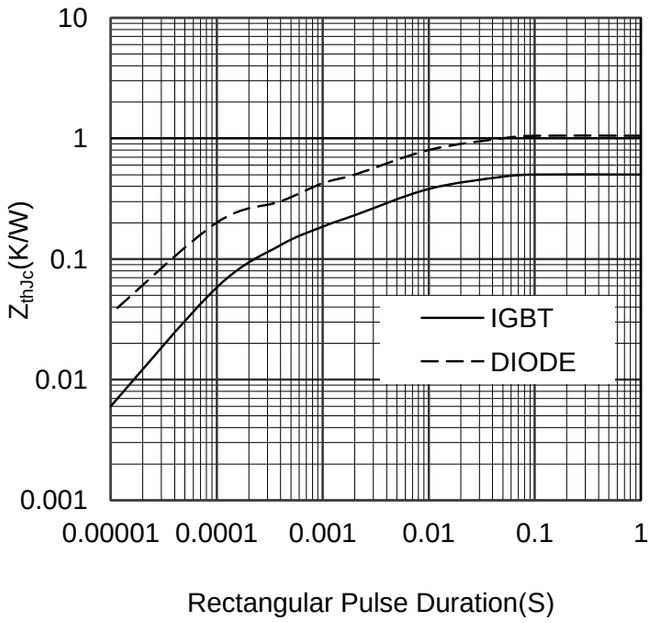
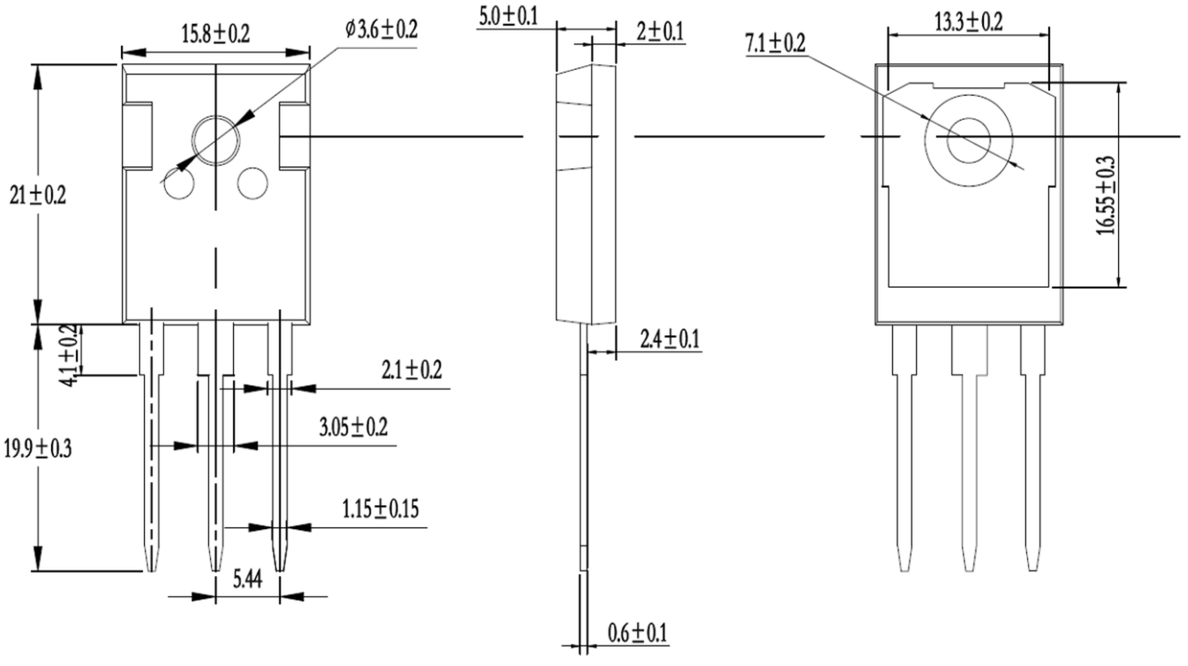



Figure 12. Transient Thermal Impedance of Diode and IGBT




Dimensions in (mm)

Figure 13. Package Outline