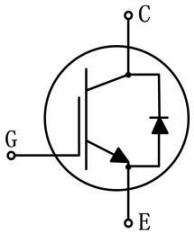
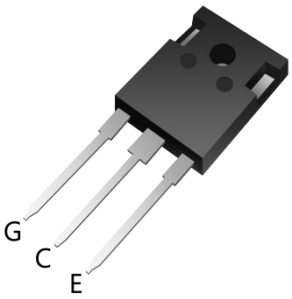
# Trench Field-stop IGBT Discrete

| Parameter | Value | Unit |
|---|---|---|
| $V_{CE}$ | 650 | V |
| $I_C$ | 20 | A |
| $V_{CE(sat)}$ | 1.75 | V |




TO-247-3L

## Features

- Positive temperature coefficient
- Fast Switching
- Low $V_{CE(sat)}$
- Reliable and Rugged

## Applications

- Motor drives
- Air Condition
- Inverters

## Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Collector-emitter voltage | $V_{CES}$ | 650 | V |
| Gate-emitter voltage | $V_{GES}$ | ±30 | V |
| Continuous collector current($T_C$=25℃) | $I_C$ | 40 | A |
| Continuous collector current($T_C$=100℃) | | 20 | A |
| Pulsed collector current,tp limited by $T_{vjmax}$ | $I_{CM}$ | 60 | A |
| Diode continuous forward current($T_C$=25℃) | $I_F$ | 40 | A |
| Diode continuous forward current($T_C$=100℃) | | 20 | A |
| Diode maximum current,tp limited by $T_{vjmax}$ | $I_{FM}$ | 60 | A |
| Short circuit withstand time | $t_{sc}$ | 10 | μs |
| Power dissipation($T_C$=25℃) | $P_{tot}$ | 176 | W |
| Operating junction temperature range | $T_{vj}$ | -55 to+175 | ℃ |
| Storage temperature range | $T_{stg}$ | -55 to+150 | ℃ |

## Thermal Characteristics

| Parameter | Symbol | Value | | Unit |
|---|---|---|---|---|
| | | Typ | Max. | |
| Thermal resistance,junction to case for IGBT | $R_{th(j-c)}$ | - | 0.85 | ℃/W |
| Thermal resistance,junction to case for Diode | $R_{th(j-c)}$ | - | 0.98 | ℃/W |
| Thermal resistance,junction to ambient | $R_{th(j-a)}$ | - | 40 | ℃/W |

## Electrical Characteristics of IGBT ($T_{vj}$=25℃ unless otherwise specified)

### Static characteristics

| Parameter | Symbol | Test condition | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Collector-emitter breakdown voltage | $B_{VCES}$ | $V_{GE}$=0V,$I_C$=250μA | 650 | - | - | V |
| Collector-emitter leakage current | $I_{CES}$ | $V_{CE}$=650V,$V_{GE}$=0V | - | - | 10 | μA |
| Gate leakage current,forward | $I_{GES}$ | $V_{GE}$=±20V,$V_{CE}$=0V | - | - | ±200 | nA |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $V_{GE}$=$V_{CE}$,$I_C$=1mA | 4.3 | 5.3 | 6.3 | V |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $V_{GE}$=15V,$I_C$=20A | - | 1.75 | 2.05 | V |
| | | $V_{GE}$=15V,$I_C$=20A,$T_{vj}$=175℃ | - | 1.98 | - | V |

### Dynamic Characteristics

| Parameter | Symbol | Test condition | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Input capacitance | $C_{ies}$ | $V_{CE}$=25V<br>$V_{GE}$=0V<br>f=1MHz | - | 780 | - | pF |
| Output capacitance | $C_{oes}$ | | - | 46 | - | pF |
| Reverse transfer capacitance | $C_{res}$ | | - | 22 | - | pF |
| Total gate charge | $Q_g$ | $V_{CC}$=520V<br>$V_{GE}$=15V<br>$I_C$=10A | - | 45 | - | nC |
| Gate-emitter charge | $Q_{ge}$ | | - | 9 | - | nC |
| Gate-collector charge | $Q_{gc}$ | | - | 22 | - | nC |

### Switching Characteristics

| Parameter | Symbol | Test condition | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}$=400V<br>$V_{GE}$=15V<br>$I_C$=20A<br>$R_G$=5Ω<br>Inductive load | - | 12 | - | ns |
| Rise time | $t_r$ | | - | 24 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 40 | - | ns |
| Fall time | $t_f$ | | - | 68 | - | ns |
| Turn-on energy | $E_{on}$ | | - | 0.26 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 0.39 | - | mJ |
| Total switching energy | $E_{ts}$ | | - | 0.65 | - | mJ |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}$=400V<br>$V_{GE}$=15V<br>$I_C$=20A<br>$R_G$=5Ω<br>Inductive load<br>$T_{vj}$=150℃ | - | 14 | - | ns |
| Rise time | $t_r$ | | - | 32 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 81 | - | ns |
| Fall time | $t_f$ | | - | 60 | - | ns |
| Turn-on energy | $E_{on}$ | | - | 0.4 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 0.57 | - | mJ |
| Total switching energy | $E_{ts}$ | | - | 0.97 | - | mJ |

## Diode Characteristics

| Parameter | Symbol | Test condition | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Diode forward voltage | $V_F$ | $I_F$=20A | - | 1.46 | 1.76 | V |
| | | $I_F$=20A,$T_{vj}$=175℃ | - | 1.3 | - | V |
| Diode reverse recovery time | $t_{rr}$ | $V_R$=400V<br>$I_F$=20A<br>diF/dt=200A/μs | - | 47 | - | ns |
| Diode peak reverse recovery current | $I_{rrm}$ | | - | 4.8 | - | A |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 67 | - | nC |
| Diode reverse recovery time | $t_{rr}$ | $V_R$=400V<br>$I_F$=20A<br>diF/dt=200A/μs $T_{vj}$=175℃ | - | 62 | - | ns |
| Diode peak reverse recovery current | $I_{rrm}$ | | - | 6.3 | - | A |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 1.0 | - | nC |

## Typical Characteristics

**Figure 1: Power Dissipation**

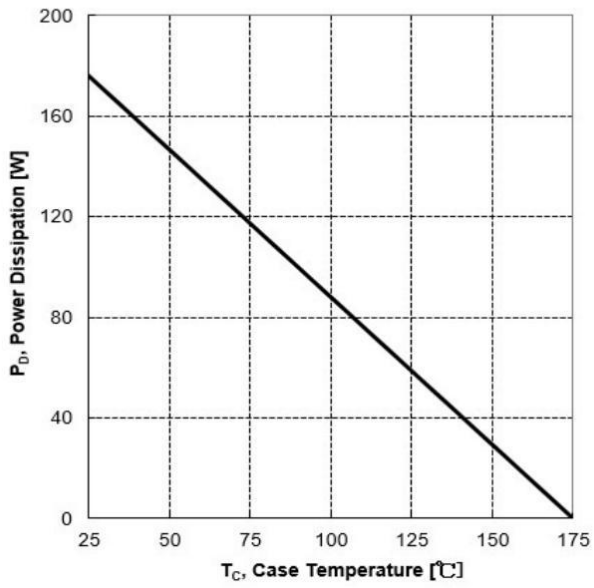



**Figure 2: Collector Current vs. Case Temperature**

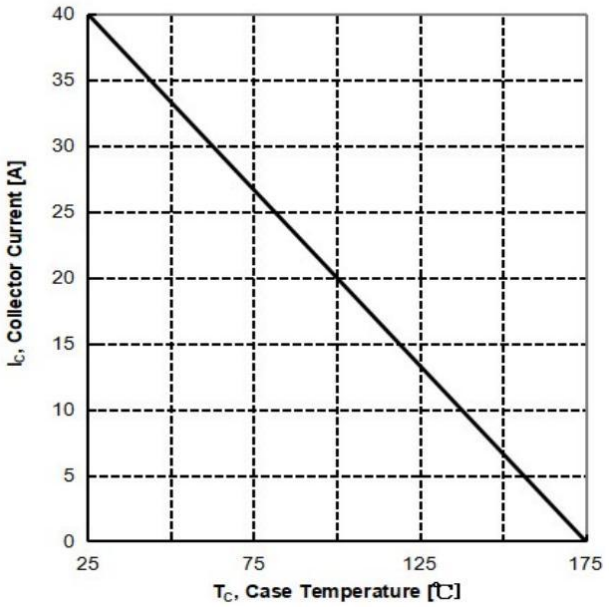


**Figure 3: Safe Operation Area**

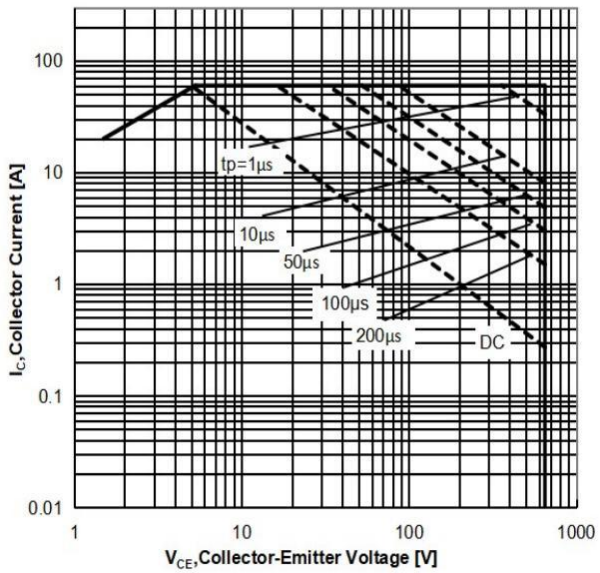



**Figure 4: Typical Transfer Characteristics**

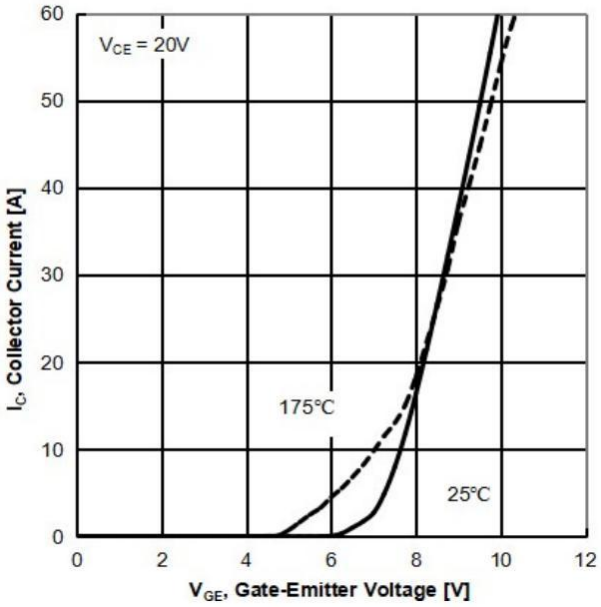



**Figure 5: Typical Output Characteristics**

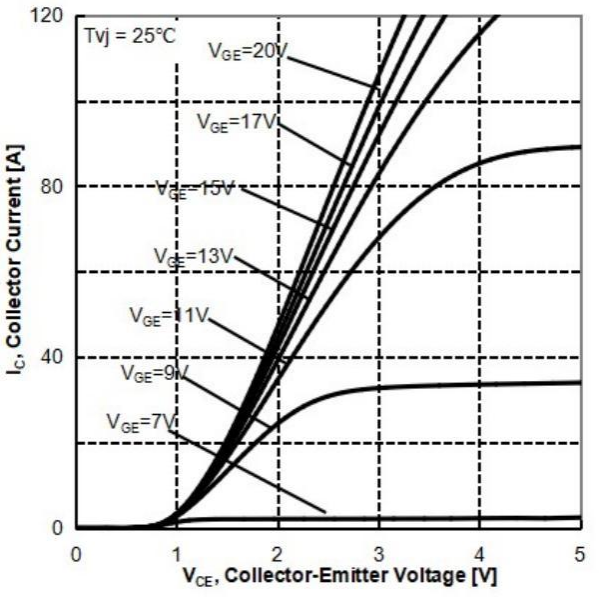



**Figure 6: Typical Output Characteristics**

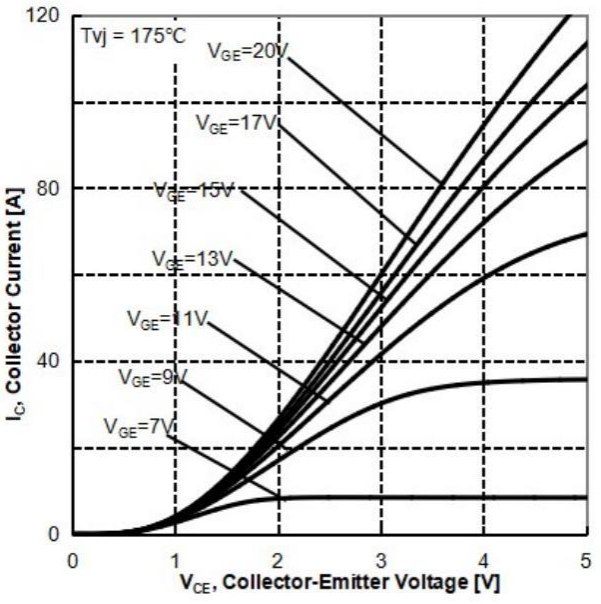


**Figure 7: Typical Collector-Emitter Saturation Voltage vs. Junction Temperature**

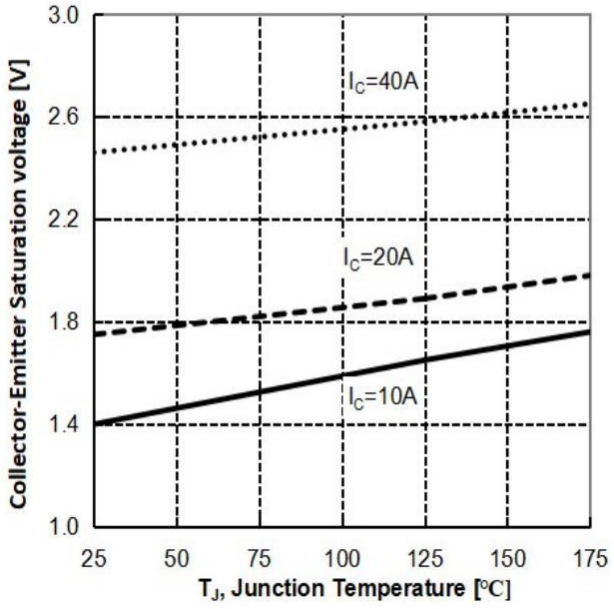



**Figure 8: Typical Gate-Emitter Threshold Voltage vs. Junction Temperature**

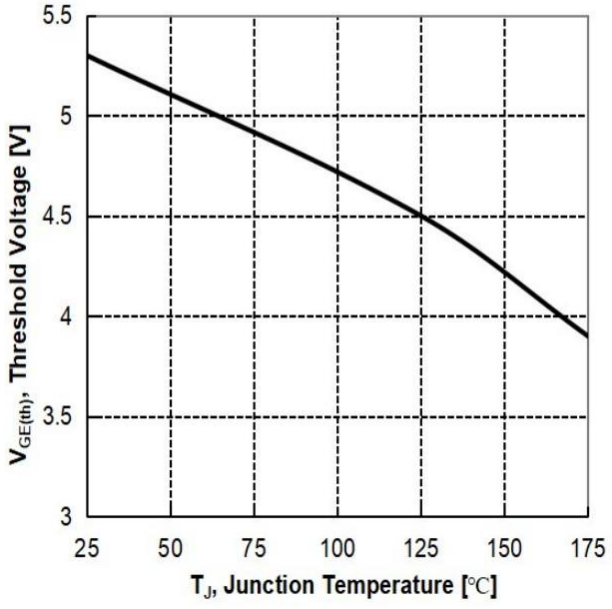



**Figure 9: Typical Switching Times vs. Gate Resistor ($T_J$=25℃, $V_{CE}$=400V, $V_{GE}$=15V, $I_C$=20A)**

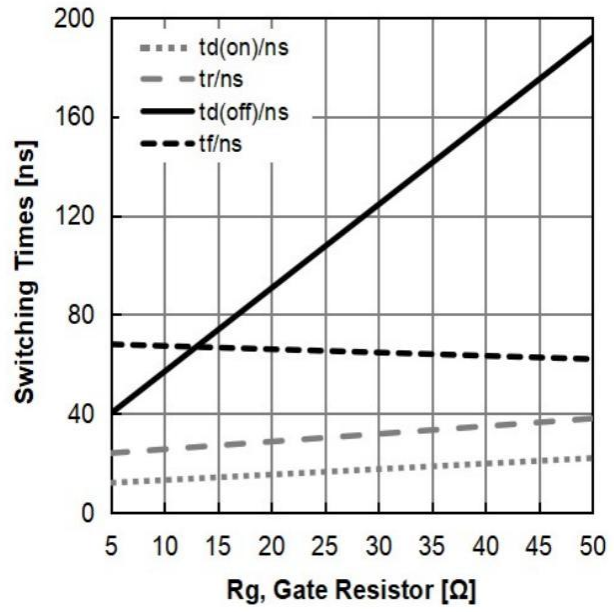



**Figure 10: Typical Switching Energy vs. Gate Resistor ($T_J$=25℃, $V_{CE}$=400V, $V_{GE}$=15V, $I_C$=20A)**

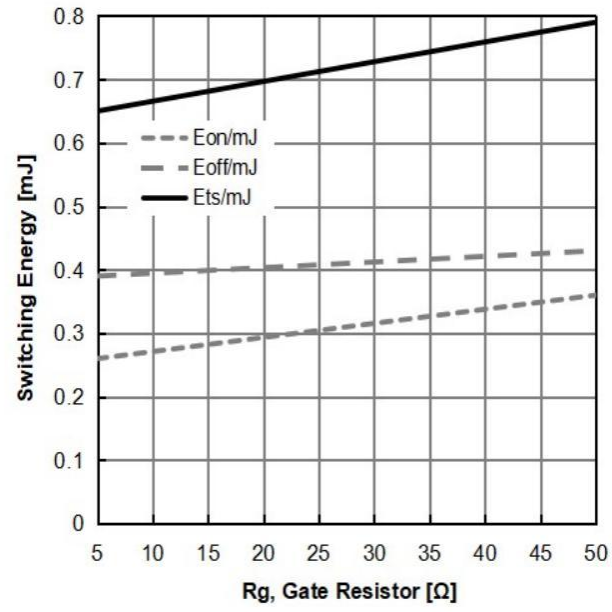


**Figure 11: Typical Switching Times vs. Junction Temperature ( $V_{CE}$=400V, $V_{GE}$=15V, $I_C$=20A,Rg=5Ω)**

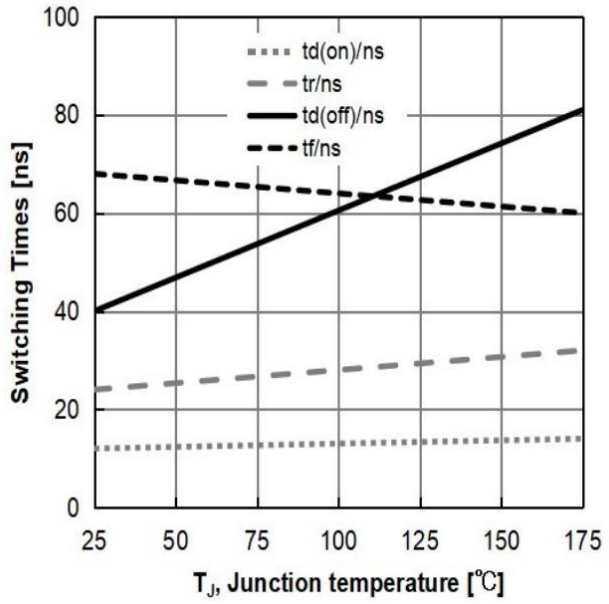



**Figure 12: Typical Switching Energy vs. Junction Temperature ($V_{CE}$=400V, $V_{GE}$=15V, $I_C$=20A,Rg=5Ω)**

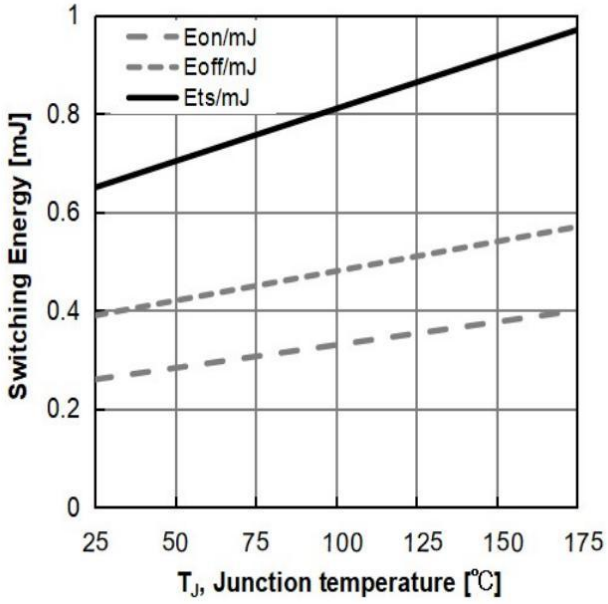



**Figure 13: Typical Switching Times vs. Collector Current ($T_J$=25℃, $V_{CE}$=400V, $V_{GE}$=15V,Rg=5Ω)**

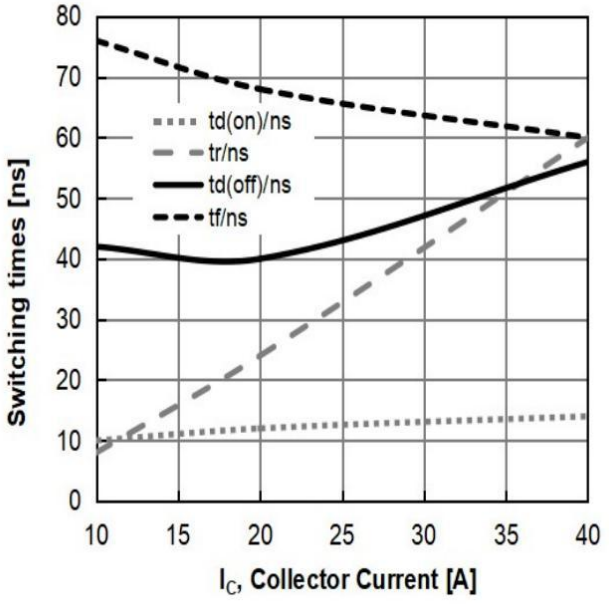



**Figure 14: Typical Switching Energy vs. Collector Current ($T_J$=25℃, $V_{CE}$=400V, $V_{GE}$=15V,Rg=5Ω)**

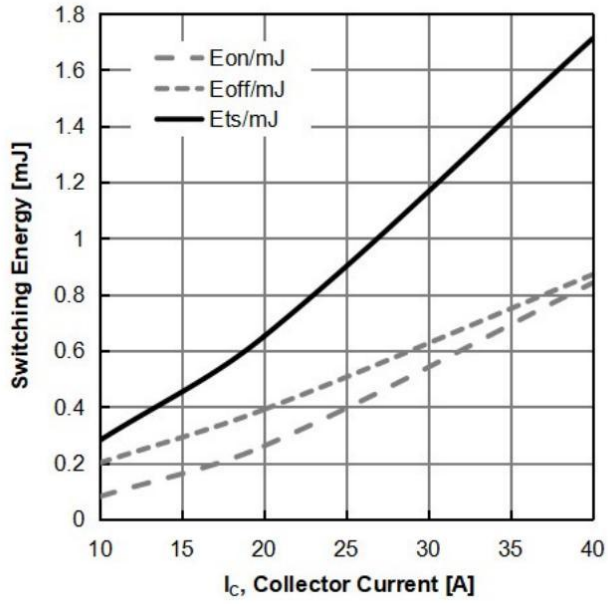


**Figure 15: Typical Switching Times vs. VCE ( $T_J$=25℃, $V_{GE}$=15V, $I_C$=20A,Rg=5Ω)**

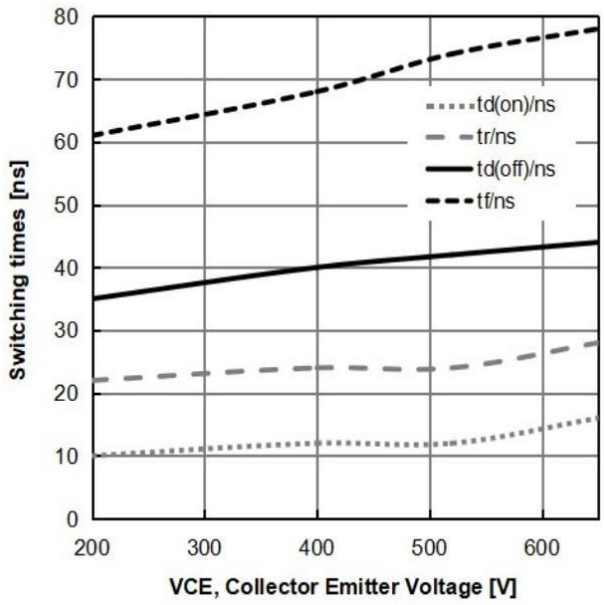



**Figure 16: Typical Switching Energy vs. VCE ( $T_J$=25℃, $V_{GE}$=15V, $I_C$=20A,Rg=5Ω)**

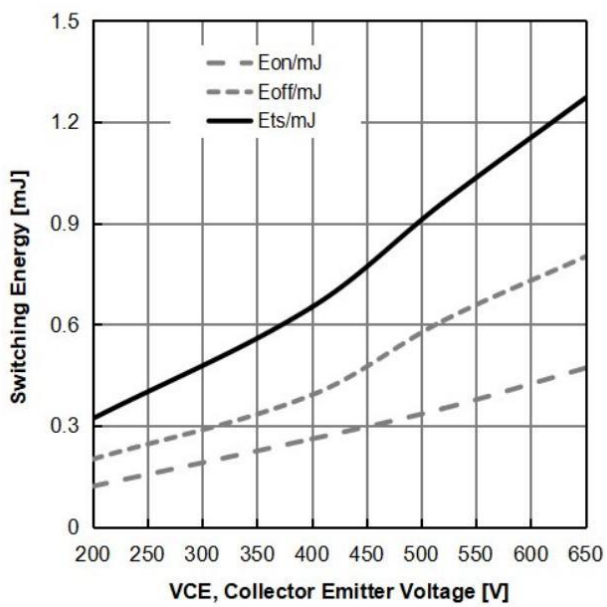



**Figure 17: Typical Capacitance vs. Collector- Emitter Voltage**

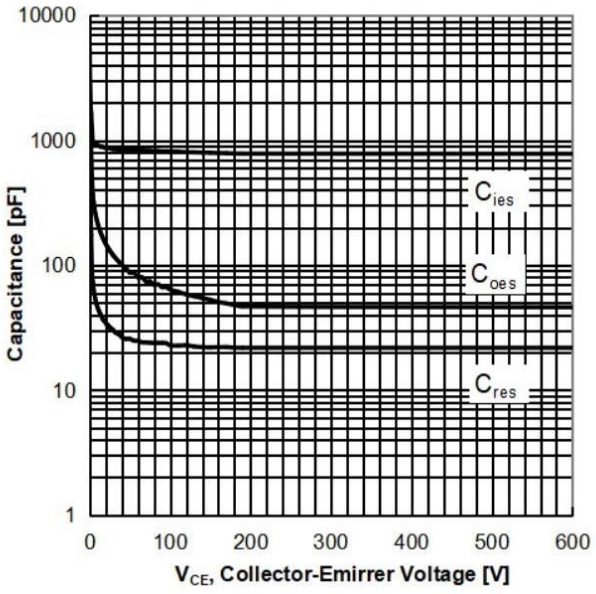



**Figure 18: Typical Gate Charge**

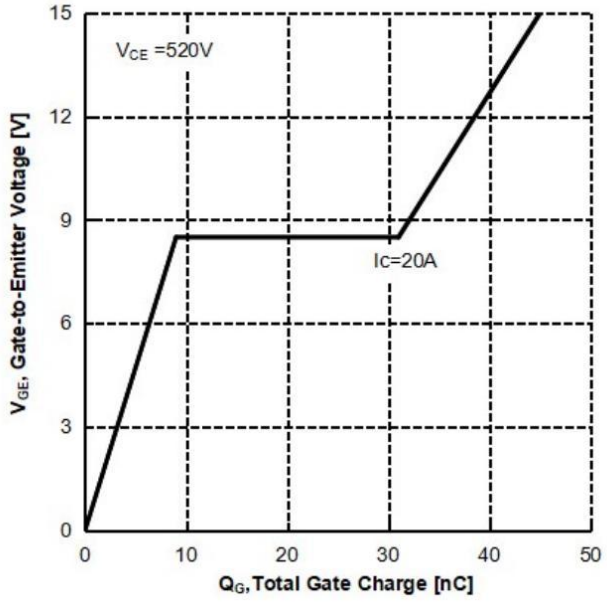


**Figure 19: IGBT Transient Thermal Impedance vs. Pulse Width**

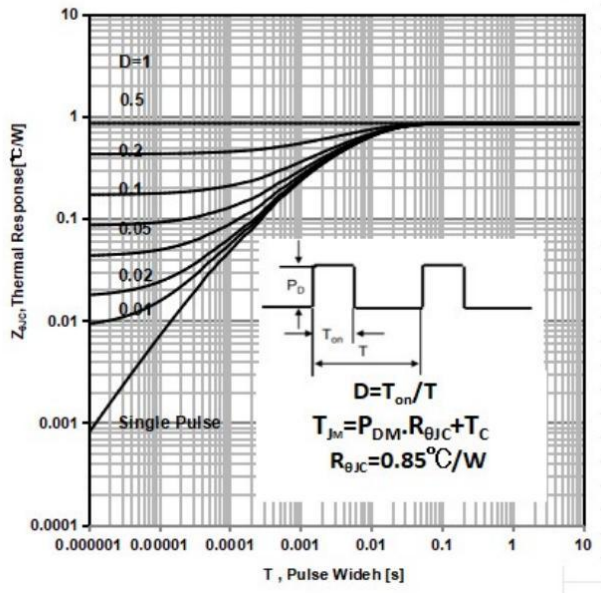



**Figure 20: Diode Transient Thermal Impedance vs. Pulse Width**

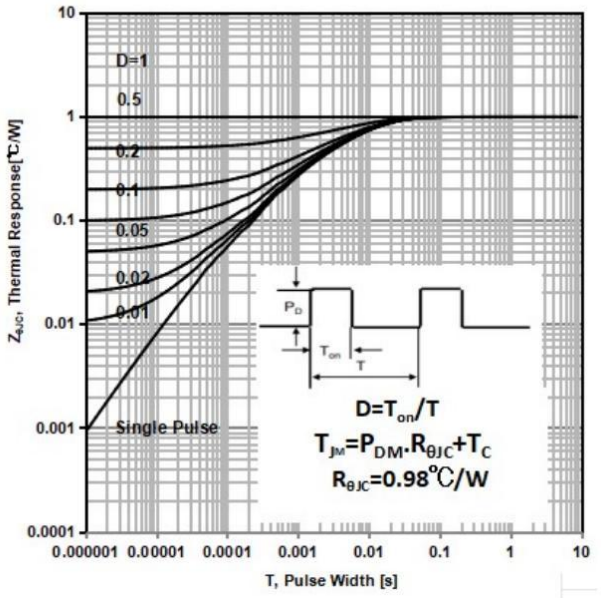
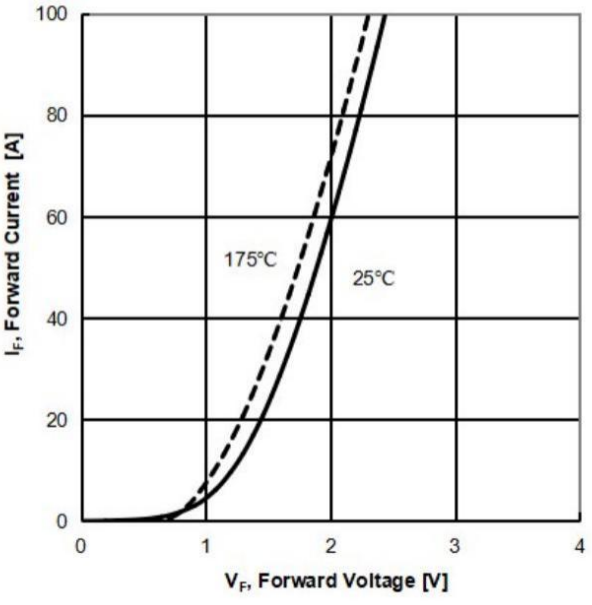
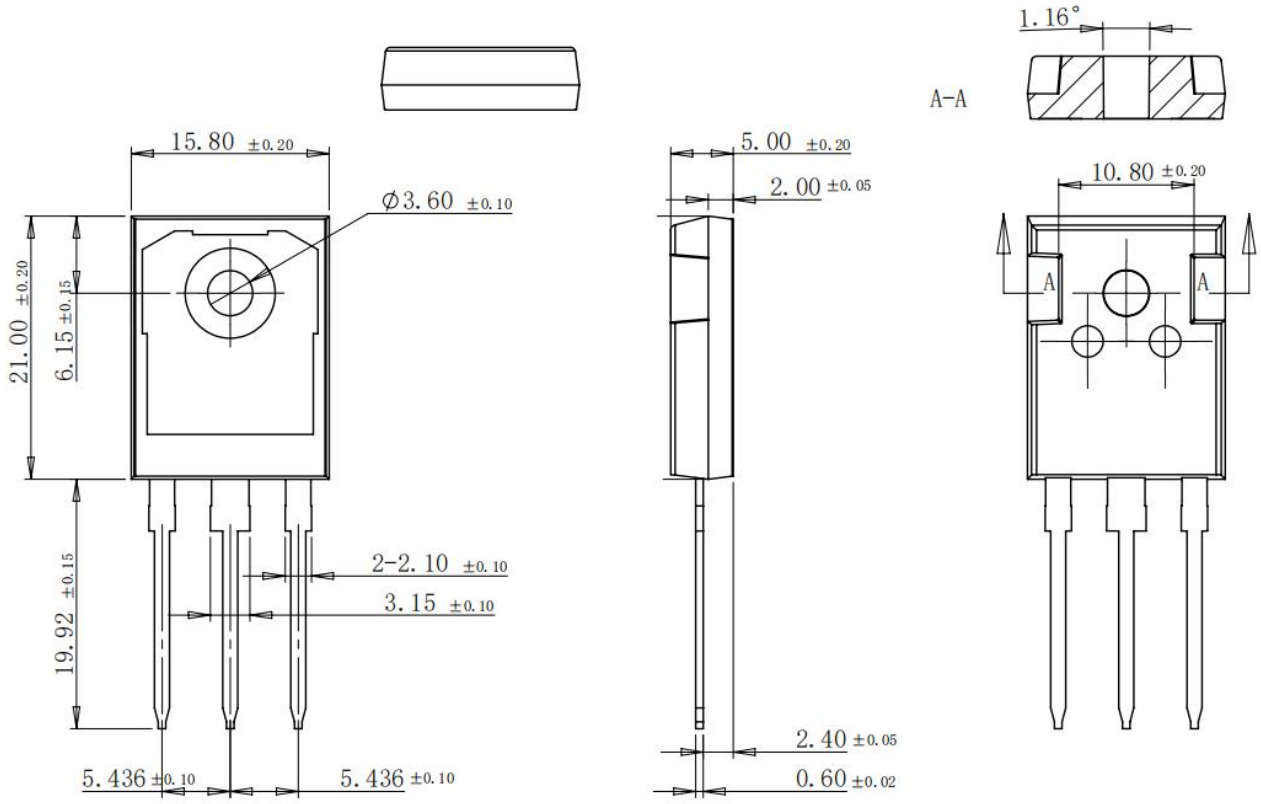



**Figure 21: Typical Diode Forward Current vs. Forward Voltage**



## Package Outlines (Unit：mm)

### TO-247-3L

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