# IGBT - Field Stop, Trench

## 650 V, 75 A

# FGH75T65SQD

**Description**

Using novel field stop IGBT technology, ON Semiconductor's new series of field stop 4th generation IGBTs offer the optimum performance for solar inverter, UPS, Welder, Telecom, ESS and PFC applications where low conduction and switching losses are essential.

**Features**

- Maximum Junction Temperature : $T_J$ =175°C
- Positive Temperature Co−efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)}$ =1.6 V(Typ.) @ $I_C$ = 75 A
- 100% of the Parts Tested for $I_{LM}$(1)
- High Input Impedance
- Fast Switching
- Tighten Parameter Distribution
- These Devices are Pb−Free and are RoHS Compliant

**Applications**

- Solar Inverter, UPS, Welder, Telecom, ESS, PFC

**ON Semiconductor®**

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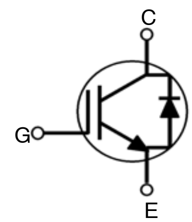
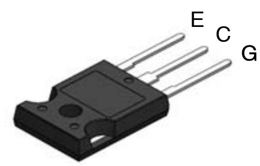
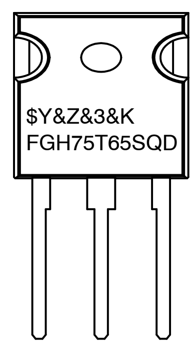



**TO−247−3LD**
**CASE 340CH**

**MARKING DIAGRAM**




| | |
|---|---|
| $Y | = ON Semiconductor Logo |
| &Z | = Assembly Plant Code |
| &3 | = Numeric Date Code |
| &K | = Lot Code |
| FGH75T65SQD | = Specific Device Code |

**ORDERING INFORMATION**

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

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

| Description | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Collector to Emitter Voltage | | $V_{CES}$ | 650 | V |
| Gate to Emitter Voltage | | $V_{GES}$ | ±20 | V |
| Transient Gate to Emitter Voltage | | | ±30 | V |
| Collector Current | $T_C$ = 25°C | $I_C$ | 150 | A |
| Collector Current | $T_C$ = 100°C | | 75 | A |
| Pulsed Collector Current | $T_C$ = 25°C | $I_{LM}$ (Note 1) | 300 | A |
| Pulsed Collector Current | | $I_{CM}$ (Note 2) | 300 | A |
| Diode Forward Current | $T_C$ = 25°C | $I_F$ | 75 | A |
| Diode Forward Current | $T_C$ = 100°C | | 50 | A |
| Pulsed Diode Maximum Forward Current | | $I_{FM}$ (Note 2) | 300 | A |
| Maximum Power Dissipation | $T_C$ = 25°C | $P_D$ | 375 | W |
| Maximum Power Dissipation | $T_C$ = 100°C | | 188 | W |
| Operating Junction Temperature | | $T_J$ | −55 to +175 | °C |
| Storage Temperature Range | | $T_{stg}$ | −55 to +175 | °C |
| Maximum Lead Temp. for soldering Purposes, 1/8” from case for 5 seconds | | $T_L$ | 300 | °C |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. $V_{CC}$ = 400 V,$V_{GE}$ = 15 V, $I_C$ = 300 A, $R_G$ = 3 Ω , Inductive Load
2. Repetive rating: Pulse width limited by max. junction temperature.

**THERMAL CHARACTERISTICS**

| Parameter | Symbol | FGH75T65SQD−F155 | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$(IGBT) | 0.4 | °C/W |
| Thermal Resistance, Junction to Case | $R_{\theta JC}$(Diode) | 0.65 | °C/W |
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | 40 | °C/W |

**PACKAGE MARKING AND ORDERING INFORMATION**

| Part Number | Top Mark | Package | Packing Method | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|---|
| FGH75T65SQD−F155 | FGH75T65SQD | TO−247−3 (Pb−Free) | Tube | − | − | 30 |

**ELECTRICAL CHARACTERISTICS OF THE IGBT** ($T_C$ = 25°C unless otherwise noted)

| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| Collector to Emitter Breakdown Voltage | $BV_{CES}$ | $V_{GE}$ = 0 V, $I_C$ = 1 mA | 650 | − | − | V |
| Temperature Coefficient of Breakdown Voltage | $\Delta BV_{CES}/\Delta T_J$ | $I_C$ = 1 mA, Reference to 25°C | − | 0.6 | − | V/°C |
| Collector Cut−Off Current | $I_{CES}$ | $V_{CE}$ = $V_{CES}$, $V_{GE}$ = 0 V | − | − | 250 | μA |
| G−E Leakage Current | $I_{GES}$ | $V_{GE}$ = $V_{GES}$, $V_{CE}$ = 0 V | − | − | ±400 | nA |
| **ON CHARACTERISTICs** | | | | | | |
| G−E Threshold Voltage | $V_{GE(th)}$ | $I_C$ = 75 mA, $V_{CE}$ = $V_{GE}$ | 2.6 | 4.5 | 6.4 | V |
| Collector to Emitter Saturation Voltage | $V_{CE(sat)}$ | $I_C$ = 75 A, $V_{GE}$ = 15 V | − | 1.6 | 2.1 | V |
| | | $I_C$ = 75 A, $V_{GE}$ = 15 V, $T_C$ = 175°C | − | 1.92 | − | V |

**ELECTRICAL CHARACTERISTICS OF THE IGBT** ($T_C$ = 25°C unless otherwise noted) (continued)

| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| Input Capacitance | $C_{ies}$ | $V_{CE}$ = 30 V, $V_{GE}$ = 0 V, f = 1 MHz | – | 4845 | – | pF |
| Output Capacitance | $C_{oes}$ | | – | 155 | – | pF |
| Reverse Transfer Capacitance | $C_{res}$ | | – | 14 | – | pF |
| **SWITCHING CHARACTERISTICS** | | | | | | |
| Turn−On Delay Time | $t_{d(on)}$ | $V_{CC}$ = 400 V, $I_C$ = 18.8 A, $R_G$ = 4.7 Ω, $V_{GE}$ = 15 V, Inductive Load, $T_C$ = 25°C | – | 23 | – | ns |
| Rise Time | $t_r$ | | – | 10 | – | ns |
| Turn−Off Delay Time | $t_{d(off)}$ | | – | 120 | – | ns |
| Fall Time | $t_f$ | | – | 7 | – | ns |
| Turn−On Switching Loss | $E_{on}$ | | – | 300 | – | μJ |
| Turn−Off Switching Loss | $E_{off}$ | | – | 70 | – | μJ |
| Total Switching Loss | $E_{ts}$ | | – | 370 | – | μJ |
| Turn−On Delay Time | $t_{d(on)}$ | $V_{CC}$ = 400 V, $I_C$ = 37.5 A, $R_G$ = 4.7 Ω, $V_{GE}$ = 15 V, Inductive Load, $T_C$ = 25°C | – | 26 | – | ns |
| Rise Time | tr | | – | 19 | – | ns |
| Turn−Off Delay Time | $t_{d(off)}$ | | – | 114 | – | ns |
| Fall Time | $t_f$ | | – | 11 | – | ns |
| Turn−On Switching Loss | $E_{on}$ | | – | 746 | – | μJ |
| Turn−Off Switching Loss | $E_{off}$ | | – | 181 | – | μJ |
| Total Switching Loss | $E_{ts}$ | | – | 927 | – | μJ |
| Turn−On Delay Time | $t_{d(on)}$ | $V_{CC}$ = 400 V, $I_C$ = 18.8 A, $R_G$ = 4.7 Ω, $V_{GE}$ = 15 V, Inductive Load, $T_C$ = 175°C | – | 22 | – | ns |
| Rise Time | $t_r$ | | – | 12 | – | ns |
| Turn−Off Delay Time | $t_{d(off)}$ | | – | 135 | – | ns |
| Fall Time | $t_f$ | | – | 14 | – | ns |
| Turn−On Switching Loss | $E_{on}$ | | – | 760 | – | μJ |
| Turn−Off Switching Loss | $E_{off}$ | | – | 180 | – | μJ |
| Total Switching Loss | $E_{ts}$ | | – | 940 | – | μJ |
| Turn−On Delay Time | $t_{d(on)}$ | $V_{CC}$ = 400 V, $I_C$ = 37.5 A, $R_G$ = 4.7 Ω, $V_{GE}$ = 15 V, Inductive Load, $T_C$ = 175°C | – | 24 | – | ns |
| Rise Time | tr | | – | 24 | – | ns |
| Turn−Off Delay Time | $t_{d(off)}$ | | – | 125 | – | ns |
| Fall Time | $t_f$ | | – | 10 | – | ns |
| Turn−On Switching Loss | $E_{on}$ | | – | 1520 | – | μJ |
| Turn−Off Switching Loss | $E_{off}$ | | – | 401 | – | μJ |
| Total Switching Loss | $E_{ts}$ | | – | 1921 | – | μJ |
| Total Gate Charge | $Q_g$ | $V_{CE}$ = 400 V, $I_C$ = 75 A, $V_{GE}$ = 15 V | – | 128 | – | nC |
| Gate to Emitter Charge | $Q_{ge}$ | | – | 23 | – | nC |
| Gate to Collector Charge | $Q_{gc}$ | | – | 29 | – | nC |

**ELECTRICAL CHARACTERISTICS OF THE DIODE** ($T_J$ = 25°C unless otherwise noted)

| Parametr | Symbol | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Diode Forward Voltage | $V_{FM}$ | $I_F$ = 50 A | $T_C$ = 25°C | – | 2.0 | 2.6 | V |
| | | | $T_C$ = 175°C | – | 1.64 | – | |
| Reverse Recovery Energy | $E_{rec}$ | $I_F$ = 50 A, $dI_F$ / dt = 200 A/μs | $T_C$ = 175°C | – | 61 | – | μJ |
| Diode Reverse Recovery Time | $t_{rr}$ | | $T_C$ = 25°C | – | 43 | – | ns |
| | | | $T_C$ = 175°C | – | 210 | – | |
| Diode Reverse Recovery Charge | $Q_{rr}$ | | $T_C$ = 25°C | – | 90 | – | nC |
| | | | $T_C$ = 175°C | – | 1280 | – | |

## TYPICAL PERFORMANCE CHARACTERISTICS

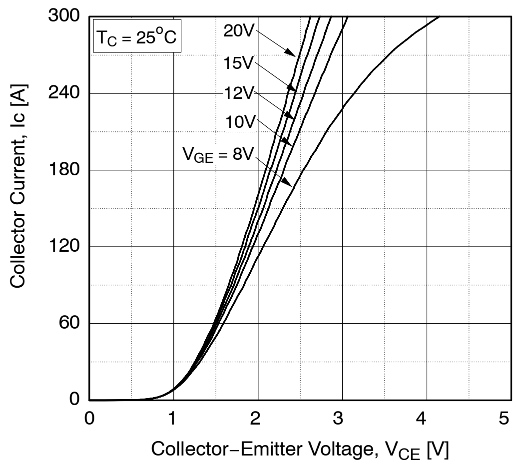



**Figure 1. Typical Output Characteristics**

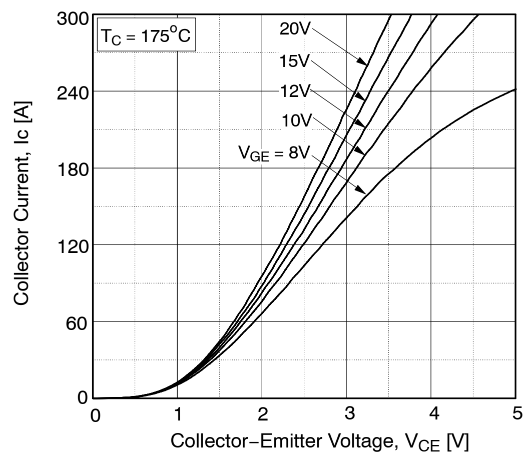



**Figure 2. Typical Output Characteristics**

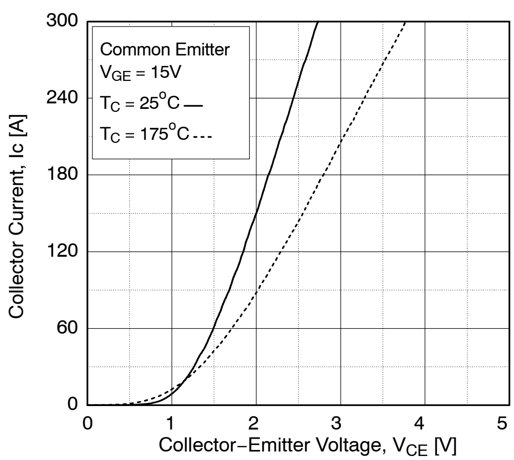



**Figure 3. Typical Saturation Voltage Characteristics**

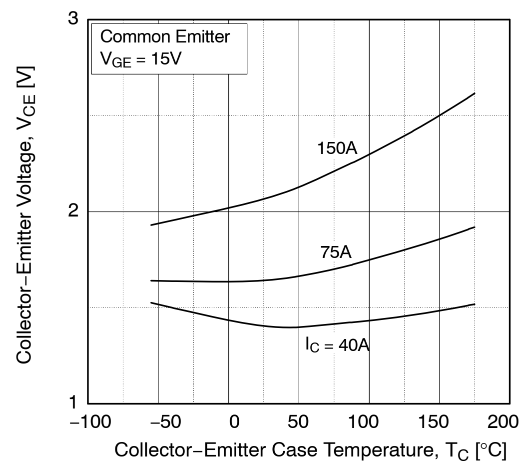



**Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level**

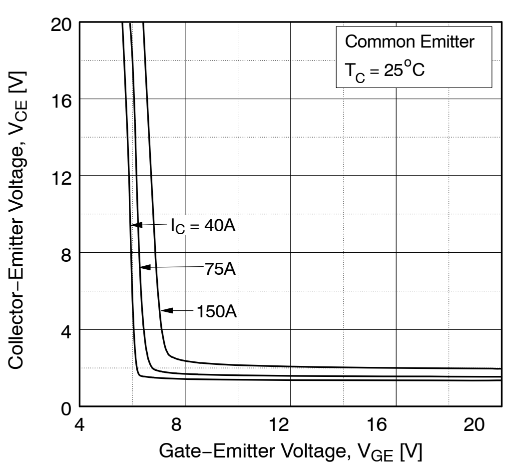



**Figure 5. Saturation Voltage vs $V_{GE}$**

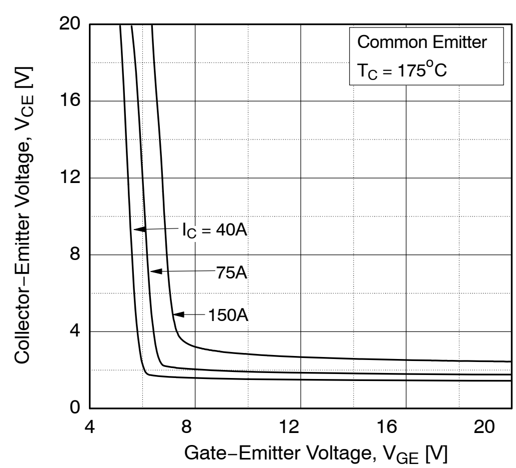



**Figure 6. Saturation Voltage vs $V_{GE}$**

## TYPICAL PERFORMANCE CHARACTERISTICS

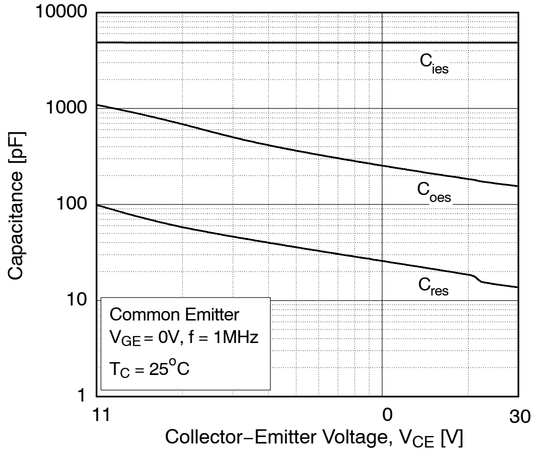



**Figure 7. Capacitance Characteristics**

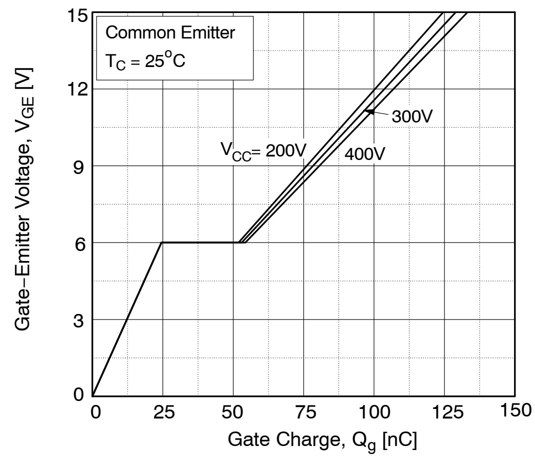



**Figure 8. Gate Charge Characteristic**

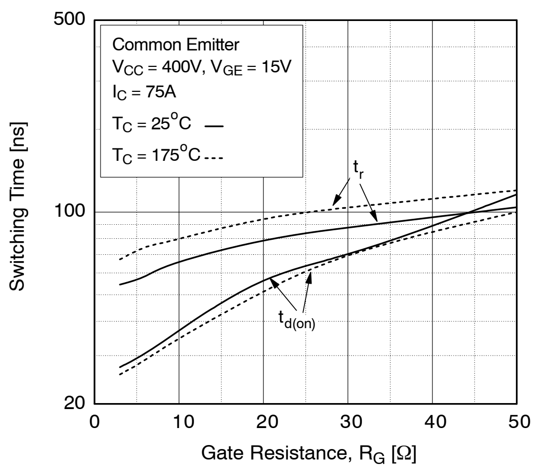



**Figure 9. Turn−On Characteristics vs. Gate Resistance**

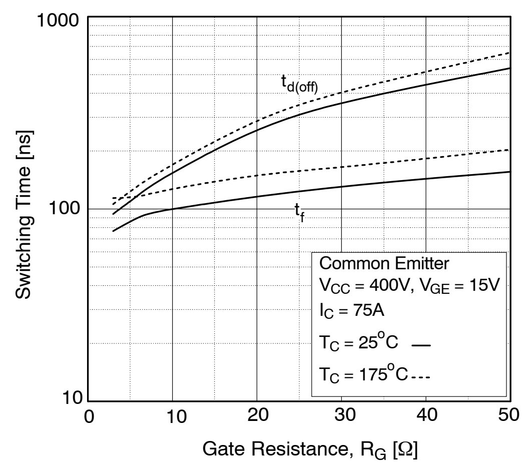



**Figure 10. Turn−Off Characteristics vs. Gate Resistance**

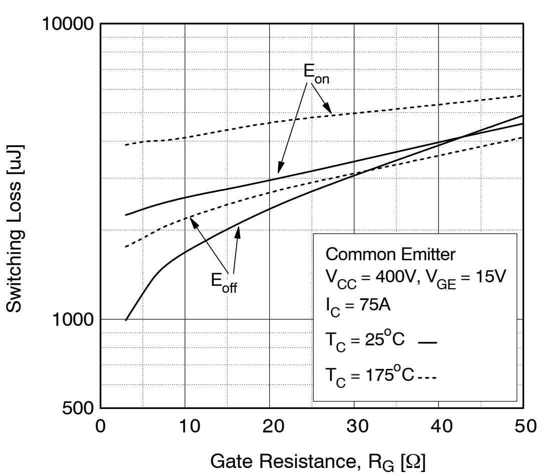



**Figure 11. Switching Loss vs. Gate Resistance**

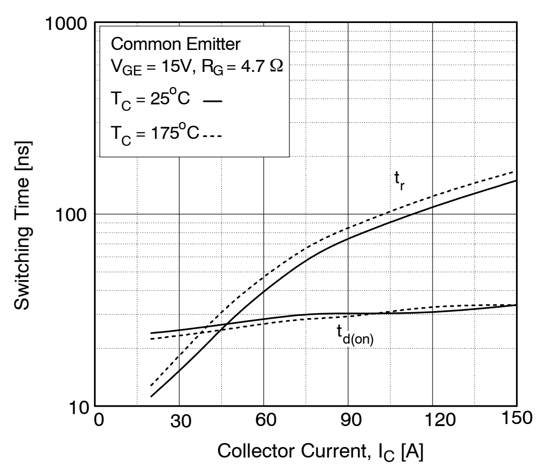



**Figure 12. Turn−On Characteristics vs. Collector Current**

## TYPICAL PERFORMANCE CHARACTERISTICS

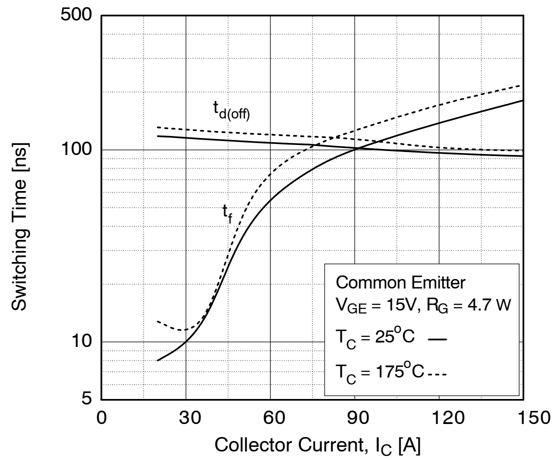



**Figure 13. Turn−Off Characteristics vs. Collector Current**

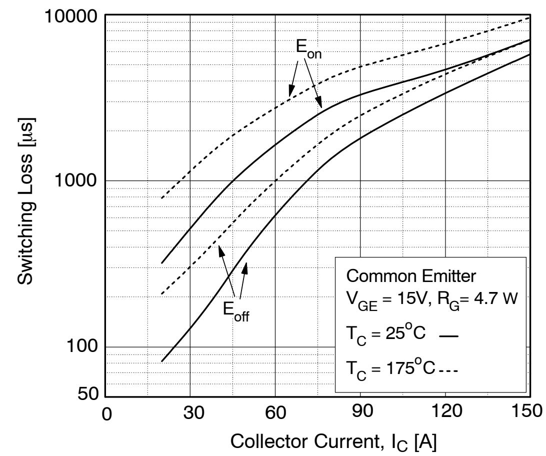



**Figure 14. Switching Loss vs. Collector Current**

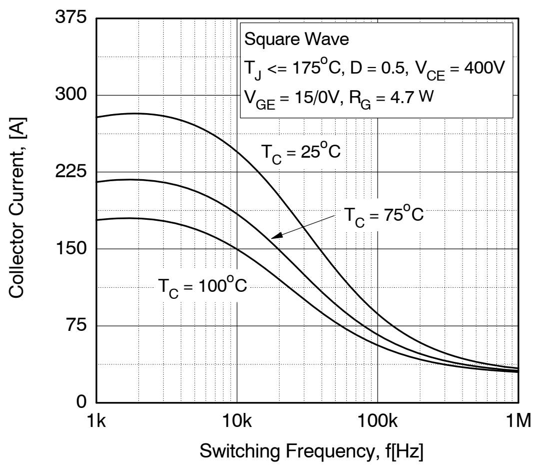



**Figure 15. Load Current vs. Frequency**

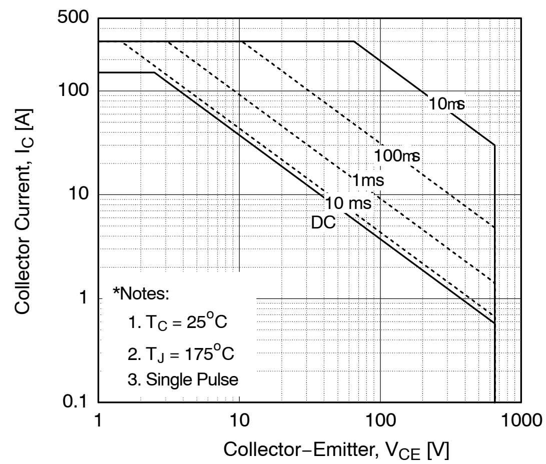



**Figure 16. SOA Characteristics**

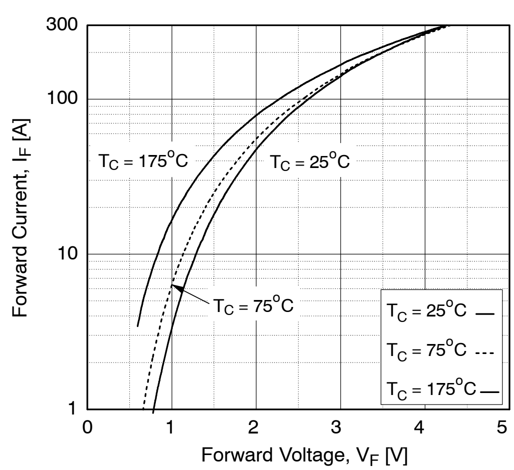



**Figure 17. Forward Characteristics**

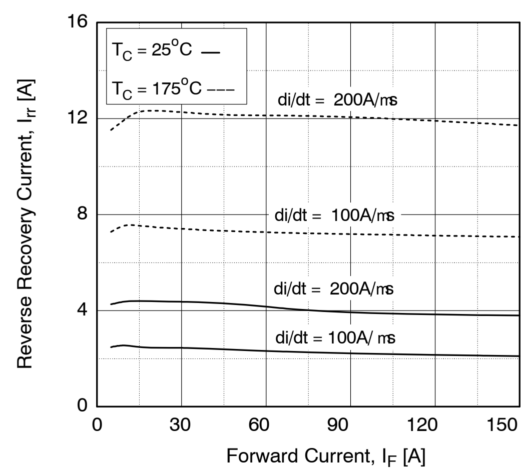



**Figure 18. Reverse Recovery Current**

## TYPICAL PERFORMANCE CHARACTERISTICS

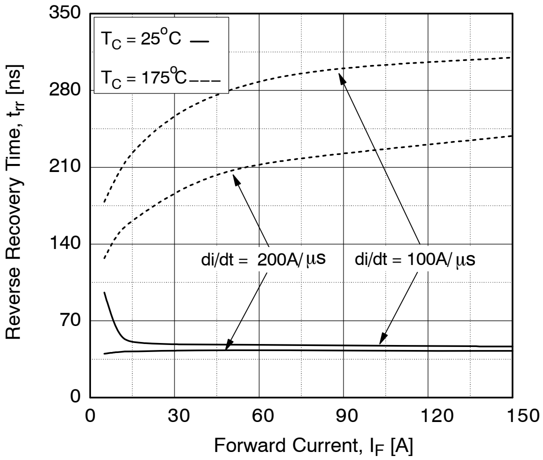



**Figure 19. Reverse Recovery Time**

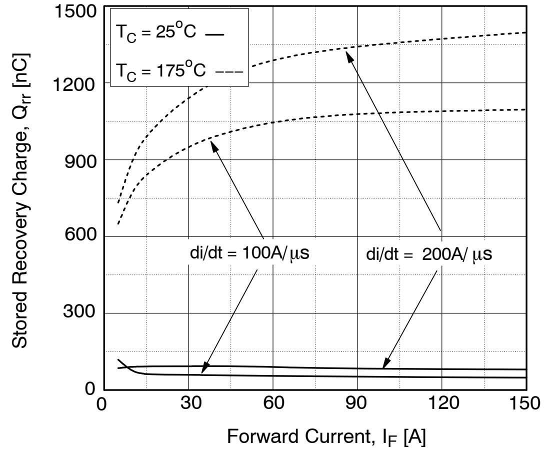



**Figure 20. Stored Charge**

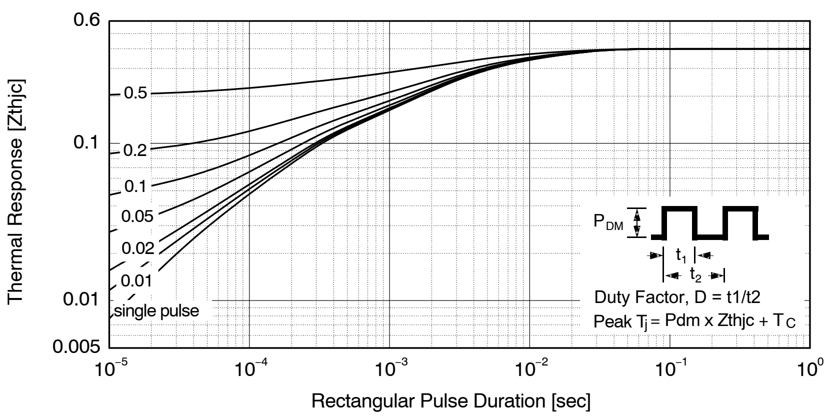



**Figure 21. Transient Thermal Impedance of IGBT**

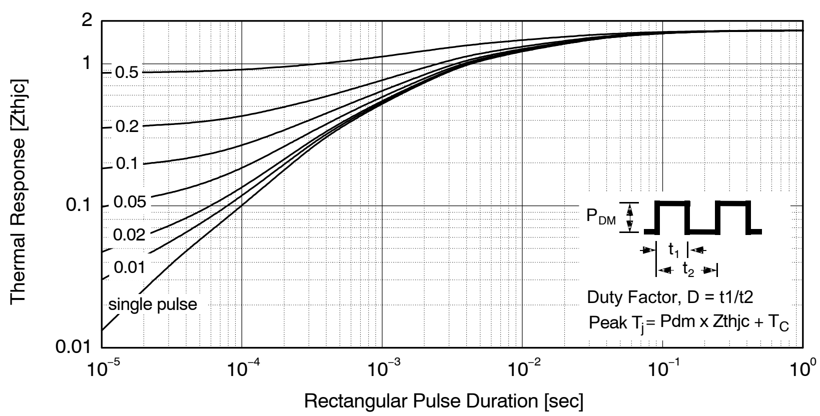
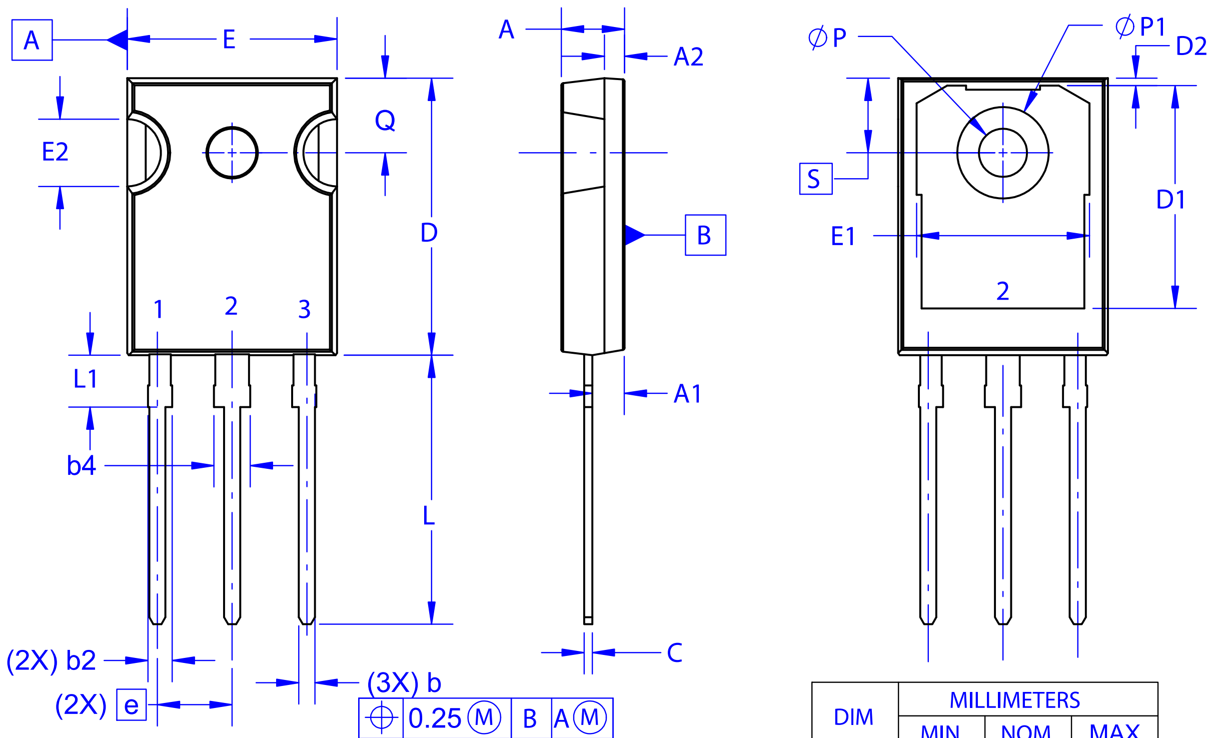



**Figure 22. Transient Thermal Impedance of Diode**

**TO−247−3LD**
CASE 340CH
ISSUE A

DATE 09 OCT 2019

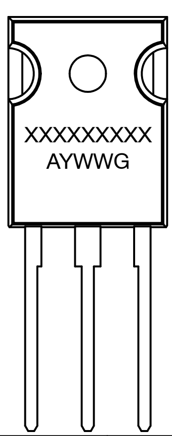



NOTES: UNLESS OTHERWISE SPECIFIED.

A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DRAWING CONFORMS TO ASME Y14.5 - 2009.
D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
E. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

| DIM | MILLIMETERS | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 4.58 | 4.70 | 4.82 |
| A1 | 2.29 | 2.475 | 2.66 |
| A2 | 1.40 | 1.50 | 1.60 |
| D | 20.32 | 20.57 | 20.82 |
| E | 15.37 | 15.62 | 15.87 |
| E2 | 4.96 | 5.08 | 5.20 |
| e | ~ | 5.56 | ~ |
| L | 19.75 | 20.00 | 20.25 |
| L1 | 3.69 | 3.81 | 3.93 |
| ∅P | 3.51 | 3.58 | 3.65 |
| Q | 5.34 | 5.46 | 5.58 |
| S | 5.34 | 5.46 | 5.58 |
| b | 1.17 | 1.26 | 1.35 |
| b2 | 1.53 | 1.65 | 1.77 |
| b4 | 2.42 | 2.54 | 2.66 |
| c | 0.51 | 0.61 | 0.71 |
| D1 | 13.08 | ~ | ~ |
| D2 | 0.51 | 0.93 | 1.35 |
| E1 | 12.81 | ~ | ~ |
| ∅P1 | 6.61 | 6.73 | 6.85 |

**GENERIC MARKING DIAGRAM***




XXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
G = Pb−Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “▪”, may or may not be present. Some products may not follow the Generic Marking.

| DOCUMENT NUMBER: | 98AON13853G | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red. |
|---|---|---|
| DESCRIPTION: | TO−247−3LD | PAGE 1 OF 1 |

## PUBLICATION ORDERING INFORMATION

**LITERATURE FULFILLMENT**:
**Email Requests to:** orderlit@onsemi.com

**onsemi Website:** www.onsemi.com

**TECHNICAL SUPPORT**
**North American Technical Support:**
Voice Mail: 1 800−282−9855 Toll Free USA/Canada
Phone: 011 421 33 790 2910

**Europe, Middle East and Africa Technical Support:**
Phone: 00421 33 790 2910
For additional information, please contact your local Sales Representative