# IGBT – Power, Co-PAK N-Channel, Field Stop VII (FS7), Non-SCR, TO247-3L

## 1200 V, 1.7 V, 140 A

# FGY140T120SWD

DATA SHEET
www.onsemi.com

| $BV_{CES}$ | $V_{CE(SAT)}$ | $I_C$ |
|---|---|---|
| 1200 V | 1.7 V | 140 A |

### Description

Using the novel field stop 7th generation IGBT technology and the Gen7 Diode in TO247 3−lead package, FGY140T120SWD offers the optimum performance with low switching and conduction losses for high−efficiency operations in various applications like Solar, UPS, and ESS.

### Features

- Maximum Junction Temperature $T_J$ = 175°C
- Positive Temperature Coefficient for Easy Parallel Operation
- High Current Capability
- Smooth and Optimized Switching
- Low Switching Loss
- RoHS Compliant

### Applications

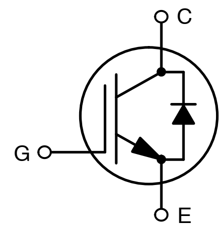
- Boost and Inverter in Solar System
- UPS
- Energy Storage System

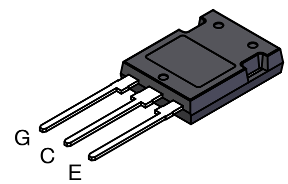
**MAXIMUM RATINGS** ($T_J$ = 25°C unless otherwise noted)

| Parameter | | Symbol | Value | Unit |
|---|---|---|---|---|
| Collector−to−Emitter Voltage | | $V_{CES}$ | 1200 | V |
| Gate−to−Emitter Voltage | | $V_{GES}$ | ±20 | |
| Transient Gate−to−Emitter Voltage | | | ±30 | |
| Collector Current | $T_C$ = 25°C(Note 1) | $I_C$ | 280 | A |
| | $T_C$ = 100°C | | 140 | |
| Power Dissipation | $T_C$ = 25°C | $P_D$ | 1153 | W |
| | $T_C$ = 100°C | | 576 | |
| Pulsed Collector Current | $T_C$ = 25°C, $t_p$ = 10 μs (Note 2) | $I_{CM}$ | 560 | A |
| Diode Forward Current | $T_C$ = 25°C | $I_F$ | 280 | |
| | $T_C$ = 100°C | | 140 | |
| Pulsed Diode Forward Current | $T_C$ = 25°C, $t_p$ = 10 μs (Note 2) | $I_{FM}$ | 560 | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | −55 to +175 | °C |
| Lead Temperature for Soldering Purposes | | $T_L$ | 260 | |

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. Value limited by bond wire
2. Repetitive rating: Pulse width limited by max. junction temperature.

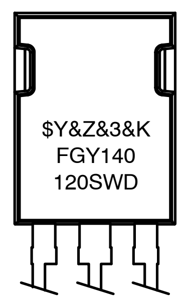
**PIN CONNECTIONS**




**TO−247−3LD**
**CASE 340CD**

**MARKING DIAGRAM**




| | |
|---|---|
| $Y | = **onsemi** Logo |
| &Z | = Assembly Plant Code |
| &3 | = 3−Digit Date Code |
| &K | = 2−Digit Lot Traceability Code |
| FGY140120SWD | = Specific Device Code |

**ORDERING INFORMATION**

| Device | Package | Shipping |
|---|---|---|
| FGY140T120SWD | TO−247−3LD (Pb−Free) | 30 Units / Tube |

## THERMAL CHARACTERISTICS

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Thermal Resistance, Junction−to−Case for IGBT | $R_{\theta JC}$ | 0.13 | °C/W |
| Thermal Resistance, Junction−to−Case for Diode | | 0.23 | |
| Thermal Resistance, Junction−to−Ambient | $R_{\theta JA}$ | 40 | |

## ELECTRICAL CHARACTERISTICS ($T_J$ = 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, $I_C$ = 5 mA | 1200 | – | – | V |
| Breakdown Voltage Temperature Coefficient | $\frac{\Delta BV_{CES}}{\Delta T_J}$ | $V_{GE}$ = 0 V, $I_C$ = 5 mA | – | 1226 | – | mV/°C |
| Collector−to−Emitter Cut−Off Current | $I_{CES}$ | $V_{GE}$ = 0 V, $V_{CE}$ = $V_{CES}$ | – | – | 40 | μA |
| Gate−to−Emitter Leakage Current | $I_{GES}$ | $V_{GE}$ = 20 V, $V_{CE}$ = 0 V | – | – | ±400 | nA |
| **ON CHARACTERISTICS** | | | | | | |
| Gate−to−Emitter Threshold Voltage | $V_{GE(th)}$ | $V_{GE}$ = $V_{CE}$, $I_C$ = 140 mA, $T_J$ = 25°C | 5.60 | 6.54 | 7.40 | V |
| Collector−to−Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_{GE}$ = 15 V, $I_C$ = 140 A, $T_J$ = 25°C | 1.35 | 1.7 | 2.0 | |
| | | $V_{GE}$ = 15 V, $I_C$ = 140 A, $T_J$ = 175°C | – | 2.25 | – | |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| Input Capacitance | $C_{ies}$ | $V_{CE}$ = 30 V, $V_{GE}$ = 0 V, f = 1 MHz | – | 13395.0 | – | pF |
| Output Capacitance | $C_{oes}$ | | – | 394 | – | |
| Reverse Transfer Capacitance | $C_{res}$ | | – | 55.4 | – | |
| Total Gate Charge | $Q_g$ | $V_{CE}$ = 600 V, $V_{GE}$ = 15 V, $I_C$ = 140 A | – | 415.4 | – | nC |
| Gate−to−Emitter Charge | $Q_{ge}$ | | – | 104.8 | – | |
| Gate−to−Collector Charge | $Q_{gc}$ | | – | 154.8 | – | |
| **SWITCHING CHARACTERISTICS** | | | | | | |
| Turn−on Delay Time | $t_{d(on)}$ | $V_{CE}$ = 600 V, $V_{GE}$ = 15 V $I_C$ = 70 A $R_G$ = 4.7 Ω $T_J$ = 25°C | – | 55.2 | – | ns |
| Turn−off Delay Time | $t_{d(off)}$ | | – | 249.6 | – | |
| Rise Time | $t_r$ | | – | 43.2 | – | |
| Fall Time | $t_f$ | | – | 65.6 | – | |
| Turn−on Switching Loss | $E_{on}$ | | – | 4.7 | – | mJ |
| Turn−off Switching Loss | $E_{off}$ | | – | 2.3 | – | |
| Total Switching Loss | $E_{ts}$ | | – | 6.9 | – | |
| Turn−on Delay Time | $t_{d(on)}$ | $V_{CE}$ = 600 V, $V_{GE}$ = 15 V $I_C$ = 140 A $R_G$ = 4.7 Ω $T_J$ = 25°C | – | 59.2 | – | ns |
| Turn−off Delay Time | $t_{d(off)}$ | | – | 227.2 | – | |
| Rise Time | $t_r$ | | – | 97.6 | – | |
| Fall Time | $t_f$ | | – | 67.2 | – | |
| Turn−on Switching Loss | $E_{on}$ | | – | 12.5 | – | mJ |
| Turn−off Switching Loss | $E_{off}$ | | – | 5.1 | – | |
| Total Switching Loss | $E_{ts}$ | | – | 17.6 | – | |

**ELECTRICAL CHARACTERISTICS** ($T_J$ = 25°C unless otherwise noted) (continued)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **SWITCHING CHARACTERISTICS** | | | | | | |
| Turn−on Delay Time | $t_{d(on)}$ | $V_{CE}$ = 600 V, $V_{GE}$ = 15 V<br>$I_C$ = 70 A $R_G$ = 4.7 Ω $T_J$ = 175°C | – | 48.0 | – | ns |
| Turn−off Delay Time | $t_{d(off)}$ | | – | 284.8 | – | |
| Rise Time | $t_r$ | | – | 41.6 | – | |
| Fall Time | $t_f$ | | – | 96.0 | – | |
| Turn−on Switching Loss | $E_{on}$ | | – | 7.5 | – | mJ |
| Turn−off Switching Loss | $E_{off}$ | | – | 3.1 | – | |
| Total Switching Loss | $E_{ts}$ | | – | 10.6 | – | |
| Turn−on Delay Time | $t_{d(on)}$ | $V_{CE}$ = 600 V, $V_{GE}$ = 15 V<br>$I_C$ = 140 A $R_G$ = 4.7 Ω $T_J$ = 175°C | – | 52.8 | – | ns |
| Turn−off Delay Time | $t_{d(off)}$ | | – | 264.0 | – | |
| Rise Time | $t_r$ | | – | 92.8 | – | |
| Fall Time | $t_f$ | | – | 113.6 | – | |
| Turn−on Switching Loss | $E_{on}$ | | – | 17.1 | – | mJ |
| Turn−off Switching Loss | $E_{off}$ | | – | 7.4 | – | |
| Total Switching Loss | $E_{ts}$ | | – | 24.5 | – | |
| **DIODE CHARACTERISTICS** | | | | | | |
| Forward Voltage | $V_F$ | $I_F$ = 140 A, $T_J$ = 25°C | 1.73 | 1.95 | 2.33 | V |
| | | $I_F$ = 140 A, $T_J$ = 175°C | – | 2.15 | – | |
| **DIODE SWITCHING CHARACTERISTICS, INDUCTIVE LOAD** | | | | | | |
| Reverse Recovery Time | $t_{rr}$ | $V_R$ = 600 V, $I_F$ = 70 A,<br>$dI_F/dt$ = 1000 A/μs, $T_J$ = 25°C | – | 219.4 | – | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | – | 4507.9 | – | nC |
| Reverse Recovery Energy | $E_{REC}$ | | – | 1.6 | – | mJ |
| Peak Reverse Recovery Current | $I_{RRM}$ | | – | 41.1 | – | A |
| Reverse Recovery Time | $t_{rr}$ | $V_R$ = 600 V, $I_F$ = 140 A,<br>$dI_F/dt$ = 1000 A/μs, $T_J$ = 25°C | – | 307.3 | – | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | – | 7047.2 | – | nC |
| Reverse Recovery Energy | $E_{REC}$ | | – | 2.7 | – | mJ |
| Peak Reverse Recovery Current | $I_{RRM}$ | | – | 45.9 | – | A |
| Reverse Recovery Time | $t_{rr}$ | $V_R$ = 600 V, $I_F$ = 70 A,<br>$dI_F/dt$ = 1000 A/μs, $T_J$ = 175°C | – | 425.3 | – | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | – | 13076.8 | – | nC |
| Reverse Recovery Energy | $E_{REC}$ | | | 5.5 | – | mJ |
| Peak Reverse Recovery Current | $I_{RRM}$ | | – | 61.5 | – | A |
| Reverse Recovery Time | $t_{rr}$ | $V_R$ = 600 V, $I_F$ = 140 A,<br>$dI_F/dt$ = 1000 A/μs, $T_J$ = 175°C | – | 516.5 | – | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | – | 18736.9 | – | nC |
| Reverse Recovery Energy | $E_{REC}$ | | – | 7.6 | – | mJ |
| Peak Reverse Recovery Current | $I_{RRM}$ | | – | 72.6 | – | A |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

## TYPICAL CHARACTERISTICS

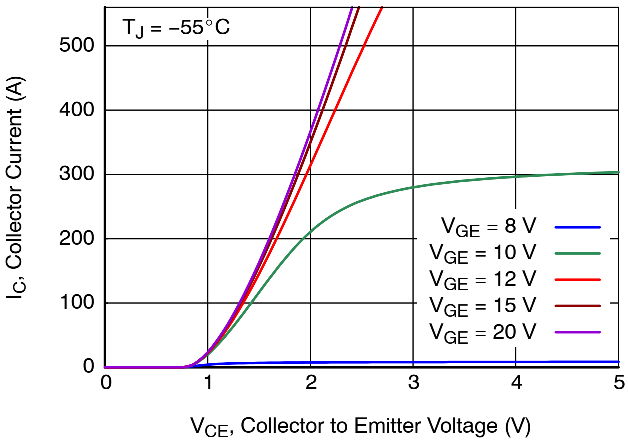



**Figure 1. Output Characteristics**

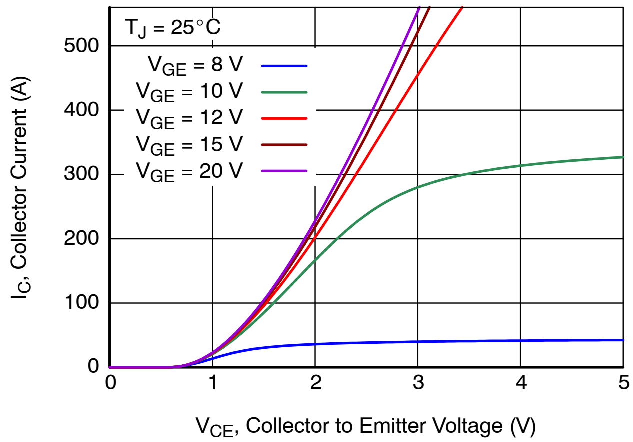



**Figure 2. Output Characteristics**

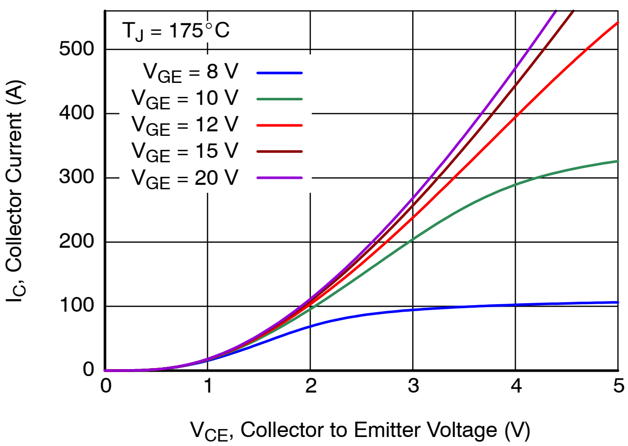



**Figure 3. Output Characteristics**

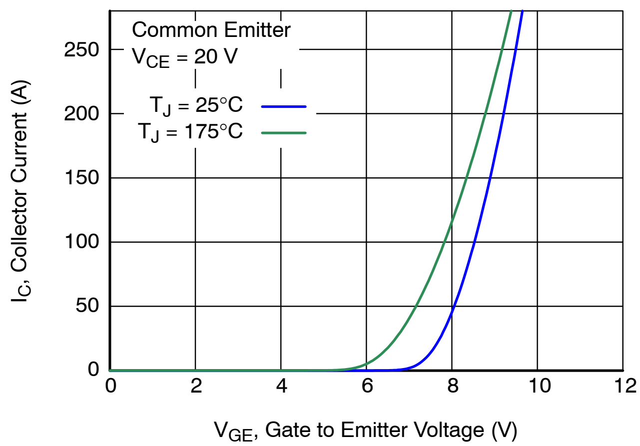



**Figure 4. Transfer Characteristics**

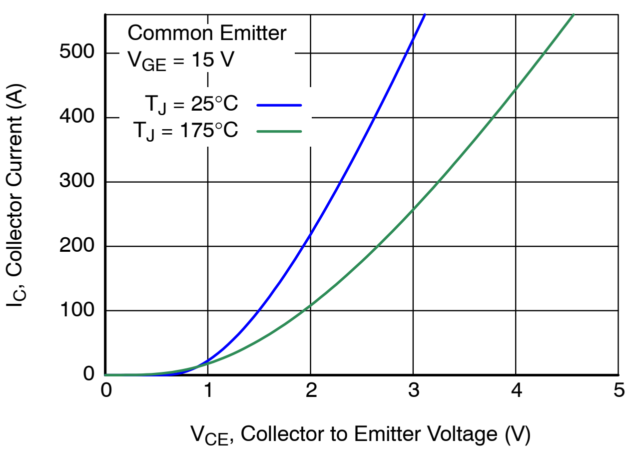



**Figure 5. Saturation Characteristics**

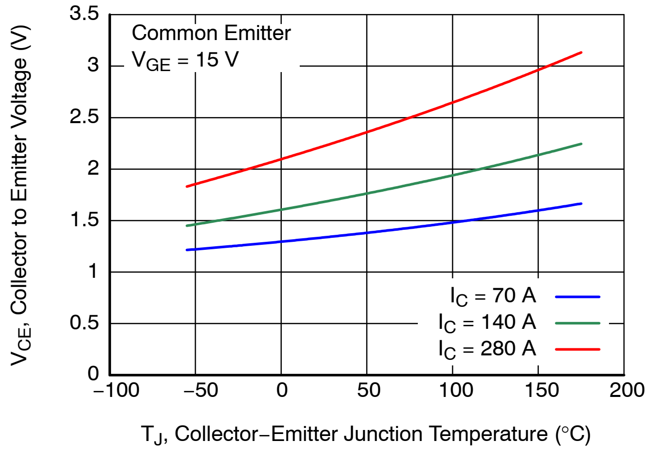



**Figure 6. Saturation Voltage vs. Junction Temperature**

## TYPICAL CHARACTERISTICS

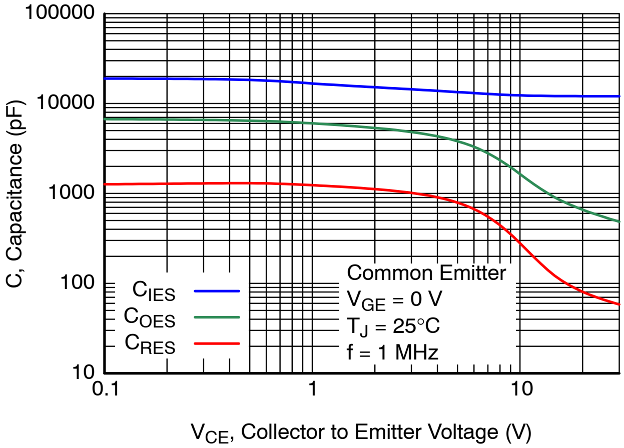



**Figure 7. Capacitance Characteristics**

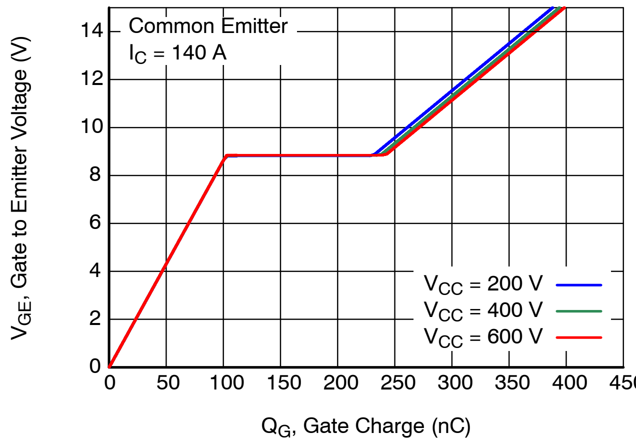



**Figure 8. Gate Charge Characteristics**

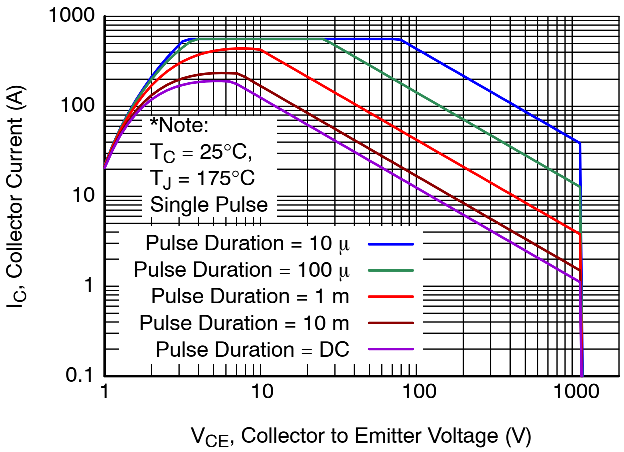



**Figure 9. SOA Characteristics**

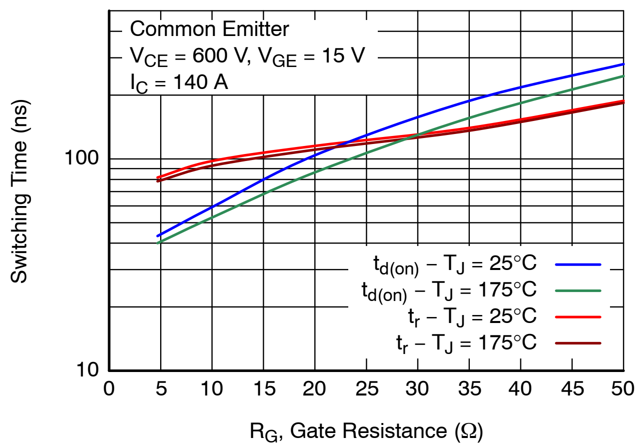



**Figure 10. Turn−on Switching Time vs. Gate Resistance**

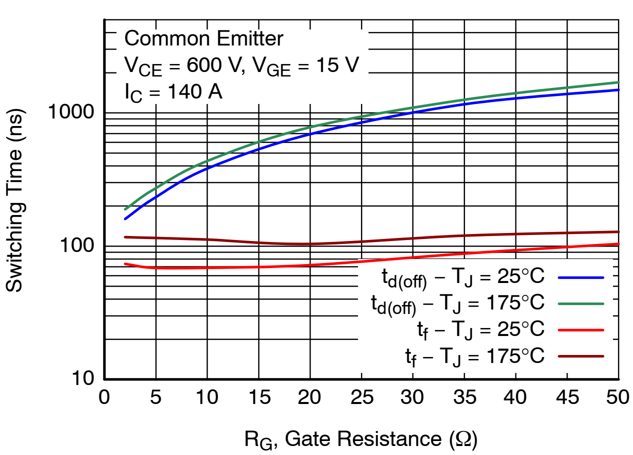



**Figure 11. Turn−Off Switching Time vs. Gate Resistance**

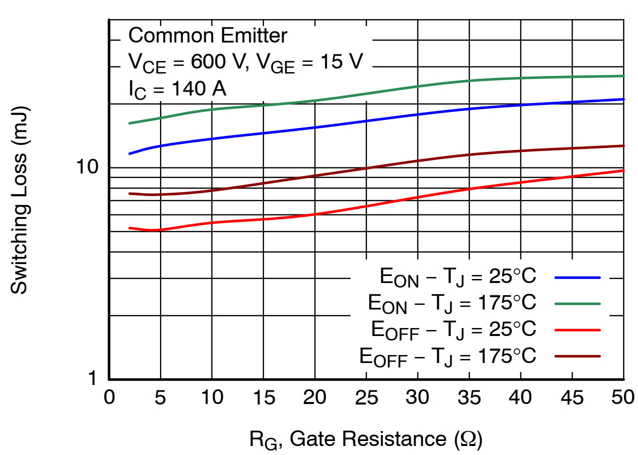



**Figure 12. Switching Loss vs. Gate Resistance**

## TYPICAL CHARACTERISTICS

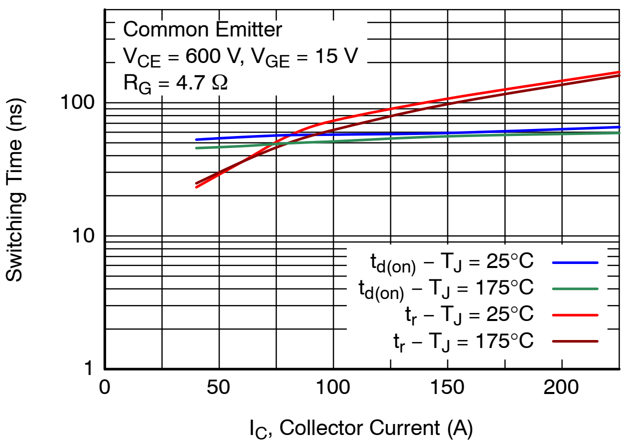



**Figure 13. Turn−On Switching Time vs. Collector Current**

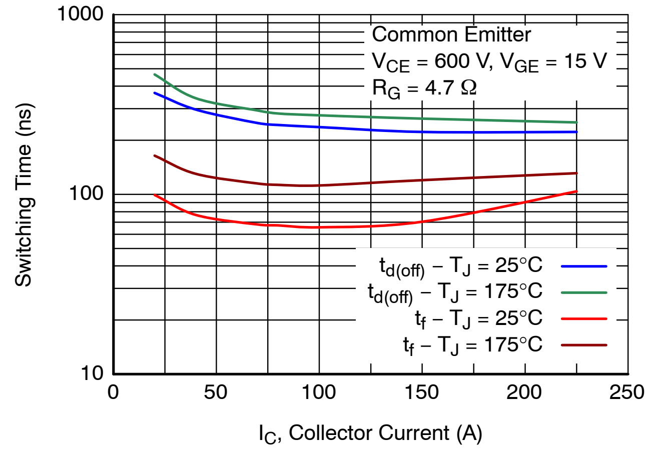



**Figure 14. Turn−Off Switching Time vs. Collector Current**

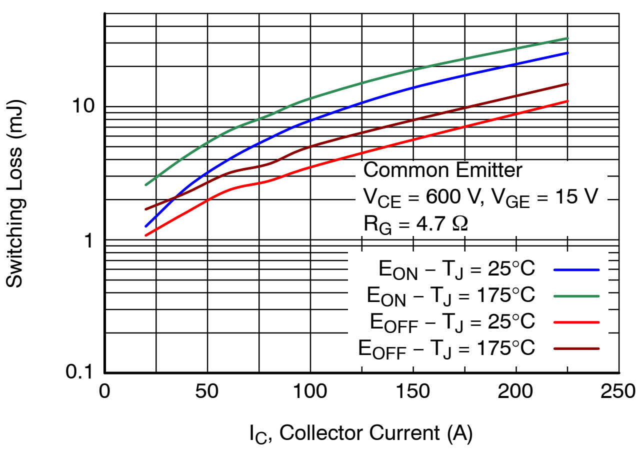



**Figure 15. Turn−On Switching Loss vs. Collector Current**

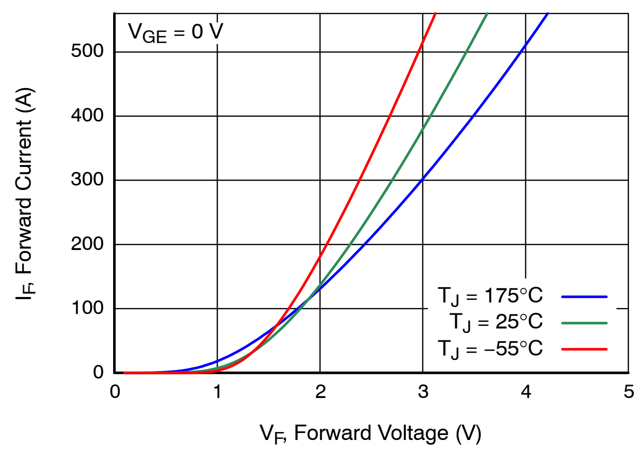



**Figure 16. Diode Forward Characteristics**

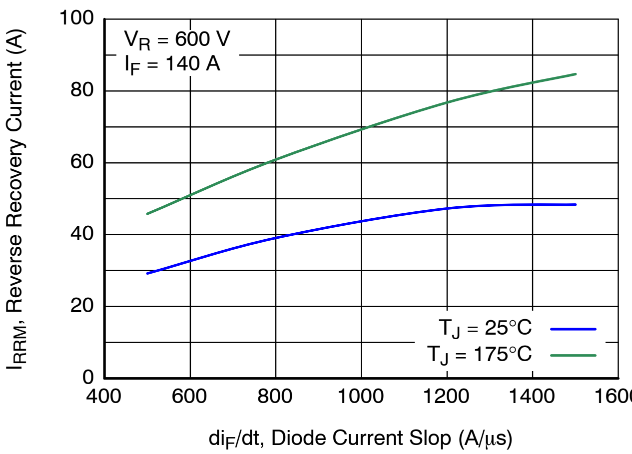



**Figure 17. Diode Reverse Recovery Current**

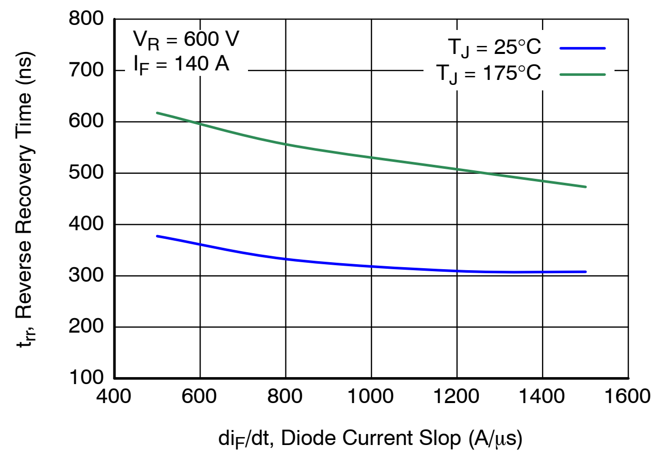



**Figure 18. Diode Reverse Recovery Time**

## TYPICAL CHARACTERISTICS

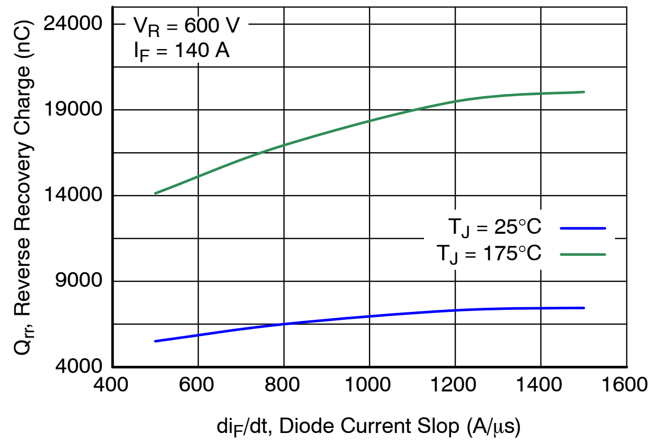



**Figure 19. Diode Stored Charge Characteristics**

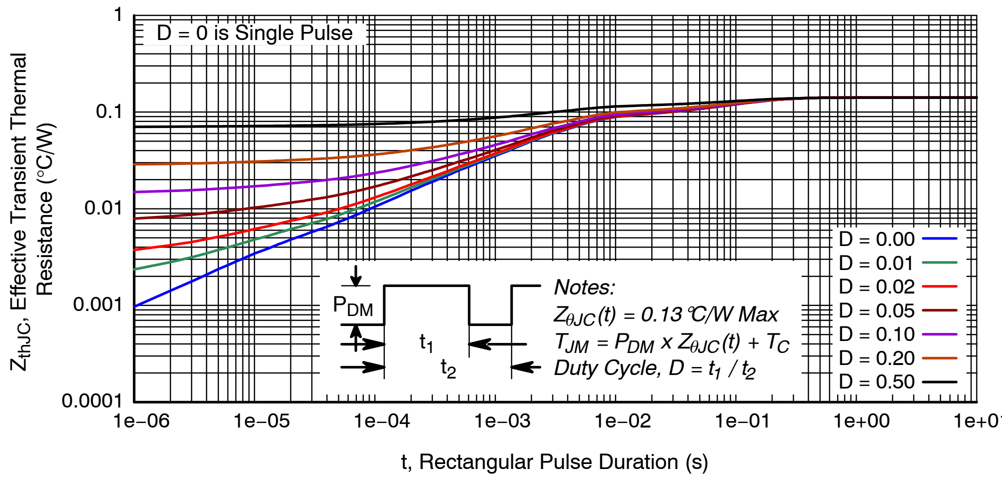



**Figure 20. Transient Thermal Impedance of IGBT**

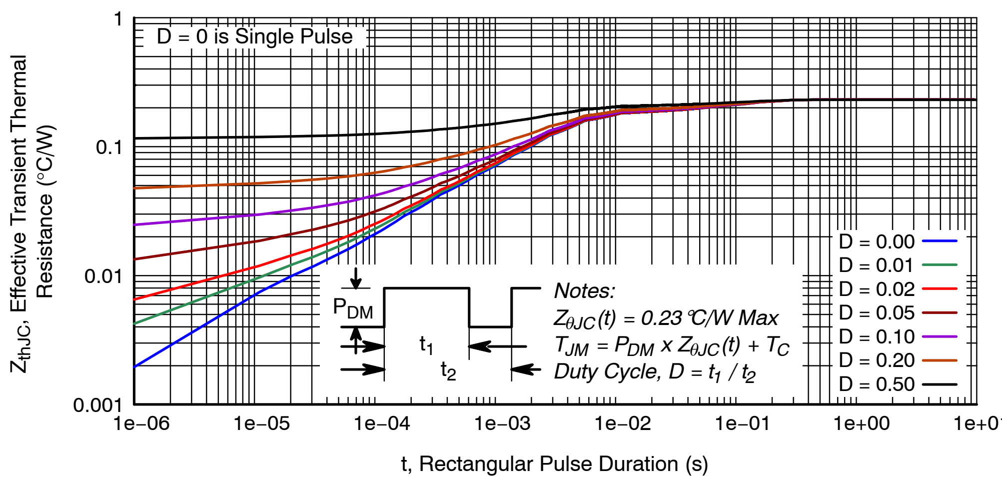
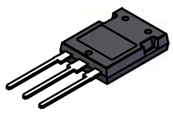



**Figure 21. Transient Thermal Impedance of Diode**

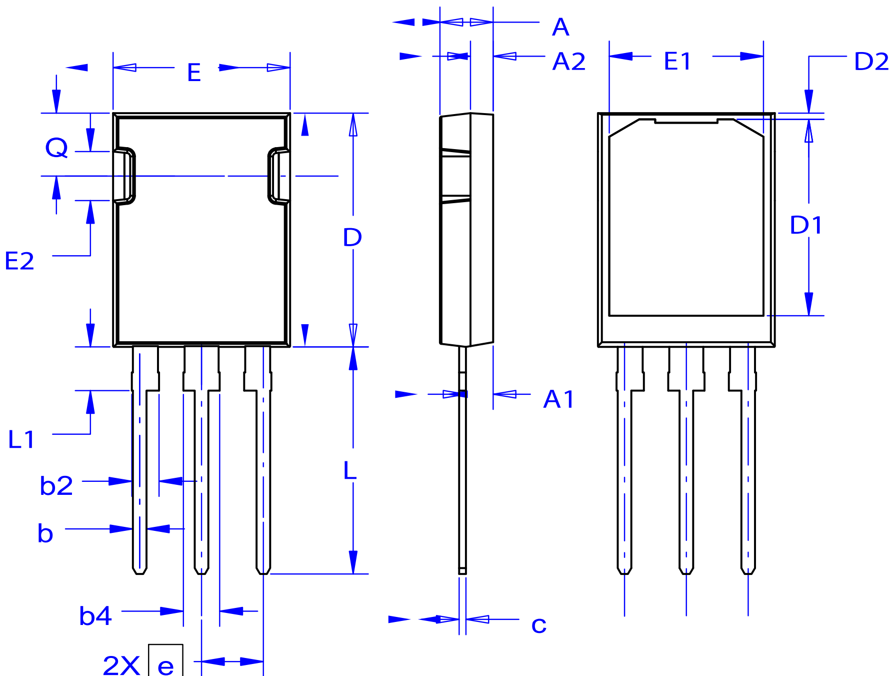


**TO−247−3LD**
CASE 340CD
ISSUE A

DATE 18 SEP 2018

NOTES:

A. THIS PACKAGE DOES NOT CONFORM TO ANY STANDARDS.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
D. DIMENSION AND TOLERANCE AS PER ASME Y14.5-2009.




| DIM | MILLIMETERS | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 4.58 | 4.70 | 4.82 |
| A1 | 2.20 | 2.40 | 2.60 |
| A2 | 1.80 | 2.00 | 2.20 |
| D | 20.32 | 20.57 | 20.82 |
| E | 15.37 | 15.62 | 15.87 |
| E2 | 4.12 | 4.32 | 4.52 |
| e | ~ | 5.45 | ~ |
| L | 19.90 | 20.00 | 20.10 |
| L1 | 3.69 | 3.81 | 3.93 |
| Q | 5.34 | 5.46 | 5.58 |
| b | 1.10 | 1.20 | 1.30 |
| b2 | 2.10 | 2.24 | 2.39 |
| b4 | 2.87 | 3.04 | 3.20 |
| c | 0.51 | 0.61 | 0.71 |
| D1 | 16.63 | 16.83 | 17.03 |
| D2 | 0.51 | 0.93 | 1.35 |
| E1 | 13.40 | 13.60 | 13.80 |

**GENERIC MARKING DIAGRAM***

XXXXXXXXX
AYWWG

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:** | **98AON13857G** | 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**
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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