# IGBT - Power, Co-PAK N-Channel, Field Stop VII (FS7), Non-SCR, TO247-3L
## 1200 V, 1.7 V, 60 A
# FGY60T120SWD

| $BV_{CES}$ | $V_{CE(SAT)}$ | $I_C$ |
|---|---|---|
| 1200 V | 1.7 V | 60 A |

### Description

Using the novel field stop 7th generation IGBT technology and the Gen7 Diode in TO247 3−lead package, FGY60T120SWD offers the optimum performance with low switching and conduction losses for high−efficiency operations in various applications like Solar, UPS, and ESS.

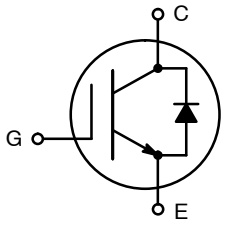
### Features

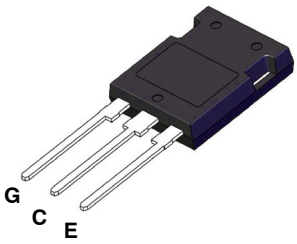
- Maximum Junction Temperature $T_J$ = 175°C
- Positive Temperature Coefficient for Easy Parallel Operation
- High Current Capability
- Smooth and Optimized Switching
- Low Switching Loss
- RoHS Compliant

### Applications

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

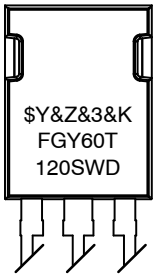
### PIN CONNECTIONS




**TO247−3LD**
**CASE 340CD**

### MARKING DIAGRAM




$Y = **onsemi** Logo
&Z = Assembly Plant Code
&3 = 3−Digit Date Code
&K = 2−Digit Lot Traceability Code
FGY60T120SWD = Specific Device Code

### 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 | V |
| Transient Gate−to−Emitter Voltage | | | ±30 | V |
| Collector Current | $T_C$ = 25°C (Note 1) | $I_C$ | 105 | A |
| | $T_C$ = 100°C | | 60 | |
| Power Dissipation | $T_C$ = 25°C | $P_D$ | 635 | W |
| | $T_C$ = 100°C | | 317 | |
| Pulsed Collector Current | $T_C$ = 25°C, $t_P$ = 10 μs (Note 2) | $I_{CM}$ | 240 | A |
| Diode Forward Current | $T_C$ = 25°C | $I_F$ | 120 | A |
| | $T_C$ = 100°C | | 600 | |
| Pulsed Diode Maximum Forward Current | $T_C$ = 25°C, $t_P$ = 10 μs (Note 2) | $I_{FM}$ | 240 | A |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{STG}$ | −55 to +175 | °C |
| Lead Temperature for Soldering Purposes | | $T_L$ | 260 | °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. Value limit by bond wire
2. Repetitive rating: Pulse width limited by max. Junction temperature

### ORDERING INFORMATION

| Device | Package | Shipping |
|---|---|---|
| FGY60T120SWD | TO−247−3LD (Pb−Free) | 30 Units / Tube |

## THERMAL CHARACTERISTICS

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Thermal Resistance, Junction−to−Case for IGBT | $R_{\theta JC}$ | 0.24 | °C/W |
| Thermal Resistance, Junction−to−Case for Diode | | 0.41 | |
| Thermal Resistance, Junction−to−Ambient | $R_{\theta JA}$ | 40 | |

## ELECTRICAL CHARACTERISTICS OF IGBT ($T_J$ = 25°C unless otherwise noted)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| Collector−to−Emitter Breakdown Voltage | $BV_{CES}$ | $V_{GE}$ = 0 V, $I_C$ = 5 mA | 1200 | | | V |
| Collector−to−Emitter Breakdown Voltage Temperature Coefficient | $\Delta BV_{CES}/\Delta T_J$ | | | 1.5 | | V/°C |
| Zero Gate Voltage Collector 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 Threshold Voltage | $V_{GE(TH)}$ | $V_{GE}$ = $V_{CE}$, $I_C$ = 60 mA | 5.6 | 6.55 | 7.4 | V |
| Collector−to−Emitter Saturation Voltage | $V_{CE(SAT)}$ | $V_{GE}$ = 15 V, $I_C$ = 60 A, $T_J$ = 25°C | 1.35 | 1.68 | 2.0 | |
| | | $V_{GE}$ = 15 V, $I_C$ = 60 A, $T_J$ = 175°C | | 2.25 | | |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| Input Capacitance | $C_{IES}$ | $V_{GE}$ = 0 V, $V_{CE}$ = 30 V, f = 1 MHz | | 5093 | | pF |
| Output Capacitance | $C_{OES}$ | | | 193 | | |
| Reverse Transfer Capacitance | $C_{RES}$ | | | 25.2 | | |
| Total Gate Charge | $Q_G$ | $V_{CE}$ = 600 V, $V_{GE}$ = 15 V, $I_C$ = 60 A | | 174 | | nC |
| Gate−to−Emitter Charge | $Q_{GE}$ | | | 43.4 | | |
| Gate−to−Collector Charge | $Q_{GC}$ | | | 65.1 | | |
| **SWITCHING CHARACTERISTICS** | | | | | | |
| Turn−On Delay Time | $t_{d(on)}$ | $V_{CE}$ = 600 V, $V_{GE}$ = 0/15 V, $I_C$ = 30 A, $R_G$ = 4.7 Ω, $T_J$ = 25°C | | 30.4 | | ns |
| Turn−Off Delay Time | $t_{d(off)}$ | | | 146.4 | | |
| Rise Time | $t_r$ | | | 15.2 | | |
| Fall Time | $t_f$ | | | 68 | | |
| Turn−On Switching Loss | $E_{on}$ | | | 1.6 | | mJ |
| Turn−Off Switching Loss | $E_{off}$ | | | 0.9 | | |
| Total Switching Loss | $E_{ts}$ | | | 2.6 | | |
| Turn−On Delay Time | $t_{d(on)}$ | $V_{CE}$ = 600 V, $V_{GE}$ = 0/15 V, $I_C$ = 60 A, $R_G$ = 4.7 Ω, $T_J$ = 25°C | | 31.2 | | ns |
| Turn−Off Delay Time | $t_{d(off)}$ | | | 130 | | |
| Rise Time | $t_r$ | | | 40.8 | | |
| Fall Time | $t_f$ | | | 68.8 | | |
| Turn−On Switching Loss | $E_{on}$ | | | 4 | | mJ |
| Turn−Off Switching Loss | $E_{off}$ | | | 1.9 | | |
| Total Switching Loss | $E_{ts}$ | | | 5.8 | | |

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

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Turn−On Delay Time | $t_{d(on)}$ | $V_{GE}$ = 0/15 V, $I_C$ = 30 A, $V_{CE}$ = 600 V, $R_G$ = 4.7 Ω, $T_J$ = 175°C | | 27.2 | | ns |
| Turn−Off Delay Time | $t_{d(off)}$ | | | 168 | | |
| Rise Time | $t_r$ | | | 16 | | |
| Fall Time | $t_f$ | | | 102.4 | | |
| Turn−On Switching Loss | $E_{on}$ | | | 2.6 | | mJ |
| Turn−Off Switching Loss | $E_{off}$ | | | 1.2 | | |
| Total Switching Loss | $E_{ts}$ | | | 3.8 | | |
| Turn−On Delay Time | $t_{d(on)}$ | $V_{GE}$ = 0/15 V, $I_C$ = 60 A, $V_{CE}$ = 600 V, $R_G$ = 4.7 Ω, $T_J$ = 175°C | | 28.8 | | ns |
| Turn−Off Delay Time | $t_{d(off)}$ | | | 153.6 | | |
| Rise Time | $t_r$ | | | 38.4 | | |
| Fall Time | $t_f$ | | | 120 | | |
| Turn−On Switching Loss | $E_{on}$ | | | 5.7 | | mJ |
| Turn−Off Switching Loss | $E_{off}$ | | | 2.8 | | |
| Total Switching Loss | $E_{ts}$ | | | 8.5 | | |

**DIODE CHARACTERISTICS**

| | | | | | | |
|---|---|---|---|---|---|---|
| Forward Voltage | $V_F$ | $I_F$ = 60 A, $T_J$ = 25°C | 1.62 | 1.91 | 2.22 | V |
| | | $I_F$ = 60 A, $T_J$ = 175°C | | 2 | | |

**DIODE SWITCHING CHARACTERISTIC, INDUCTIVE LOAD**

| | | | | | | |
|---|---|---|---|---|---|---|
| Reverse Recovery Time | $t_{rr}$ | $V_R$ = 600 V, $I_F$ = 30 A, $dI_F/dt$ = 1000 A/μs, $T_J$ = 25°C | | 143 | | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | | 2262 | | nC |
| Reverse Recovery Energy | $E_{rec}$ | | | 0.7 | | mJ |
| Peak Reverse Recovery Current | $I_{RRM}$ | | | 32 | | A |
| Reverse Recovery Time | $t_{rr}$ | $V_R$ = 600 V, $I_F$ = 60 A, $dI_F/dt$ = 1000 A/μs, $T_J$ = 25°C | | 200 | | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | | 3486 | | nC |
| Reverse Recovery Energy | $E_{rec}$ | | | 1.1 | | mJ |
| Peak Reverse Recovery Current | $I_{RRM}$ | | | 35 | | A |
| Reverse Recovery Time | $t_{rr}$ | $V_R$ = 600 V, $I_F$ = 30 A, $dI_F/dt$ = 1000 A/μs, $T_J$ = 175°C | | 221 | | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | | 4908 | | nC |
| Reverse Recovery Energy | $E_{rec}$ | | | 1.7 | | mJ |
| Peak Reverse Recovery Current | $I_{RRM}$ | | | 44 | | A |
| Reverse Recovery Time | $t_{rr}$ | $V_R$ = 600 V, $I_F$ = 60 A, $dI_F/dt$ = 1000 A/μs, $T_J$ = 175°C | | 334 | | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | | 8665 | | nC |
| Reverse Recovery Energy | $E_{rec}$ | | | 3.1 | | mJ |
| Peak Reverse Recovery Current | $I_{RRM}$ | | | 52 | | 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

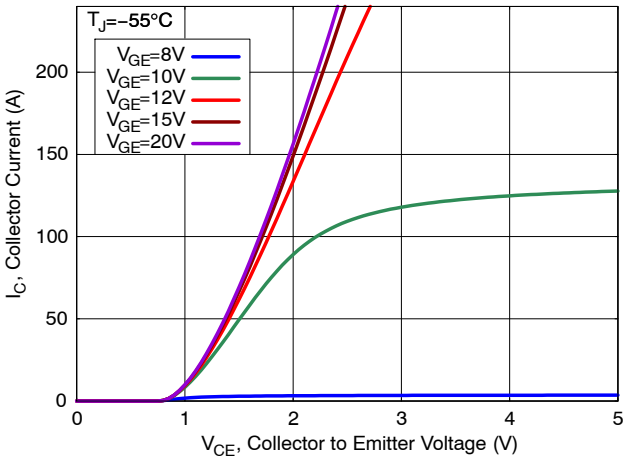



**Figure 1. Output Characteristics**

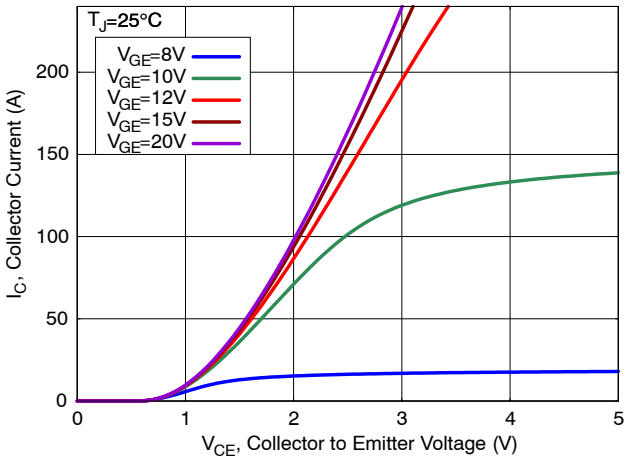



**Figure 2. Output Characteristics**

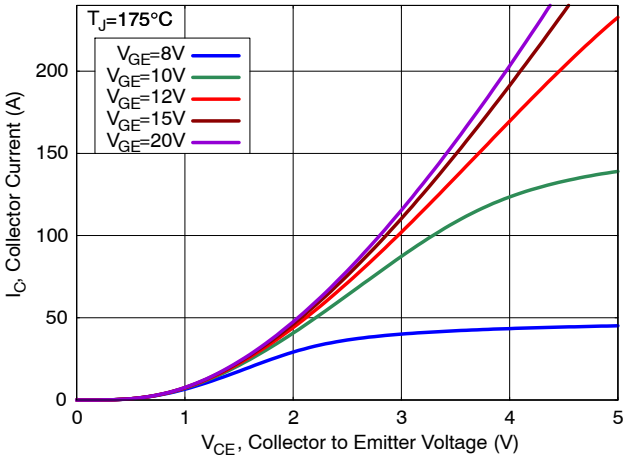



**Figure 3. Output Characteristics**

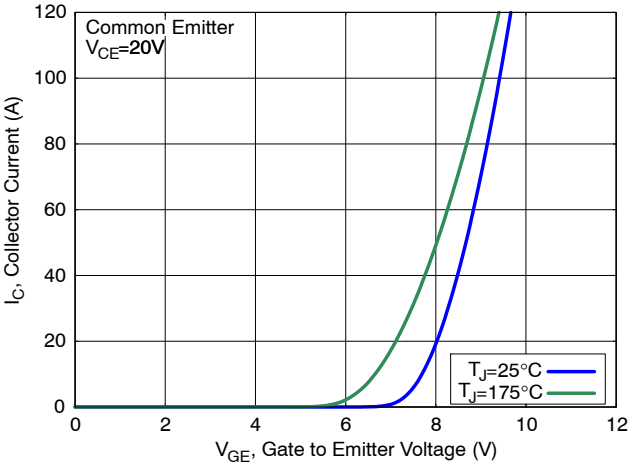



**Figure 4. Transfer Characteristics**

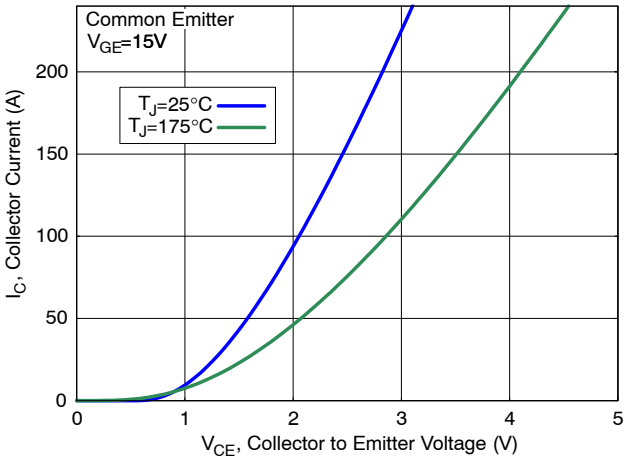



**Figure 5. Saturation Characteristics**

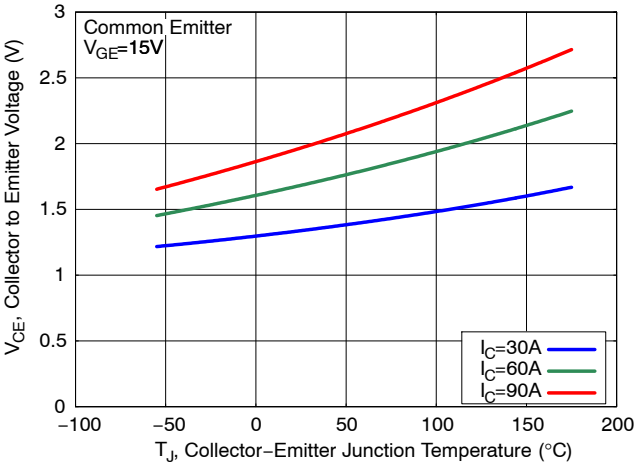



**Figure 6. Saturation Voltage vs. Junction Temperature**

## TYPICAL CHARACTERISTICS

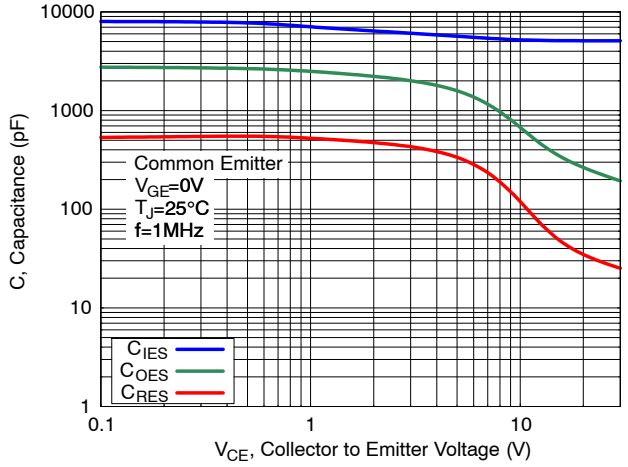



**Figure 7. Capacitance Characteristics**

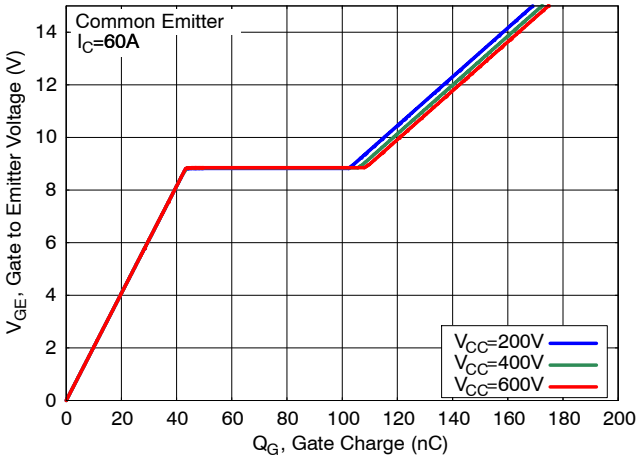



**Figure 8. Gate Charge Characteristics**

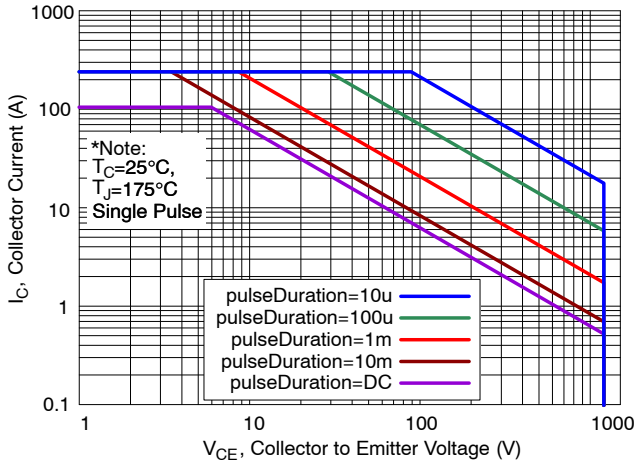



**Figure 9. SOA Characteristics**

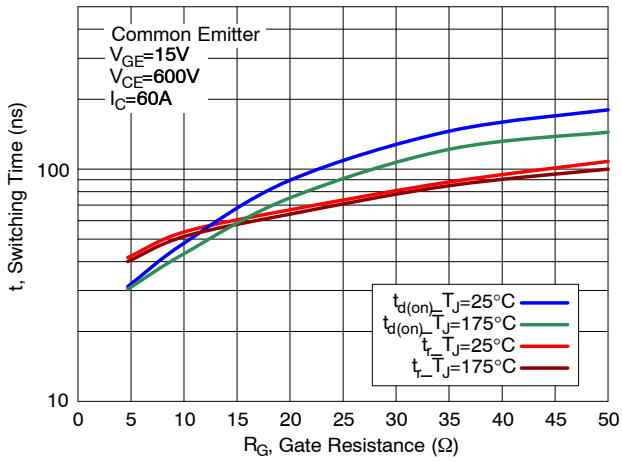



**Figure 10. Turn−On Switching Time vs. Gate Resistance**

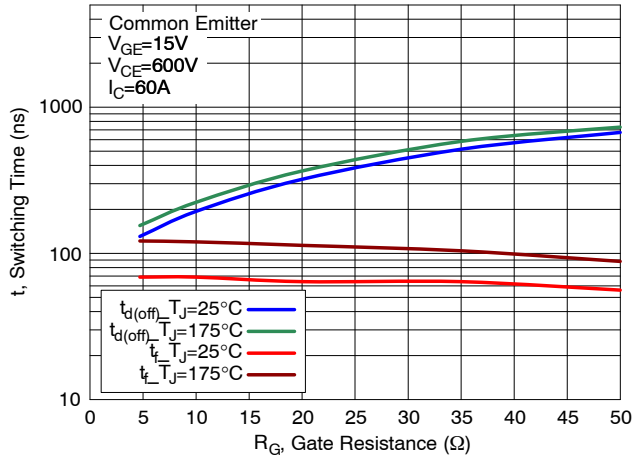



**Figure 11. Turn−Off Switching Time vs. Gate Resistance**

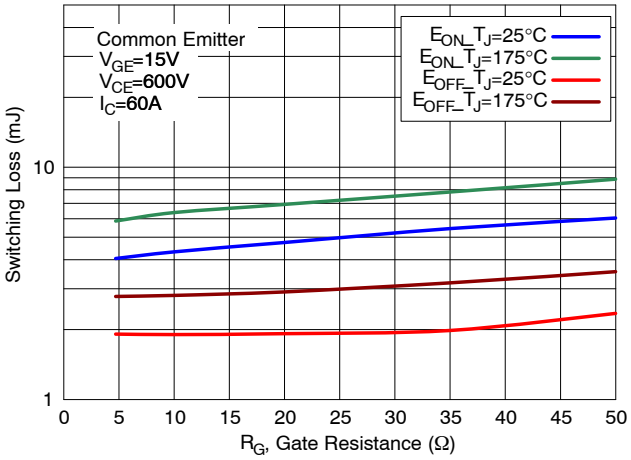



**Figure 12. Switching Loss vs. Gate Resistance**

## TYPICAL CHARACTERISTICS

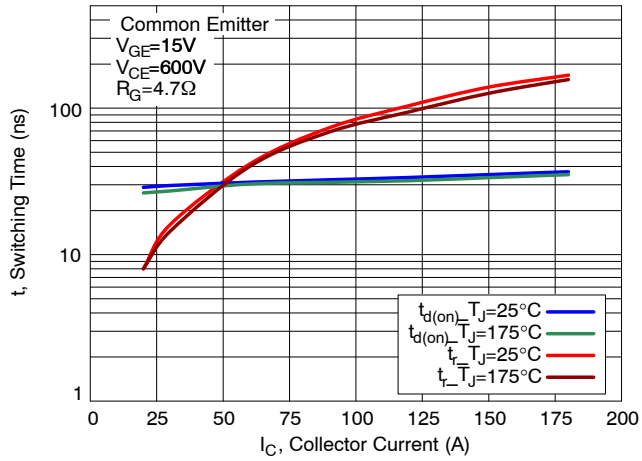



**Figure 13. Turn−On Switching Time vs. Collector Current**

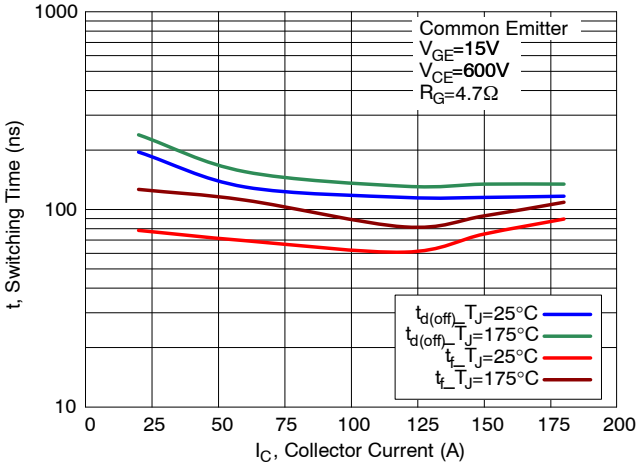



**Figure 14. Turn−Off Switching Time vs. Collector Current**

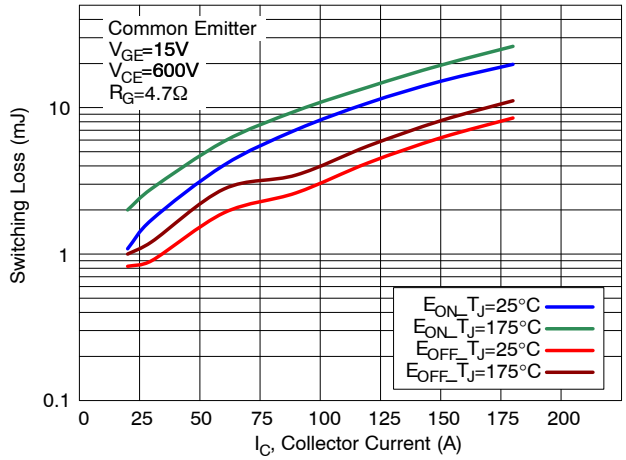



**Figure 15. Switching Loss vs. Collector Current**

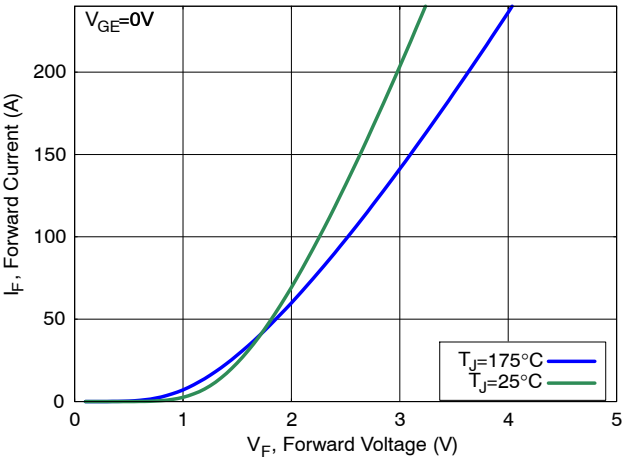



**Figure 16. Diode Forward Characteristics**

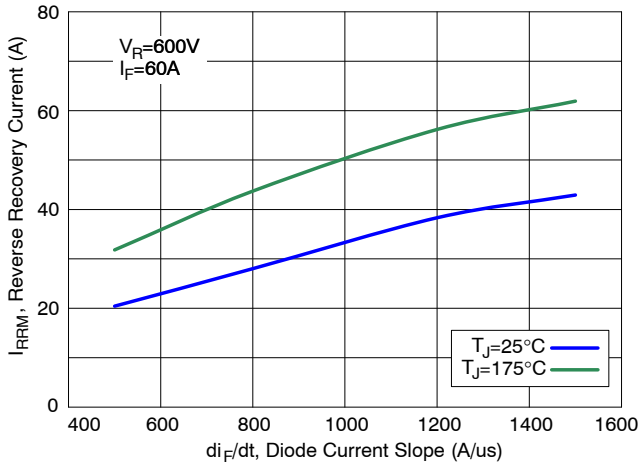



**Figure 17. Diode Reverse Recovery Current**

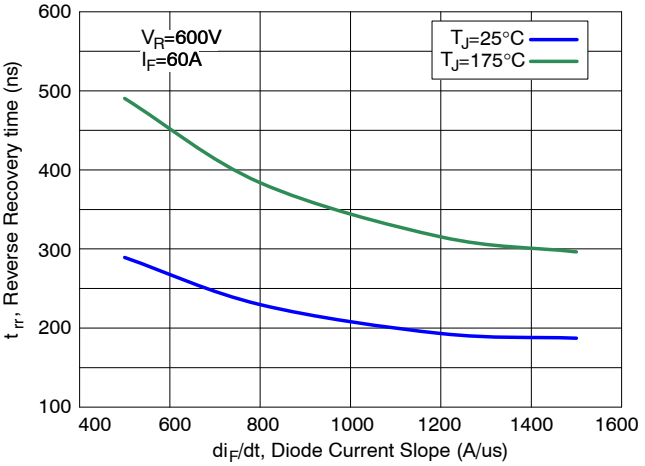



**Figure 18. Diode Reverse Recovery Time**

## TYPICAL CHARACTERISTICS

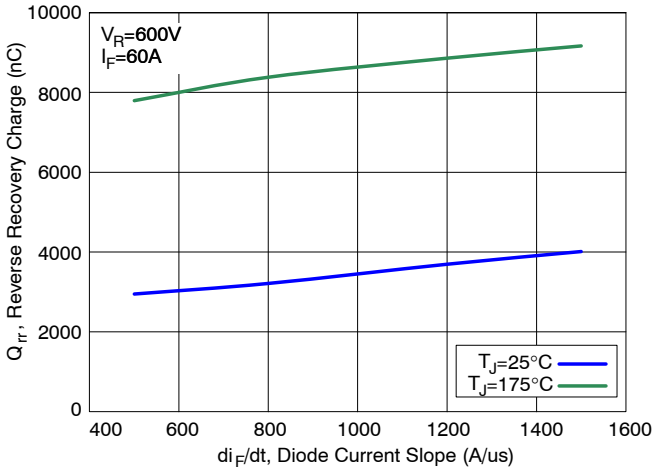



**Figure 19. Diode Stored Charge Characteristics**

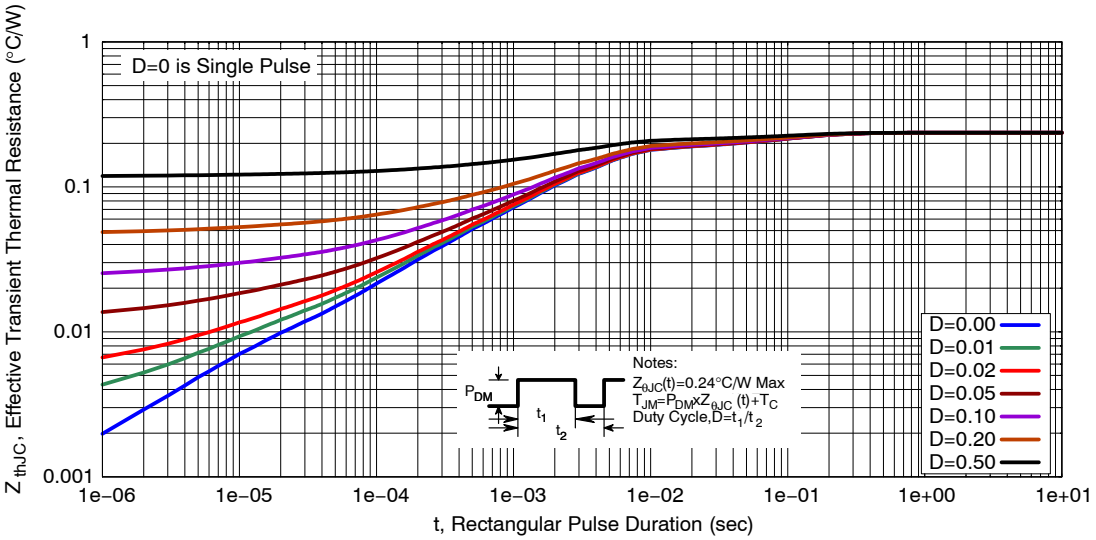



**Figure 20. Transient Thermal Impedance of IGBT**

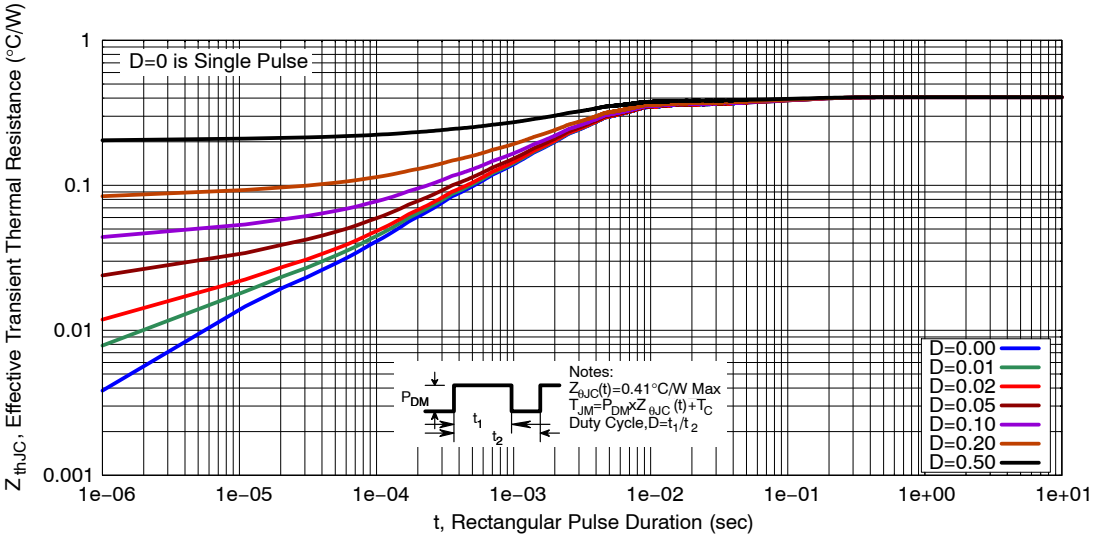



**Figure 21. Transient Thermal Impedance of Diode**

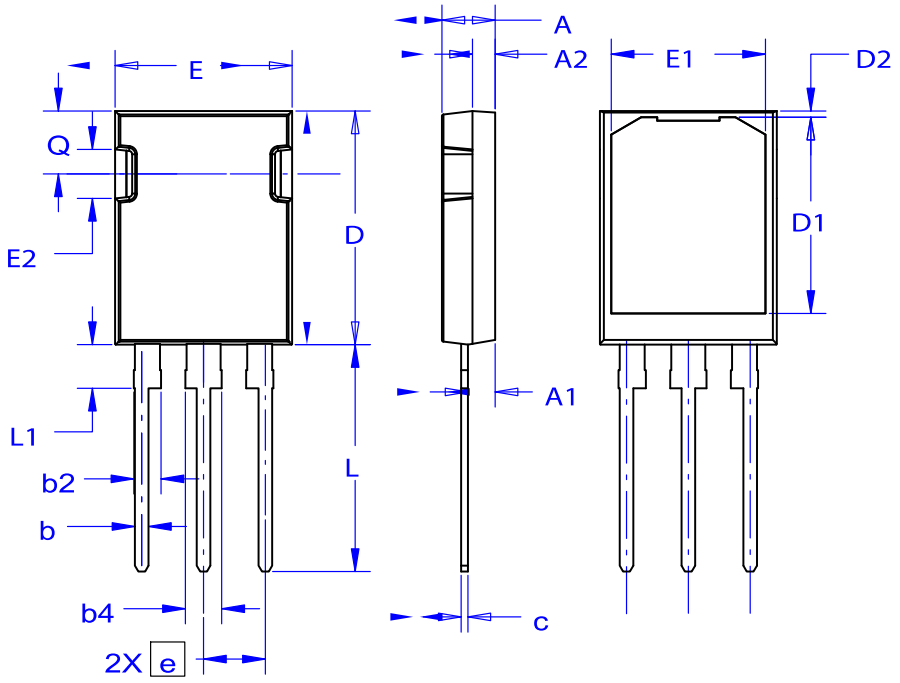
# FGY60T120SWD

## PACKAGE DIMENSIONS

**TO−247−3LD**
CASE 340CD
ISSUE A

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 |



### 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

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