

# IGBT – Power, Co-PAK

## N-Channel, Field Stop VII (FS7), Non SCR, Power TO247-3L, 1200 V, 1.7 V, 75 A

### FGY75T120SWD

#### Description

Using the novel field stop 7<sup>th</sup> generation IGBT technology and the Gen7 Diode in TO247 3-lead package, FGY75T120SWD 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 –  $T_J = 175^{\circ}\text{C}$
- 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 ( $T_J = 25^{\circ}\text{C}$ unless otherwise noted)

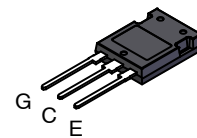
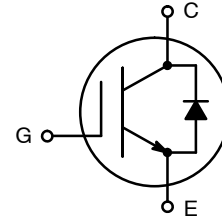
| Parameter                                        | Symbol                      | Value      | Unit               |
|--------------------------------------------------|-----------------------------|------------|--------------------|
| Collector-to-Emitter Voltage                     | $V_{CES}$                   | 1200       | V                  |
| Gate-to-Emitter Voltage                          | $V_{GES}$                   | $\pm 20$   |                    |
| Transient Gate-to-Emitter Voltage                |                             | $\pm 30$   |                    |
| Collector Current                                | $T_C = 25^{\circ}\text{C}$  | $I_C$      | A                  |
|                                                  |                             | 150        |                    |
| Power Dissipation                                | $T_C = 25^{\circ}\text{C}$  | $P_D$      | W                  |
|                                                  |                             | 714        |                    |
| Pulsed Collector Current                         | $T_C = 100^{\circ}\text{C}$ |            | A                  |
|                                                  |                             | 75         |                    |
| Diode Forward Current                            | $T_C = 25^{\circ}\text{C}$  | $I_{CM}$   | A                  |
|                                                  |                             | 300        |                    |
| Pulsed Diode Maximum Forward Current             | $T_C = 100^{\circ}\text{C}$ |            | A                  |
|                                                  |                             | 75         |                    |
| Operating Junction and Storage Temperature Range | $T_J, T_{STG}$              |            | $^{\circ}\text{C}$ |
|                                                  |                             | -55 to 175 |                    |
| 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. Repetitive rating: pulse width limited by max. Junction temperature.

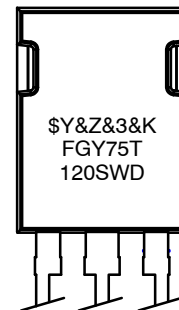
| $BV_{CES}$ | $V_{CE(SAT)}$ | $I_C$  |
|------------|---------------|--------|
| 1200 V     | 1.7 V         | 75.0 A |

#### 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  
 FGY75T120SWD = Specific Device code

#### ORDERING INFORMATION

| Device       | Package                | Shipping           |
|--------------|------------------------|--------------------|
| FGY75T120SWD | TO247-3LD<br>(Pb-Free) | 30 Units /<br>Tube |

# FGY75T120SWD

## THERMAL CHARACTERISTICS

| Parameter                                      | Symbol          | Value | Unit                 |
|------------------------------------------------|-----------------|-------|----------------------|
| Thermal Resistance, Junction-to-Case for IGBT  | $R_{\theta JC}$ | 0.21  | $^{\circ}\text{C/W}$ |
| Thermal Resistance, Junction-to-Case for Diode |                 | 0.35  |                      |
| Thermal Resistance, Junction-to-Ambient        | $R_{\theta JA}$ | 40    |                      |

## ELECTRICAL CHARACTERISTICS OF THE IGBT ( $T_J = 25^{\circ}\text{C}$ unless otherwise noted)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|-----------|--------|-----------------|-----|-----|-----|------|
|-----------|--------|-----------------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                           |                                |                                             |      |      |           |                        |
|-------------------------------------------|--------------------------------|---------------------------------------------|------|------|-----------|------------------------|
| Collector-to-Emitter Breakdown Voltage    | $BV_{CES}$                     | $V_{GE} = 0\text{ V}, I_C = 5\text{ mA}$    | 1200 | –    | –         | V                      |
| Breakdown Voltage Temperature Coefficient | $\Delta BV_{CES} / \Delta T_J$ | $V_{GE} = 0\text{ V}, I_C = 5\text{ mA}$    | –    | 1223 | –         | mV/ $^{\circ}\text{C}$ |
| Collector-to-Emitter Cut-Off Current      | $I_{CES}$                      | $V_{GE} = 0\text{ V}, V_{CE} = V_{CES}$     | –    | –    | 40        | $\mu\text{A}$          |
| Gate-to-Emitter Leakage Current           | $I_{GES}$                      | $V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$ | –    | –    | $\pm 400$ | nA                     |

### ON CHARACTERISTICS

|                                         |               |                                                                      |      |      |     |   |
|-----------------------------------------|---------------|----------------------------------------------------------------------|------|------|-----|---|
| Gate-to-Emitter Threshold Voltage       | $V_{GE(TH)}$  | $V_{GE} = V_{CE}, I_C = 75\text{ mA}$                                | 5.6  | 6.55 | 7.4 | V |
| Collector-to-Emitter Saturation Voltage | $V_{CE(SAT)}$ | $V_{GE} = 15\text{ V}, I_C = 75\text{ A}, T_J = 25^{\circ}\text{C}$  | 1.35 | 1.68 | 2.0 | V |
|                                         |               | $V_{GE} = 15\text{ V}, I_C = 75\text{ A}, T_J = 175^{\circ}\text{C}$ | –    | 2.24 | –   |   |

### DYNAMIC CHARACTERISTICS

|                              |           |                                                                  |   |      |   |    |
|------------------------------|-----------|------------------------------------------------------------------|---|------|---|----|
| Input Capacitance            | $C_{IES}$ | $V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$    | – | 6331 | – | pF |
| Output Capacitance           | $C_{OES}$ |                                                                  | – | 234  | – |    |
| Reverse Transfer Capacitance | $C_{RES}$ |                                                                  | – | 29.6 | – |    |
| Total Gate Charge            | $Q_G$     | $V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 75\text{ A}$ | – | 214  | – | nC |
| Gate-to-Emitter Charge       | $Q_{GE}$  |                                                                  | – | 53.9 | – |    |
| Gate-to-Collector Charge     | $Q_{GC}$  |                                                                  | – | 77.7 | – |    |

### SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

|                         |              |                                                                                                                       |   |      |   |    |
|-------------------------|--------------|-----------------------------------------------------------------------------------------------------------------------|---|------|---|----|
| Turn-On Delay Time      | $t_{d(on)}$  | $V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 37.5\text{ A}, R_G = 4.7\text{ }\Omega, T_J = 25^{\circ}\text{C}$ | – | 42   | – | ns |
| Turn-Off Delay Time     | $t_{d(off)}$ |                                                                                                                       | – | 221  | – |    |
| Rise Time               | $t_r$        |                                                                                                                       | – | 27   | – |    |
| Fall Time               | $t_f$        |                                                                                                                       | – | 77   | – |    |
| Turn-On Switching Loss  | $E_{on}$     | $V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 75\text{ A}, R_G = 4.7\text{ }\Omega, T_J = 25^{\circ}\text{C}$   | – | 2.12 | – | mJ |
| Turn-Off Switching Loss | $E_{off}$    |                                                                                                                       | – | 1.43 | – |    |
| Total Switching Loss    | $E_{ts}$     |                                                                                                                       | – | 3.55 | – |    |
| Turn-On Delay Time      | $t_{d(on)}$  |                                                                                                                       | – | 42   | – | ns |
| Turn-Off Delay Time     | $t_{d(off)}$ |                                                                                                                       | – | 171  | – |    |
| Rise Time               | $t_r$        |                                                                                                                       | – | 56   | – |    |
| Fall Time               | $t_f$        |                                                                                                                       | – | 66   | – |    |
| Turn-On Switching Loss  | $E_{on}$     | $V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V}, I_C = 75\text{ A}, R_G = 4.7\text{ }\Omega, T_J = 25^{\circ}\text{C}$   | – | 5.00 | – | mJ |
| Turn-Off Switching Loss | $E_{off}$    |                                                                                                                       | – | 2.32 | – |    |
| Total Switching Loss    | $E_{ts}$     |                                                                                                                       | – | 7.32 | – |    |



# FGY75T120SWD

## ELECTRICAL CHARACTERISTICS OF THE IGBT ( $T_J = 25^\circ\text{C}$ unless otherwise noted) (continued)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|-----------|--------|-----------------|-----|-----|-----|------|
|-----------|--------|-----------------|-----|-----|-----|------|

### SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

|                         |              |                                                                                                                          |   |       |   |    |
|-------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------|---|-------|---|----|
| Turn-On Delay Time      | $t_{d(on)}$  | $V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V},$<br>$I_C = 37.5\text{ A}, R_G = 4.7\ \Omega,$<br>$T_J = 175^\circ\text{C}$ | – | 38    | – | ns |
| Turn-Off Delay Time     | $t_{d(off)}$ |                                                                                                                          | – | 276   | – |    |
| Rise Time               | $t_r$        |                                                                                                                          | – | 26    | – |    |
| Fall Time               | $t_f$        |                                                                                                                          | – | 132   | – |    |
| Turn-On Switching Loss  | $E_{on}$     | $V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V},$<br>$I_C = 75\text{ A}, R_G = 4.7\ \Omega,$<br>$T_J = 175^\circ\text{C}$   | – | 3.50  | – | mJ |
| Turn-Off Switching Loss | $E_{off}$    |                                                                                                                          | – | 2.31  | – |    |
| Total Switching Loss    | $E_{ts}$     |                                                                                                                          | – | 5.81  | – |    |
| Turn-On Delay Time      | $t_{d(on)}$  |                                                                                                                          | – | 38    | – | ns |
| Turn-Off Delay Time     | $t_{d(off)}$ |                                                                                                                          | – | 210   | – |    |
| Rise Time               | $t_r$        |                                                                                                                          | – | 53    | – |    |
| Fall Time               | $t_f$        |                                                                                                                          | – | 115   | – |    |
| Turn-On Switching Loss  | $E_{on}$     | $V_{CE} = 600\text{ V}, V_{GE} = 15\text{ V},$<br>$I_C = 75\text{ A}, R_G = 4.7\ \Omega,$<br>$T_J = 175^\circ\text{C}$   | – | 7.29  | – | mJ |
| Turn-Off Switching Loss | $E_{off}$    |                                                                                                                          | – | 3.50  | – |    |
| Total Switching Loss    | $E_{ts}$     |                                                                                                                          | – | 10.79 | – |    |

### DIODE CHARACTERISTIC

|                       |       |                                              |      |      |      |   |
|-----------------------|-------|----------------------------------------------|------|------|------|---|
| Diode Forward Voltage | $V_F$ | $I_F = 75\text{ A}, T_J = 25^\circ\text{C}$  | 1.62 | 1.84 | 2.22 | V |
|                       |       | $I_F = 75\text{ A}, T_J = 175^\circ\text{C}$ | –    | 1.91 | –    |   |

### DIODE SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

|                               |           |                                                                                                                   |   |      |   |    |
|-------------------------------|-----------|-------------------------------------------------------------------------------------------------------------------|---|------|---|----|
| Reverse Recovery Time         | $t_{rr}$  | $V_R = 600\text{ V}, I_F = 37.5\text{ A},$<br>$di_F/dt = 1000\text{ A}/\mu\text{s},$<br>$T_J = 25^\circ\text{C}$  | – | 136  | – | ns |
| Reverse Recovery Charge       | $Q_{rr}$  |                                                                                                                   | – | 2340 | – | nC |
| Reverse Recovery Energy       | $E_{rec}$ |                                                                                                                   | – | 0.7  | – | mJ |
| Peak Reverse Recovery Current | $I_{RRM}$ |                                                                                                                   | – | 34.5 | – | A  |
| Reverse Recovery Time         | $t_{rr}$  | $V_R = 600\text{ V}, I_F = 75\text{ A},$<br>$di_F/dt = 1000\text{ A}/\mu\text{s},$<br>$T_J = 25^\circ\text{C}$    | – | 204  | – | ns |
| Reverse Recovery Charge       | $Q_{rr}$  |                                                                                                                   | – | 3974 | – | nC |
| Reverse Recovery Energy       | $E_{rec}$ |                                                                                                                   | – | 1.3  | – | mJ |
| Peak Reverse Recovery Current | $I_{RRM}$ |                                                                                                                   | – | 38.8 | – | A  |
| Reverse Recovery Time         | $t_{rr}$  | $V_R = 600\text{ V}, I_F = 37.5\text{ A},$<br>$di_F/dt = 1000\text{ A}/\mu\text{s},$<br>$T_J = 175^\circ\text{C}$ | – | 236  | – | ns |
| Reverse Recovery Charge       | $Q_{rr}$  |                                                                                                                   | – | 5980 | – | nC |
| Reverse Recovery Energy       | $E_{rec}$ |                                                                                                                   | – | 2.1  | – | mJ |
| Peak Reverse Recovery Current | $I_{RRM}$ |                                                                                                                   | – | 50.7 | – | A  |
| Reverse Recovery Time         | $t_{rr}$  | $V_R = 600\text{ V}, I_F = 75\text{ A},$<br>$di_F/dt = 1000\text{ A}/\mu\text{s},$<br>$T_J = 175^\circ\text{C}$   | – | 334  | – | ns |
| Reverse Recovery Charge       | $Q_{rr}$  |                                                                                                                   | – | 9544 | – | nC |
| Reverse Recovery Energy       | $E_{rec}$ |                                                                                                                   | – | 3.5  | – | mJ |
| Peak Reverse Recovery Current | $I_{RRM}$ |                                                                                                                   | – | 57.1 | – | 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

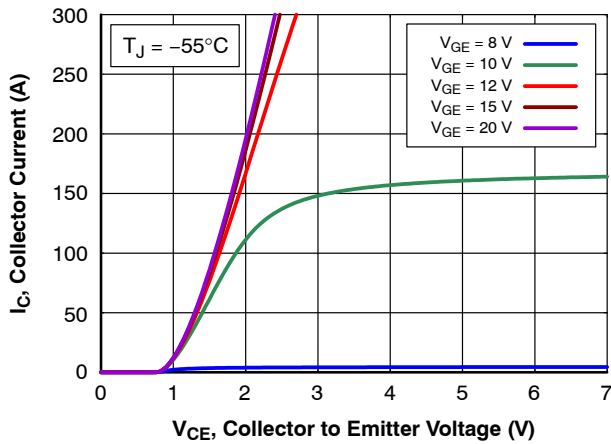


Figure 1. Output Characteristics

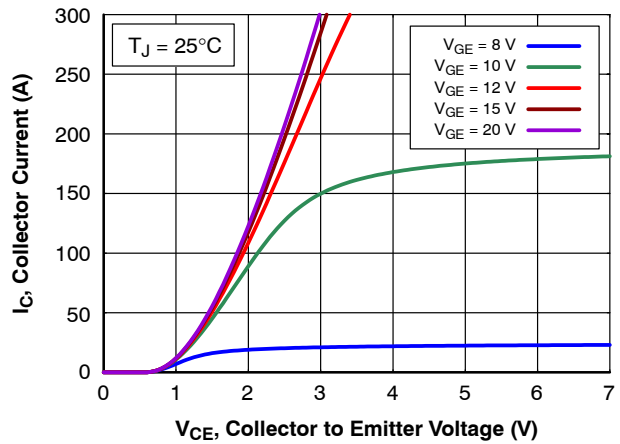


Figure 2. Output Characteristics

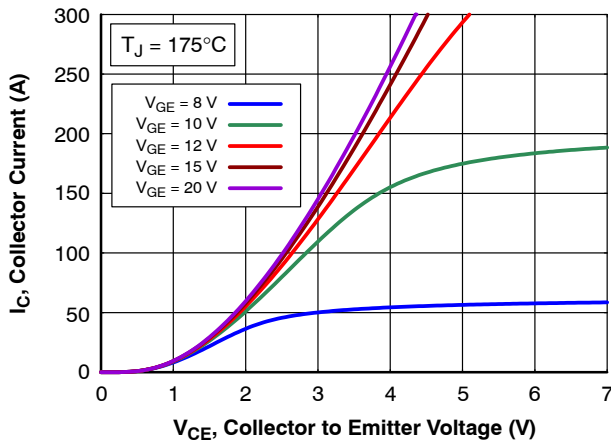


Figure 3. Output Characteristics

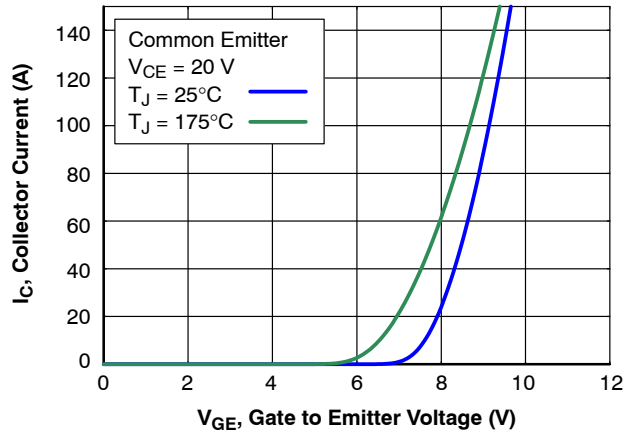


Figure 4. Transfer Characteristics

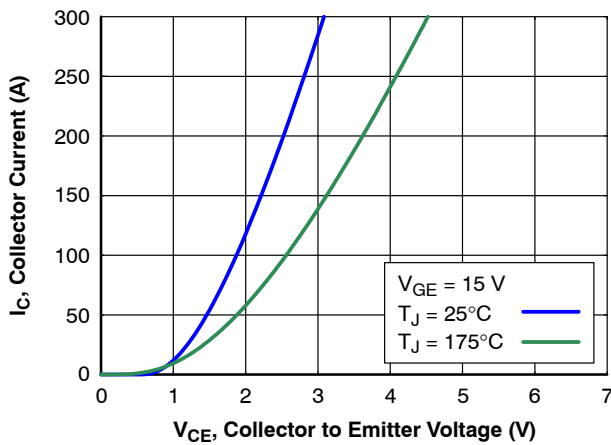


Figure 5. Saturation Voltage Characteristics

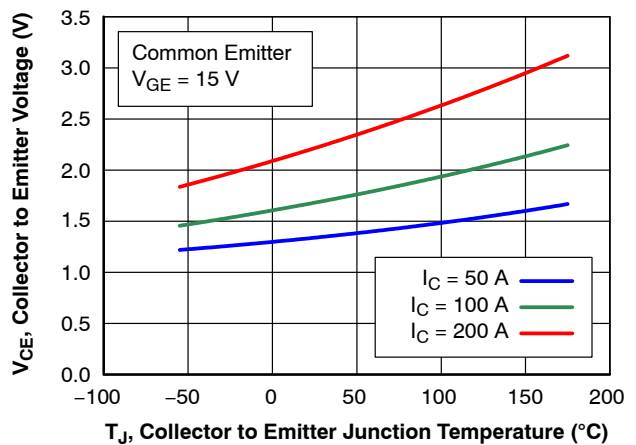


Figure 6. Saturation Voltage vs Junction Temperature

TYPICAL CHARACTERISTICS (CONTINUED)

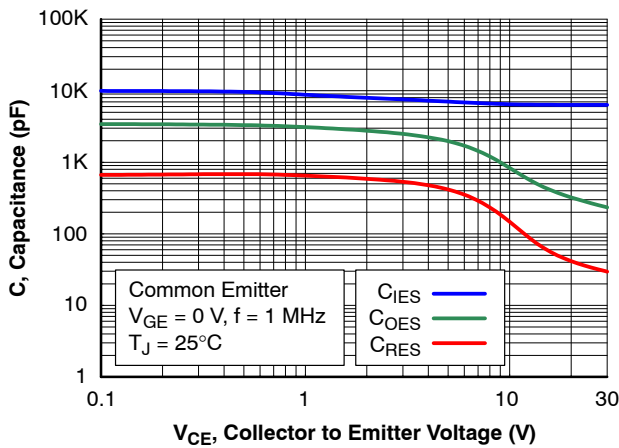


Figure 7. Capacitance Characteristics

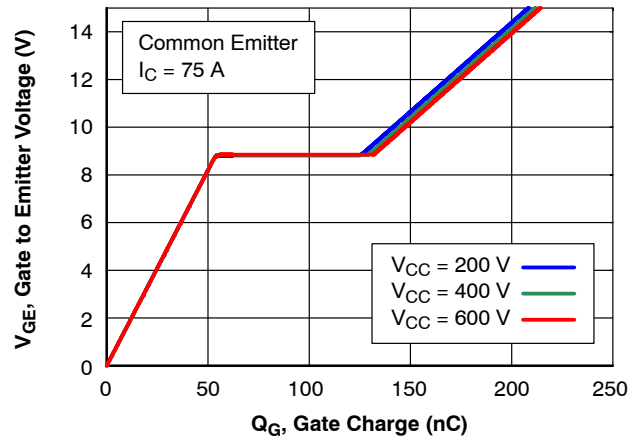


Figure 8. Gate Charge Characteristics

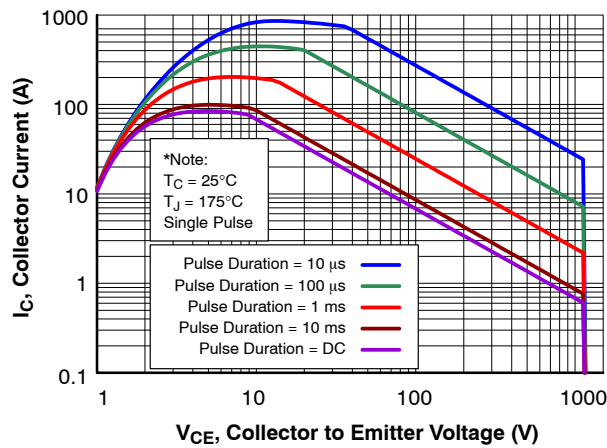


Figure 9. SOA Characteristics

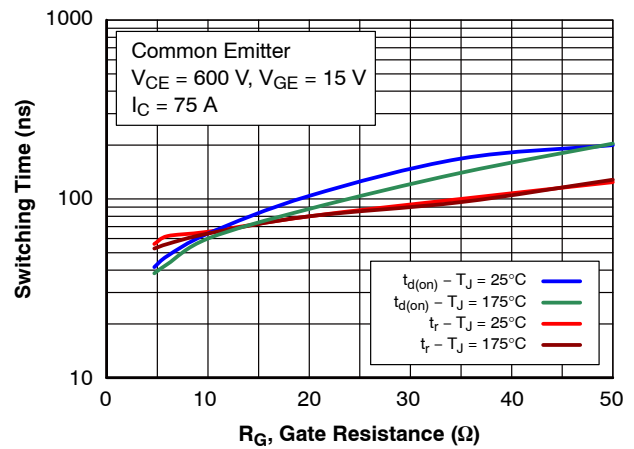


Figure 10. Turn-On Time vs Gate Resistance

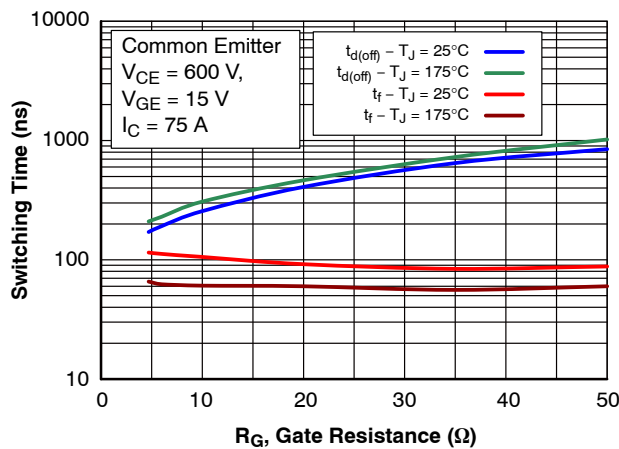


Figure 11. Turn-Off Time vs Gate Resistance

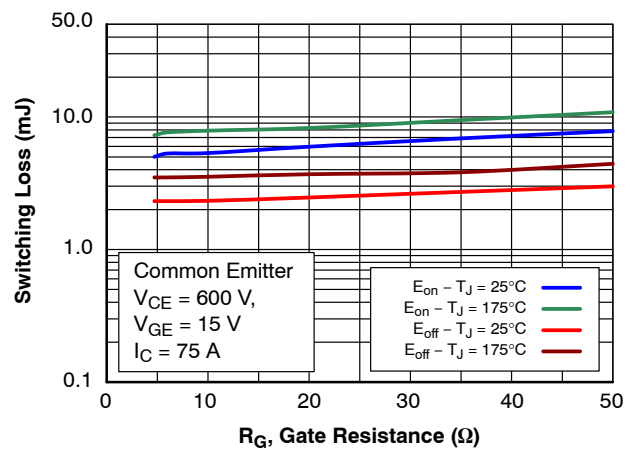


Figure 12. Switching Loss vs Gate Resistance

TYPICAL CHARACTERISTICS (CONTINUED)

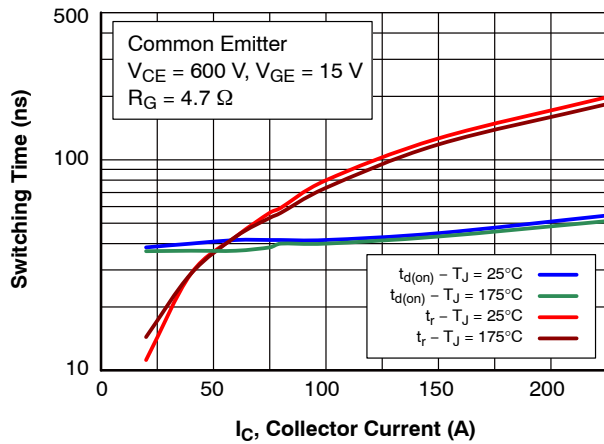


Figure 13. Turn-On Time vs Collector Current

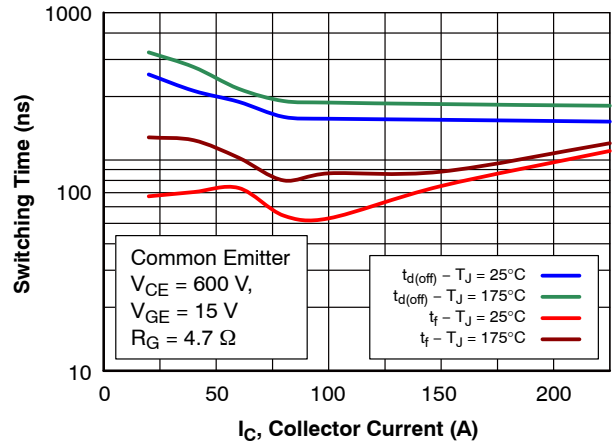


Figure 14. Turn-Off Time vs Collector Current

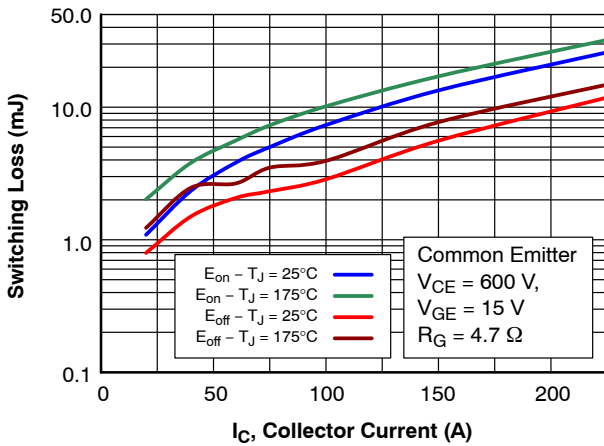


Figure 15. Switching Loss vs Collector Current

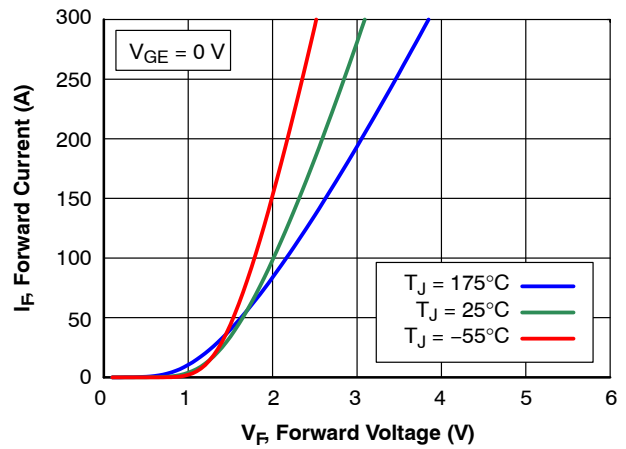


Figure 16. Diode Forward Characteristics

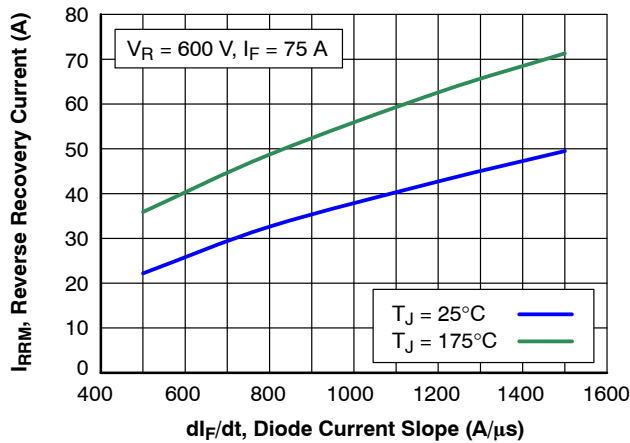


Figure 17. Diode Reverse Recovery Current

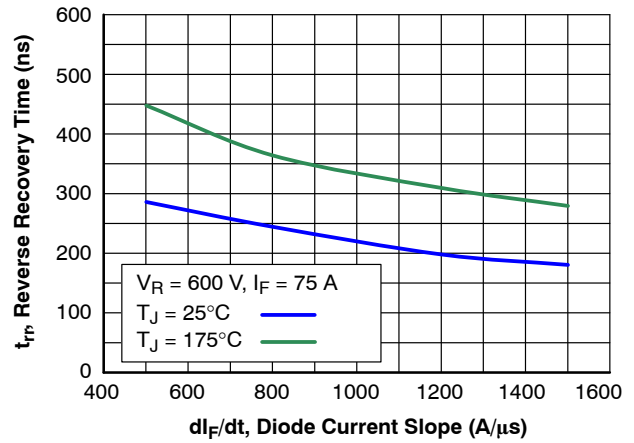


Figure 18. Diode Reverse Recovery Time

TYPICAL CHARACTERISTICS (CONTINUED)

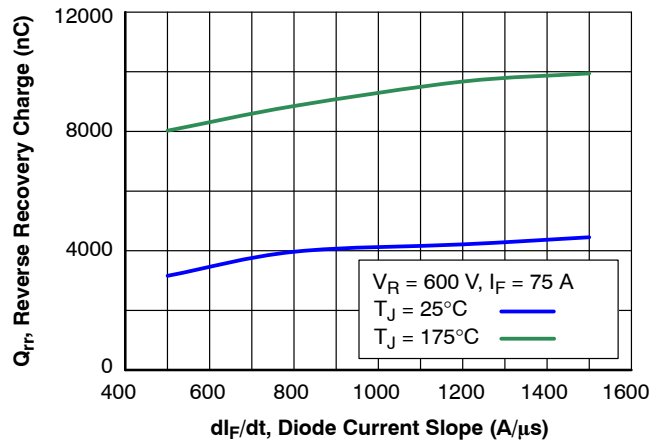


Figure 19. Diode Stored Charge Characteristics

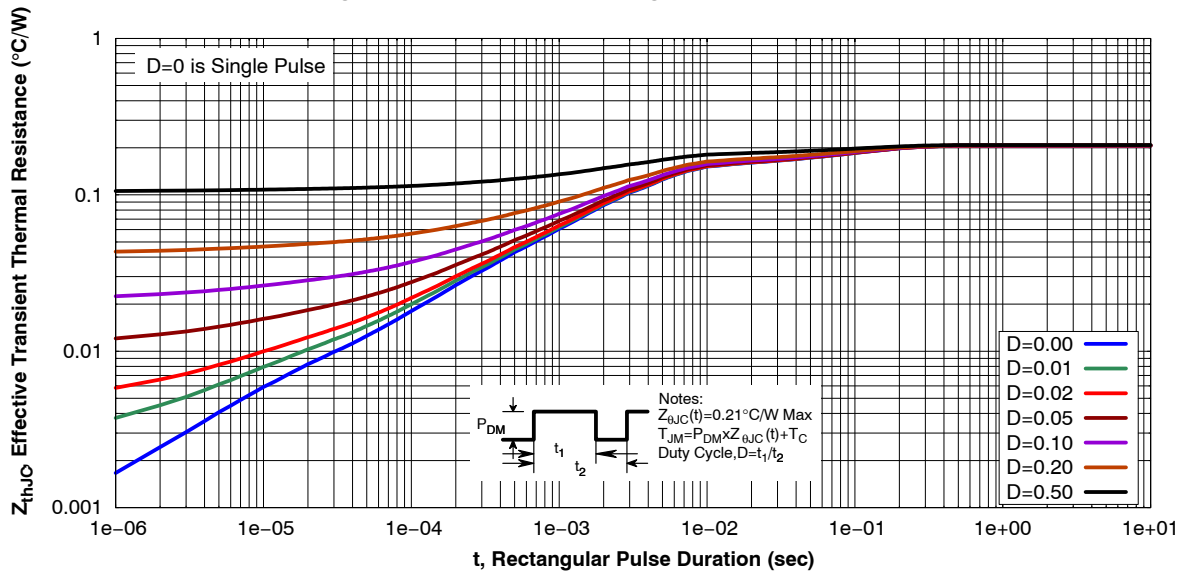


Figure 20. Transient Thermal Impedance of IGBT

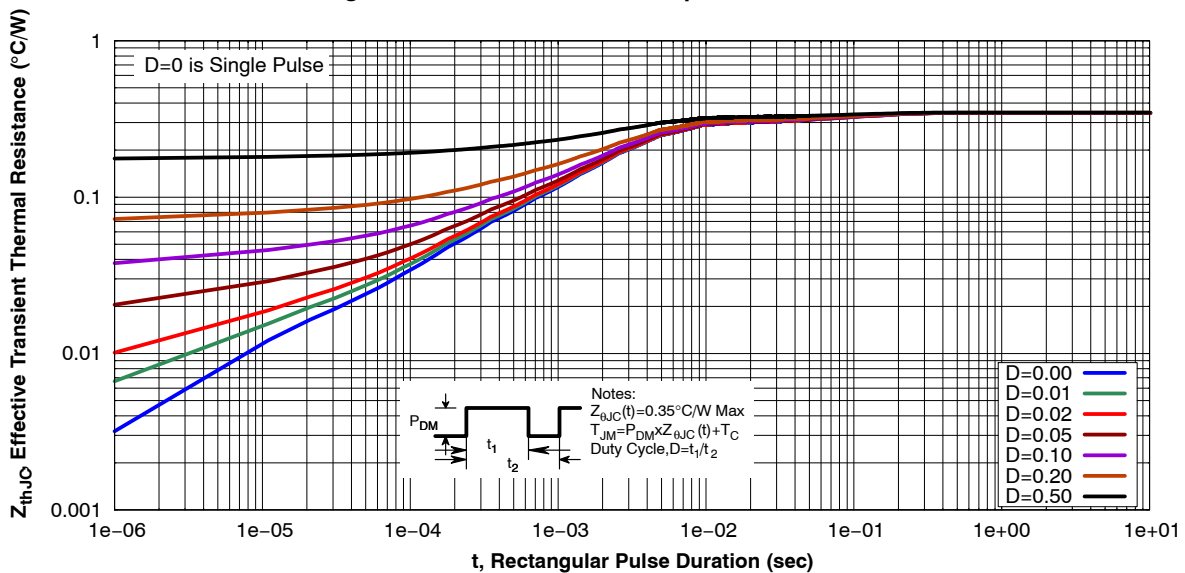
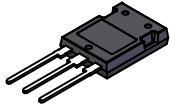


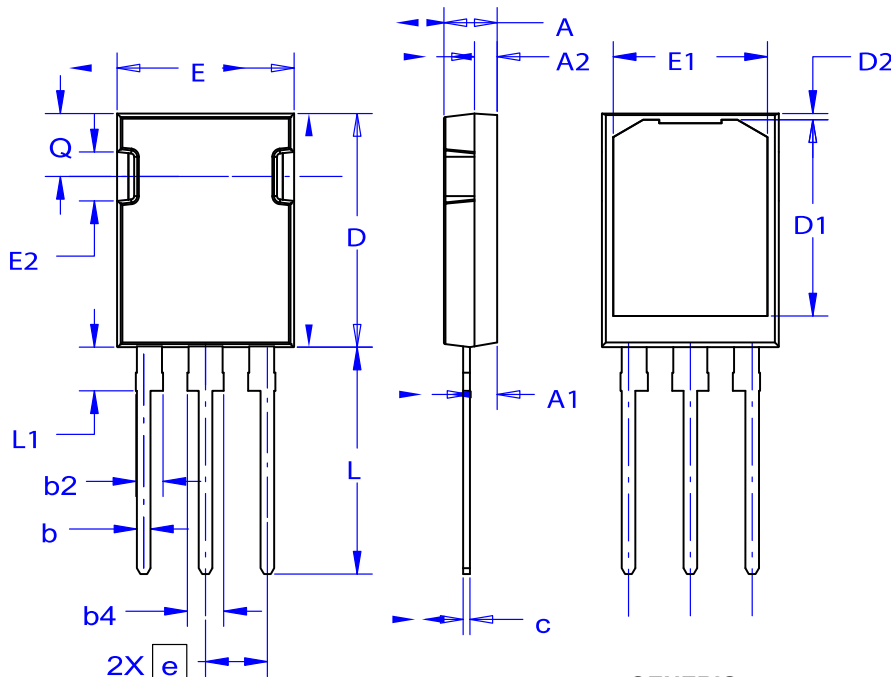
Figure 21. Transient Thermal Impedance of Diode


**TO-247-3LD**  
**CASE 340CD**  
**ISSUE A**

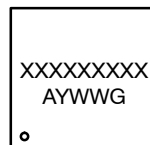
DATE 18 SEP 2018

**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\***


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.

|                         |                    |                                                                                                                                                                                     |
|-------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>DOCUMENT NUMBER:</b> | <b>98AON13857G</b> | Electronic versions are uncontrolled except when accessed directly from the Document Repository.<br>Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| <b>DESCRIPTION:</b>     | <b>TO-247-3LD</b>  | <b>PAGE 1 OF 1</b>                                                                                                                                                                  |

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