

# IGBT - Field Stop, Trench

75 A, 650 V

## FGHL75T65LQDT

### Description

Field stop 4<sup>th</sup> generation Low  $V_{CE(sat)}$  IGBT technology and Full current rated copak Diode technology.

### Features

- Maximum Junction Temperature:  $T_J = 175^{\circ}\text{C}$
- Positive Temperature Co-efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage:  $V_{CE(sat)} = 1.15\text{ V (Typ.) @ } I_C = 75\text{ A}$
- 100% Of The Part Are Tested For  $I_{LM}$  (Note 2)
- Smooth & Optimized Switching
- Tight Parameter Distribution
- Co-Packed With Soft And Fast Recovery Diode
- RoHS Compliant

### Typical Applications

- Solar Inverter
- UPS, ESS
- PFC, Converters

### MAXIMUM RATINGS

| Parameter                                                                          | Symbol         | Value           | Unit               |
|------------------------------------------------------------------------------------|----------------|-----------------|--------------------|
| Collector to Emitter Voltage                                                       | $V_{CES}$      | 650             | V                  |
| Gate to Emitter Voltage                                                            | $V_{GES}$      | $\pm 20$        | V                  |
| Transient Gate to Emitter Voltage                                                  |                | $\pm 30$        |                    |
| Collector Current @ $T_C = 25^{\circ}\text{C}$ (Note 1)                            | $I_C$          | 80              | A                  |
| Collector Current @ $T_C = 100^{\circ}\text{C}$                                    |                | 75              |                    |
| Pulsed Collector Current (Note 2)                                                  | $I_{LM}$       | 300             | A                  |
| Pulsed Collector Current (Note 3)                                                  | $I_{CM}$       | 300             | A                  |
| Diode Forward Current @ $T_C = 25^{\circ}\text{C}$ (Note 1)                        | $I_F$          | 80              | A                  |
| Diode Forward Current @ $T_C = 100^{\circ}\text{C}$                                |                | 75              |                    |
| Pulsed Diode Maximum Forward Current                                               | $I_{FM}$       | 300             | A                  |
| Maximum Power Dissipation @ $T_C = 25^{\circ}\text{C}$                             | $P_D$          | 469             | W                  |
| Maximum Power Dissipation @ $T_C = 100^{\circ}\text{C}$                            |                | 234             |                    |
| Operating Junction Temperature / Storage Temperature Range                         | $T_J, T_{STG}$ | $-55$ to $+175$ | $^{\circ}\text{C}$ |
| Maximum Lead Temp. For soldering Purposes, $\frac{1}{8}$ " from case for 5 seconds | $T_L$          | 260             | $^{\circ}\text{C}$ |

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.

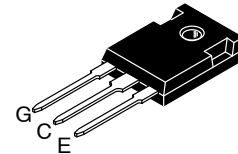
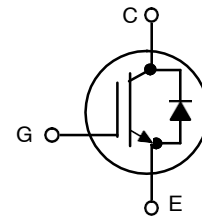
1. Value limit by bond wire.
2.  $V_{CC} = 400\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $I_C = 300\text{ A}$ , Inductive Load, 100% Tested.
3. Repetitive rating: pulse width limited by max. Junction temperature.



ON Semiconductor®

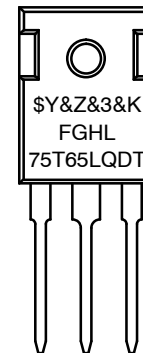
[www.onsemi.com](http://www.onsemi.com)

| $V_{CES}$ | $I_C$ | $V_{CE(sat)}$ |
|-----------|-------|---------------|
| 650 V     | 75 A  | 1.15 V        |



TO-247-3L  
CASE 340CX

### MARKING DIAGRAM



\$Y = ON Semiconductor Logo  
&Z = Assembly Plant Code  
&3 = 3-Digit Data Code  
&K = 2-Digit Lot Traceability Code  
FGHL75T65LQDT = Specific Device Code

### ORDERING INFORMATION

| Device        | Package   | Shipping        |
|---------------|-----------|-----------------|
| FGHL75T65LQDT | TO-247-3L | 30 Units / Rail |

# FGHL75T65LQDT

## THERMAL CHARACTERISTICS

| Parameter                                      | Symbol          | Value | Units                |
|------------------------------------------------|-----------------|-------|----------------------|
| Thermal Resistance Junction to Case, for IGBT  | $R_{\theta JC}$ | 0.32  | $^{\circ}\text{C/W}$ |
| Thermal Resistance Junction to Case, for Diode | $R_{\theta JC}$ | 0.6   | $^{\circ}\text{C/W}$ |
| Thermal Resistance Junction to Ambient         | $R_{\theta JA}$ | 40    | $^{\circ}\text{C/W}$ |

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

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

### OFF CHARACTERISTICS

|                                                                   |                                              |                                |     |     |           |                             |
|-------------------------------------------------------------------|----------------------------------------------|--------------------------------|-----|-----|-----------|-----------------------------|
| Collector-emitter Breakdown Voltage, Gate-emitter Short-circuited | $V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$     | $BV_{CES}$                     | 650 | –   | –         | V                           |
| Temperature Coefficient of Breakdown Voltage                      | $V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$     | $\Delta BV_{CES} / \Delta T_J$ | –   | 0.6 | –         | $\text{V}/^{\circ}\text{C}$ |
| Collector-emitter Cut-off Current, Gate-emitter Short-circuited   | $V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}$ | $I_{CES}$                      | –   | –   | 250       | $\mu\text{A}$               |
| Gate Leakage Current, Collector-emitter Short-circuited           | $V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$  | $I_{GES}$                      | –   | –   | $\pm 400$ | nA                          |

### ON CHARACTERISTICS

|                                      |                                                                      |               |     |      |      |   |
|--------------------------------------|----------------------------------------------------------------------|---------------|-----|------|------|---|
| Gate-emitter Threshold Voltage       | $V_{GE} = V_{CE}, I_C = 75\text{ mA}$                                | $V_{GE(th)}$  | 3.0 | 4.5  | 6.0  | V |
| Collector-emitter Saturation Voltage | $V_{GE} = 15\text{ V}, I_C = 75\text{ A}, T_J = 25^{\circ}\text{C}$  | $V_{CE(sat)}$ | –   | 1.15 | 1.35 | V |
|                                      | $V_{GE} = 15\text{ V}, I_C = 75\text{ A}, T_J = 175^{\circ}\text{C}$ |               | –   | 1.22 | –    |   |

### DYNAMIC CHARACTERISTICS

|                              |                                                                  |           |   |       |   |    |
|------------------------------|------------------------------------------------------------------|-----------|---|-------|---|----|
| Input Capacitance            | $V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$    | $C_{ies}$ | – | 15300 | – | pF |
| Output Capacitance           |                                                                  | $C_{oes}$ | – | 181   | – |    |
| Reverse Transfer Capacitance |                                                                  | $C_{res}$ | – | 68    | – |    |
| Gate Charge Total            | $V_{CE} = 400\text{ V}, I_C = 75\text{ A}, V_{GE} = 15\text{ V}$ | $Q_g$     | – | 793   | – | nC |
| Gate to Emitter Charge       |                                                                  | $Q_{ge}$  | – | 72    | – |    |
| Gate to Collector Charge     |                                                                  | $Q_{gc}$  | – | 248   | – |    |

### SWITCHING CHARACTERISTICS, INDUCTIVE LOAD

|                         |                                                                                                                             |              |   |      |   |    |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------|--------------|---|------|---|----|
| Turn-on Delay Time      | $T_J = 25^{\circ}\text{C}$<br>$V_{CC} = 400\text{ V}, I_C = 37.5\text{ A}$<br>$R_g = 4.7\ \Omega$<br>$V_{GE} = 15\text{ V}$ | $t_{d(on)}$  | – | 45   | – | ns |
| Rise Time               |                                                                                                                             | $t_r$        | – | 20   | – |    |
| Turn-off Delay Time     |                                                                                                                             | $t_{d(off)}$ | – | 608  | – |    |
| Fall Time               |                                                                                                                             | $t_f$        | – | 160  | – |    |
| Turn-on Switching Loss  |                                                                                                                             | $E_{on}$     | – | 0.78 | – | mJ |
| Turn-off Switching Loss |                                                                                                                             | $E_{off}$    | – | 1.36 | – |    |
| Total Switching Loss    |                                                                                                                             | $E_{ts}$     | – | 2.14 | – |    |
| Turn-on Delay Time      | $T_J = 25^{\circ}\text{C}$<br>$V_{CC} = 400\text{ V}, I_C = 75\text{ A}$<br>$R_g = 4.7\ \Omega$<br>$V_{GE} = 15\text{ V}$   | $t_{d(on)}$  | – | 48   | – | ns |
| Rise Time               |                                                                                                                             | $t_r$        | – | 40   | – |    |
| Turn-off Delay Time     |                                                                                                                             | $t_{d(off)}$ | – | 568  | – |    |
| Fall Time               |                                                                                                                             | $t_f$        | – | 128  | – |    |
| Turn-on Switching Loss  |                                                                                                                             | $E_{on}$     | – | 1.88 | – | mJ |
| Turn-off Switching Loss |                                                                                                                             | $E_{off}$    | – | 2.38 | – |    |
| Total Switching Loss    |                                                                                                                             | $E_{ts}$     | – | 4.26 | – |    |

# FGHL75T65LQDT

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

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

### SWITCHING CHARACTERISTICS, INDUCTIVE LOAD

|                         |                                                                                                                               |              |   |      |   |    |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------|--------------|---|------|---|----|
| Turn-on Delay Time      | $T_J = 175^\circ\text{C}$<br>$V_{CC} = 400\text{ V}$ , $I_C = 37.5\text{ A}$<br>$R_g = 4.7\ \Omega$<br>$V_{GE} = 15\text{ V}$ | $t_{d(on)}$  | – | 44   | – | ns |
| Rise Time               |                                                                                                                               | $t_r$        | – | 24   | – |    |
| Turn-off Delay Time     |                                                                                                                               | $t_{d(off)}$ | – | 680  | – |    |
| Fall Time               |                                                                                                                               | $t_f$        | – | 256  | – |    |
| Turn-on Switching Loss  |                                                                                                                               | $E_{on}$     | – | 1.54 | – | mJ |
| Turn-off Switching Loss |                                                                                                                               | $E_{off}$    | – | 2.11 | – |    |
| Total Switching Loss    |                                                                                                                               | $E_{ts}$     | – | 3.65 | – |    |
| Turn-on Delay Time      | $T_J = 175^\circ\text{C}$<br>$V_{CC} = 400\text{ V}$ , $I_C = 75\text{ A}$<br>$R_g = 4.7\ \Omega$<br>$V_{GE} = 15\text{ V}$   | $t_{d(on)}$  | – | 44   | – | ns |
| Rise Time               |                                                                                                                               | $t_r$        | – | 44   | – |    |
| Turn-off Delay Time     |                                                                                                                               | $t_{d(off)}$ | – | 632  | – |    |
| Fall Time               |                                                                                                                               | $t_f$        | – | 184  | – |    |
| Turn-on Switching Loss  |                                                                                                                               | $E_{on}$     | – | 3.14 | – | mJ |
| Turn-off Switching Loss |                                                                                                                               | $E_{off}$    | – | 3.58 | – |    |
| Total Switching Loss    |                                                                                                                               | $E_{ts}$     | – | 6.72 | – |    |

### DIODE CHARACTERISTICS

|                          |                                                                                                                        |           |   |      |     |               |
|--------------------------|------------------------------------------------------------------------------------------------------------------------|-----------|---|------|-----|---------------|
| Diode Forward Voltage    | $I_F = 75\text{ A}$ , $T_J = 25^\circ\text{C}$                                                                         | $V_F$     | – | 1.65 | 2.1 | V             |
|                          | $I_F = 75\text{ A}$ , $T_J = 175^\circ\text{C}$                                                                        |           | – | 1.55 | –   |               |
| Reverse Recovery Energy  | $T_J = 25^\circ\text{C}$ ,<br>$V_R = 400\text{ V}$ , $I_F = 37.5\text{ A}$ ,<br>$di_F/dt = 1000\text{ A}/\mu\text{s}$  | $E_{rec}$ | – | 105  | –   | $\mu\text{J}$ |
| Reverse Recovery Time    |                                                                                                                        | $T_{rr}$  | – | 59   | –   | ns            |
| Reverse Recovery Charge  |                                                                                                                        | $Q_{rr}$  | – | 574  | –   | nC            |
| Reverse Recovery Current |                                                                                                                        | $I_{rr}$  | – | 20   | –   | A             |
| Reverse Recovery Energy  | $T_J = 25^\circ\text{C}$ ,<br>$V_R = 400\text{ V}$ , $I_F = 75\text{ A}$ ,<br>$di_F/dt = 1000\text{ A}/\mu\text{s}$    | $E_{rec}$ | – | 152  | –   | $\mu\text{J}$ |
| Reverse Recovery Time    |                                                                                                                        | $T_{rr}$  | – | 87   | –   | ns            |
| Reverse Recovery Charge  |                                                                                                                        | $Q_{rr}$  | – | 794  | –   | nC            |
| Reverse Recovery Current |                                                                                                                        | $I_{rr}$  | – | 18   | –   | A             |
| Reverse Recovery Energy  | $T_J = 175^\circ\text{C}$ ,<br>$V_R = 400\text{ V}$ , $I_F = 37.5\text{ A}$ ,<br>$di_F/dt = 1000\text{ A}/\mu\text{s}$ | $E_{rec}$ | – | 550  | –   | $\mu\text{J}$ |
| Reverse Recovery Time    |                                                                                                                        | $T_{rr}$  | – | 119  | –   | ns            |
| Reverse Recovery Charge  |                                                                                                                        | $Q_{rr}$  | – | 2154 | –   | nC            |
| Reverse Recovery Current |                                                                                                                        | $I_{rr}$  | – | 36   | –   | A             |
| Reverse Recovery Energy  | $T_J = 175^\circ\text{C}$ ,<br>$V_R = 400\text{ V}$ , $I_F = 75\text{ A}$ ,<br>$di_F/dt = 1000\text{ A}/\mu\text{s}$   | $E_{rec}$ | – | 764  | –   | $\mu\text{J}$ |
| Reverse Recovery Time    |                                                                                                                        | $T_{rr}$  | – | 145  | –   | ns            |
| Reverse Recovery Charge  |                                                                                                                        | $Q_{rr}$  | – | 2947 | –   | nC            |
| Reverse Recovery Current |                                                                                                                        | $I_{rr}$  | – | 40   | –   | 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

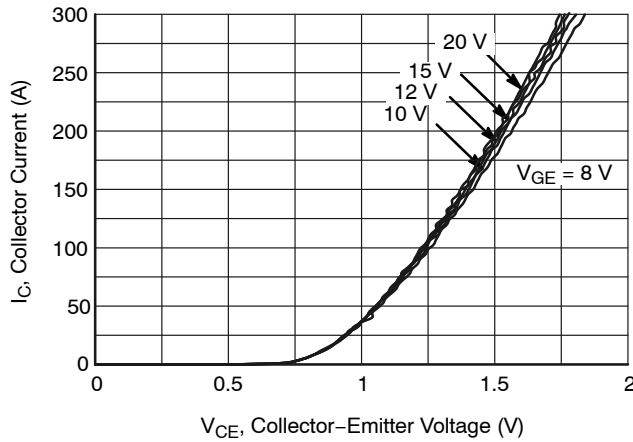


Figure 1. Typical Output Characteristics  
( $T_J = 25^\circ\text{C}$ )

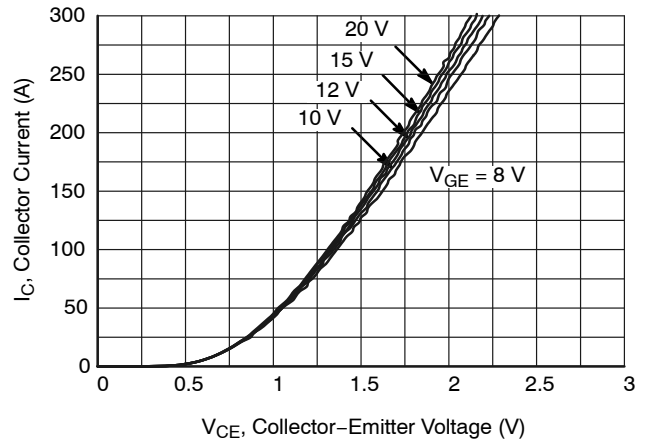


Figure 2. Typical Output Characteristics  
( $T_J = 175^\circ\text{C}$ )

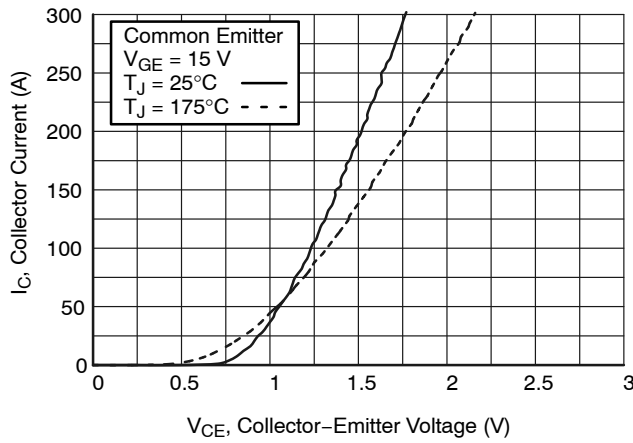


Figure 3. Typical Saturation Voltage Characteristics

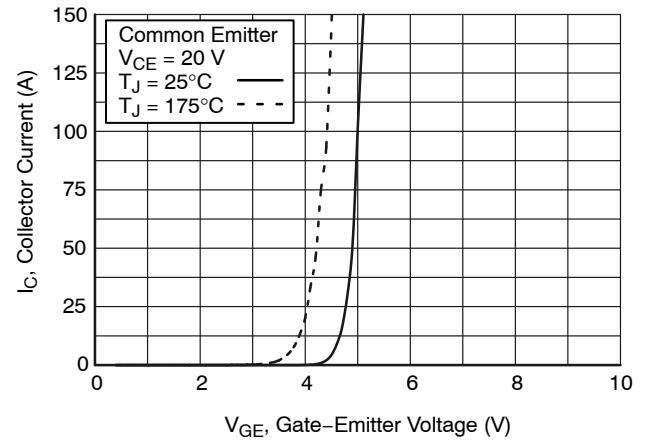


Figure 4. Typical Transfer Characteristics

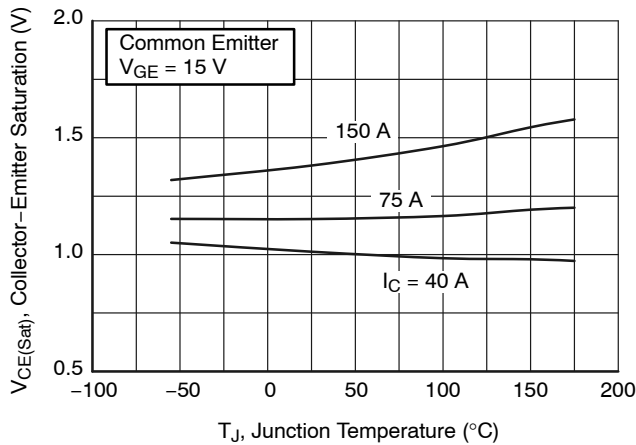


Figure 5. Saturation Voltage vs. Junction Temperature

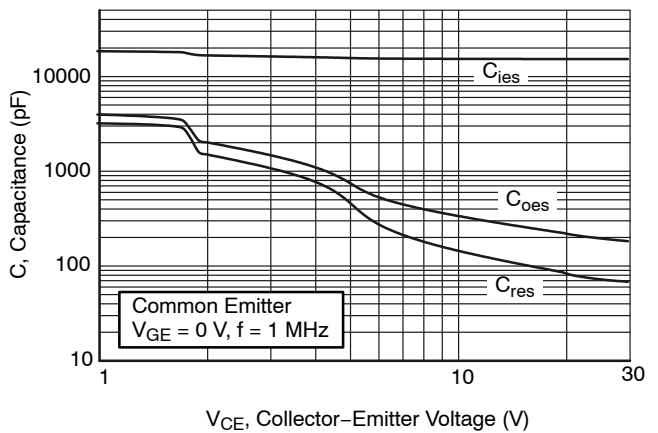


Figure 6. Capacitance Characteristics

TYPICAL CHARACTERISTICS (continued)

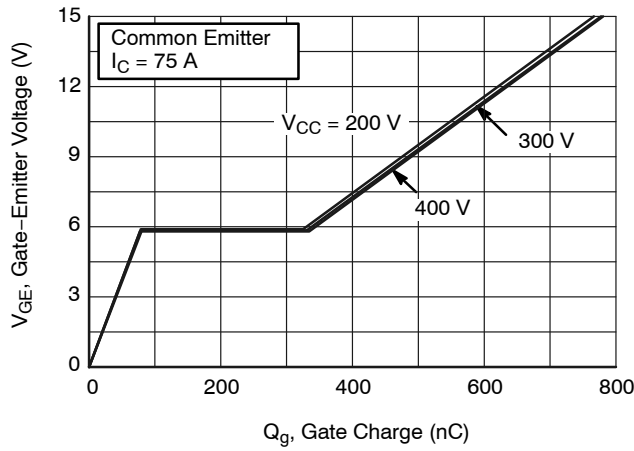


Figure 7. Gate Charge Characteristics

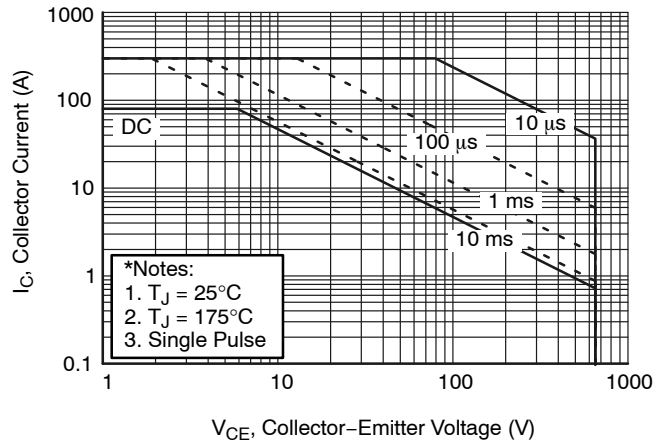


Figure 8. SOA Characteristics

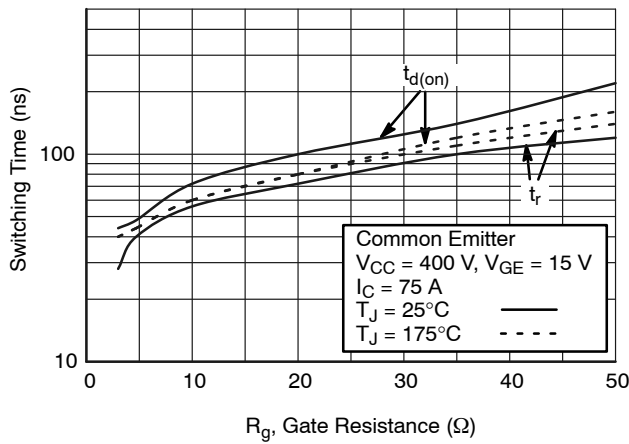


Figure 9. Turn-On Characteristics vs. Gate Resistance

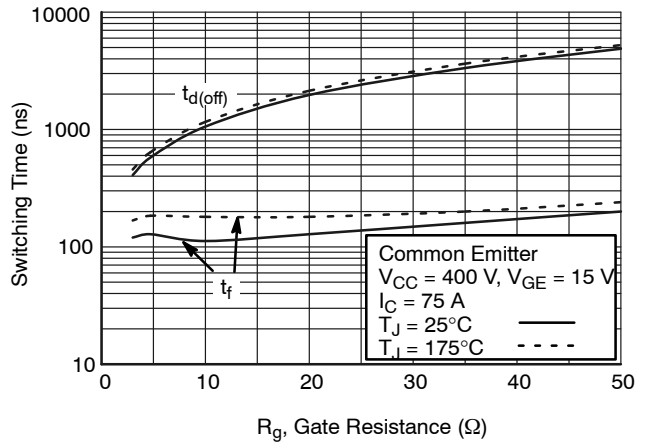


Figure 10. Turn-Off Characteristics vs. Gate Resistance

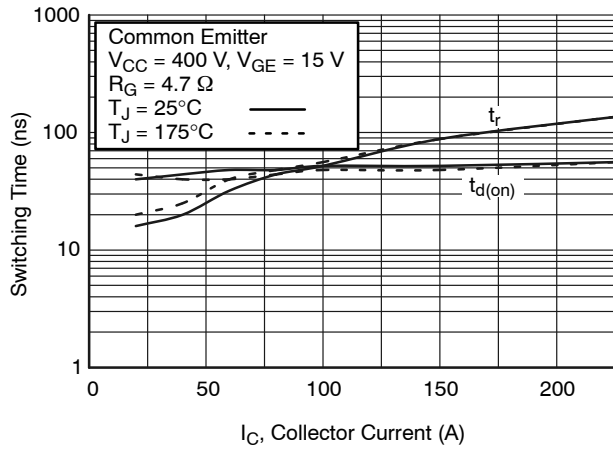


Figure 11. Turn-On Characteristics vs. Collector Current

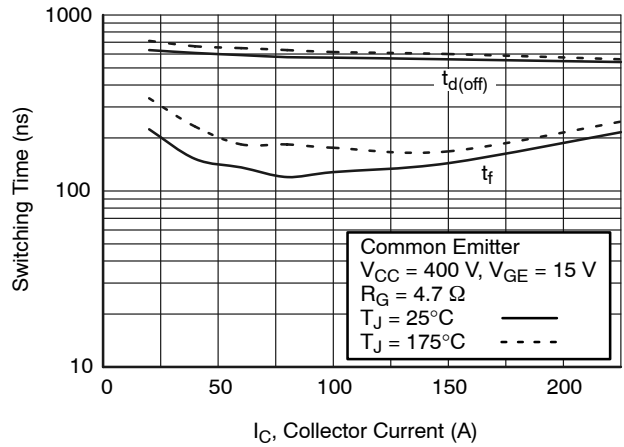


Figure 12. Turn-Off Characteristics vs. Collector Current

TYPICAL CHARACTERISTICS (continued)

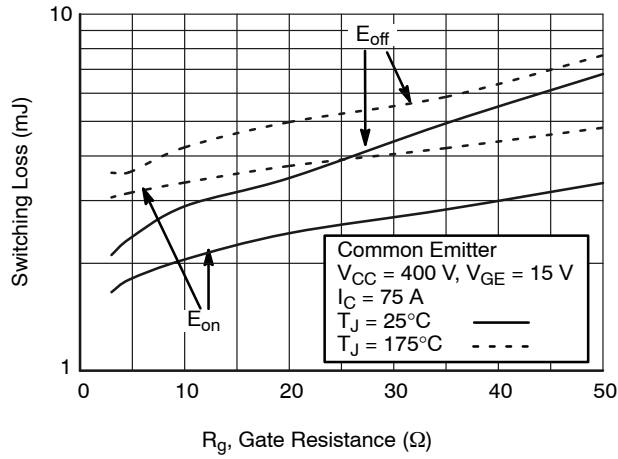


Figure 13. Switching Loss vs. Gate Resistance

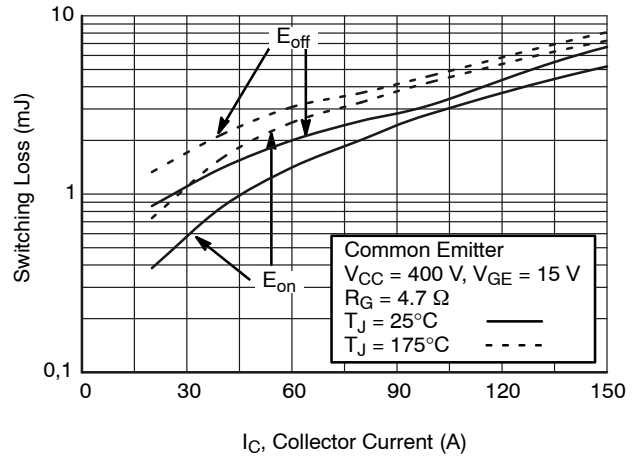


Figure 14. Switching Loss vs. Collector Current

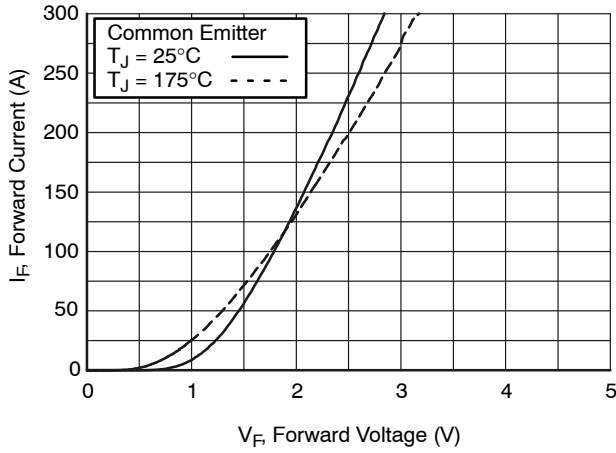


Figure 15. Forward Characteristics

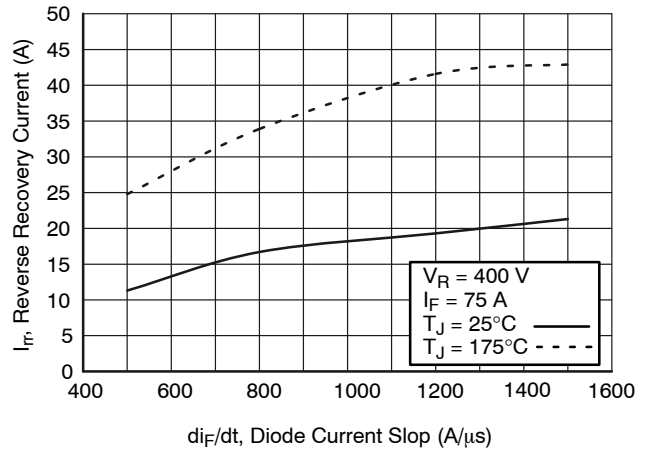


Figure 16. Reverse Recovery Current

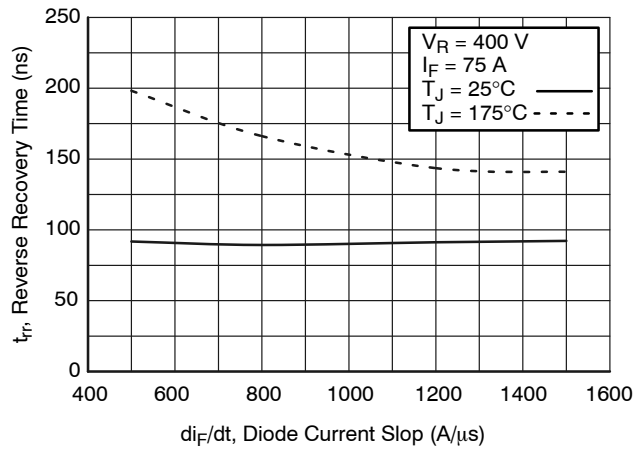


Figure 17. Reverse Recovery Time

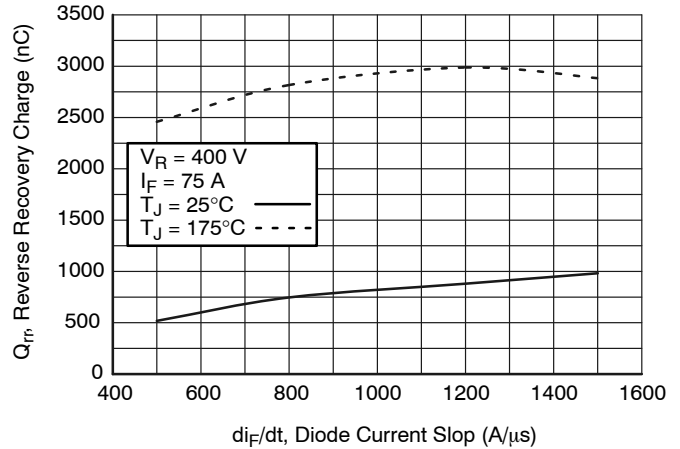


Figure 18. Stored Charge

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

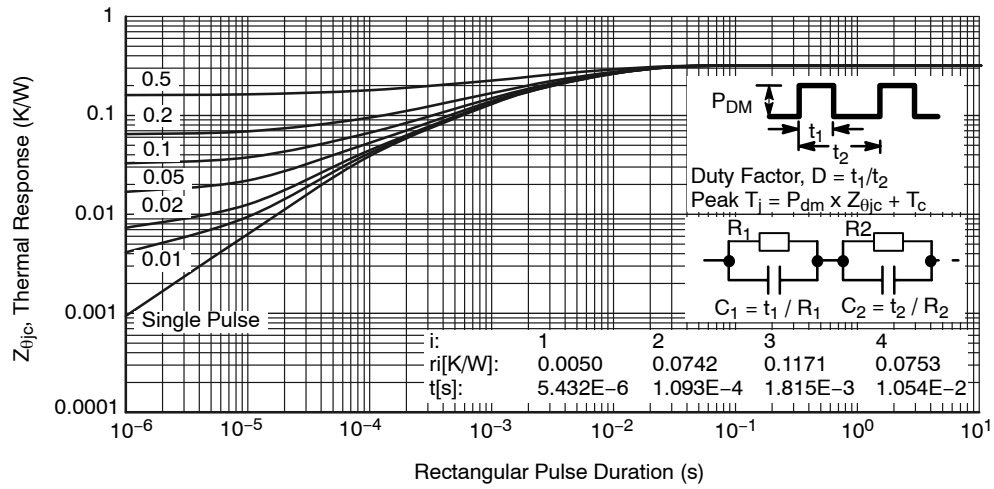


Figure 19. Transient Thermal Impedance of IGBT

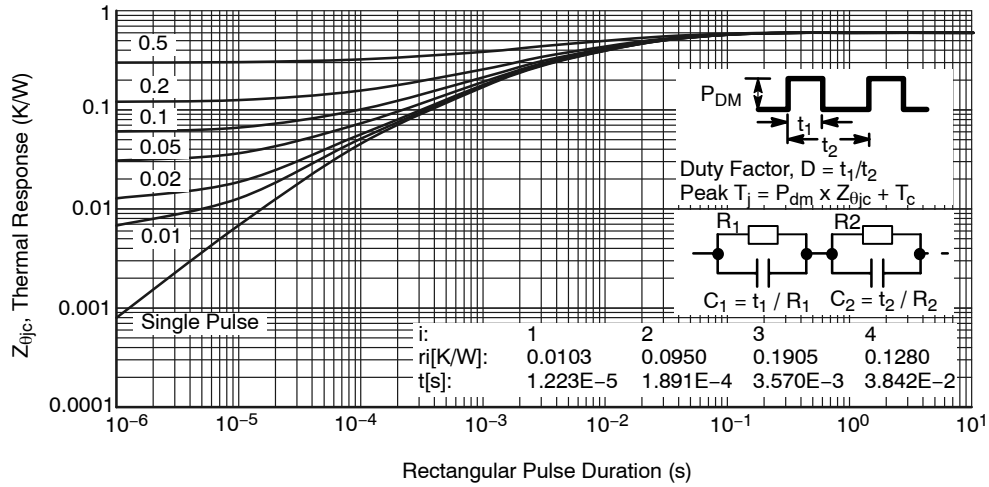
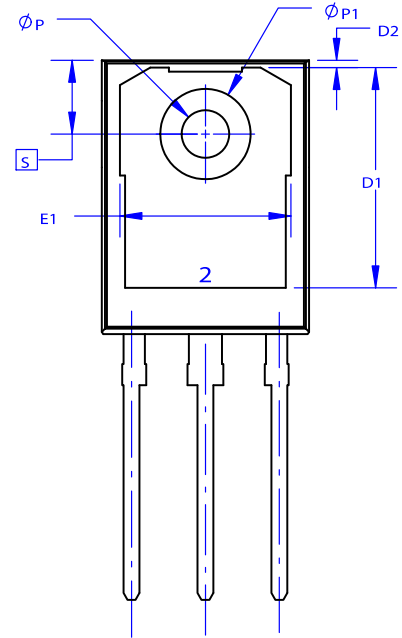
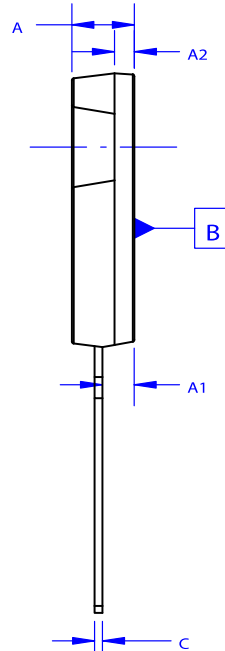
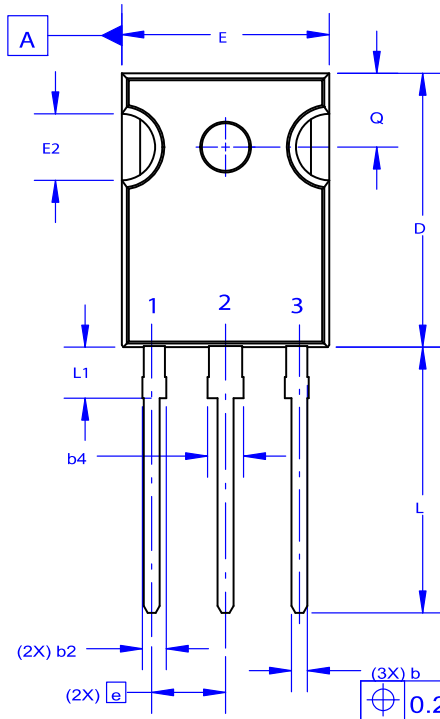


Figure 20. Transient Thermal Impedance of Diode

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

DATE 06 JUL 2020



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.

**GENERIC**  
**MARKING DIAGRAM\***


XXXXX = 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.

| DIM | MILLIMETERS |       |       |
|-----|-------------|-------|-------|
|     | MIN         | NOM   | MAX   |
| A   | 4.58        | 4.70  | 4.82  |
| A1  | 2.20        | 2.40  | 2.60  |
| 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  |
| ØP  | 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       | ~     | ~     |
| ØP1 | 6.60        | 6.80  | 7.00  |

|                         |                    |                                                                                                                                                                                     |
|-------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| <b>DESCRIPTION:</b>     | <b>TO-247-3LD</b>  | <b>PAGE 1 OF 1</b>                                                                                                                                                                  |

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