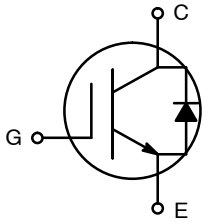
# IGBT - Field Stop, Trench, Soft Fast Recovery Diode

## 650 V, 160 A

## FGY160T65SPD-F085




### Benefits

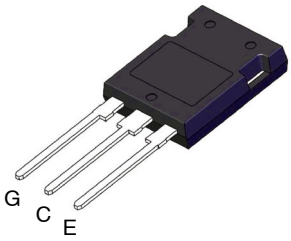
- Very Low Conduction and Switching Losses for a High Efficiency Operation in Various Applications
- Rugged Transient Reliability
- Outstanding Parallel Operation Performance with Balance Current Sharing
- Low EMI

### Features

- AEC−Q101 Qualified and PPAP Capable
- Very Low Saturation Voltage: $V_{CE(sat)}$ = 1.6 V (Typ.) @ $I_C$ = 160 A
- Maximum Junction Temperature: $T_J$ = 175°C
- Positive Temperature Co−Efficient
- Tight Parameter Distribution
- High Input Impedance
- 100% of the Parts are Dynamically Tested
- Short circuit ruggedness > 6 μs @ 25°C
- Copacked with Soft, Fast Recovery Extremefast Diode
- This Device is Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

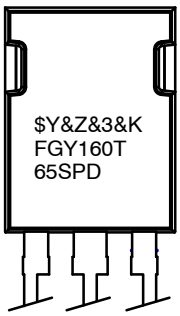
### Applications

- Traction Inverter for HEV/EV
- Auxiliary DC/AC Converter
- Motor Drives
- Other Power−Train Applications Requiring High Power Switch




**TO−247−3LD**
**CASE 340CU**

### MARKING DIAGRAM




| | |
|---|---|
| &Y | = **onsemi** Logo |
| &Z | = Assembly Plant Code |
| &3 | = Data Code (Year & Week) |
| &K | = Lot |
| FGY160T65SPD | = Specific Device Code |

### ORDERING INFORMATION

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

© Semiconductor Components Industries, LLC, 2017

## ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Ratings | Unit |
|---|---|---|---|
| $V_{CES}$ | Collector to Emitter Voltage | 650 | V |
| $V_{GES}$ | Gate to Emitter Voltage | ±20 | V |
| | Transient Gate to Emitter Voltage | ±30 | V |
| $I_C$ | Collector Current @ $T_C$ = 25°C (Note 1) | 240 | A |
| | Collector Current @ $T_C$ = 100°C | 220 | A |
| $I_{Nominal}$ | Nominal Current | 160 | A |
| $I_{CM}$ | Pulsed Collector Current | 480 | A |
| $I_{FM}$ | Diode Forward Current @ $T_C$ = 25°C (Note 1) | 240 | A |
| | Diode Forward Current @ $T_C$ = 100°C | 188 | A |
| $P_D$ | Maximum Power Dissipation @ $T_C$ = 25°C | 882 | W |
| | Maximum Power Dissipation @ $T_C$ = 100°C | 441 | W |
| SCWT | Short Circuit Withstand Time @ $T_C$ = 25°C | 6 | μs |
| $\Delta V/\Delta t$ | Voltage Transient Ruggedness (Note 2) | 10 | V/ns |
| $T_J$ | Operating Junction Temperature | −55 to +175 | °C |
| $T_{stg}$ | Storage Temperature Range | −55 to +175 | °C |
| $T_L$ | Maximum Lead Temp. for soldering Purposes, 1/8” from case for 5 seconds | 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. Limited to bondwire.
2. $V_{CC}$ = 400 V, $V_{GE}$ = 15 V, $I_{CE}$ = 480 A, Inductive load.

## THERMAL CHARACTERISTICS

| Symbol | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JC}$ (IGBT) | Thermal Resistance, Junction to Case | – | 0.17 | °C/W |
| $R_{\theta JC}$ (Diode) | Thermal Resistance, Junction to Case | – | 0.32 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | – | 40 | °C/W |

## PACKAGE MARKING AND ORDERING INFORMATION

| Device Marking | Device | Package | Packing Type | Qty per Tube |
|---|---|---|---|---|
| FGY160T65SPD | FGY160T65SPD−F085 | TP−247−3LD | Tube | 30 ea |

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

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | $V_{GE}$ = 0 V, $I_C$ = 1 mA | 650 | – | – | V |
| $\Delta BV_{CES}/\Delta T_J$ | Temperature Coefficient of Breakdown Voltage | $V_{GE}$ = 0 V, $I_C$ = 1 mA | – | 0.6 | – | V/°C |
| $I_{CES}$ | Collector Cut-Off Current | $V_{CE}$ = $V_{CES}$, $V_{GE}$ = 0 V | – | – | 40 | μA |
| $I_{GES}$ | G−E Leakage Current | $V_{GE}$ = $V_{GES}$, $V_{CE}$ = 0 V | – | – | ±250 | nA |
| **ON CHARACTERISTICS** | | | | | | |
| $V_{GE(th)}$ | G−E Threshold Voltage | $I_C$ = 160 mA, $V_{CE}$ = $V_{GE}$ | 4.3 | 5.3 | 6.3 | V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C$ = 160 A, $V_{GE}$ = 15 V | – | 1.6 | 2.05 | V |
| | | $I_C$ = 160 A, $V_{GE}$ = 15 V, $T_J$ = 175°C | – | 2.15 | – | V |



Share Feedback
Your Opinion Matters

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

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| $C_{ies}$ | Input Capacitance | $V_{CE}$ = 30 V, $V_{GE}$ = 0 V, f = 1 MHz | – | 6710 | – | pF |
| $C_{oes}$ | Output Capacitance | | – | 450 | – | pF |
| $C_{res}$ | Reverse Transfer Capacitance | | – | 55 | – | pF |
| $R_G$ | Internal Gate Resistance | f = 1 MHz | – | 3 | – | Ω |
| **SWITCHING CHARACTERISTICS** | | | | | | |
| $T_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 400 V, $I_C$ = 160 A, $R_G$ = 5 Ω, $V_{GE}$ = 15 V, Inductive Load, $T_J$ = 25°C | – | 53 | – | ns |
| $T_r$ | Rise Time | | – | 197 | – | ns |
| $T_{d(off)}$ | Turn-Off Delay Time | | – | 98 | – | ns |
| $T_f$ | Fall Time | | – | 141 | – | ns |
| $E_{on}$ | Turn-On Switching Loss | | – | 12.4 | – | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | – | 5.7 | – | mJ |
| $E_{ts}$ | Total Switching Loss | | – | 18.1 | – | mJ |
| $T_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 400 V, $I_C$ = 160 A, $R_G$ = 5 Ω, $V_{GE}$ = 15 V, Inductive Load, $T_J$ = 175°C | – | 52 | – | ns |
| $T_r$ | Rise Time | | – | 236 | – | ns |
| $T_{d(off)}$ | Turn-Off Delay Time | | – | 104 | – | ns |
| $T_f$ | Fall Time | | – | 204 | – | ns |
| $E_{on}$ | Turn-On Switching Loss | | – | 21 | – | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | – | 8.5 | – | mJ |
| $E_{ts}$ | Total Switching Loss | | – | 29.5 | – | mJ |
| $Q_g$ | Total Gate Charge | $V_{CE}$ = 400 V, $I_C$ = 160 A, $V_{GE}$ = 15 V | – | 163 | 245 | nC |
| $Q_{ge}$ | Gate to Emitter Charge | | – | 50 | – | nC |
| $Q_{gc}$ | Gate to Collector Charge | | – | 49 | – | nC |

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.

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

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{FM}$ | Diode Forward Voltage | $I_F$ = 160 A | $T_J$ = 25°C | – | 1.4 | 1.7 | V |
| | | | $T_J$ = 175°C | – | 1.35 | – | |
| $E_{rec}$ | Reverse Recovery Energy | $V_{CE}$ = 400 V, $I_F$ = 160 A, $\Delta I_F/\Delta t$ = 1000 A/μs | $T_J$ = 25°C | – | 598 | – | μJ |
| | | | $T_J$ = 175°C | – | 4000 | – | |
| $T_{rr}$ | Diode Reverse Recovery Time | | $T_J$ = 25°C | – | 132 | – | ns |
| | | | $T_J$ = 175°C | – | 245 | – | |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | $T_J$ = 25°C | – | 3.3 | – | μC |
| | | | $T_J$ = 175°C | – | 12.5 | – | |

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.



Share Feedback
Your Opinion Matters

## TYPICAL PERFORMANCE CHARACTERISTICS

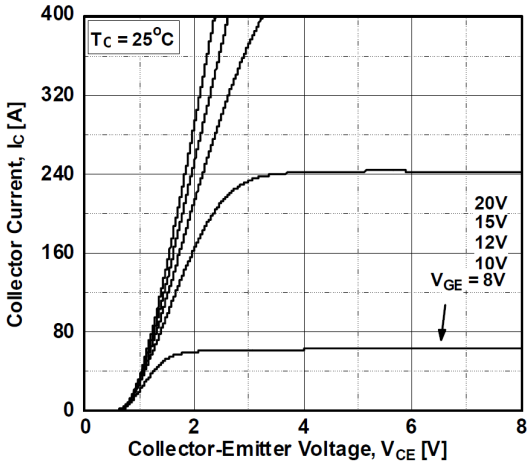



Figure 1. Typical Output Characteristics

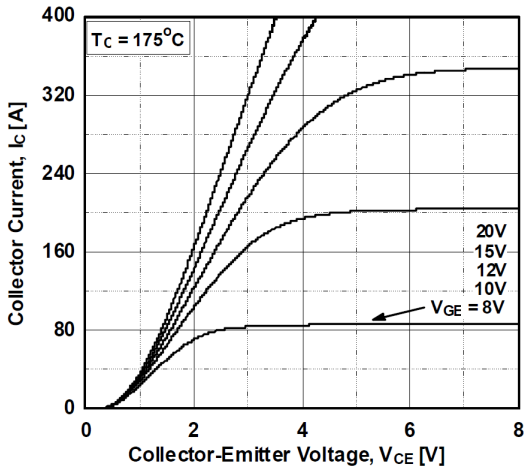



Figure 2. Typical Output Characteristics

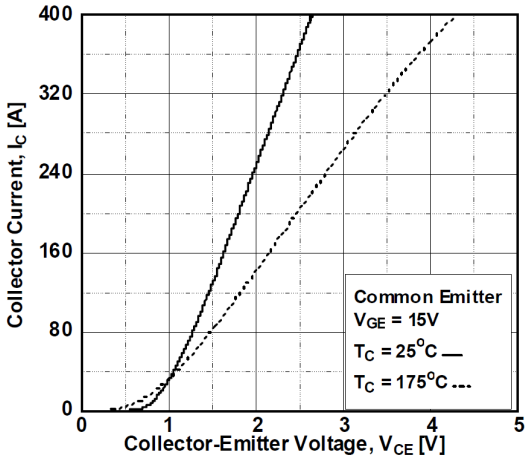



Figure 3. Typical Saturation Voltage Characteristics

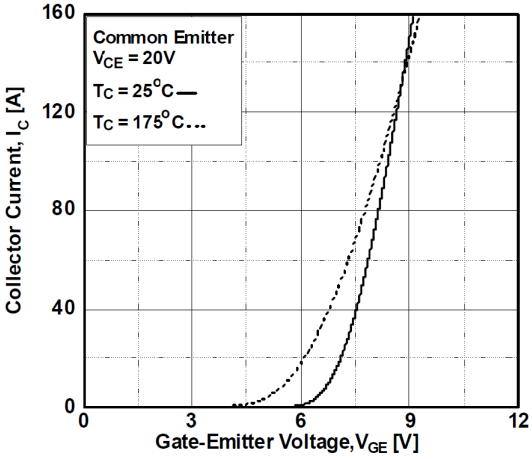



Figure 4. Transfer Characteristics

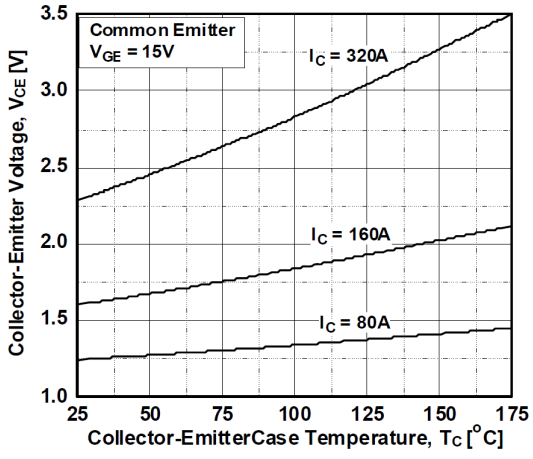



Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

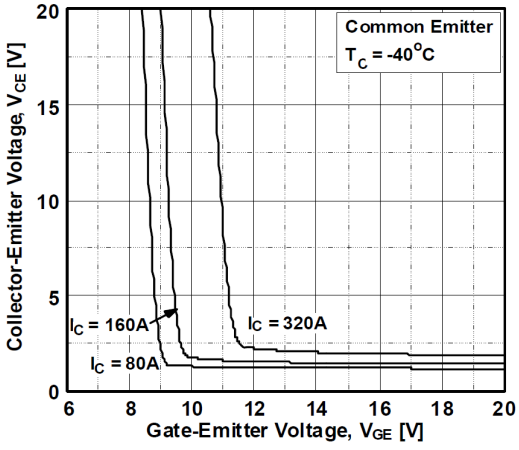



Figure 6. Saturation Voltage vs. $V_{GE}$



Share Feedback
Your Opinion Matters

## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

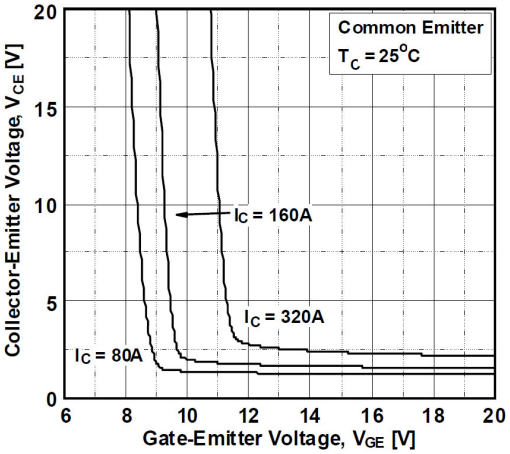



**Figure 7. Saturation Voltage vs. $V_{GE}$**

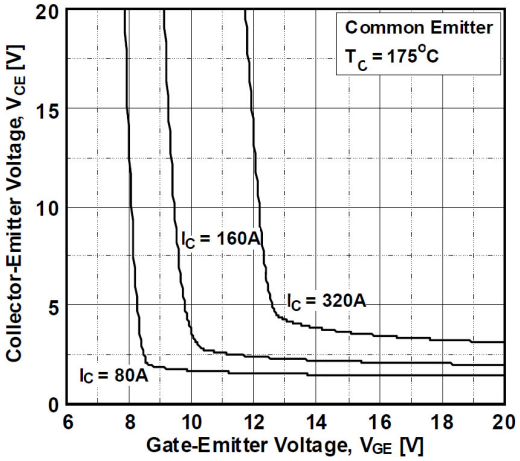



**Figure 8. Saturation Voltage vs. $V_{GE}$**

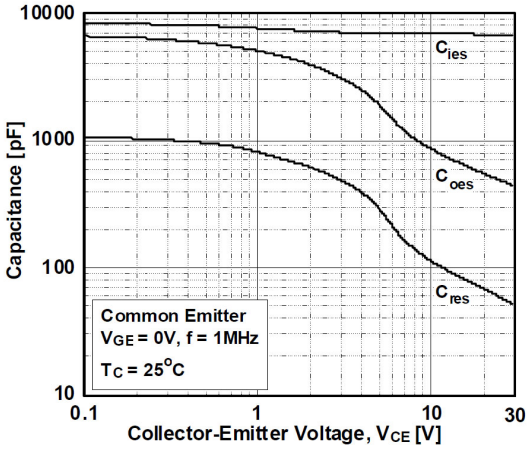



**Figure 9. Capacitance Characteristics**

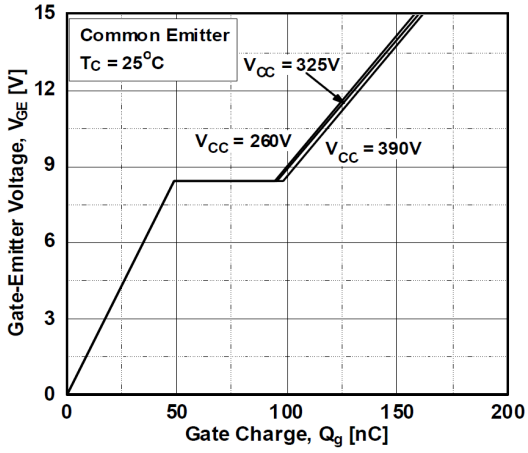



**Figure 10. Gate Charge Characteristics**

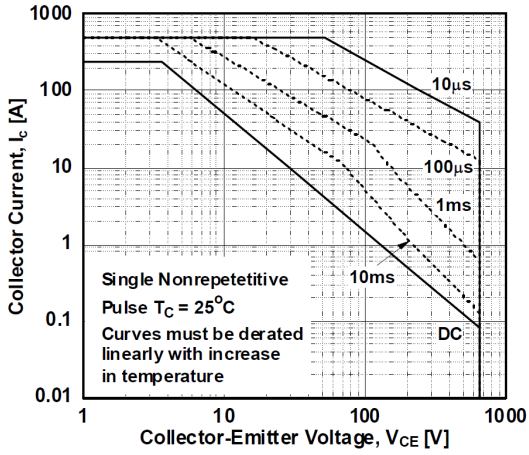



**Figure 11. SOA Characteristics**

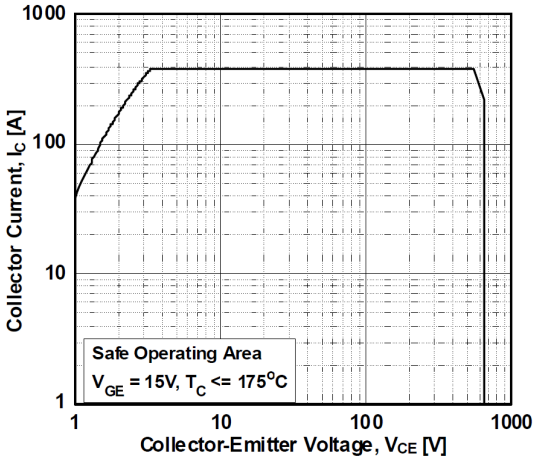



**Figure 12. Turn Off Switching SOA Characteristics**



Share Feedback
Your Opinion Matters

## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

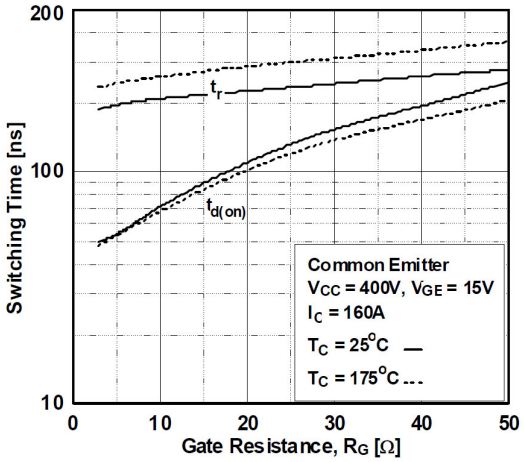



**Figure 13. Turn−on Characteristics vs. Gate Resistance**

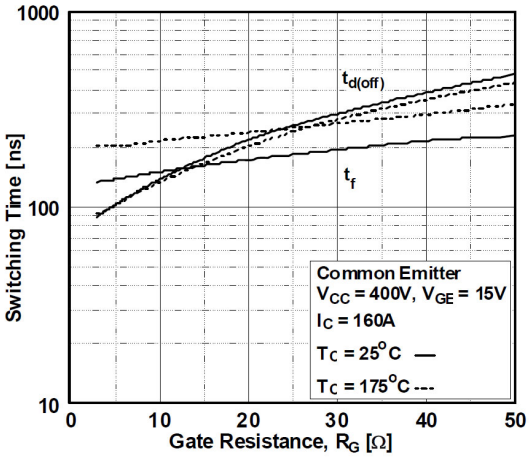



**Figure 14. Turn−off Characteristics vs. Gate Resistance**

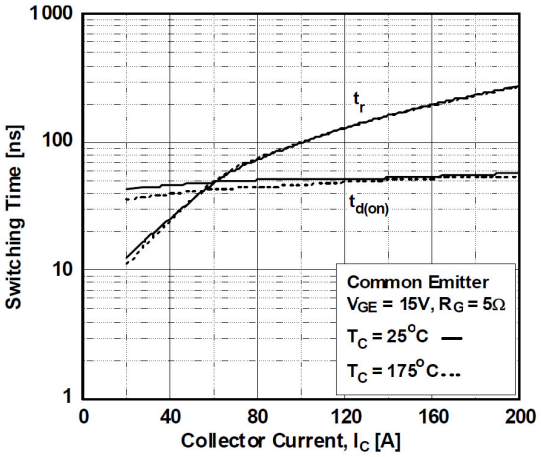



**Figure 15. Turn−on Characteristics vs. Collector Current**

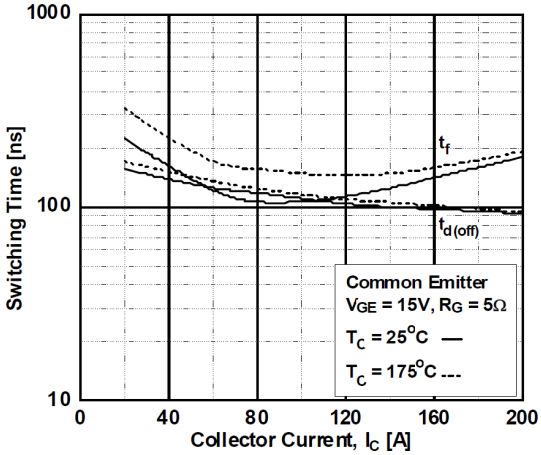



**Figure 16. Turn−off Characteristics vs. Collector Current**

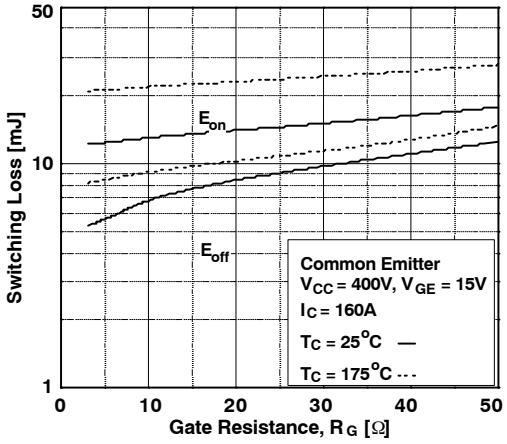



**Figure 17. Switching Loss vs. Gate Resistance**

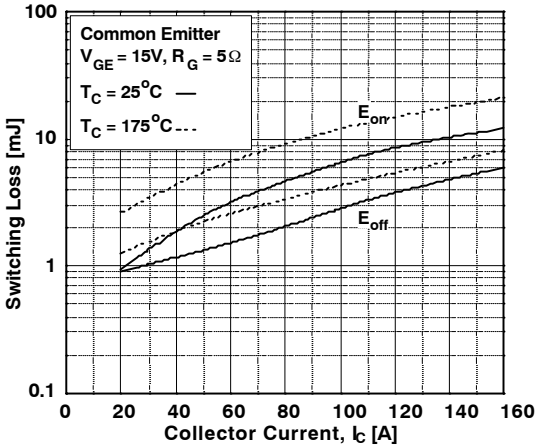



**Figure 18. Switching Loss vs. Collector Current**



Share Feedback
Your Opinion Matters

## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

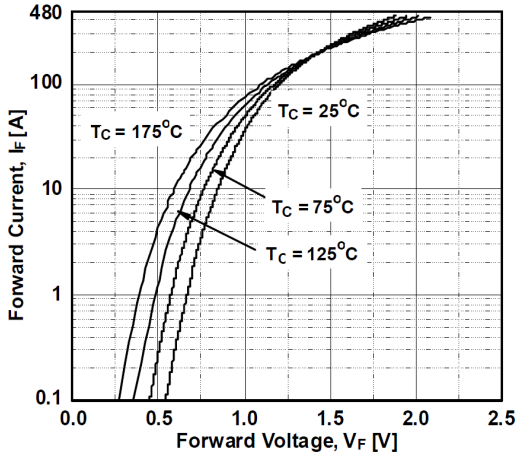



**Figure 19. Forward Characteristics**

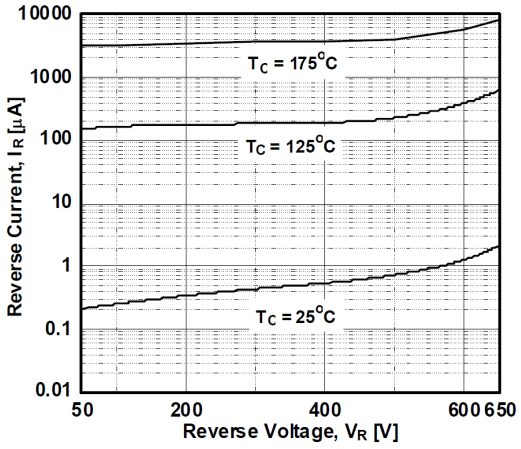



**Figure 20. Reverse Current**

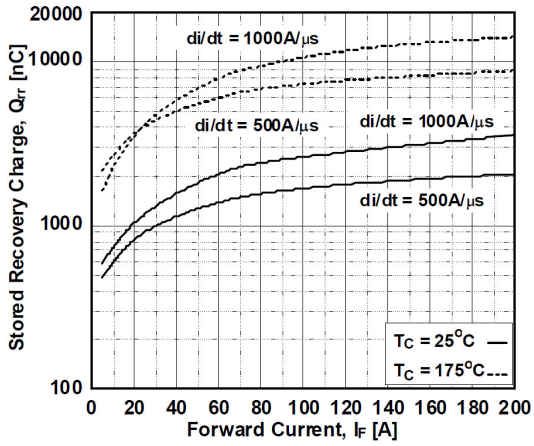



**Figure 21. Stored Charge**

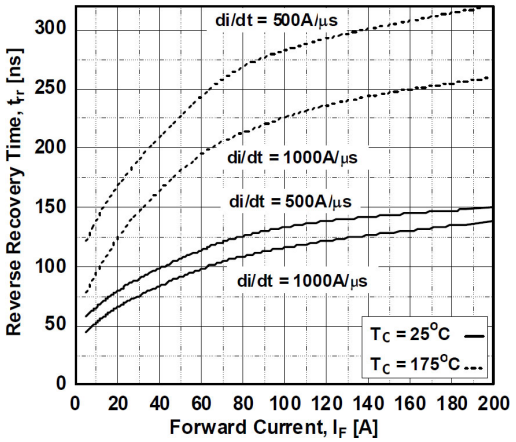



**Figure 22. Reverse Recovery Time**

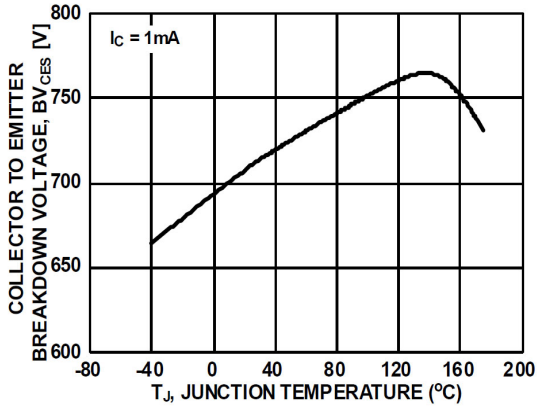



**Figure 23. Collector to Emitter Breakdown Voltage vs. Junction Temperature**



Share Feedback
Your Opinion Matters

## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

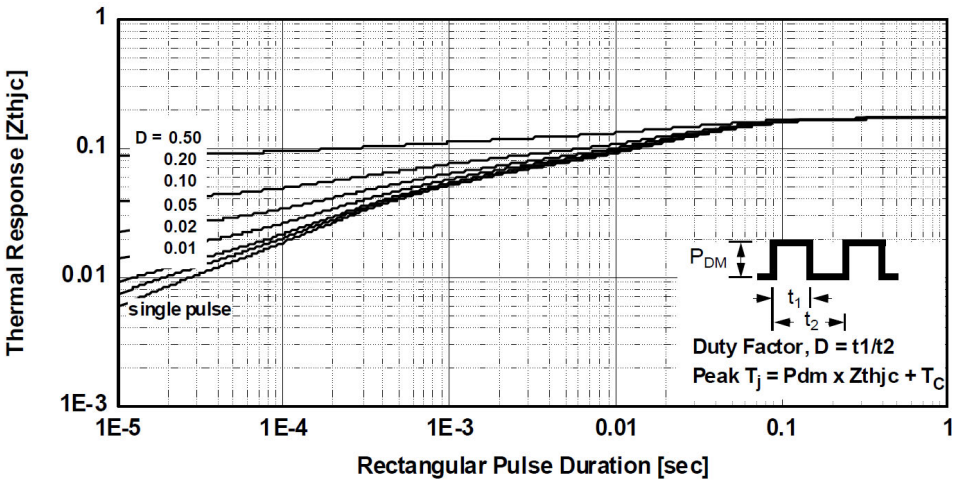



**Figure 24. Transient Thermal Impedance of IGBT**

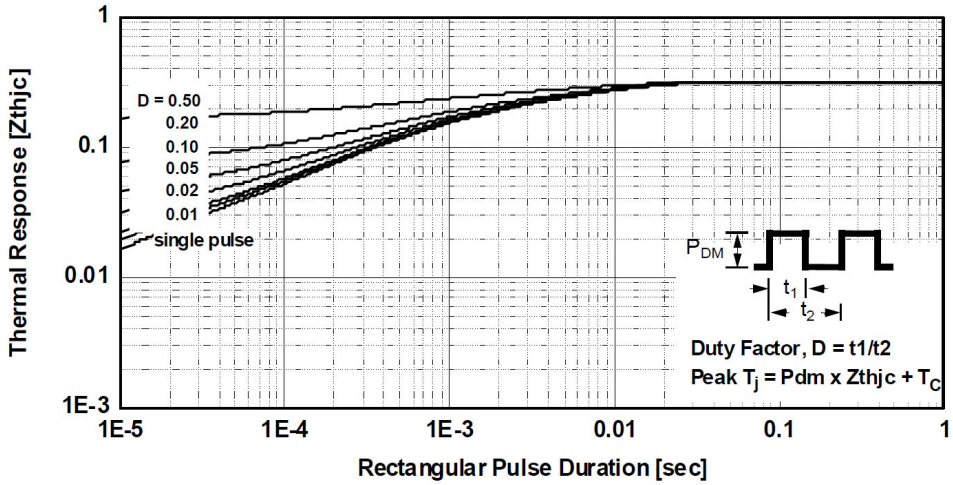
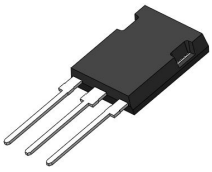



**Figure 25. Transient Thermal Impedance of Diode**

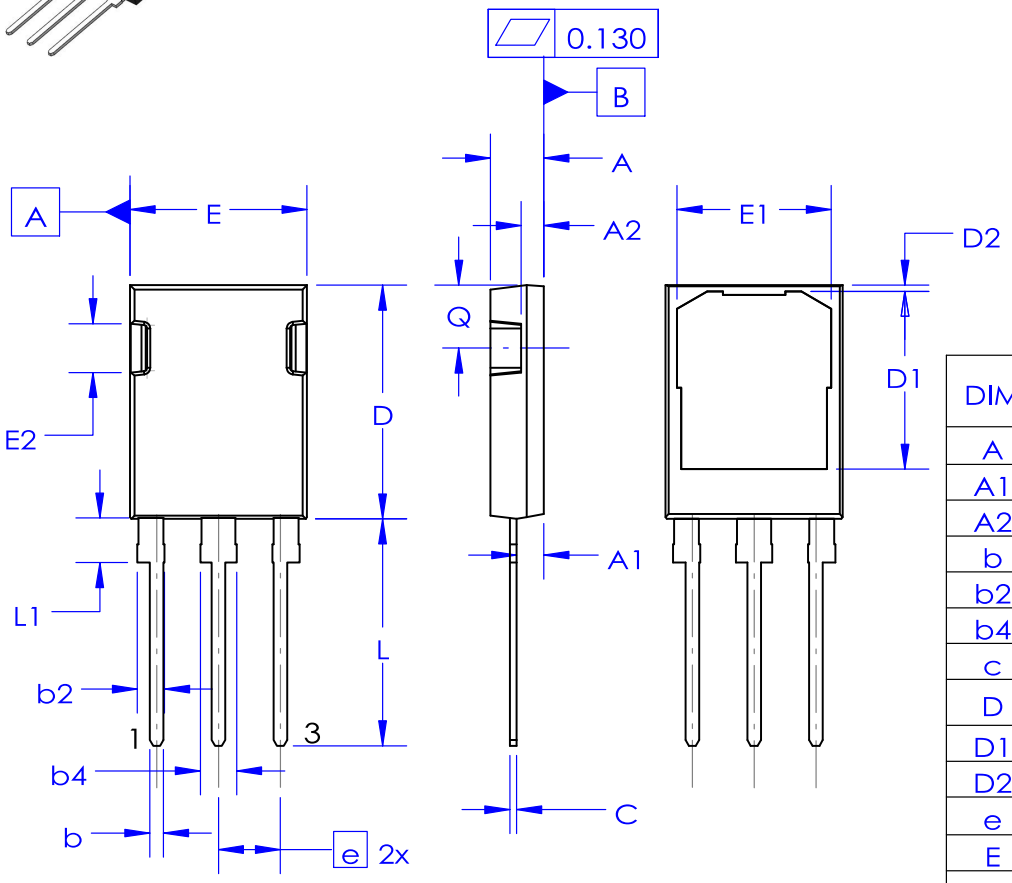


Share Feedback
Your Opinion Matters



**TO−247−3LD**
CASE 340CU
ISSUE B

DATE 28 OCT 2021

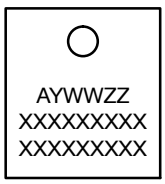



| DIM | MILLIMETERS | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 4.60 | 4.70 | 4.80 |
| A1 | 2.10 | 2.40 | 2.70 |
| A2 | 1.70 | 2.00 | 2.30 |
| b | 1.16 | 1.20 | 1.26 |
| b2 | 2.20 | 2.40 | 2.60 |
| b4 | 3.00 | 3.20 | 3.40 |
| c | 0.59 | 0.60 | 0.66 |
| D | 20.40 | 20.60 | 20.80 |
| D1 | 15.47 | 15.67 | 15.87 |
| D2 | 0.25 | 0.55 | 0.85 |
| e | 5.45 BSC | | |
| E | 15.40 | 15.60 | 15.80 |
| E1 | 13.40 | 13.60 | 13.80 |
| E2 | 4.12 | 4.30 | 4.52 |
| L | 19.70 | 20.00 | 20.30 |
| L1 | 3.65 | 3.85 | 4.05 |
| Q | 5.35 | 5.55 | 5.75 |

NOTES:

A. NO INDUSTRY STANDARS APPLIES TO THIS PACKAGE.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
D. DRAWING CONFORMS TO ASME Y14.5-2009.

**GENERIC MARKING DIAGRAM***




XXXX = Specific Device Code
A = Assembly Site Code
Y = Year
WW = Work Week
ZZ = Assembly Lot Code

*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:** | **98AON13773G** | 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** |

**onsemi** and onsemi are trademarks of Semiconductor Components Industries, LLC dba **onsemi** or its subsidiaries in the United States and/or other countries. **onsemi** reserves the right to make changes without further notice to any products herein. **onsemi** makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. **onsemi** does not convey any license under its patent rights nor the rights of others.

**onsemi**, , and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent−Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as−is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## ADDITIONAL INFORMATION

**TECHNICAL PUBLICATIONS**:
**Technical Library:** www.onsemi.com/design/resources/technical−documentation
**onsemi Website:** www.onsemi.com

**ONLINE SUPPORT**: www.onsemi.com/support
**For additional information, please contact your local Sales Representative at** www.onsemi.com/support/sales

ENTEGRECİ

Bu belge www.entegreci.com üzerinden sunulmaktadır.

# Elektronik komponent tedarikinde Entegreci

Entegreci, Eskişehir merkezli, Türkiye geneline satış yapan bir elektronik komponent mağazasıdır. Entegreler (IC), mikrodenetleyiciler, transistörler, diyotlar, pasif elemanlar, konnektörler, modüller ve geliştirme kartları tek adetten seri üretim adetlerine kadar satılır. Ürün sayfalarında güncel stok durumunu, fiyatı ve datasheet bağlantısını bulabilirsiniz.

### Parça koduyla arama

Üretici parça numarasını yazın; stok ve fiyatı hemen görün.

**www.entegreci.com**

### Ürün kategorileri

Entegreden kapasitöre tüm elektronik komponent kategorileri.

**Kategorilere göz atın**

### Üreticiler

Aradığınız üreticinin ürünlerini tek sayfada inceleyin.

**Üreticileri görün**

### Toplu alım ve teklif

Listede olmayan ya da yüksek adetli parçalar için teklif isteyin.

**Teklif isteyin**

**www.entegreci.com** | **destek@entegreci.com** | **0850 305 90 34**

Entegreci is an online electronic components store based in Türkiye. Search by manufacturer part number to see stock, prices and datasheets for integrated circuits, microcontrollers, transistors, passive components and connectors, or request a quote for parts that are not listed.

Bu sayfa Entegreci tarafından eklenmiştir. Belgenin önceki sayfaları asıl yayıncısına aittir ve içeriği değiştirilmemiştir; en güncel sürüm için belgenin yayıncısına başvurun.