# "High Side Chopper" IGBT SOT-227 (Ultrafast IGBT), 50 A

SOT-227

| PRIMARY CHARACTERISTICS | |
|---|---|
| $V_{CES}$ | 1200 V |
| $I_C$ DC | 50 A at 92 °C |
| $V_{CE(on)}$ typical at 50 A, 25 °C | 3.3 V |
| Speed | 8 kHz to 60 kHz |
| Package | SOT-227 |
| Circuit configuration | High side chopper |

## FEATURES

- NPT Gen 5 IGBT technology
- Square RBSOA
- HEXFRED® clamping diode
- Positive $V_{CE(on)}$ temperature coefficient
- Fully isolated package
- Very low internal inductance (≤ 5 nH typical)
- Industry standard outline
- UL approved file E78996
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS
COMPLIANT

## BENEFITS

- Designed for increased operating efficiency in power conversion: UPS, SMPS, welding, induction heating
- Easy to assemble and parallel
- Direct mounting on heatsink
- Plug-in compatible with other SOT-227 packages
- Low EMI, requires less snubbing

| ABSOLUTE MAXIMUM RATINGS | | | | |
|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MAX.** | **UNITS** |
| Collector to emitter voltage | $V_{CES}$ | | 1200 | V |
| Continuous collector current | $I_C$ | $T_C$ = 25 °C | 84 | A |
| | | $T_C$ = 80 °C | 57 | |
| Pulsed collector current | $I_{CM}$ | | 150 | |
| Clamped inductive load current | $I_{LM}$ | | 150 | |
| Diode continuous forward current | $I_F$ | $T_C$ = 25 °C | 87 | |
| | | $T_C$ = 80 °C | 59 | |
| Single pulse forward current | $I_{FSM}$ | 10 ms sine or 6 ms rectangular pulse, $T_J$ = 25 °C | 310 | |
| Gate to emitter voltage | $V_{GE}$ | | ± 20 | V |
| Power dissipation, IGBT | $P_D$ | $T_C$ = 25 °C | 431 | W |
| | | $T_C$ = 80 °C | 242 | |
| Power dissipation, diode | $P_D$ | $T_C$ = 25 °C | 338 | |
| | | $T_C$ = 80 °C | 190 | |
| RMS isolation voltage | $V_{ISOL}$ | Any terminal to case, t = 1 min | 2500 | V |


For technical questions within your region: DiodesAmericas@vishay.com, DiodesAsia@vishay.com, DiodesEurope@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

| **ELECTRICAL SPECIFICATIONS** ($T_J$ = 25 °C unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Collector to emitter breakdown voltage | $V_{BR(CES)}$ | $V_{GE}$ = 0 V, $I_C$ = 500 μA | 1200 | - | - | V |
| Collector to emitter voltage | $V_{CE(on)}$ | $V_{GE}$ = 15 V, $I_C$ = 25 A | - | 2.5 | 2.8 | |
| | | $V_{GE}$ = 15 V, $I_C$ = 50 A | - | 3.3 | - | |
| | | $V_{GE}$ = 15 V, $I_C$ = 25 A, $T_J$ = 125 °C | - | 3.0 | - | |
| | | $V_{GE}$ = 15 V, $I_C$ = 50 A, $T_J$ = 125 °C | - | 4.03 | - | |
| Gate threshold voltage | $V_{GE(th)}$ | $V_{CE}$ = $V_{GE}$, $I_C$ = 500 μA | 4.0 | 5.5 | 7.1 | |
| Temperature coefficient of threshold voltage | $V_{GE(th)}/\Delta T_J$ | $V_{CE}$ = $V_{GE}$, $I_C$ = 1 mA (25 °C to 125 °C) | - | -12.9 | - | mV/°C |
| Collector to emitter leakage current | $I_{CES}$ | $V_{GE}$ = 0 V, $V_{CE}$ = 1200 V | - | 8 | 50 | μA |
| | | $V_{GE}$ = 0 V, $V_{CE}$ = 1200 V, $T_J$ = 125 °C | - | 0.15 | - | mA |
| Diode reverse breakdown voltage | $V_{BR}$ | $I_R$ = 1 mA | 1200 | - | - | V |
| Diode forward voltage drop | $V_{FM}$ | $I_F$ = 25 A, $V_{GE}$ = 0 V | - | 2.11 | 2.42 | V |
| | | $I_F$ = 50 A, $V_{GE}$ = 0 V | - | 2.72 | - | |
| | | $I_F$ = 25 A, $V_{GE}$ = 0 V, $T_J$ = 125 °C | - | 2.04 | - | |
| | | $I_F$ = 50 A, $V_{GE}$ = 0 V, $T_J$ = 125 °C | - | 2.83 | - | |
| Diode reverse leakage current | $I_{RM}$ | $V_R$ = 1200 V | - | 4 | 50 | μA |
| | | $T_J$ = 125 °C, $V_R$ = 1200 V | - | 0.8 | - | mA |
| Gate to emitter leakage current | $I_{GES}$ | $V_{GE}$ = ± 20 V | - | - | ± 200 | nA |

| **SWITCHING CHARACTERISTICS** ($T_J$ = 25 °C unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Total gate charge (turn-on) | $Q_g$ | $I_C$ = 50 A, $V_{CC}$ = 600 V, $V_{GE}$ = 15 V | | - | 400 | - | nC |
| Gate to emitter charge (turn-on) | $Q_{ge}$ | | | - | 43 | - | |
| Gate to collector charge (turn-on) | $Q_{gc}$ | | | - | 187 | - | |
| Turn-on switching loss | $E_{on}$ | $I_C$ = 50 A, $V_{CC}$ = 600 V, $V_{GE}$ = 15 V, $R_g$ = 4.7 Ω, L = 500 μH, $T_J$ = 25 °C | Energy losses include tail and diode recovery | - | 1.87 | - | mJ |
| Turn-off switching loss | $E_{off}$ | | | - | 0.83 | - | |
| Total switching loss | $E_{tot}$ | | | - | 2.7 | - | |
| Turn-on switching loss | $E_{on}$ | $I_C$ = 50 A, $V_{CC}$ = 600 V, $V_{GE}$ = 15 V, $R_g$ = 4.7 Ω, L = 500 μH, $T_J$ = 125 °C | | - | 3.43 | - | |
| Turn-off switching loss | $E_{off}$ | | | - | 1.29 | - | |
| Total switching loss | $E_{tot}$ | | | - | 4.72 | - | |
| Turn-on delay time | $t_{d(on)}$ | | | - | 147 | - | ns |
| Rise time | $t_r$ | | | - | 35 | - | |
| Turn-off delay time | $t_{d(off)}$ | | | - | 186 | - | |
| Fall time | $t_f$ | | | - | 119 | - | |
| Reverse bias safe operating area | RBSOA | $T_J$ = 150 °C, $I_C$ = 150 A, $R_g$ = 22 Ω, $V_{GE}$ = 15 V to 0 V, $V_{CC}$ = 900 V, $V_P$ = 1200 V | | | Fullsquare | | |
| Diode reverse recovery time | $t_{rr}$ | $I_F$ = 50 A, $dI_F/dt$ = 200 A/μs, $V_R$ = 200 V | | - | 129 | - | ns |
| Diode peak reverse current | $I_{rr}$ | | | - | 11 | - | A |
| Diode recovery charge | $Q_{rr}$ | | | - | 710 | - | nC |
| Diode reverse recovery time | $t_{rr}$ | $I_F$ = 50 A, $dI_F/dt$ = 200 A/μs, $V_R$ = 200 V, $T_J$ = 125 °C | | - | 208 | - | ns |
| Diode peak reverse current | $I_{rr}$ | | | - | 17 | - | A |
| Diode recovery charge | $Q_{rr}$ | | | - | 1768 | - | nC |


For technical questions within your region: DiodesAmericas@vishay.com, DiodesAsia@vishay.com, DiodesEurope@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

| THERMAL AND MECHANICAL SPECIFICATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | | **SYMBOL** | | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Junction and storage temperature range | | $T_J$, $T_{Stg}$ | | -40 | - | 150 | °C |
| Junction to case | IGBT | $R_{thJC}$ | | - | - | 0.29 | °C/W |
| | Diode | | | - | - | 0.37 | |
| Case to heatsink | | $R_{thCS}$ | Flat, greased surface | - | 0.05 | - | |
| Weight | | | | - | 30 | - | g |
| Mounting torque | | | Torque to terminal | - | - | 1.1 (9.7) | Nm (lbf.in) |
| | | | Torque to heatsink | - | - | 1.8 (15.9) | Nm (lbf.in) |
| Case style | | SOT-227 | | | | | |

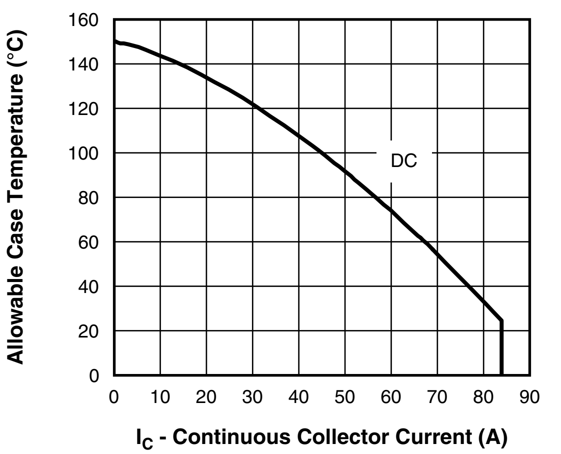



Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature

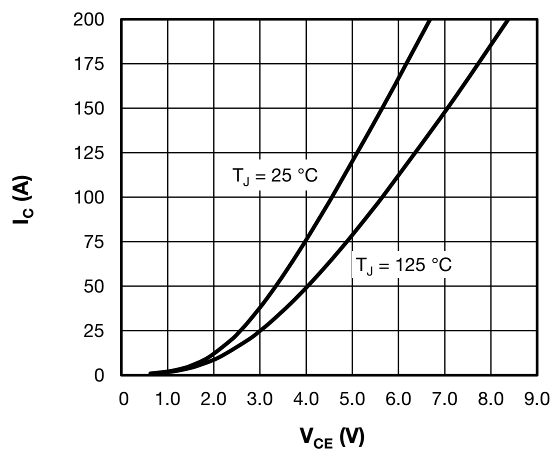



Fig. 3 - Typical IGBT Output Characteristics, $V_{GE}$ = 15V

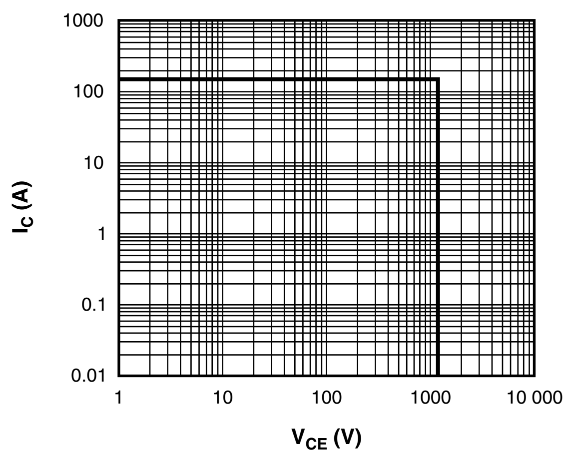



Fig. 2 - IGBT Reverse Bias SOA
$T_J$ = 150 °C, $V_{GE}$ = 15 V

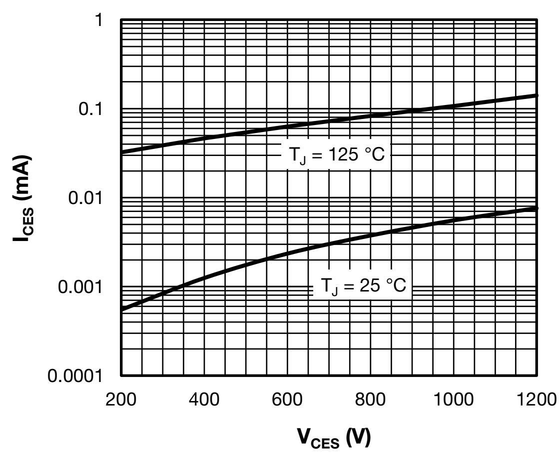



Fig. 4 - Typical IGBT Zero Gate Voltage Collector Current


For technical questions within your region: DiodesAmericas@vishay.com, DiodesAsia@vishay.com, DiodesEurope@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

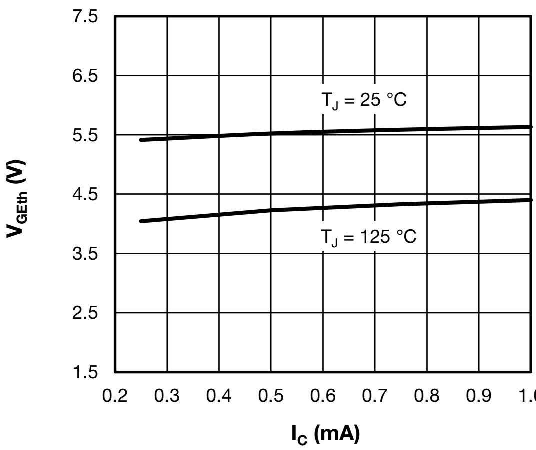



Fig. 5 - Typical IGBT Threshold Voltage

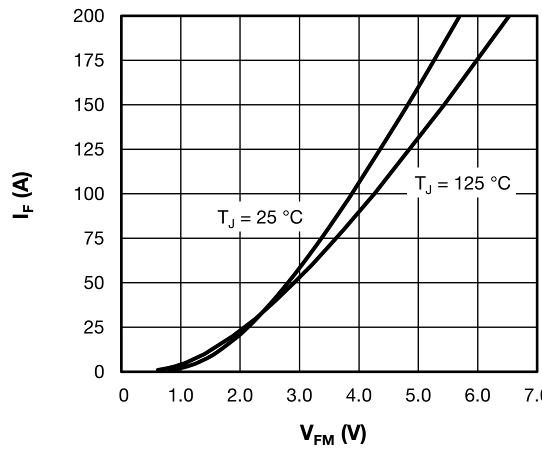



Fig. 8 - Typical Diode Forward Characteristics

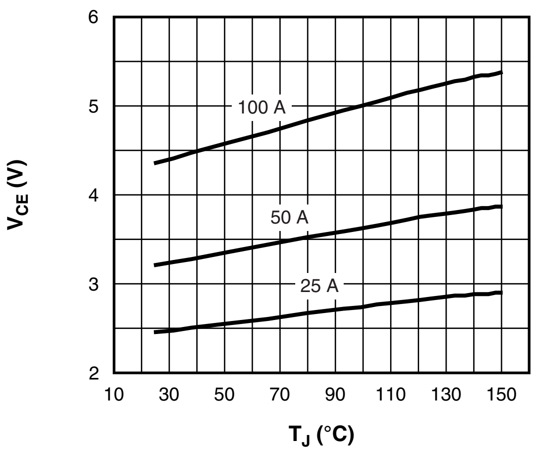



Fig. 6 - Typical IGBT Collector to Emitter Voltage vs. Junction Temperature, $V_{GE}$ = 15 V

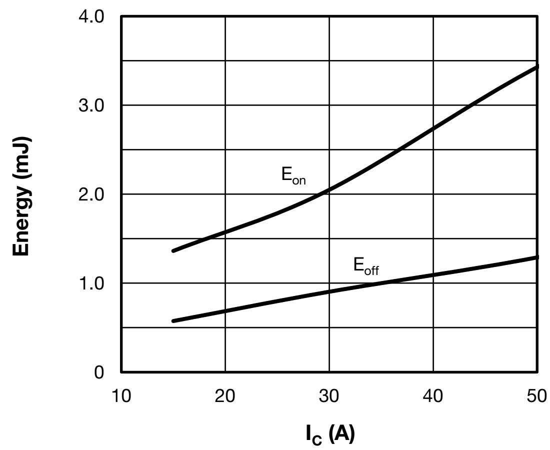



Fig. 9 - Typical IGBT Energy Losses vs. $I_C$
$T_J$ = 125 °C, $V_{CC}$ = 600 V, $V_{GE}$ = 15 V, L = 500 µH, $R_g$ = 4.7 Ω

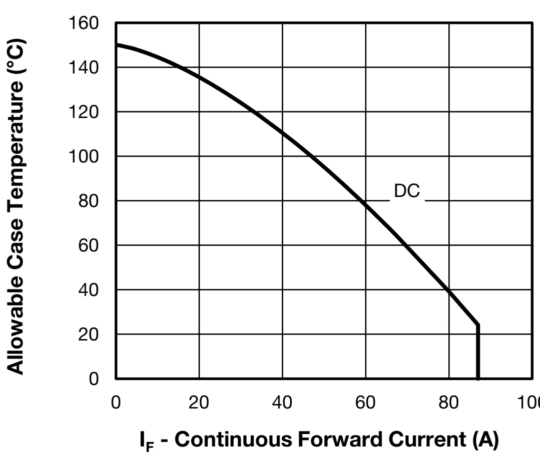



Fig. 7 - Maximum Diode Continuous Forward Current vs. Case Temperature

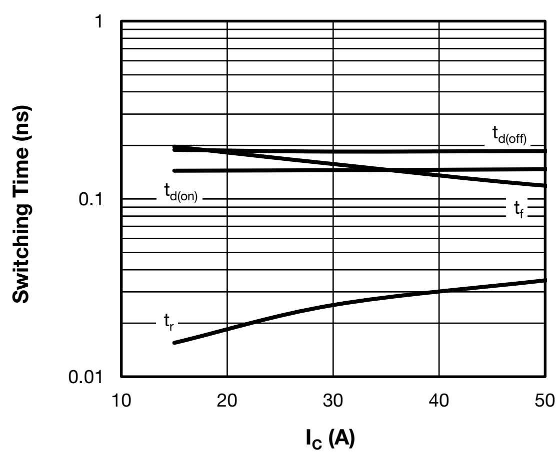



Fig. 10 - Typical IGBT Switching Time vs. $I_C$
$T_J$ = 125 °C, $V_{CC}$ = 600 V, $V_{GE}$ = 15 V, L = 500 µH, $R_g$ = 4.7 Ω


THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

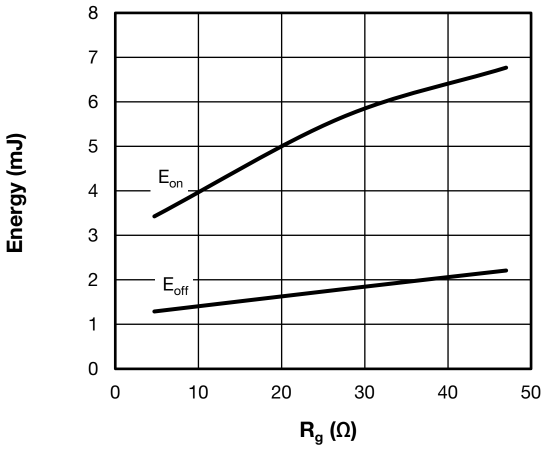



Fig. 11 - Typical IGBT Energy Losses vs. $R_g$
$T_J$ = 125 °C, $I_C$ = 50 A, $V_{CC}$ = 600 V, $V_{GE}$ = 15 V, L = 500 μH

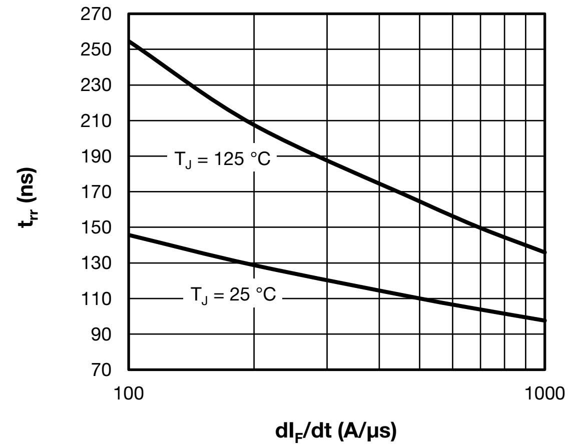



Fig. 13 - Typical $t_{rr}$ Diode vs. $dI_F/dt$
$V_R$ = 200 V, $I_F$ = 50 A

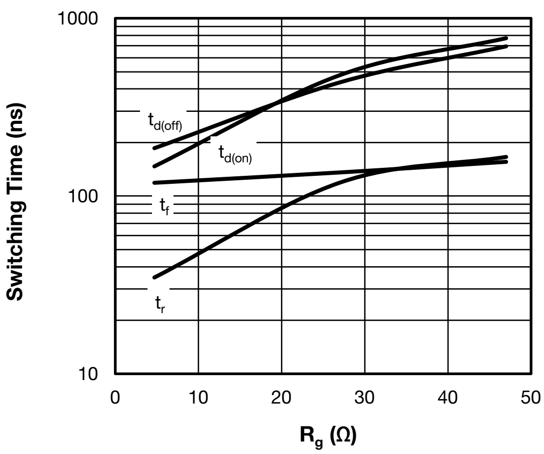



Fig. 12 - Typical IGBT Switching Time vs. $R_g$
$T_J$ = 125 °C, $I_C$ = 50 A, $V_{CC}$ = 600 V, $V_{GE}$ = 15 V, L = 500 μH

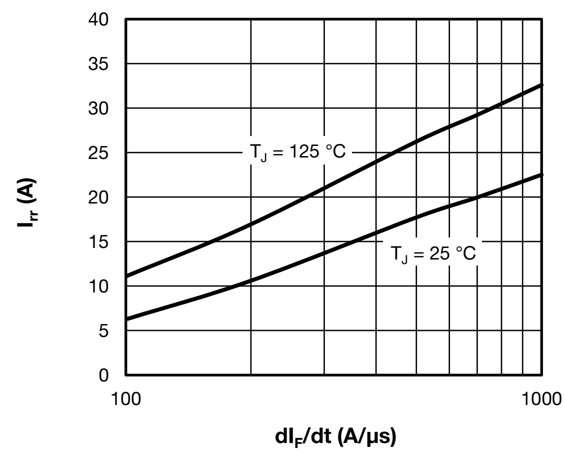



Fig. 14 - Typical $I_{rr}$ Diode vs. $dI_F/dt$
$V_R$ = 200 V, $I_F$ = 50 A

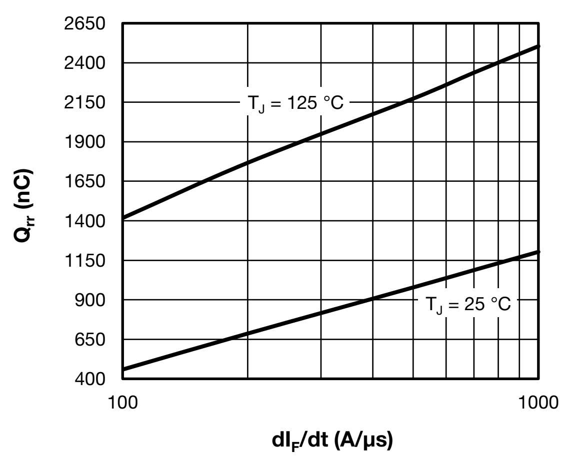



Fig. 15 - Typical $Q_{rr}$ Diode vs. $dI_F/dt$,
$V_R$ = 200 V, $I_F$ = 50 A


For technical questions within your region: DiodesAmericas@vishay.com, DiodesAsia@vishay.com, DiodesEurope@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

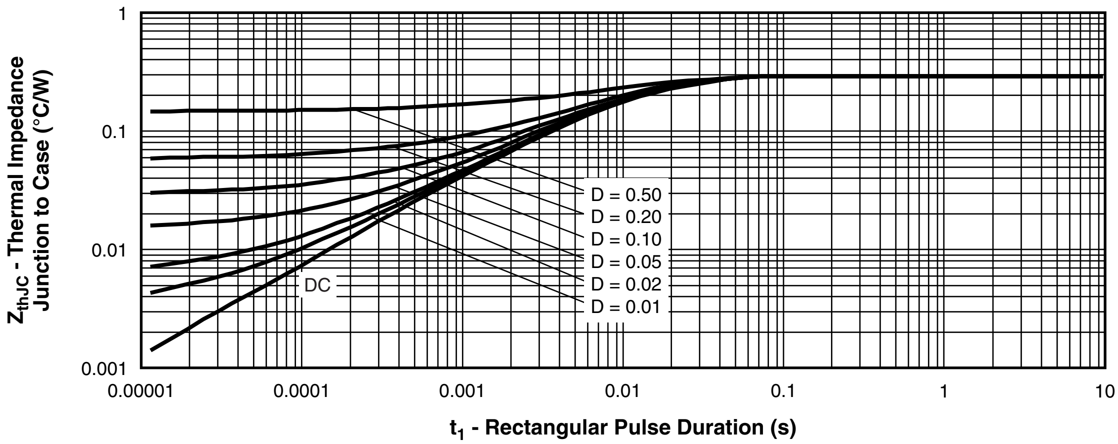



Fig. 16 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics (IGBT)

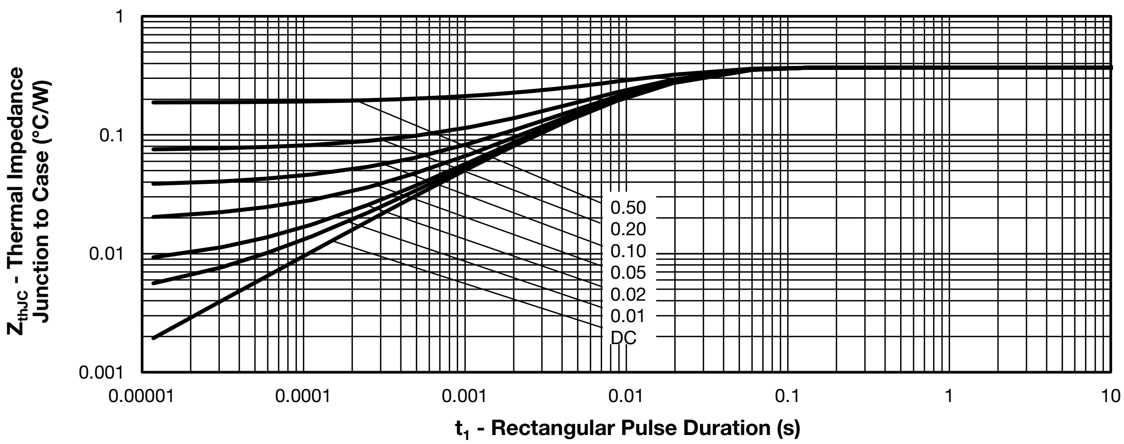


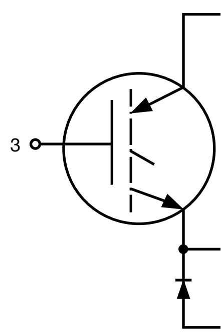
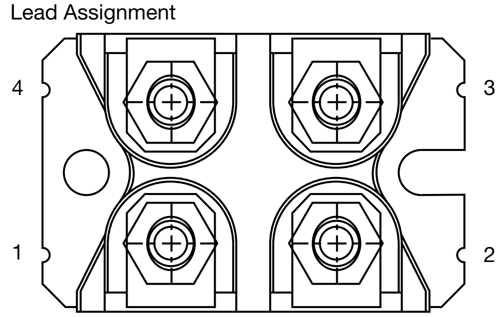

Fig. 17 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics (Diode)


For technical questions within your region: DiodesAmericas@vishay.com, DiodesAsia@vishay.com, DiodesEurope@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

## ORDERING INFORMATION TABLE

| Device code | VS- | G | B | 55 | N | A | 120 | U | X |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

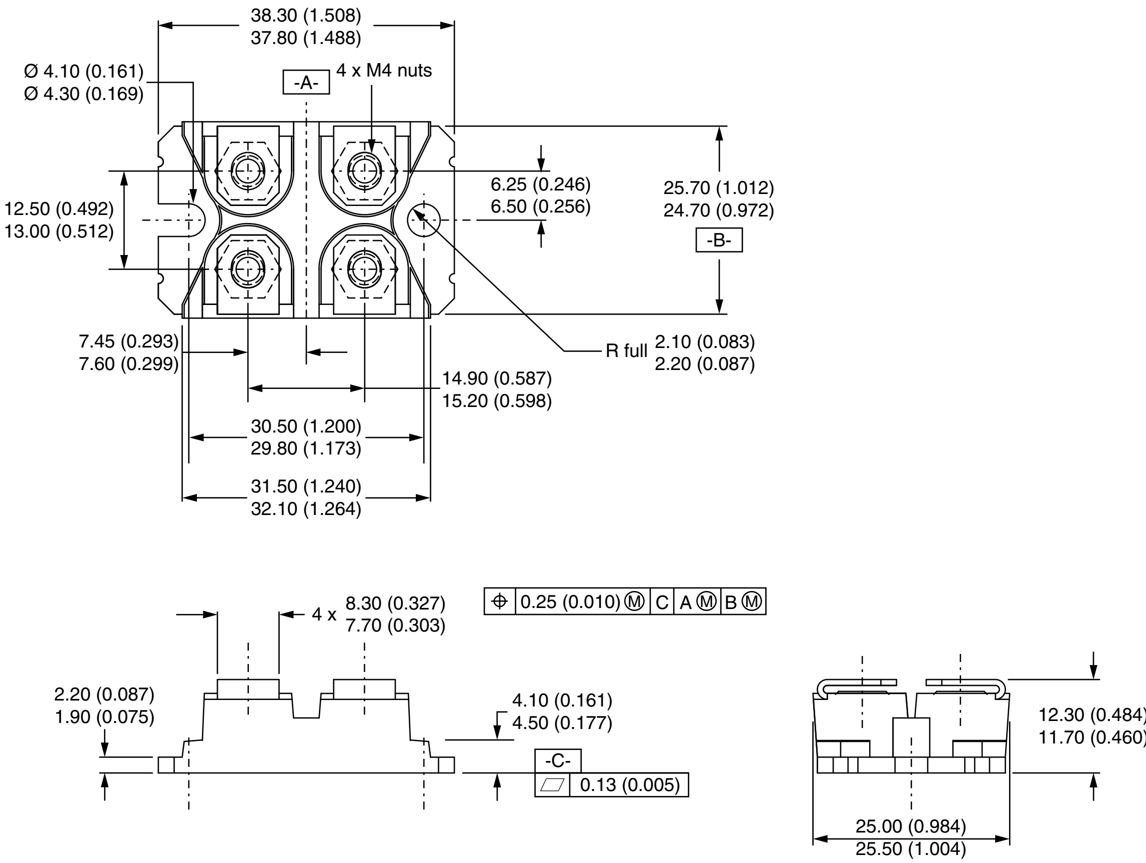
1 - Vishay Semiconductors product
2 - Insulated gate bipolar transistor (IGBT)
3 - B = IGBT Gen 5
4 - Current rating (55 = 50 A)
5 - Circuit configuration (N = high side chopper)
6 - Package indicator (A = SOT-227)
7 - Voltage rating (120 = 1200 V)
8 - Speed / type (U = ultrafast IGBT)
9 - Diode (X = HEXFRED® diode)

| CIRCUIT CONFIGURATION | | |
|---|---|---|
| CIRCUIT | CIRCUIT CONFIGURATION CODE | CIRCUIT DRAWING |
| High side chopper | N |     |

| LINKS TO RELATED DOCUMENTS | |
|---|---|
| Dimensions | www.vishay.com/doc?95423 |
| Packaging information | www.vishay.com/doc?95425 |


For technical questions within your region: DiodesAmericas@vishay.com, DiodesAsia@vishay.com, DiodesEurope@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

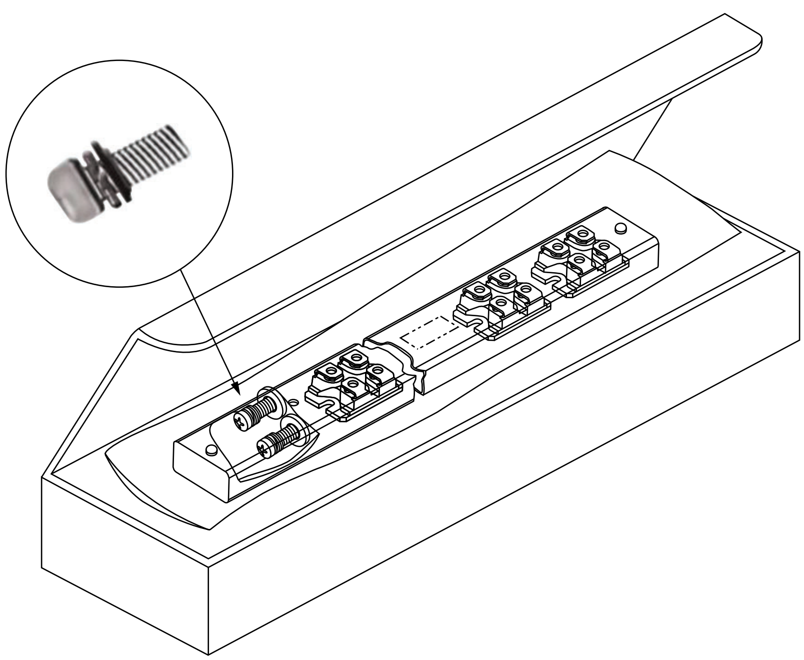
**DIMENSIONS** in millimeters (inches)




**Note**

- Controlling dimension: millimeter

**PACKAGING INFORMATION**

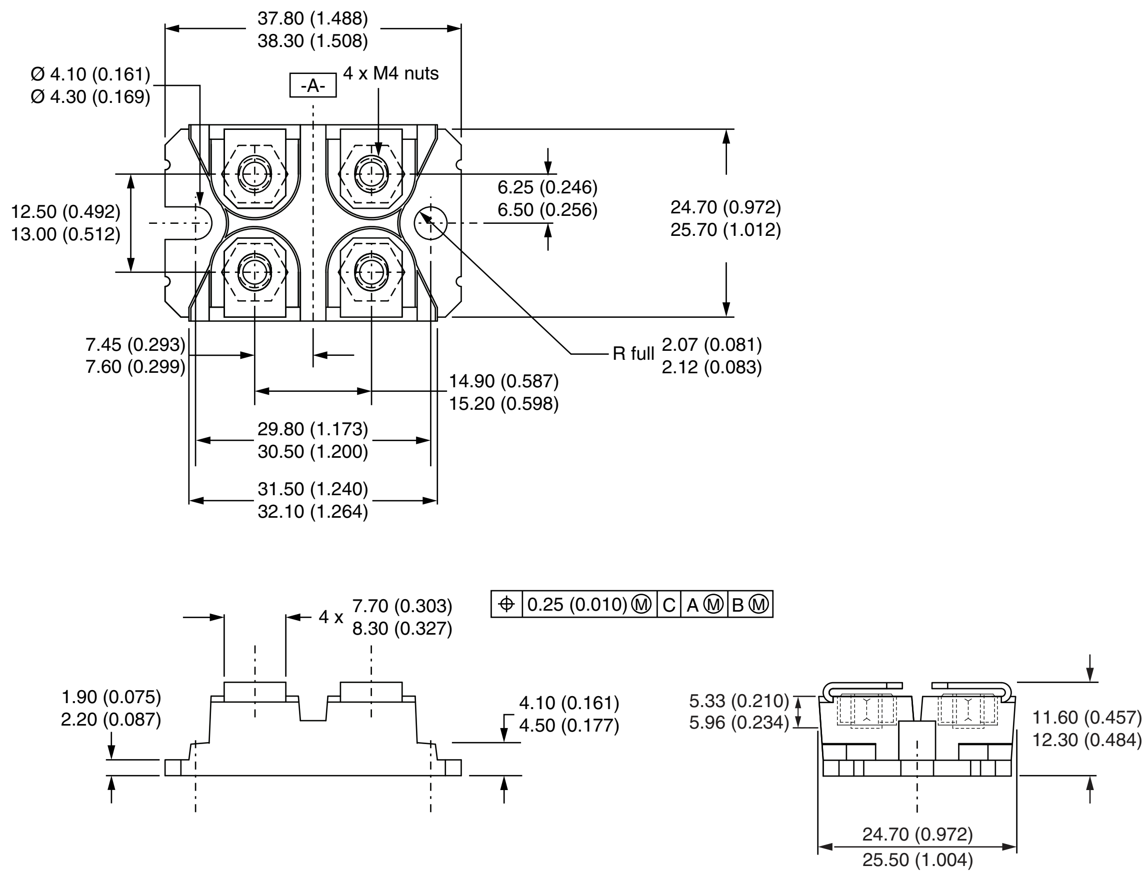




For technical questions within your region: DiodesAmericas@vishay.com, DiodesAsia@vishay.com, DiodesEurope@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

# SOT-227 Generation 2

**DIMENSIONS** in millimeters (inches)




**Note**

- Controlling dimension: millimeter


For technical questions, contact: DiodesAmericas@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT
ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

# Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

***© 2019 VISHAY INTERTECHNOLOGY, INC. ALL RIGHTS RESERVED***