


## SOT-227 Power Module Single Switch - Power MOSFET, 400 A



SOT-227

**FEATURES**

- $I_D = 400\text{ A}$ ,  $T_C = 25\text{ °C}$
- ThunderFET Power MOSFET
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Reduced switching and conduction losses
- Ultra low gate charge ( $Q_g$ )
- Maximum 175 °C junction temperature
- UL approved file E78996 
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

**PRIMARY CHARACTERISTICS**

|                       |                  |
|-----------------------|------------------|
| $V_{DSS}$             | 150 V            |
| $R_{DS(on)}$ at 200 A | 1.93 mΩ          |
| $I_D$                 | 300 A at 90 °C   |
| Type                  | Modules - MOSFET |
| Package               | SOT-227          |

**APPLICATIONS**

- DC/DC conversions
- Motor drives
- DC/AC inverter
- Power supplies
- Uninterruptible power supplies
- AC/DC switch-mode power supplies

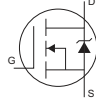
**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER                                  | SYMBOL         | TEST CONDITIONS  | MAX.        | UNITS |
|--|----------------|--|-------------|-------|
| <b>MOSFET</b>                              |                |  |             |       |
| Drain to source voltage                    | $V_{DSS}$      |  | 150         | V     |
| Continuous drain current, $V_{GS}$ at 10 V | $I_D$          | $T_C = 25\text{ °C}$   | 400         | A     |
|  |                | $T_C = 90\text{ °C}$   | 300         |       |
| Pulsed drain current                       | $I_{DM}^{(1)}$ |  | 860         |       |
| Power dissipation                          | $P_D$          | $T_C = 25\text{ °C}$   | 909         | W     |
| Gate to source voltage                     | $V_{GS}$       |  | ± 20        | V     |
| Single pulse avalanche current             | $E_{AS}$       |  | 720         | J     |
| Avalanche current                          | $I_{AS}$       | $T_C = 25\text{ °C}$ , $L = 10\text{ mH}$ , $V_{GS} = 10\text{ V}$ | 120         | A     |
| <b>MODULE</b>                              |                |  |             |       |
| Operating junction temperature range       | $T_J$          |  | -55 to +175 | °C    |
| Operating storage temperature range        | $T_{Stg}$      |  | -40 to +150 |       |
| Insulation voltage (RMS)                   | $V_{ISOL}$     | any terminal to case, $t = 1\text{ min}$                           | 2500        | V     |

**Note**
<sup>(1)</sup> Limited at max. junction temperature

| THERMAL - MECHANICAL SPECIFICATIONS  |                      |                       |         |      |            |              |
|--------------------------------------|----------------------|-----------------------|---------|------|------------|--------------|
| PARAMETER                            | SYMBOL               | TEST CONDITIONS       | MIN.    | TYP. | MAX.       | UNITS        |
| Operating junction temperature range | $T_J$                |                       | -55     | -    | 175        | °C           |
| Operating storage temperature range  | $T_{Stg}$            |                       | -40     | -    | 150        |              |
| Junction to case                     | MOSFET<br>$R_{thJC}$ |                       | -       | -    | 0.165      | °C/W         |
| Case to heatsink                     | Module<br>$R_{thCS}$ | Flat, greased surface | -       | 0.1  | -          |              |
| Weight                               |                      |                       | -       | 30   | -          | g            |
| Mounting torque                      |                      | Torque to terminal    | -       | -    | 1.1 (9.7)  | Nm (lbf. in) |
|                                      |                      | Torque to heatsink    | -       | -    | 1.3 (11.5) | Nm (lbf. in) |
| Case style                           |                      |                       | SOT-227 |      |            |              |

| ELECTRICAL CHARACTERISTICS ( $T_J = 25\text{ °C}$ unless otherwise specified) |                                 |   |      |       |       |       |
|---|---------------------------------|---|------|-------|-------|-------|
| PARAMETER   | SYMBOL                          | TEST CONDITIONS   | MIN. | TYP.  | MAX.  | UNITS |
| Drain to source breakdown voltage   | $V_{(BR)DSS}$                   | $V_{GS} = 0\text{ V}$ , $I_D = 500\text{ }\mu\text{A}$  | 150  | -     | -     | V     |
| Breakdown voltage temperature coefficient                                     | $\Delta V_{(BR)DSS}/\Delta T_J$ | Reference to $25\text{ °C}$ , $I_D = 1.0\text{ mA}$   | -    | 9.0   | -     | mV/°C |
| Static drain to source on-resistance  | $R_{DS(on)}$                    | $V_{GS} = 10\text{ V}$ , $I_D = 200\text{ A}$   | -    | 1.93  | 2.75  | mΩ    |
| Gate threshold voltage  | $V_{GS(th)}$                    | $V_{DS} = V_{GS}$ , $I_D = 1.0\text{ mA}$   | 1.80 | 3.46  | 5.4   | V     |
| Temperature coefficient of threshold voltage                                  | $\Delta V_{GE(th)}/\Delta T_J$  | $V_{DS} = V_{GS}$ , $I_D = 1.0\text{ mA}$<br>( $25\text{ °C}$ to $125\text{ °C}$ )                  | -    | 9.6   | -     | mV/°C |
| Forward transconductance  | $g_{fs}$                        | $V_{DS} = 15\text{ V}$ , $I_D = 100\text{ A}$ , $V_{GS} = 10\text{ V}$                              | -    | 200   | -     | S     |
| Drain to source leakage current   | $I_{DSS}$                       | $V_{DS} = 150\text{ V}$ , $V_{GS} = 0\text{ V}$   | -    | 0.5   | 10.0  | μA    |
|   |                                 | $V_{DS} = 150\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 150\text{ °C}$                             | -    | 19    | -     |       |
| Gate to source leakage  | $I_{GSS}$                       | $V_{GS} = \pm 20\text{ V}$  | -    | -     | ± 200 | nA    |
| Total gate charge   | $Q_g$                           | $I_D = 250\text{ A}$<br>$V_{DS} = 75\text{ V}$<br>$V_{GS} = 10\text{ V}$                            | -    | 250   | -     | nC    |
| Gate to source charge   | $Q_{gs}$                        |   | -    | 79    | -     |       |
| Gate to drain ("Miller") charge   | $Q_{gd}$                        |   | -    | 82    | -     |       |
| Turn-on delay time  | $t_{d(on)}$                     | $V_{DD} = 75\text{ V}$<br>$I_D = 100\text{ A}$<br>$R_g = 1\text{ }\Omega$<br>$V_{GS} = 10\text{ V}$ | -    | 139   | -     | ns    |
| Rise time   | $t_r$                           |   | -    | 285   | -     |       |
| Turn-off delay time   | $t_{d(off)}$                    |   | -    | 120   | -     |       |
| Fall time   | $t_f$                           |   | -    | 142   | -     |       |
| Input capacitance   | $C_{iss}$                       | $V_{GS} = 0\text{ V}$<br>$V_{DS} = 25\text{ V}$<br>$f = 1\text{ MHz}$                               | -    | 13.7  | -     | nF    |
| Output capacitance  | $C_{oss}$                       |   | -    | 2.2   | -     |       |
| Reverse transfer capacitance  | $C_{rss}$                       |   | -    | 0.104 | -     |       |

| SOURCE-DRAIN RATINGS AND CHARACTERISTICS ( $T_J = 25\text{ °C}$ unless otherwise specified) |          |  |      |      |      |       |
|---|----------|--|------|------|------|-------|
| PARAMETER   | SYMBOL   | TEST CONDITIONS  | MIN. | TYP. | MAX. | UNITS |
| Continuous source current (body diode)  | $I_S$    |  | -    | -    | 476  | A     |
| Pulsed source current (body diode)  | $I_{SM}$ | MOSFET symbol showing the integral reverse p-n junction diode  | -    | -    | 850  |       |
| Diode forward voltage   | $V_{SD}$ | $I_S = 250\text{ A}$ , $V_{GS} = 0\text{ V}$   | -    | 0.95 | -    | V     |
| Reverse recovery time   | $t_{rr}$ | $T_J = 25\text{ °C}$ , $I_F = I_S = 50\text{ A}$ ,<br>$dI/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 50\text{ V}$                                     | -    | 171  | -    | ns    |
| Reverse recovery charge   | $Q_{rr}$ |  | -    | 1032 | -    | nC    |
| Reverse recovery current  | $I_{RM}$ |  | -    | 12   | -    | A     |

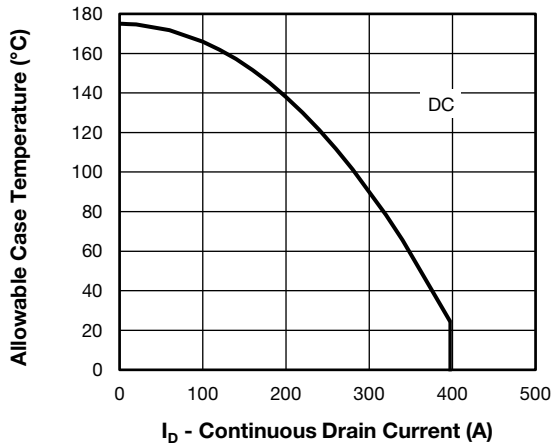


Fig. 1 - Maximum Continuous Drain Current vs. Case Temperature

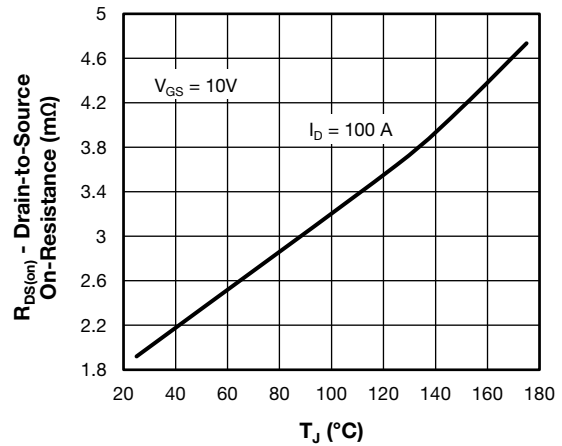


Fig. 4 - Typical Drain-to-Source On-Resistance vs. Temperature

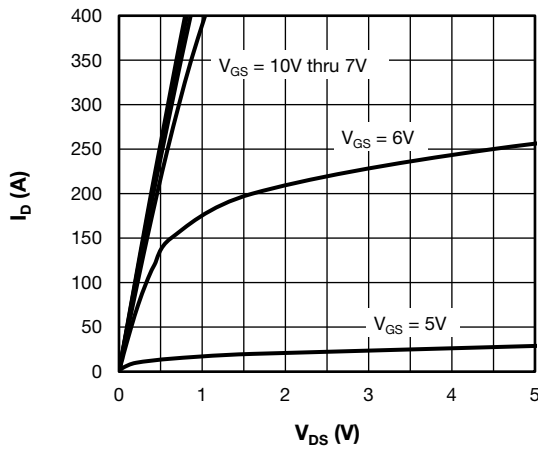


Fig. 2 - Typical Drain to Source Current Output Characteristics at  $T_J = 25\text{ }^\circ\text{C}$

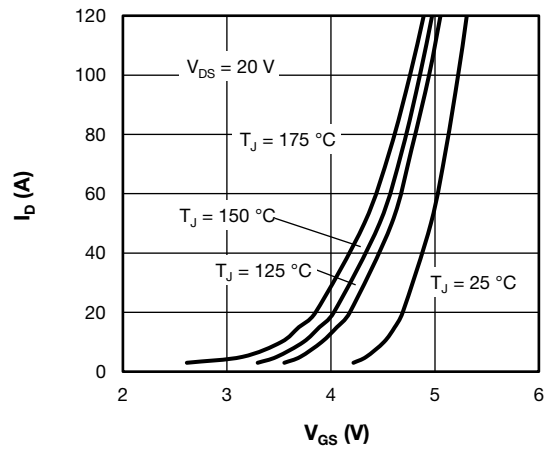


Fig. 5 - Typical Transfer Characteristics

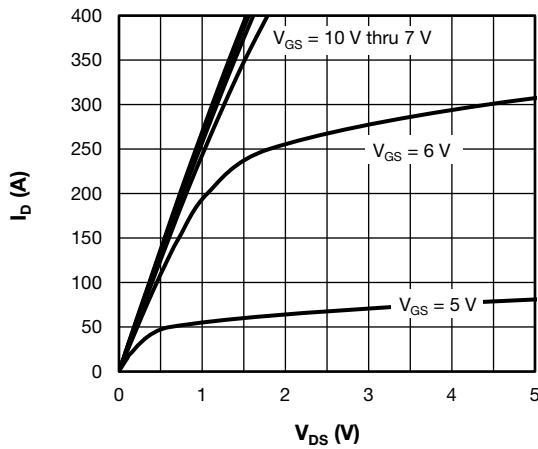


Fig. 3 - Typical Drain to Source Current Output Characteristics at  $T_J = 125\text{ }^\circ\text{C}$

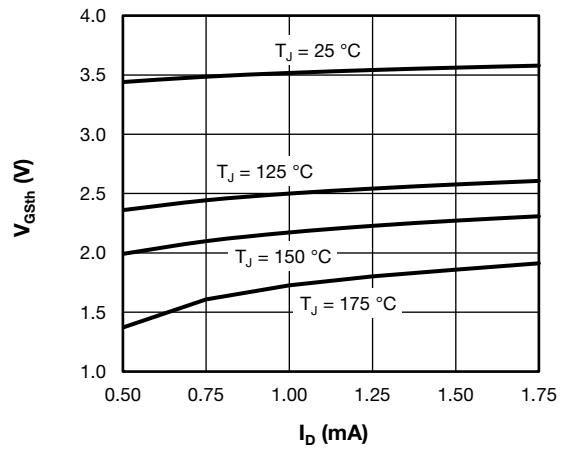


Fig. 6 - Typical Gate Threshold Voltage Characteristics

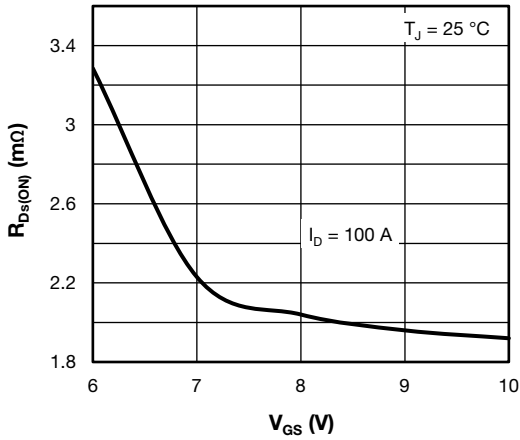


Fig. 7 - Typical Drain - State Resistance vs. Gate to Source Voltage

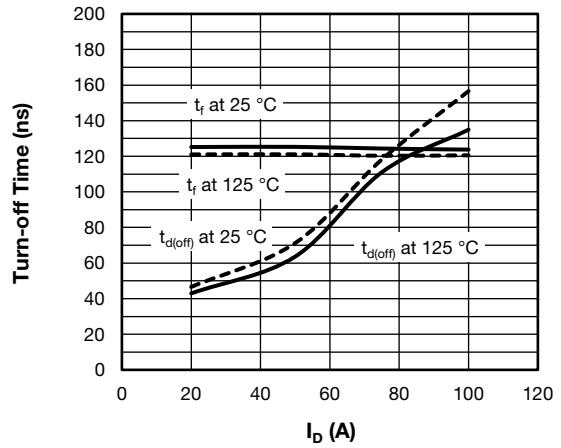


Fig. 10 - Typical Turn-off Switching Time vs.  $I_D$

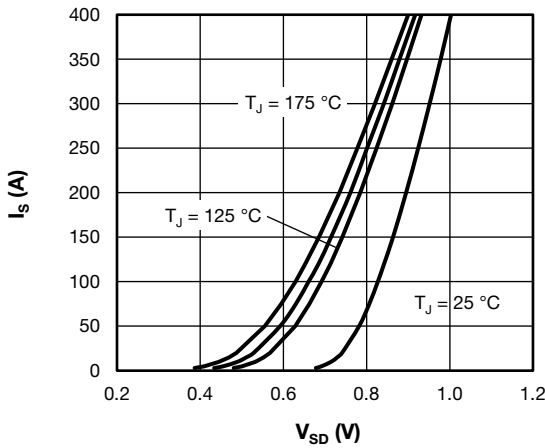


Fig. 8 - Typical Body Diode Source-to-Drain Current Characteristics

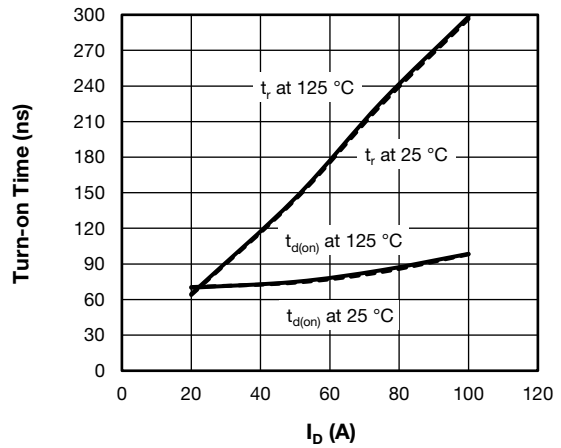


Fig. 11 - Typical Turn-on Switching Time vs.  $I_D$

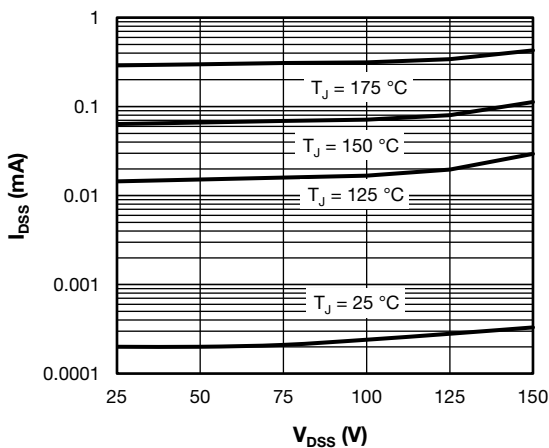


Fig. 9 - Typical Zero Gate Voltage Drain Current

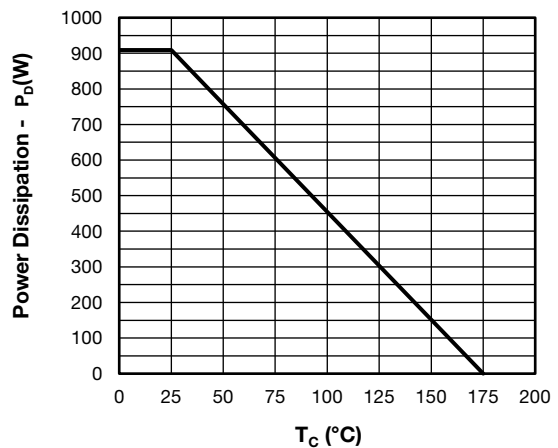


Fig. 12 - Power Dissipation Curve

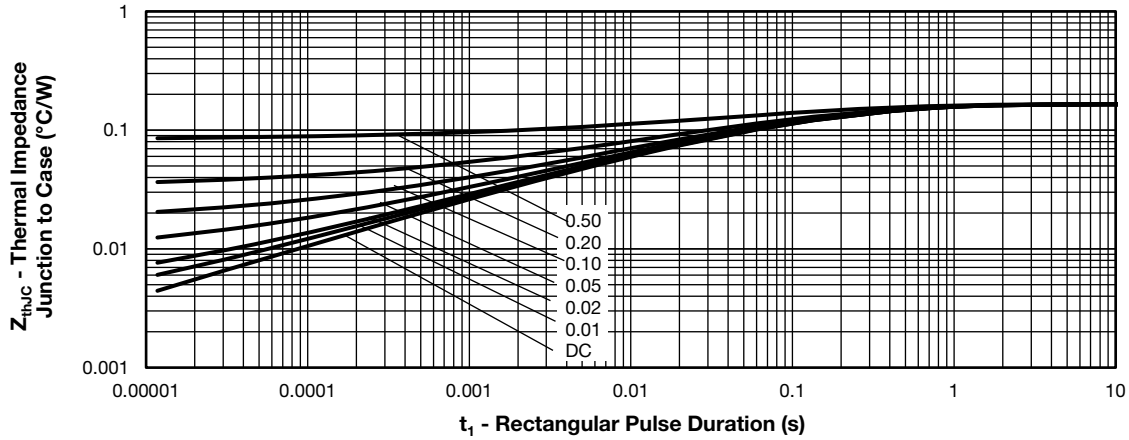


Fig. 13 - Maximum Thermal Impedance Junction-to-Case Characteristics

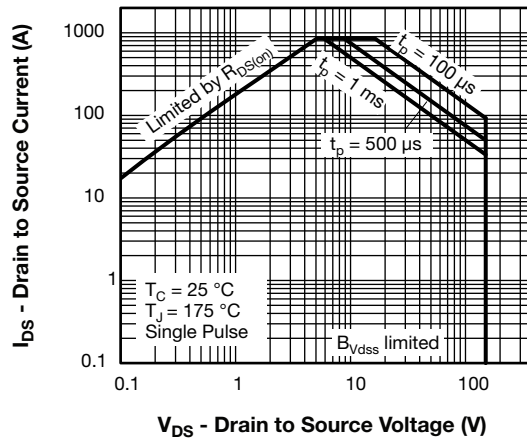


Fig. 14 - Safe Operating Area

**ORDERING INFORMATION TABLE**

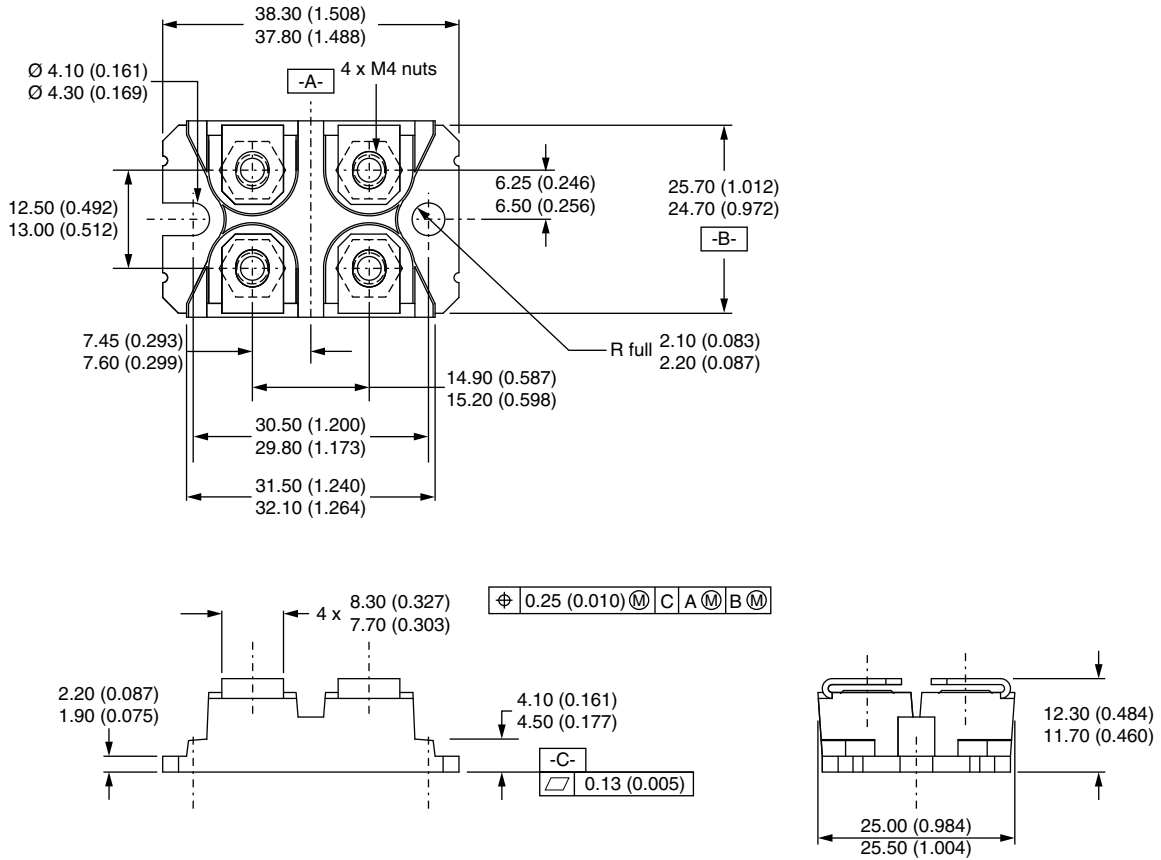
|             |            |          |          |            |          |          |           |
|-------------|------------|----------|----------|------------|----------|----------|-----------|
| Device code | <b>VS-</b> | <b>F</b> | <b>C</b> | <b>420</b> | <b>S</b> | <b>A</b> | <b>15</b> |
|             | ①          | ②        | ③        | ④          | ⑤        | ⑥        | ⑦         |

- 1** - Vishay Semiconductors product
- 2** - MOSFET module
- 3** - MOSFET die generation
- 4** - Current rating (420 = 420 A)
- 5** - Circuit configuration (S = single switch)
- 6** - Package indicator (SOT-227)
- 7** - Voltage rating (15 = 150 V)

| CIRCUIT CONFIGURATION |                            |  |
|-----------------------|----------------------------|--|
| CIRCUIT               | CIRCUIT CONFIGURATION CODE | CIRCUIT DRAWING  |
| Single switch         | S                          | <p>The circuit drawing for the 'Single switch' configuration (code S) consists of three parts:</p> <ul style="list-style-type: none"> <li><b>Schematic:</b> A diode and a transistor are shown. The diode's cathode is connected to the transistor's base. The diode's anode is connected to the transistor's emitter. The transistor's collector is connected to the diode's cathode. The diode is labeled D (3), the transistor's gate is G (2), and the transistor's source is S (1-4).</li> <li><b>Lead Assignment:</b> A diagram of the component's package with four leads labeled: (S) at pin 1, (D) at pin 2, (S) at pin 3, and (G) at pin 4.</li> <li><b>Wiring Diagram:</b> A detailed circuit diagram showing the connection of the four leads. Pin 3 (D) is connected to the diode's anode. Pin 2 (G) is connected to the diode's cathode. Pin 4 (S) is connected to the transistor's base. Pin 1 (S) is connected to the transistor's emitter.</li> </ul> |



**DIMENSIONS** in millimeters





## SOT-227 Generation 2

**DIMENSIONS** in millimeters (inches)



**Note**

- Controlling dimension: millimeter





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