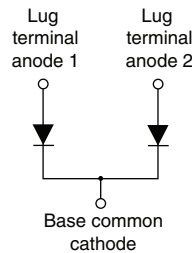


# High Performance Schottky Rectifier, 400 A


**TO-244**


## FEATURES

- 150 °C T<sub>J</sub> operation
- Center tap module
- Very low forward voltage drop
- High frequency operation
- Guard ring for enhanced ruggedness and long term reliability
- UL approved file E222165 
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

## PRIMARY CHARACTERISTICS

|                       |                           |
|-----------------------|---------------------------|
| I <sub>F(AV)</sub>    | 400 A                     |
| V <sub>R</sub>        | 45 V                      |
| Package               | TO-244                    |
| Circuit configuration | Two diodes common cathode |

## DESCRIPTION / APPLICATIONS

The VS-400CNQ045PbF center tap, high current, Schottky rectifier module has been optimized for very low forward voltage drop, with moderate leakage. The proprietary barrier technology allows for reliable operation up to 150 °C junction temperature. Typical applications are in switching power supplies, converters, freewheeling diodes, welding, and reverse battery protection.

## MAJOR RATINGS AND CHARACTERISTICS

| SYMBOL             | CHARACTERISTICS                                         | VALUES      | UNITS |
|--------------------|---------------------------------------------------------|-------------|-------|
| I <sub>F(AV)</sub> | Rectangular waveform                                    | 400         | A     |
| V <sub>RRM</sub>   |                                                         | 45          | V     |
| I <sub>FSM</sub>   | t <sub>p</sub> = 5 µs sine                              | 29 000      | A     |
| V <sub>F</sub>     | 200 A <sub>pk</sub> , T <sub>J</sub> = 125 °C (per leg) | 0.52        | V     |
| T <sub>J</sub>     | Range                                                   | -55 to +150 | °C    |

## VOLTAGE RATINGS

| PARAMETER                            | SYMBOL           | VS-400CNQ045PbF | UNITS |
|--------------------------------------|------------------|-----------------|-------|
| Maximum DC reverse voltage           | V <sub>R</sub>   | 45              | V     |
| Maximum working peak reverse voltage | V <sub>RWM</sub> |                 |       |

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                                                 | SYMBOL             | TEST CONDITIONS                                                                                                                        | VALUES | UNITS |
|---------------------------------------------------------------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------------|--------|-------|
| Maximum average forward current<br>See fig. 5                             | I <sub>F(AV)</sub> | 50 % duty cycle at T <sub>C</sub> = 114 °C, rectangular waveform                                                                       | 200    | A     |
| per leg                                                                   |                    |                                                                                                                                        | 400    |       |
| Maximum peak one cycle non-repetitive surge current per leg<br>See fig. 7 | I <sub>FSM</sub>   | 5 µs sine or 3 µs rect. pulse                                                                                                          | 29 000 |       |
|                                                                           |                    | 10 ms sine or 6 ms rect. pulse                                                                                                         | 3400   |       |
| Non-repetitive avalanche energy per leg                                   | E <sub>AS</sub>    | T <sub>J</sub> = 25 °C, I <sub>AS</sub> = 19 A, L = 1 mH                                                                               | 180    | mJ    |
| Repetitive avalanche current per leg                                      | I <sub>AR</sub>    | Current decaying linearly to zero in 1 µs<br>Frequency limited by T <sub>J</sub> maximum V <sub>A</sub> = 1.5 x V <sub>R</sub> typical | 40     | A     |

**ELECTRICAL SPECIFICATIONS**

| PARAMETER                                             | SYMBOL         | TEST CONDITIONS                                                                            |                                     | VALUES | UNITS |
|-------------------------------------------------------|----------------|--------------------------------------------------------------------------------------------|-------------------------------------|--------|-------|
| Maximum forward voltage drop per leg<br>See fig. 1    | $V_{FM}^{(1)}$ | 200 A                                                                                      | $T_J = 25\text{ }^{\circ}\text{C}$  | 0.57   | V     |
|                                                       |                | 400 A                                                                                      |                                     | 0.73   |       |
|                                                       |                | 200 A                                                                                      | $T_J = 125\text{ }^{\circ}\text{C}$ | 0.52   |       |
|                                                       |                | 400 A                                                                                      |                                     | 0.7    |       |
| Maximum reverse leakage current per leg<br>See fig. 2 | $I_{RM}^{(1)}$ | $T_J = 25\text{ }^{\circ}\text{C}$                                                         | $V_R = \text{Rated } V_R$           | 20     | mA    |
|                                                       |                | $T_J = 125\text{ }^{\circ}\text{C}$                                                        |                                     | 1.2    | A     |
| Threshold voltage                                     | $V_{F(TO)}$    | $T_J = T_J \text{ maximum}$                                                                |                                     | 0.32   | V     |
| Forward slope resistance                              | $r_t$          |                                                                                            |                                     | 0.81   | mΩ    |
| Maximum junction capacitance per leg                  | $C_T$          | $V_R = 5\text{ }V_{DC}$ (test signal range 100 kHz to 1 MHz), $25\text{ }^{\circ}\text{C}$ |                                     | 10 300 | pF    |
| Typical series inductance per leg                     | $L_S$          | From top of terminal hole to mounting plane                                                |                                     | 5.0    | nH    |
| Maximum voltage rate of change                        | dV/dt          | Rated $V_R$                                                                                |                                     | 10 000 | V/μs  |

**Note**(1) Pulse width < 300  $\mu$ s, duty cycle < 2 %**THERMAL - MECHANICAL SPECIFICATIONS**

| PARAMETER                                       | SYMBOL         | MIN.     | TYP. | MAX.     | UNITS                |
|-------------------------------------------------|----------------|----------|------|----------|----------------------|
| Maximum junction and storage temperature range  | $T_J, T_{Stg}$ | -55      | -    | 150      | $^{\circ}\text{C}$   |
| Thermal resistance, junction to case per leg    | $R_{thJC}$     | -        | -    | 0.19     | $^{\circ}\text{C/W}$ |
| Thermal resistance, junction to case per module |                | -        | -    | 0.095    |                      |
| Thermal resistance, case to heatsink            | $R_{thCS}$     | -        | 0.10 | -        |                      |
| Weight                                          |                | -        | 68   | -        | g                    |
|                                                 |                | -        | 2.4  | -        | oz.                  |
| Mounting torque                                 |                | 35.4 (4) |      | 53.1 (6) | lbf · in<br>(N · m)  |
| Mounting torque center hole                     |                | 30 (3.4) |      | 40 (4.6) |                      |
| Terminal torque                                 |                | 30 (3.4) | -    | 44.2 (5) |                      |
| Vertical pull                                   |                | -        | -    | 80       | lbf · in             |
| 2" lever pull                                   |                | -        | -    | 35       |                      |

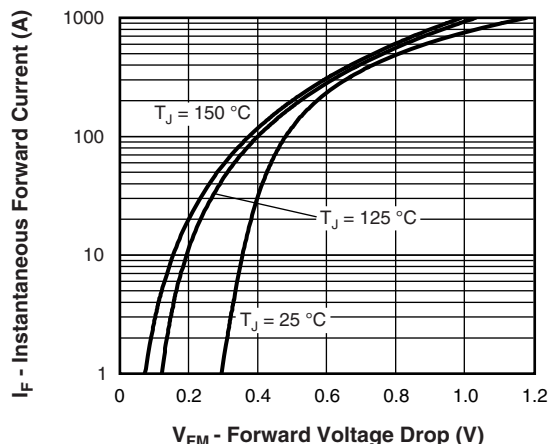


Fig. 1 - Maximum Forward Voltage Drop Characteristics (Per Leg)

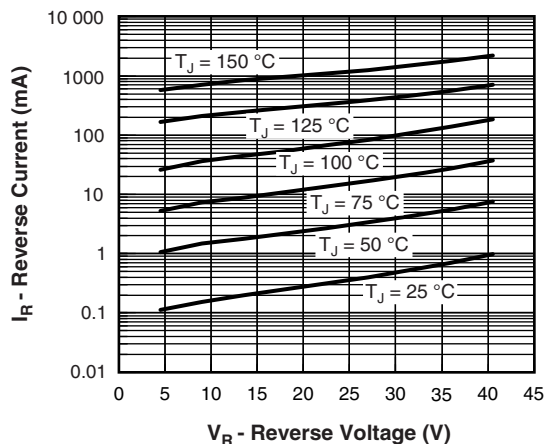


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage (Per Leg)

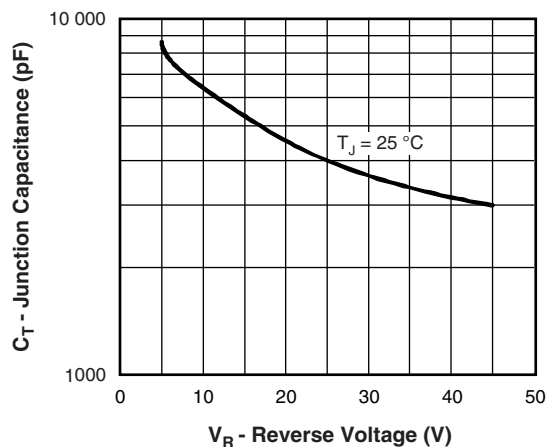
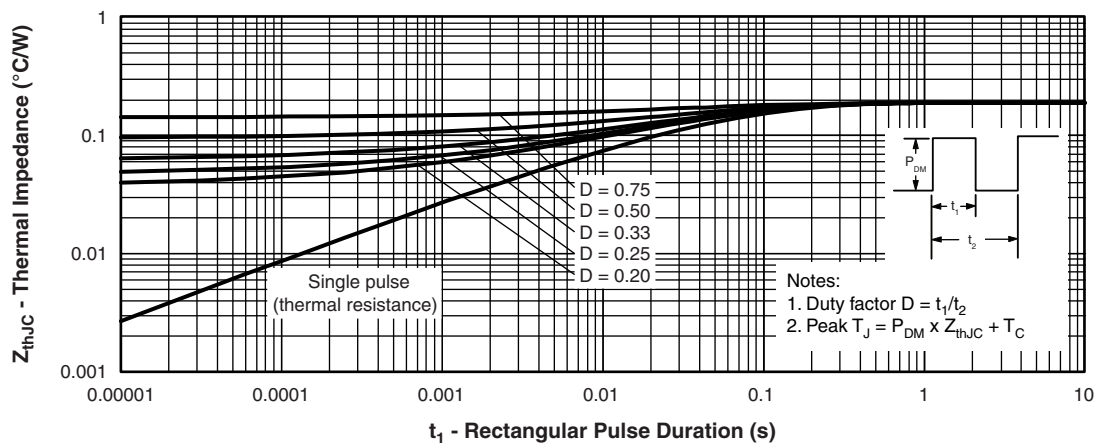


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage (Per Leg)


Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (Per Leg)

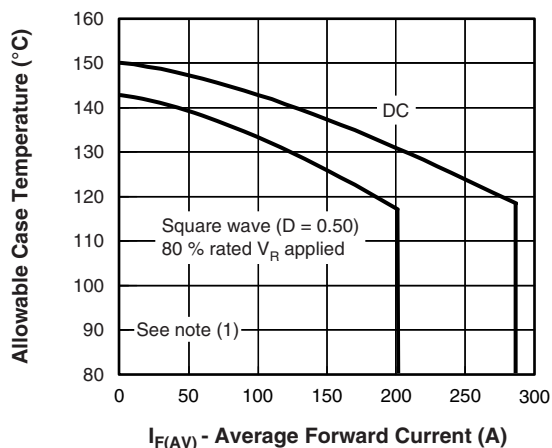


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current (Per Leg)

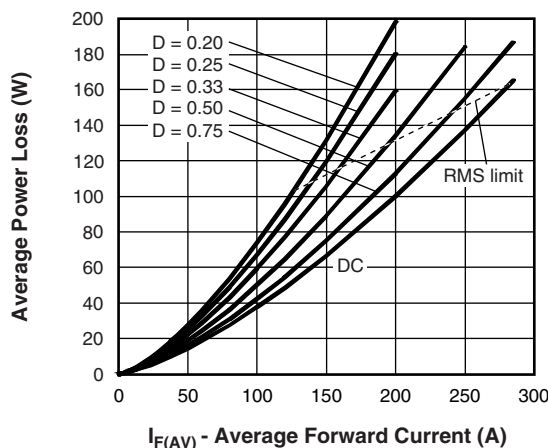


Fig. 6 - Forward Power Loss Characteristics (Per Leg)

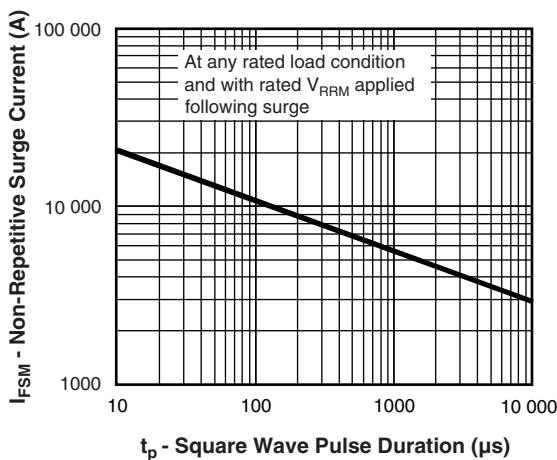


Fig. 7 - Maximum Non-Repetitive Surge Current (Per Leg)

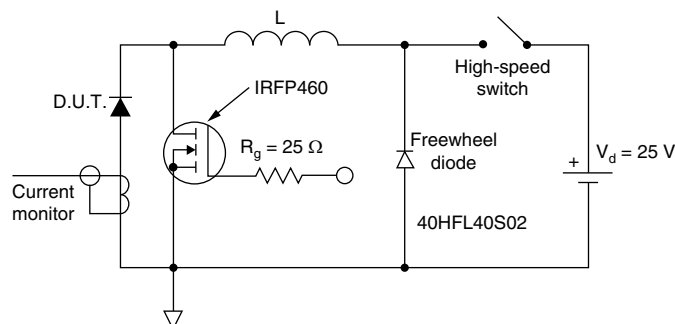


Fig. 8 - Unclamped Inductive Test Circuit

#### Note

- (1) Formula used:  $T_C = T_J - (P_d + P_{dREV}) \times R_{thJC}$ ;  
 $P_d$  = forward power loss =  $I_{F(AV)} \times V_{FM}$  at  $(I_{F(AV)}/D)$  (see fig. 6);  
 $P_{dREV}$  = inverse power loss =  $V_{R1} \times I_R (1 - D)$ ;  $I_R$  at  $V_{R1} = 80\%$  rated  $V_R$



**ORDERING INFORMATION TABLE**

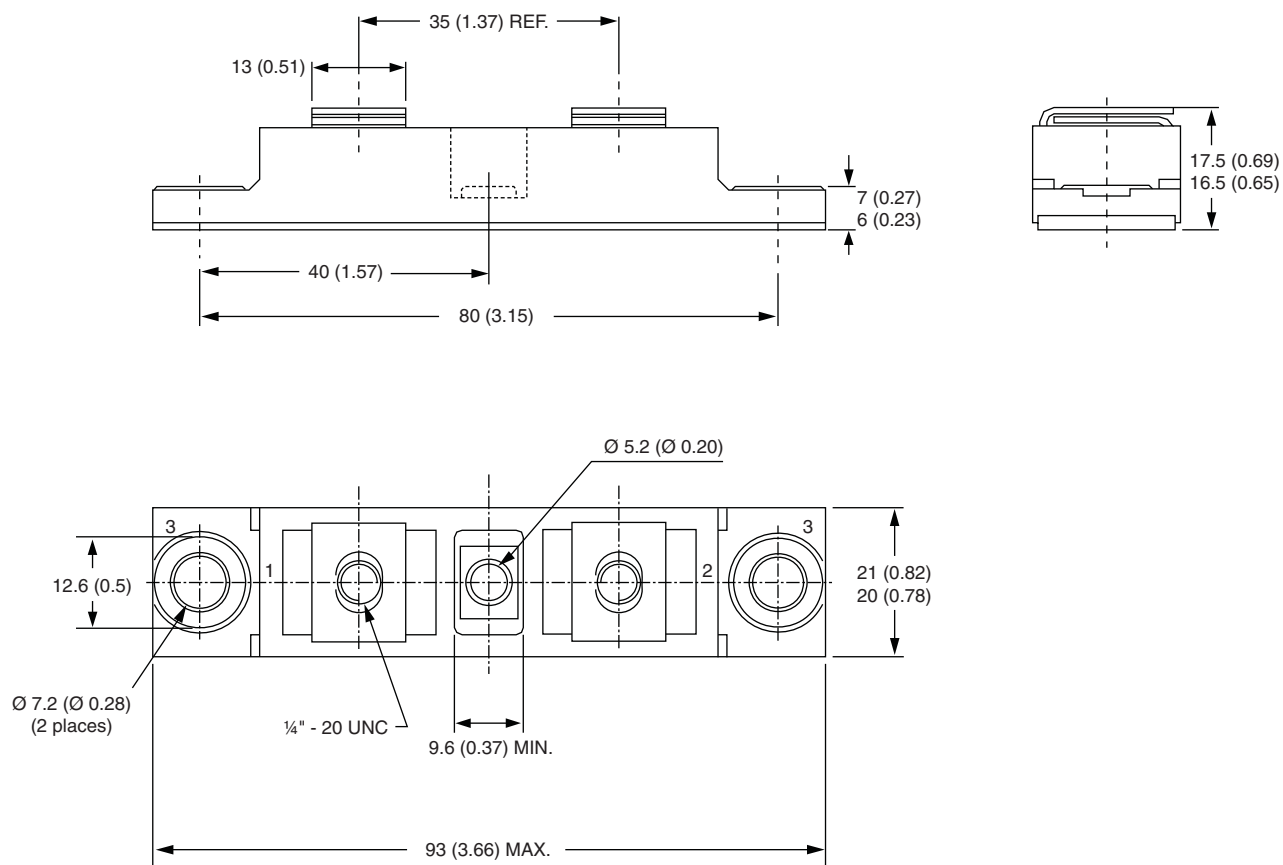
|             |                                  |           |          |          |          |          |            |            |
|-------------|----------------------------------|-----------|----------|----------|----------|----------|------------|------------|
| Device code | <b>VS-</b>                       | <b>40</b> | <b>0</b> | <b>C</b> | <b>N</b> | <b>Q</b> | <b>045</b> | <b>PbF</b> |
|             | ①                                | ②         | ③        | ④        | ⑤        | ⑥        | ⑦          | ⑧          |
| ①           | - Vishay Semiconductors product  |           |          |          |          |          |            |            |
| ②           | - Average current rating (x 10)  |           |          |          |          |          |            |            |
| ③           | - Product silicon identification |           |          |          |          |          |            |            |
| ④           | - C = circuit configuration      |           |          |          |          |          |            |            |
| ⑤           | - N = not isolated               |           |          |          |          |          |            |            |
| ⑥           | - Q = Schottky rectifier diode   |           |          |          |          |          |            |            |
| ⑦           | - Voltage rating (045 = 45 V)    |           |          |          |          |          |            |            |
| ⑧           | - Lead (Pb)-free                 |           |          |          |          |          |            |            |

| LINKS TO RELATED DOCUMENTS |                                                                        |
|----------------------------|------------------------------------------------------------------------|
| Dimensions                 | <a href="http://www.vishay.com/doc?95021">www.vishay.com/doc?95021</a> |



## TO-244

**DIMENSIONS** in millimeters (inches)





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