

## Standard Recovery Diodes, 400 A



TO-244

### FEATURES

- Standard rectifier
- Popular series for rough service
- Cathode and anode to base available
- 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

### TYPICAL APPLICATIONS

- Welders
- Power supplies
- Motor controls
- Battery chargers
- General industrial current rectification

### PRIMARY CHARACTERISTICS

|                        |                                                       |
|------------------------|-------------------------------------------------------|
| $I_{F(AV)}$ per module | 400 A                                                 |
| Type                   | Modules - diode, high voltage                         |
| Package                | TO-244                                                |
| Circuit configuration  | Two diodes common anode,<br>two diodes common cathode |

### MAJOR RATINGS AND CHARACTERISTICS

| SYMBOL         | CHARACTERISTICS | VALUES      | UNITS              |
|----------------|-----------------|-------------|--------------------|
| $I_{F(AV)}$    |                 | 400         | A                  |
|                | $T_C$           | 133         | °C                 |
| $I_{F(RMS)}$   |                 | 628         | A                  |
| $I_{FSM}$      | 50 Hz           | 2500        |                    |
|                | 60 Hz           | 2620        |                    |
| $I^2t$         | 50 Hz           | 31          | kA <sup>2</sup> s  |
|                | 60 Hz           | 28          |                    |
| $I^2\sqrt{t}$  |                 | 312         | kA <sup>2</sup> √s |
| $V_{RRM}$      |                 | 600         | V                  |
| $T_{Stg}, T_J$ |                 | -40 to +175 | °C                 |

### ELECTRICAL SPECIFICATIONS

#### VOLTAGE RATINGS

| TYPE NUMBER    | VOLTAGE CODE | $V_{RRM}$ , MAXIMUM REPETITIVE<br>PEAK REVERSE VOLTAGE<br>V | $V_{RSM}$ , MAXIMUM NON-REPETITIVE<br>PEAK REVERSE VOLTAGE<br>V | $I_{RRM}$ MAXIMUM<br>AT $T_J = 175\text{ °C}$<br>mA |
|----------------|--------------|-------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------|
| VS-VSMD400.W60 | 60           | 600                                                         | 700                                                             | 12                                                  |

**FORWARD CONDUCTION**

| PARAMETER                                                             | SYMBOL              | TEST CONDITIONS                                                                                           |                                  |                                                                       | VALUES | UNITS              |
|-----------------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------|----------------------------------|-----------------------------------------------------------------------|--------|--------------------|
| Maximum average forward current at case temperature per leg           | I <sub>F(AV)</sub>  | 180° conduction, half sine wave, 133 °C                                                                   |                                  |                                                                       | 200    | A                  |
| Maximum RMS forward current per leg                                   | I <sub>F(RMS)</sub> | DC at 137 °C case temperature                                                                             |                                  |                                                                       | 314    | A                  |
| Maximum peak, one-cycle forward, non-repetitive surge current per leg | I <sub>FSM</sub>    | t = 10 ms                                                                                                 | No voltage reapplied             | Sinusoidal half wave, initial T <sub>J</sub> = T <sub>J</sub> maximum | 2500   |                    |
|                                                                       |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 2620   |                    |
|                                                                       |                     | t = 10 ms                                                                                                 | 100 % V <sub>RRM</sub> reapplied |                                                                       | 2100   |                    |
|                                                                       |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 2200   |                    |
| Maximum I <sup>2</sup> t for fusing per leg                           | I <sup>2</sup> t    | t = 10 ms                                                                                                 | No voltage reapplied             |                                                                       | 32     | kA <sup>2</sup> s  |
|                                                                       |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 29     |                    |
|                                                                       |                     | t = 10 ms                                                                                                 | 100 % V <sub>RRM</sub> reapplied |                                                                       | 22     |                    |
|                                                                       |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 20     |                    |
| Maximum I <sup>2</sup> √t for fusing per leg                          | I <sup>2</sup> √t   | t = 0.1 ms to 10 ms, no voltage reapplied                                                                 |                                  |                                                                       | 311    | kA <sup>2</sup> √s |
| Low level value of threshold voltage per leg                          | V <sub>F(TO)1</sub> | (16.7 % × π × I <sub>F(AV)</sub> ) < I < π × I <sub>F(AV)</sub> , T <sub>J</sub> = T <sub>J</sub> maximum |                                  |                                                                       | 0.73   | V                  |
| High level value of threshold voltage per leg                         | V <sub>F(TO)2</sub> | (I > π × I <sub>F(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum                                    |                                  |                                                                       | 0.85   |                    |
| Low level value of forward slope resistance per leg                   | r <sub>f1</sub>     | (16.7 % × π × I <sub>F(AV)</sub> ) < I < π × I <sub>F(AV)</sub> , T <sub>J</sub> = T <sub>J</sub> maximum |                                  |                                                                       | 1.52   | mΩ                 |
| High level value of forward slope resistance per leg                  | r <sub>f2</sub>     | (I > π × I <sub>F(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum                                    |                                  |                                                                       | 1.36   |                    |
| Maximum forward voltage drop per leg                                  | V <sub>FM</sub>     | I <sub>FM</sub> = 200 A, T <sub>J</sub> = 25 °C, t <sub>p</sub> = 400 μs square wave                      |                                  |                                                                       | 1.31   | V                  |

**BLOCKING**

| PARAMETER                                    | SYMBOL    | TEST CONDITIONS | VALUES | UNITS |
|----------------------------------------------|-----------|-----------------|--------|-------|
| Maximum peak reverse leakage current per leg | $I_{RRM}$ | $T_J = 175$ °C  | 12     | mA    |
|                                              |           | $T_J = 25$ °C   | 200    | μA    |

**THERMAL AND MECHANICAL SPECIFICATIONS**

| PARAMETER                                                                           | SYMBOL            | VALUES   |      |          | UNITS               |
|-------------------------------------------------------------------------------------|-------------------|----------|------|----------|---------------------|
|                                                                                     |                   | MIN.     | TYP. | MAX.     |                     |
| Thermal resistance,<br>junction to case<br><div>per leg</div> <div>per module</div> | R <sub>thJC</sub> | -        | -    | 0.10     | °C/W                |
|                                                                                     |                   | -        | -    | 0.05     |                     |
| Thermal resistance,<br>case to heatsink per module                                  | R <sub>thCS</sub> | -        | 0.10 | -        |                     |
| Weight                                                                              |                   | -        | 68   | -        | g                   |
|                                                                                     |                   | -        | 2.4  | -        | oz.                 |
| Mounting torque                                                                     |                   | 30 (3.4) | -    | 40 (4.6) | lbf · in<br>(N · m) |
| Mounting torque center hole                                                         |                   | 12 (1.4) | -    | 18 (2.1) |                     |
| Terminal torque                                                                     |                   | 30 (3.4) | -    | 40 (4.6) |                     |
| Vertical pull                                                                       |                   | -        | -    | 80       | lbf · in            |
| 2" lever pull                                                                       |                   | -        | -    | 35       |                     |
| Case style                                                                          |                   | TO-244   |      |          |                     |

**ΔR CONDUCTION PER JUNCTION**

| DEVICES     | SINE HALF WAVE CONDUCTION |       |       |       |       | RECTANGULAR WAVE CONDUCTION |       |       |       |       | UNITS |
|-------------|---------------------------|-------|-------|-------|-------|-----------------------------|-------|-------|-------|-------|-------|
|             | 180°                      | 120°  | 90°   | 60°   | 30°   | 180°                        | 120°  | 90°   | 60°   | 30°   |       |
| VSMD400.W60 | 0.041                     | 0.047 | 0.060 | 0.084 | 0.131 | 0.029                       | 0.049 | 0.064 | 0.087 | 0.132 | °C/W  |

**Note**

- Table shows the increment of thermal resistance  $R_{thJC}$  when devices operate at different conduction angles than DC

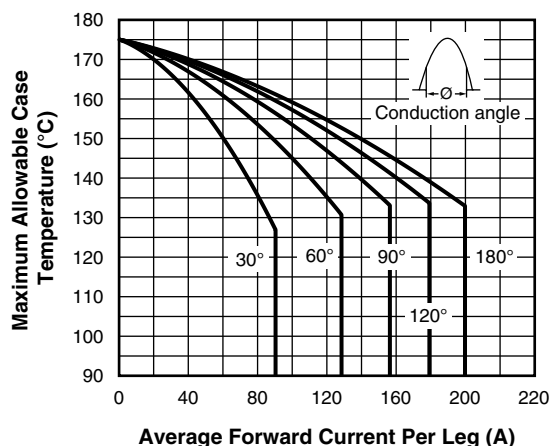


Fig. 1 - Current Ratings Characteristics Per Leg

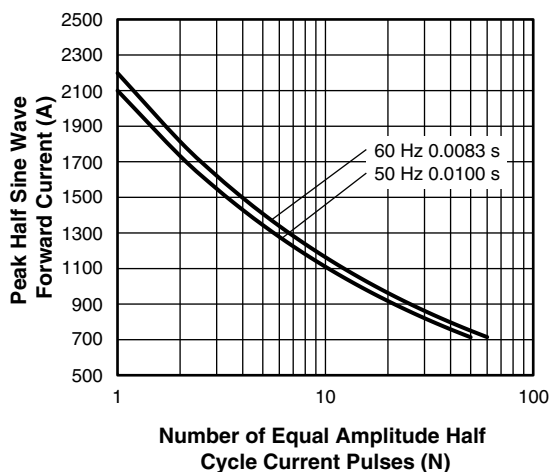


Fig. 3 - Maximum Non-Repetitive Surge Current Per Leg

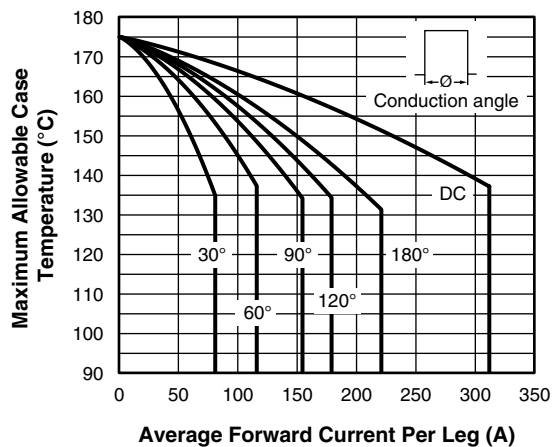


Fig. 2 - Current Ratings Characteristics Per Leg

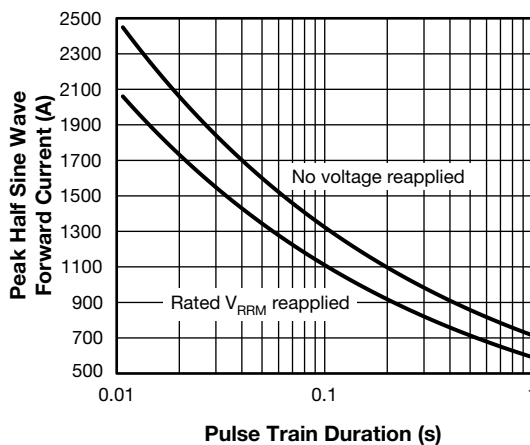


Fig. 4 - Maximum Non-Repetitive Surge Current Per Leg

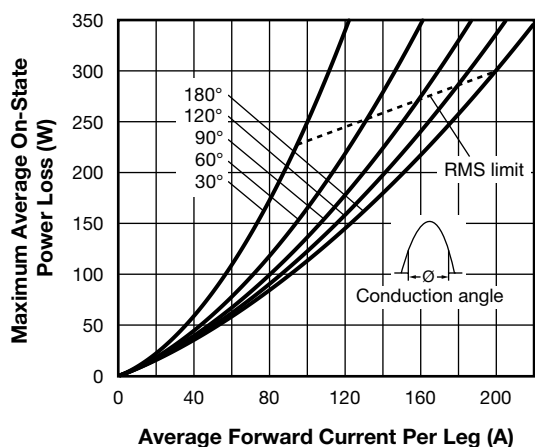
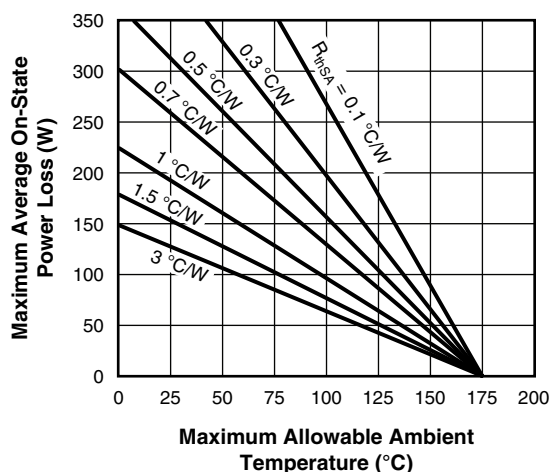


Fig. 5 - Forward Power Loss Characteristics



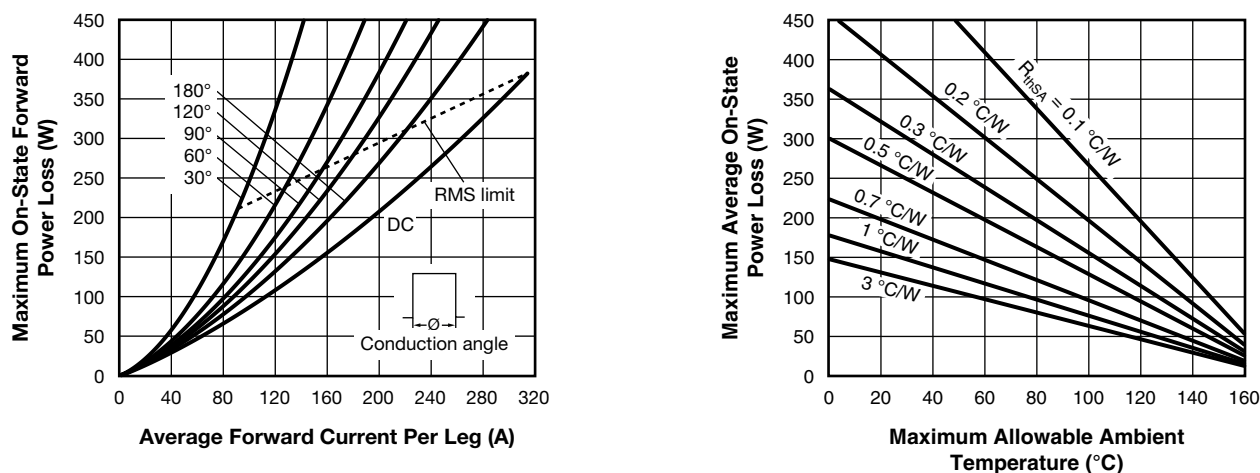


Fig. 6 - Forward Power Loss Characteristics

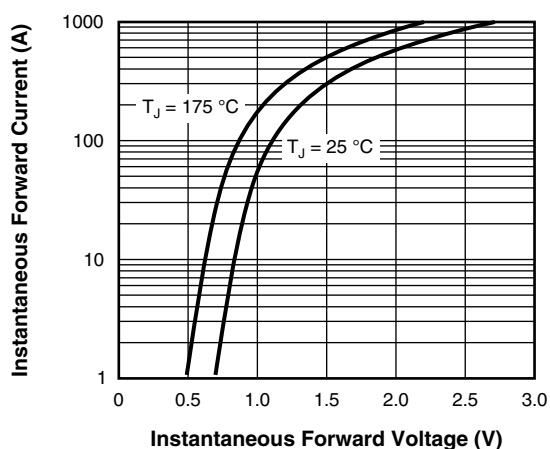


Fig. 7 - Forward Voltage Drop Characteristics Per Leg

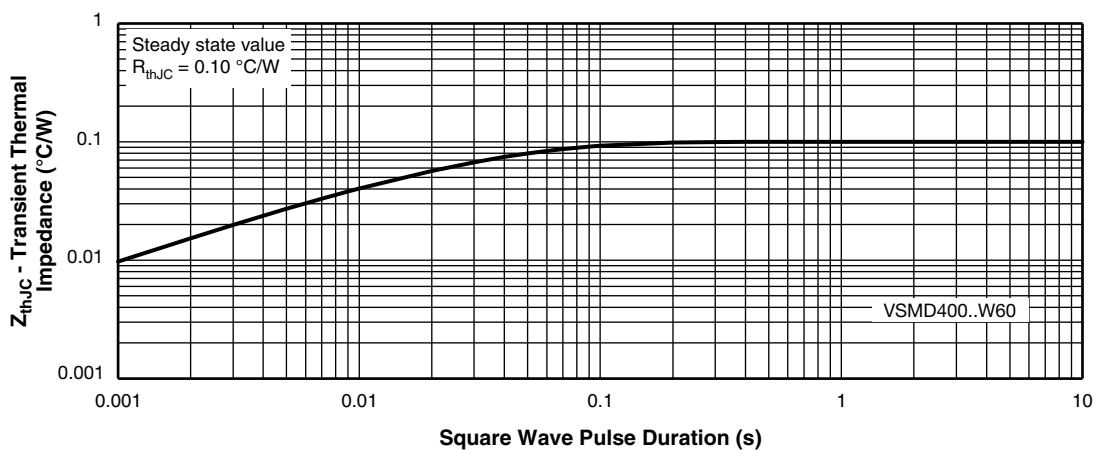
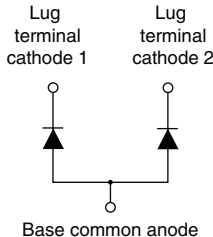
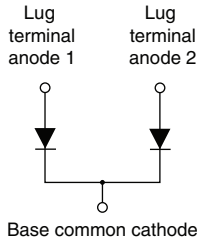


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristics Per Leg

**ORDERING INFORMATION TABLE**

| Device code | VS-VS | MD | 400 | C | W | 60 |
|-------------|-------|----|-----|---|---|----|
|             | 1     | 2  | 3   | 4 | 5 | 6  |

- 1** - Vishay Semiconductors product
- 2** - MD = standard recovery diode
- 3** - Current rating (400 = 400 A)
- 4** - Circuit configuration:
  - C = two diodes common cathode
  - A = two diodes common anode
- 5** - Type of device:  
W = TO-244 not isolated
- 6** - Voltage rating (60 = 600 V)

| CIRCUIT CONFIGURATION     |                            |                                                                                       |
|---------------------------|----------------------------|---------------------------------------------------------------------------------------|
| CIRCUIT DESCRIPTION       | CIRCUIT CONFIGURATION CODE | CIRCUIT DRAWING                                                                       |
| Two diodes common anode   | A                          |   |
| Two diodes common cathode | C                          |  |

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



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