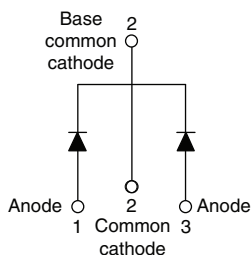


# High Performance Schottky Rectifier, 2 x 10 A



TO-220AB



## FEATURES

- 175 °C  $T_J$  operation
- Low forward voltage drop
- High frequency operation
- High purity, high temperature epoxy encapsulation for enhanced mechanical strength and moisture resistance
- Guard ring for enhanced ruggedness and long term reliability
- AEC-Q101 qualified
- Meets JESD 201 class 2 whisker test
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
**HALOGEN**  
**FREE**

## PRODUCT SUMMARY

|                 |                  |
|-----------------|------------------|
| Package         | TO-220AB         |
| $I_{F(AV)}$     | 2 x 10 A         |
| $V_R$           | 35 V, 40 V, 45 V |
| $V_F$ at $I_F$  | 0.57 V           |
| $I_{RM}$ max.   | 15 mA at 125 °C  |
| $T_J$ max.      | 175 °C           |
| Diode variation | Common cathode   |
| $E_{AS}$        | 13 mJ            |

## DESCRIPTION

The VS-20CTQ...HN3 Series center tap Schottky rectifier series has been optimized for low reverse leakage at high temperature. The proprietary barrier technology allows for reliable operation up to 175 °C junction temperature. Typical applications are in switching power supplies, converters, freewheeling diodes, and reverse battery protection.

## MAJOR RATINGS AND CHARACTERISTICS

| SYMBOL      | CHARACTERISTICS                               | VALUES      | UNITS |
|-------------|-----------------------------------------------|-------------|-------|
| $I_{F(AV)}$ | Rectangular waveform                          | 20          | A     |
| $V_{RRM}$   | Range                                         | 35 to 45    | V     |
| $I_{FSM}$   | $t_p = 5 \mu s$ sine                          | 1060        | A     |
| $V_F$       | 10 A <sub>pk</sub> , $T_J = 125$ °C (per leg) | 0.57        | V     |
| $T_J$       | Range                                         | - 55 to 175 | °C    |

## VOLTAGE RATINGS

| PARAMETER                            | SYMBOL    | VS-20CTQ035HN3 | VS-20CTQ040HN3 | VS-20CTQ045HN3 | UNITS |
|--------------------------------------|-----------|----------------|----------------|----------------|-------|
| Maximum DC reverse voltage           | $V_R$     | 35             | 40             | 45             | V     |
| Maximum working peak reverse voltage | $V_{RWM}$ |                |                |                |       |

## 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> = 145 °C, rectangular waveform                                                                       |                                                                            | 20     | A     |
| 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                                                                                                          | Following any rated load condition and with rated V <sub>RRM</sub> applied | 1060   |       |
|                                                                           |                    | 10 ms sine or 6 ms rect. pulse                                                                                                         |                                                                            | 265    |       |
| Non-repetitive avalanche energy per leg                                   | E <sub>AS</sub>    | T <sub>J</sub> = 25 °C, I <sub>AS</sub> = 2.0 A, L = 6.5 mH                                                                            |                                                                            | 13     | 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 |                                                                            | 2.0    | A     |

**ELECTRICAL SPECIFICATIONS**

| PARAMETER                                             | SYMBOL         | TEST CONDITIONS                                                                           | VALUES | UNITS      |
|-------------------------------------------------------|----------------|-------------------------------------------------------------------------------------------|--------|------------|
| Maximum forward voltage drop per leg<br>See fig. 1    | $V_{FM}^{(1)}$ | 10 A                                                                                      | 0.64   | V          |
|                                                       |                | 20 A                                                                                      | 0.76   |            |
|                                                       |                | 10 A                                                                                      | 0.57   |            |
|                                                       |                | 20 A                                                                                      | 0.68   |            |
| Maximum reverse leakage current per leg<br>See fig. 2 | $I_{RM}^{(1)}$ | $T_J = 25\text{ }^{\circ}\text{C}$                                                        | 2      | mA         |
|                                                       |                | $T_J = 125\text{ }^{\circ}\text{C}$                                                       | 15     |            |
| Maximum junction capacitance per leg                  | $C_T$          | $V_R = 5\text{ V}_{DC}$ (test signal range 100 kHz to 1 MHz) $25\text{ }^{\circ}\text{C}$ | 900    | pF         |
| Typical series inductance per leg                     | $L_S$          | Measured lead to lead 5 mm from package body                                              | 8.0    | nH         |
| Maximum voltage rate of change                        | $dV/dt$        | Rated $V_R$                                                                               | 10 000 | V/ $\mu$ s |

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

| PARAMETER                                                | SYMBOL                            | TEST CONDITIONS                      | VALUES      | UNITS                  |
|----------------------------------------------------------|-----------------------------------|--------------------------------------|-------------|------------------------|
| Maximum junction and storage temperature range           | T <sub>J</sub> , T <sub>Stg</sub> |                                      | - 55 to 175 | °C                     |
| Maximum thermal resistance, junction to case per leg     | R <sub>thJC</sub>                 | DC operation<br>See fig. 4           | 3.25        | °C/W                   |
| Maximum thermal resistance, junction to case per package |                                   | DC operation                         | 1.63        |                        |
| Typical thermal resistance, case to heatsink             | R <sub>thCS</sub>                 | Mounting surface, smooth and greased | 0.50        |                        |
| Approximate weight                                       |                                   |                                      | 2           | g                      |
|                                                          |                                   |                                      | 0.07        | oz.                    |
| Mounting torque                                          | minimum<br>maximum                |                                      | 6 (5)       | kgf · cm<br>(lbf · in) |
|                                                          |                                   |                                      | 12 (10)     |                        |
| Marking device                                           |                                   | Case style TO-220AB                  | 20CTQ035H   |                        |
|                                                          |                                   |                                      | 20CTQ040H   |                        |
|                                                          |                                   |                                      | 20CTQ045H   |                        |

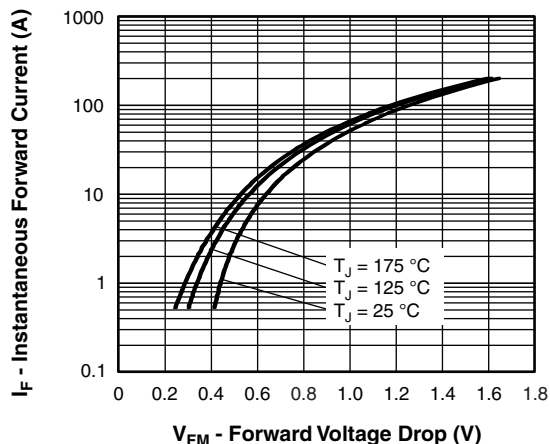


Fig. 1 - Maximum Forward Voltage Drop Characteristics (Per Leg)

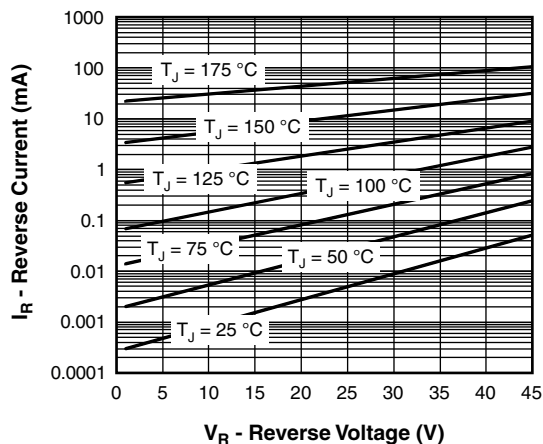


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage (Per Leg)

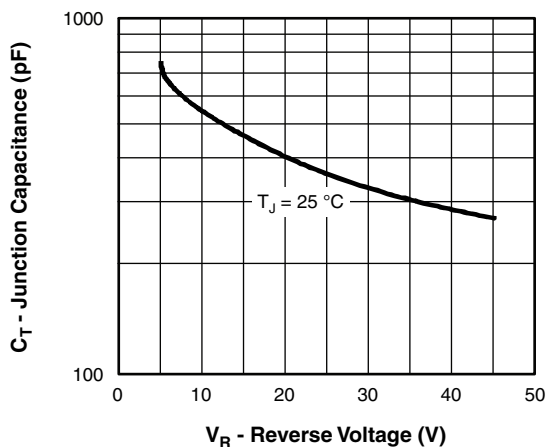


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage (Per Leg)

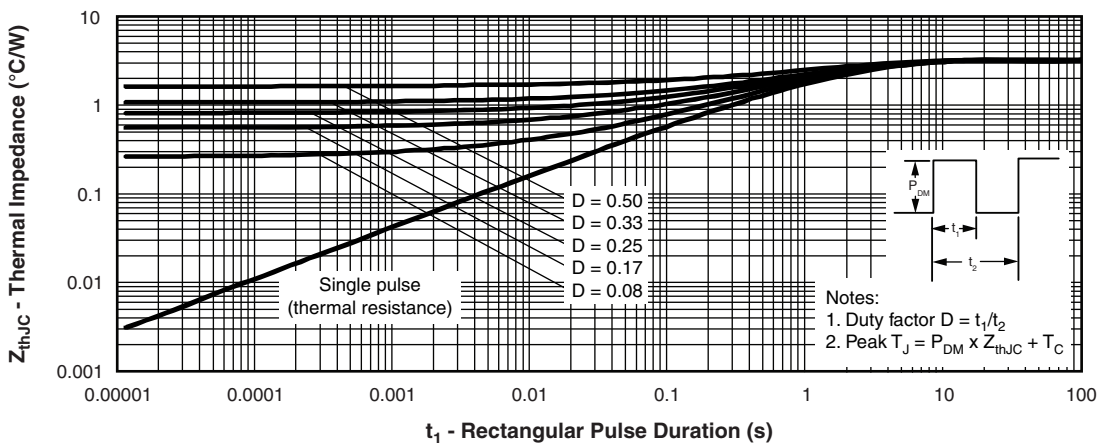


Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (Per Leg)

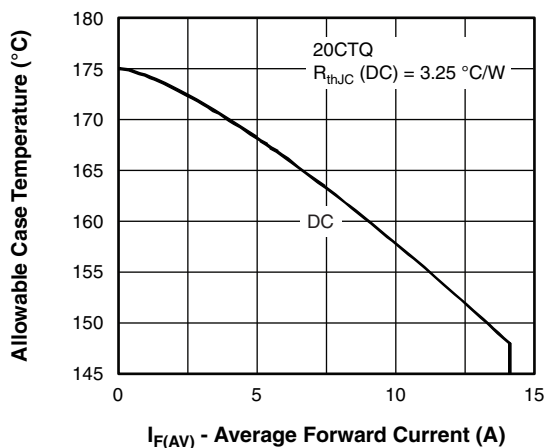


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current (Per Leg)

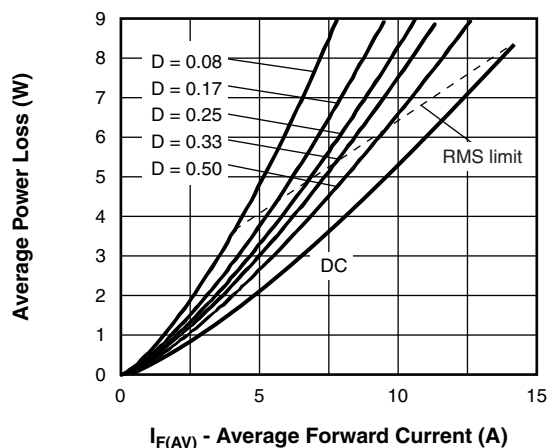


Fig. 6 - Forward Power Loss Characteristics (Per Leg)

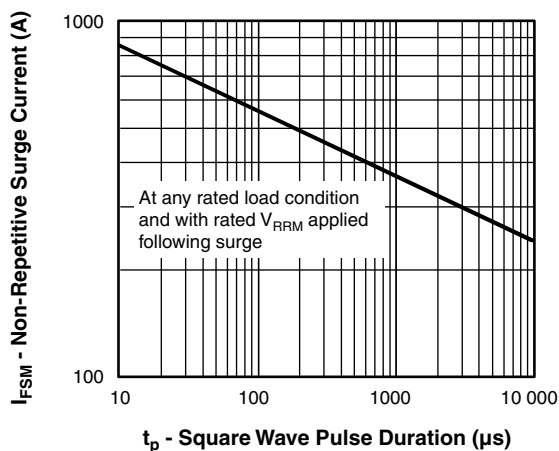


Fig. 7 - Maximum Non-Repetitive Surge Current (Per Leg)

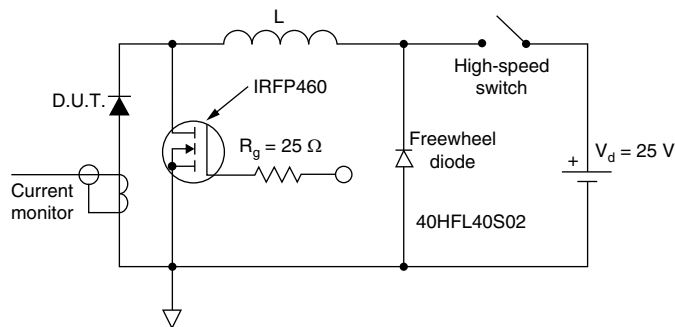


Fig. 8 - Unclamped Inductive Test Circuit



## ORDERING INFORMATION TABLE

|             |     |    |   |   |   |     |   |    |
|-------------|-----|----|---|---|---|-----|---|----|
| Device code | VS- | 20 | C | T | Q | 045 | H | N3 |
|             | 1   | 2  | 3 | 4 | 5 | 6   | 7 | 8  |

- |          |   |                                                               |                   |
|----------|---|---------------------------------------------------------------|-------------------|
| <b>1</b> | - | Vishay Semiconductors product                                 |                   |
| <b>2</b> | - | Current rating (20 = 20 A)                                    |                   |
| <b>3</b> | - | Circuit configuration                                         |                   |
|          |   | C = Common cathode                                            |                   |
| <b>4</b> | - | Package                                                       |                   |
|          |   | T = TO-220                                                    |                   |
| <b>5</b> | - | Schottky "Q" series                                           | <b>035 = 35 V</b> |
| <b>6</b> | - | Voltage rating                                                | <b>040 = 40 V</b> |
| <b>7</b> | - | H = AEC-Q101 qualified                                        | <b>045 = 45 V</b> |
| <b>8</b> | - | Environmental digit:                                          |                   |
|          |   | N3 = Halogen-free, RoHS-compliant, and totally lead (Pb)-free |                   |

### ORDERING INFORMATION (Example)

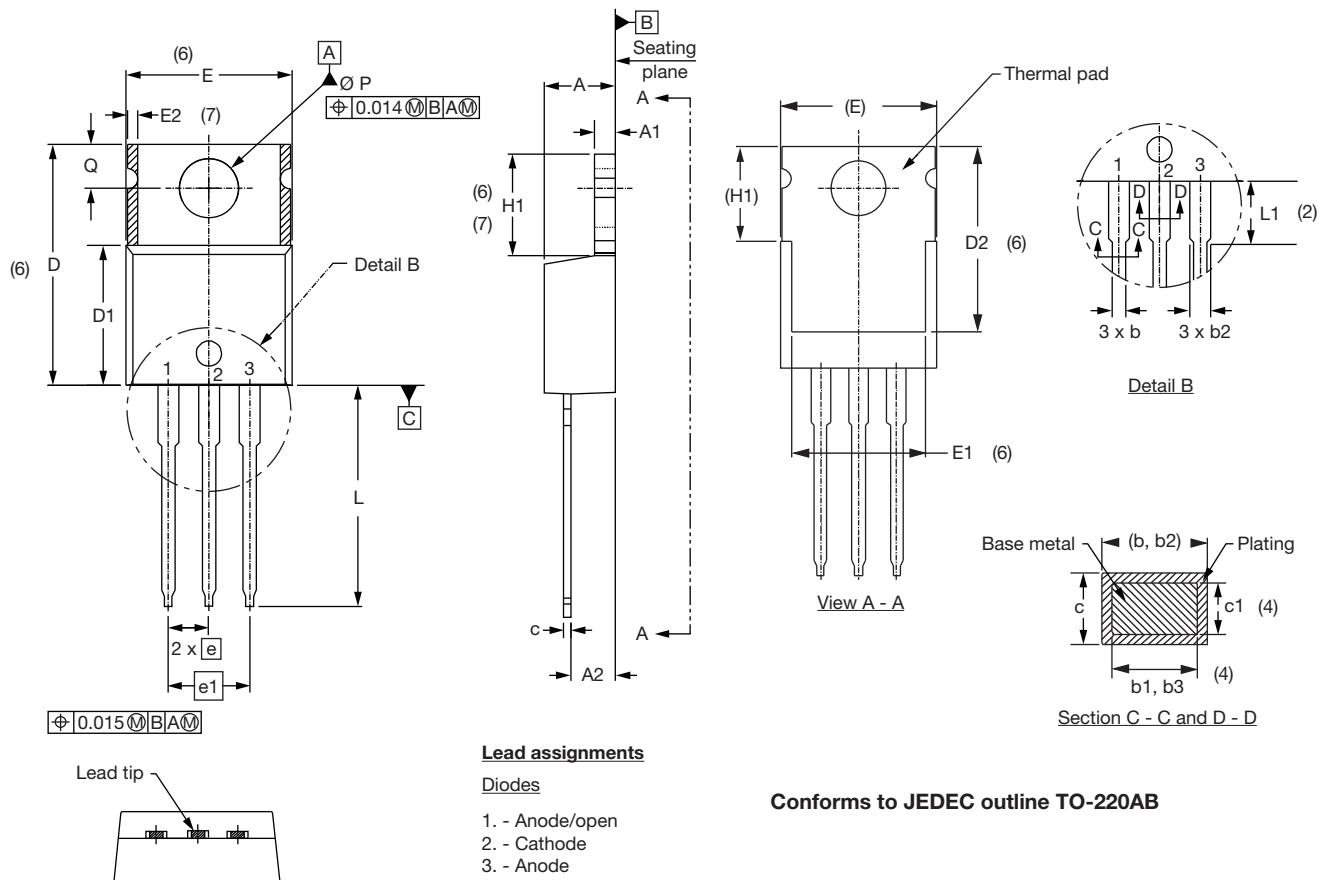
| PREFERRED P/N  | QUANTITY PER T/R | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION   |
|----------------|------------------|------------------------|-------------------------|
| VS-20CTQ035HN3 | 50               | 1000                   | Antistatic plastic tube |
| VS-20CTQ040HN3 | 50               | 1000                   | Antistatic plastic tube |
| VS-20CTQ045HN3 | 50               | 1000                   | Antistatic plastic tube |

### LINKS TO RELATED DOCUMENTS

|                          |                                                                                 |
|--------------------------|---------------------------------------------------------------------------------|
| Dimensions               | <a href="http://www.vishay.com/doc?95222">www.vishay.com/doc?95222</a>          |
| Part marking information | TO-220AB <a href="http://www.vishay.com/doc?95028">www.vishay.com/doc?95028</a> |

## TO-220AB

**DIMENSIONS** in millimeters and inches



| SYMBOL | MILLIMETERS |       | INCHES |       | NOTES |
|--------|-------------|-------|--------|-------|-------|
|        | MIN.        | MAX.  | MIN.   | MAX.  |       |
| A      | 4.25        | 4.65  | 0.167  | 0.183 |       |
| A1     | 1.14        | 1.40  | 0.045  | 0.055 |       |
| A2     | 2.56        | 2.92  | 0.101  | 0.115 |       |
| b      | 0.69        | 1.01  | 0.027  | 0.040 |       |
| b1     | 0.38        | 0.97  | 0.015  | 0.038 | 4     |
| b2     | 1.20        | 1.73  | 0.047  | 0.068 |       |
| b3     | 1.14        | 1.73  | 0.045  | 0.068 | 4     |
| c      | 0.36        | 0.61  | 0.014  | 0.024 |       |
| c1     | 0.36        | 0.56  | 0.014  | 0.022 | 4     |
| D      | 14.85       | 15.25 | 0.585  | 0.600 | 3     |
| D1     | 8.38        | 9.02  | 0.330  | 0.355 |       |
| D2     | 11.68       | 12.88 | 0.460  | 0.507 | 6     |

| SYMBOL | MILLIMETERS |       | INCHES     |       | NOTES |
|--------|-------------|-------|------------|-------|-------|
|        | MIN.        | MAX.  | MIN.       | MAX.  |       |
| E      | 10.11       | 10.51 | 0.398      | 0.414 | 3, 6  |
| E1     | 6.86        | 8.89  | 0.270      | 0.350 | 6     |
| E2     | -           | 0.76  | -          | 0.030 | 7     |
| e      | 2.41        | 2.67  | 0.095      | 0.105 |       |
| e1     | 4.88        | 5.28  | 0.192      | 0.208 |       |
| H1     | 6.09        | 6.48  | 0.240      | 0.255 | 6, 7  |
| L      | 13.52       | 14.02 | 0.532      | 0.552 |       |
| L1     | 3.32        | 3.82  | 0.131      | 0.150 | 2     |
| Ø P    | 3.54        | 3.73  | 0.139      | 0.147 |       |
| Q      | 2.60        | 3.00  | 0.102      | 0.118 |       |
| θ      | 90° to 93°  |       | 90° to 93° |       |       |

### Notes

- (1) Dimensioning and tolerancing as per ASME Y14.5M-1994
- (2) Lead dimension and finish uncontrolled in L1
- (3) Dimension D, D1 and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outermost extremes of the plastic body
- (4) Dimension b1, b3 and c1 apply to base metal only
- (5) Controlling dimensions: inches
- (6) Thermal pad contour optional within dimensions E, H1, D2 and E1
- (7) Dimensions E2 x H1 define a zone where stamping and singulation irregularities are allowed
- (8) Outline conforms to JEDEC TO-220, except A2 (maximum) and D2 (minimum) where dimensions are derived from the actual package outline



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#### Как с нами связаться

**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.