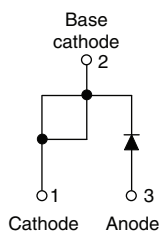


## Schottky Rectifier, 20 A


**TO-220AC**


### FEATURES

- 150 °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
- Compliant to RoHS Directive 2002/95/EC
- Designed and qualified according to JEDEC-JESD47
- Halogen-free according to IEC 61249-2-21 definition (-N3 only)



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

### PRODUCT SUMMARY

|                 |                  |
|-----------------|------------------|
| Package         | TO-220AC         |
| $I_{F(AV)}$     | 20 A             |
| $V_R$           | 35 V, 40 V, 45 V |
| $V_F$ at $I_F$  | 0.51 V           |
| $I_{RM}$ max.   | 105 mA at 125 °C |
| $T_J$           | 150 °C           |
| Diode variation | Single die       |
| $E_{AS}$        | 27 mJ            |

### DESCRIPTION

The VS-20TQ... Schottky rectifier series 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, 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                | 1800        | A     |
| $V_F$       | 20 A <sub>pk</sub> , $T_J = 125$ °C | 0.51        | V     |
| $T_J$       | Range                               | - 55 to 150 | °C    |

### VOLTAGE RATINGS

| PARAMETER                            | SYMBOL    | VS-20TQ035PbF | VS-20TQ035-N3 | VS-20TQ040PbF | VS-20TQ040-N3 | VS-20TQ045PbF | VS-20TQ045-N3 | UNITS |
|--------------------------------------|-----------|---------------|---------------|---------------|---------------|---------------|---------------|-------|
| Maximum DC reverse voltage           | $V_R$     | 35            | 35            | 40            | 40            | 45            | 45            | V     |
| Maximum working peak reverse voltage | $V_{RRM}$ |               |               |               |               |               |               |       |

### ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                                         | SYMBOL      | TEST CONDITIONS                                                                                                     | VALUES | UNITS |
|-------------------------------------------------------------------|-------------|---------------------------------------------------------------------------------------------------------------------|--------|-------|
| Maximum average forward current<br>See fig. 5                     | $I_{F(AV)}$ | 50 % duty cycle at $T_C = 116$ °C, rectangular waveform                                                             | 20     | A     |
| Maximum peak one cycle non-repetitive surge current<br>See fig. 7 | $I_{FSM}$   | 5 $\mu s$ sine or 3 $\mu s$ rect. pulse                                                                             | 1800   |       |
|                                                                   |             | 10 ms sine or 6 ms rect. pulse                                                                                      | 400    |       |
| Non-repetitive avalanche energy                                   | $E_{AS}$    | $T_J = 25$ °C, $I_{AS} = 4$ A, $L = 3.4$ mH                                                                         | 27     | mJ    |
| Repetitive avalanche current                                      | $I_{AR}$    | Current decaying linearly to zero in 1 $\mu s$<br>Frequency limited by $T_J$ maximum $V_A = 1.5 \times V_R$ typical | 4      | A     |

**ELECTRICAL SPECIFICATIONS**

| PARAMETER                                    | SYMBOL         | TEST CONDITIONS                                                                             |                                     | VALUES | UNITS      |
|----------------------------------------------|----------------|---------------------------------------------------------------------------------------------|-------------------------------------|--------|------------|
| Maximum forward voltage drop<br>See fig. 1   | $V_{FM}^{(1)}$ | 20 A                                                                                        | $T_J = 25\text{ }^{\circ}\text{C}$  | 0.57   | V          |
|                                              |                | 40 A                                                                                        |                                     | 0.73   |            |
|                                              |                | 20 A                                                                                        | $T_J = 125\text{ }^{\circ}\text{C}$ | 0.51   |            |
|                                              |                | 40 A                                                                                        |                                     | 0.67   |            |
| Maximum reverse leakage curent<br>See fig. 2 | $I_{RM}^{(1)}$ | $T_J = 25\text{ }^{\circ}\text{C}$                                                          | $V_R = \text{Rated } V_R$           | 2.7    | mA         |
|                                              |                | $T_J = 125\text{ }^{\circ}\text{C}$                                                         |                                     | 105    |            |
| Maximum junction capacitance                 | $C_T$          | $V_R = 5\text{ V}_{DC}$ , (test signal range 100 kHz to 1 MHz) $25\text{ }^{\circ}\text{C}$ |                                     | 1400   | pF         |
| Typical series inductance                    | $L_S$          | 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  $\mu\text{s}$ , 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 150 | °C                     |
| Maximum thermal resistance, junction to case   | R <sub>thJC</sub>                 | DC operation<br>See fig. 4           | 1.50        | °C/W                   |
| 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                           |                                      | 6 (5)       | kgf · cm<br>(lbf · in) |
|                                                | maximum                           |                                      | 12 (10)     |                        |
| Marking device                                 |                                   | Case style TO-220AC                  | 20TQ035     |                        |
|                                                |                                   |                                      | 20TQ040     |                        |
|                                                |                                   |                                      | 20TQ045     |                        |

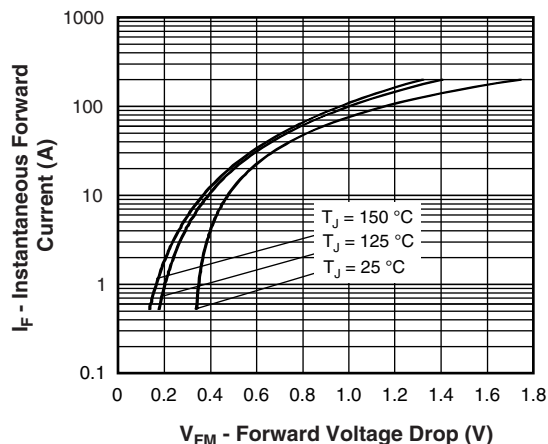


Fig. 1 - Maximum Forward Voltage Drop Characteristics

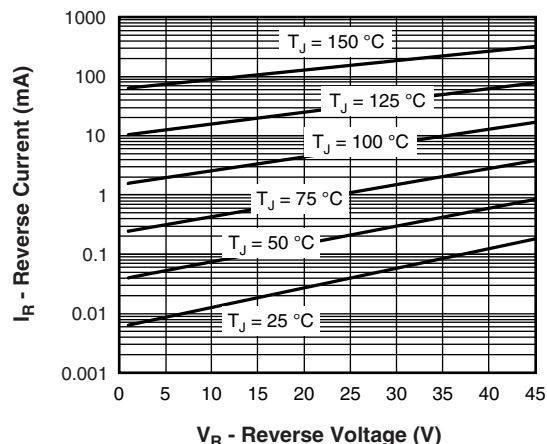


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

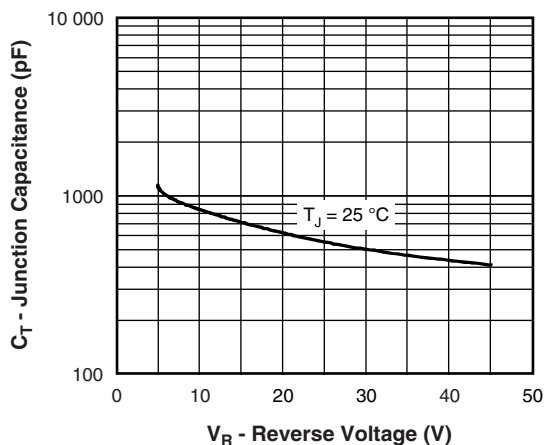
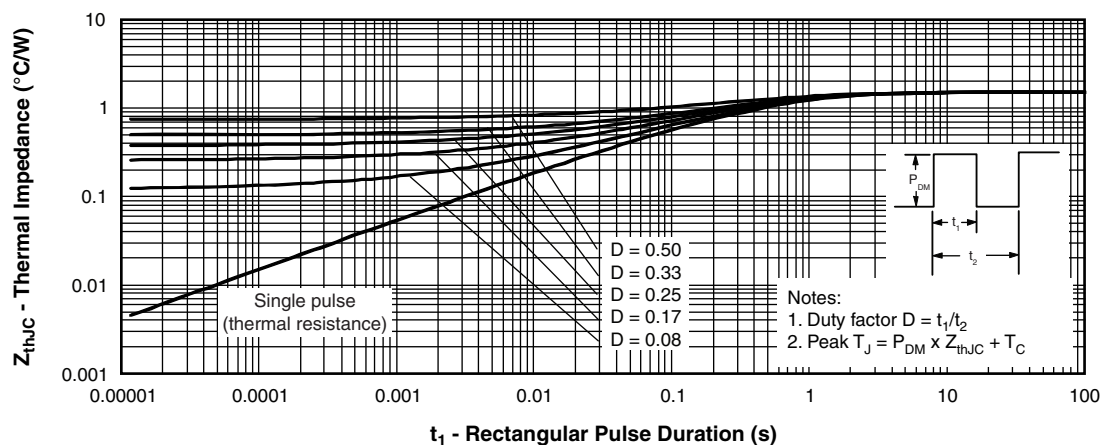


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage


Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics

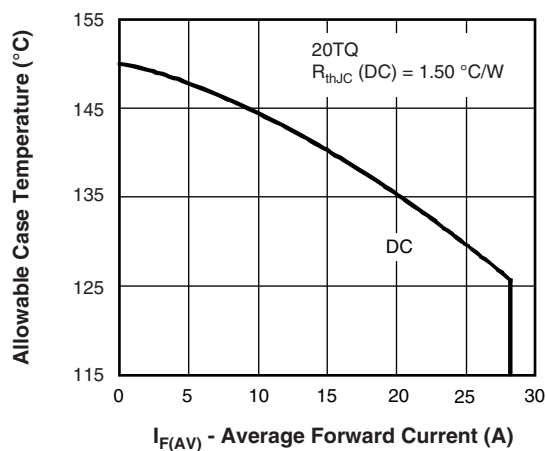


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

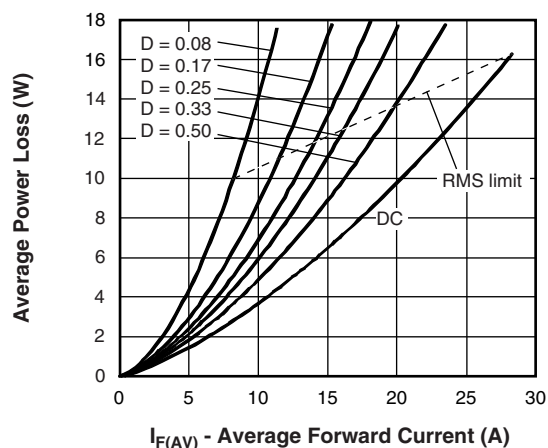


Fig. 6 - Forward Power Loss Characteristics

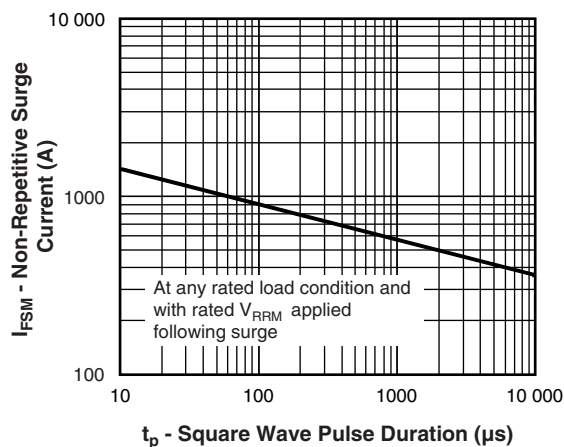


Fig. 7 - Maximum Non-Repetitive Surge Current



Fig. 8 - Unclamped Inductive Test Circuit

**ORDERING INFORMATION TABLE**

|             |            |           |          |          |            |            |
|-------------|------------|-----------|----------|----------|------------|------------|
| Device code | <b>VS-</b> | <b>20</b> | <b>T</b> | <b>Q</b> | <b>045</b> | <b>PbF</b> |
|             | 1          | 2         | 3        | 4        | 5          | 6          |

- |          |   |                               |            |
|----------|---|-------------------------------|------------|
| <b>1</b> | - | Vishay Semiconductors product |            |
| <b>2</b> | - | Current rating (20 = 20 A)    |            |
| <b>3</b> | - | Package:<br>T = TO-220        |            |
| <b>4</b> | - | Schottky "Q" series           | 035 = 35 V |
| <b>5</b> | - | Voltage ratings               | 040 = 40 V |
| <b>6</b> | - | Environmental digit           | 045 = 45 V |
- PbF = Lead (Pb)-free and RoHS compliant
  - -N3 = Halogen-free, RoHS compliant, and totally lead (Pb)-free

| <b>ORDERING INFORMATION</b> (Example) |                  |                        |                         |
|---------------------------------------|------------------|------------------------|-------------------------|
| PREFERRED P/N                         | QUANTITY PER T/R | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION   |
| VS-20TQ035PbF                         | 50               | 1000                   | Antistatic plastic tube |
| VS-20TQ035-N3                         | 50               | 1000                   | Antistatic plastic tube |
| VS-20TQ040PbF                         | 50               | 1000                   | Antistatic plastic tube |
| VS-20TQ040-N3                         | 50               | 1000                   | Antistatic plastic tube |
| VS-20TQ045PbF                         | 50               | 1000                   | Antistatic plastic tube |
| VS-20TQ045-N3                         | 50               | 1000                   | Antistatic plastic tube |

| <b>LINKS TO RELATED DOCUMENTS</b> |              |                                                                        |
|-----------------------------------|--------------|------------------------------------------------------------------------|
| Dimensions                        |              | <a href="http://www.vishay.com/doc?95221">www.vishay.com/doc?95221</a> |
| Part marking information          | TO-220AC PbF | <a href="http://www.vishay.com/doc?95224">www.vishay.com/doc?95224</a> |
|                                   | TO-220AC -N3 | <a href="http://www.vishay.com/doc?95068">www.vishay.com/doc?95068</a> |

### TO-220AC

**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     |
| E      | 10.11       | 10.51 | 0.398  | 0.414 | 3, 6  |

| SYMBOL | MILLIMETERS |       | INCHES     |       | NOTES |
|--------|-------------|-------|------------|-------|-------|
|        | MIN.        | MAX.  | MIN.       | MAX.  |       |
| 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     |
| L3     | 1.78        | 2.13  | 0.070      | 0.084 |       |
| L4     | 0.76        | 1.27  | 0.030      | 0.050 | 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 dimension: inches
- (6) Thermal pad contour optional within dimensions E, H1, D2 and E1
- (7) Dimension E2 x H1 define a zone where stamping and singulation irregularities are allowed
- (8) Outline conforms to JEDEC TO-220, D2 (minimum) where dimensions are derived from the actual package outline



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