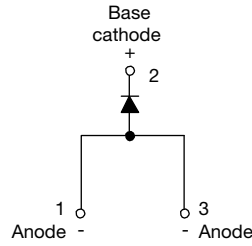




## Surface Mount Fast Soft Recovery Rectifier Diode, 20 A



### FEATURES

- Glass passivated pellet chip junction
- Meets MSL level 1, per J-STD-020, LF maximum peak of 245 °C
- Designed and qualified according to JEDEC®-JESD 47
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### APPLICATIONS

- Output rectification and freewheeling in inverters, choppers and converters
- Input rectifications where severe restrictions on conducted EMI should be met

### DESCRIPTION

The VS-20ETF..S-M3 soft recovery rectifier series has been optimized for combined short reverse recovery time and low forward voltage drop.

The glass passivation ensures stable reliable operation in the most severe temperature and power cycling conditions.

| PRIMARY CHARACTERISTICS |                               |
|-------------------------|-------------------------------|
| $I_{F(AV)}$             | 20 A                          |
| $V_R$                   | 200 V, 400 V, 600 V           |
| $V_F$ at $I_F$          | 1.3 V                         |
| $I_{FSM}$               | 300 A                         |
| $t_{rr}$                | 60 ns                         |
| $T_J$ max.              | 150 °C                        |
| Snap factor             | 0.6                           |
| Package                 | D <sup>2</sup> PAK (TO-263AB) |
| Circuit configuration   | Single                        |

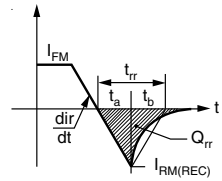
| MAJOR RATINGS AND CHARACTERISTICS |                            |             |       |
|-----------------------------------|----------------------------|-------------|-------|
| SYMBOL                            | CHARACTERISTICS            | VALUES      | UNITS |
| $I_{F(AV)}$                       | Sinusoidal waveform        | 20          | A     |
| $V_{RRM}$                         |                            | 200 to 600  | V     |
| $I_{FSM}$                         |                            | 300         | A     |
| $V_F$                             | 10 A, $T_J = 25\text{ °C}$ | 1.2         | V     |
| $t_{rr}$                          | 1 A, 100 A/ $\mu$ s        | 60          | ns    |
| $T_J$                             | Range                      | -40 to +150 | °C    |

| VOLTAGE RATINGS |   |  |                              |
|-----------------|---|--|------------------------------|
| PART NUMBER     | $V_{RRM}$ , MAXIMUM PEAK REVERSE VOLTAGE<br>V | $V_{RSM}$ , MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE<br>V | $I_{RRM}$<br>AT 150 °C<br>mA |
| VS-20ETF02S-M3  | 200   | 300  | 5                            |
| VS-20ETF04S-M3  | 400   | 500  |                              |
| VS-20ETF06S-M3  | 600   | 700  |                              |

| ABSOLUTE MAXIMUM RATINGS                            |               |  |        |                           |
|---|---------------|--|--------|---------------------------|
| PARAMETER   | SYMBOL        | TEST CONDITIONS  | VALUES | UNITS                     |
| Maximum average forward current                     | $I_{F(AV)}$   | $T_C = 97\text{ °C}$ , 180° conduction half sine wave      | 20     | A                         |
| Maximum peak one cycle non-repetitive surge current | $I_{FSM}$     | 10 ms sine pulse, rated $V_{RRM}$ applied                  | 250    |                           |
|   |               | 10 ms sine pulse, no voltage reapplied                     | 300    |                           |
| Maximum $I^2t$ for fusing                           | $I^2t$        | 10 ms sine pulse, rated $V_{RRM}$ applied                  | 316    | A <sup>2</sup> s          |
|   |               | 10 ms sine pulse, no voltage reapplied                     | 442    |                           |
| Maximum $I^2\sqrt{t}$ for fusing                    | $I^2\sqrt{t}$ | $t = 0.1\text{ ms to }10\text{ ms}$ , no voltage reapplied | 4420   | A <sup>2</sup> $\sqrt{s}$ |

| ELECTRICAL SPECIFICATIONS       |             |  |                                   |        |            |
|---------------------------------|-------------|--|-----------------------------------|--------|------------|
| PARAMETER                       | SYMBOL      | TEST CONDITIONS                        |                                   | VALUES | UNITS      |
| Maximum forward voltage drop    | $V_{FM}$    | 20 A, $T_J = 25\text{ }^\circ\text{C}$ |                                   | 1.30   | V          |
|                                 |             | 60 A, $T_J = 25\text{ }^\circ\text{C}$ |                                   | 1.67   |            |
| Forward slope resistance        | $r_t$       |  |                                   | 12.5   | m $\Omega$ |
| Threshold voltage               | $V_{F(TO)}$ | $T_J = 150\text{ }^\circ\text{C}$      |                                   | 0.9    | V          |
| Maximum reverse leakage current | $I_{RM}$    | $V_R = \text{rated } V_{RRM}$          | $T_J = 25\text{ }^\circ\text{C}$  | 0.1    | mA         |
|                                 |             |  | $T_J = 150\text{ }^\circ\text{C}$ | 5.0    |            |

| RECOVERY CHARACTERISTICS |          |  |        |               |
|--------------------------|----------|--|--------|---------------|
| PARAMETER                | SYMBOL   | TEST CONDITIONS  | VALUES | UNITS         |
| Reverse recovery time    | $t_{rr}$ | $I_F$ at 20 A <sub>pk</sub><br>100 A/ $\mu$ s<br>25 $^\circ\text{C}$ | 160    | ns            |
| Reverse recovery current | $I_{rr}$ |  | 10     | A             |
| Reverse recovery charge  | $Q_{rr}$ |  | 1.25   | $\mu\text{C}$ |
| Snap factor              | S        | Typical  | 0.6    |               |



| THERMAL - MECHANICAL SPECIFICATIONS                         |                  |  |             |                    |
|---|------------------|--|-------------|--------------------|
| PARAMETER   | SYMBOL           | TEST CONDITIONS                          | VALUES      | UNITS              |
| Maximum junction and storage temperature range              | $T_J, T_{Stg}$   |  | -40 to +150 | $^\circ\text{C}$   |
| Maximum thermal resistance, junction to case                | $R_{thJC}$       | DC operation                             | 0.9         | $^\circ\text{C/W}$ |
| Maximum thermal resistance, junction to ambient (PCB mount) | $R_{thJA}^{(1)}$ |  | 40          |                    |
| Approximate weight  |                  |  | 2           | g                  |
|   |                  |  | 0.07        | oz.                |
| Marking device  |                  | Case style D <sup>2</sup> PAK (TO-263AB) | 20ETF02S    |                    |
|   |                  |  | 20ETF04S    |                    |
|   |                  |  | 20ETF06S    |                    |

**Note**

(1) When mounted on 1" square (650 mm<sup>2</sup>) PCB of FR-4 or G-10 material 4 oz. (140  $\mu$ m) copper 40  $^\circ\text{C/W}$ . For recommended footprint and soldering techniques refer to application note #AN-994

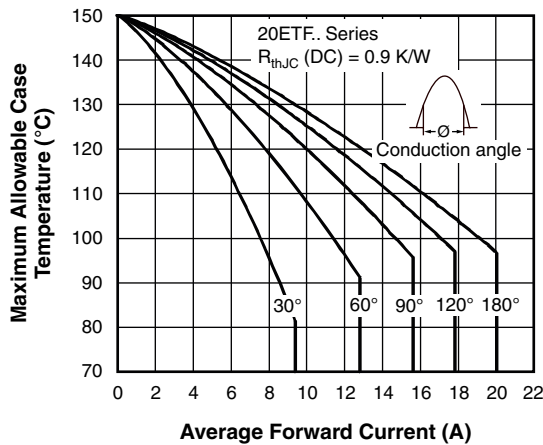


Fig. 1 - Current Rating Characteristics

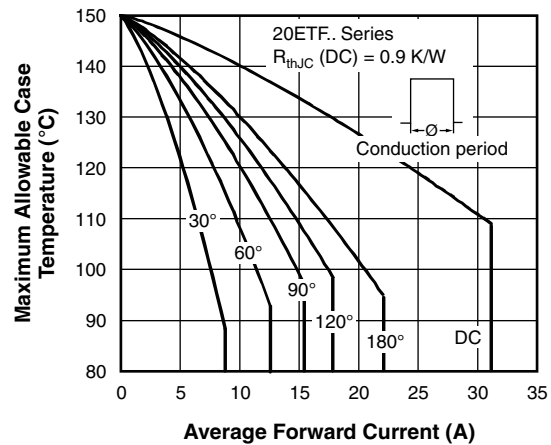


Fig. 2 - Current Rating Characteristics

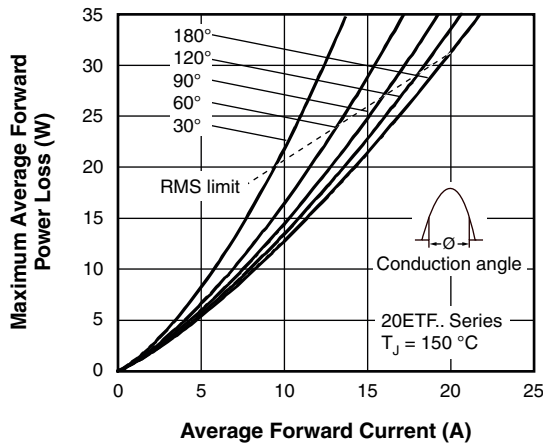


Fig. 3 - Forward Power Loss Characteristics

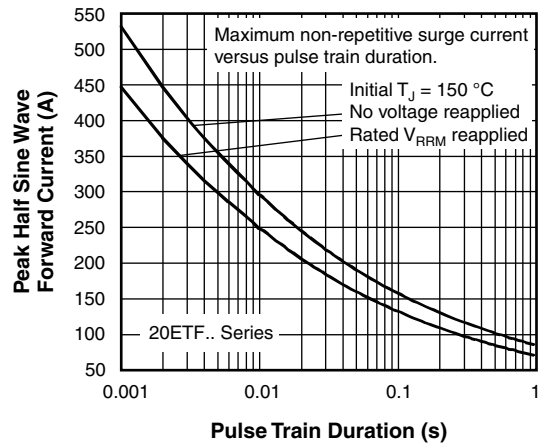


Fig. 6 - Maximum Non-Repetitive Surge Current

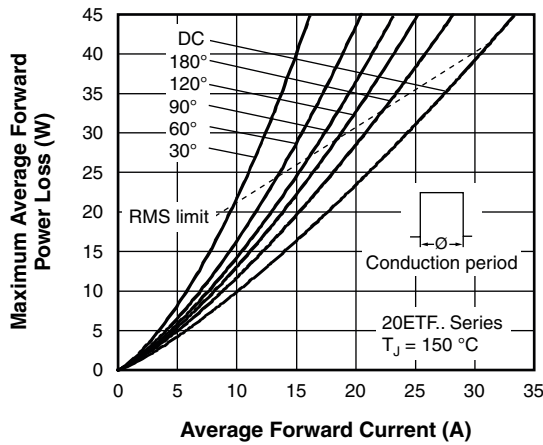


Fig. 4 - Forward Power Loss Characteristics

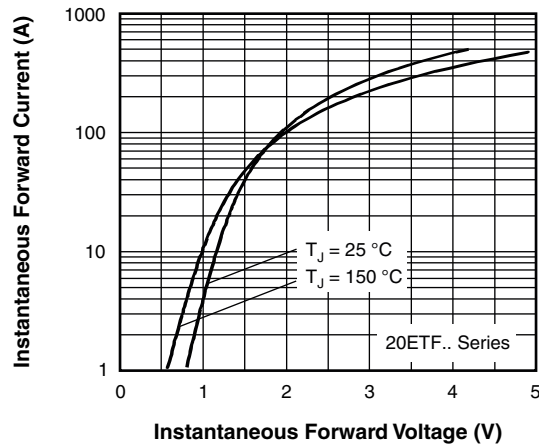


Fig. 7 - Forward Voltage Drop Characteristics

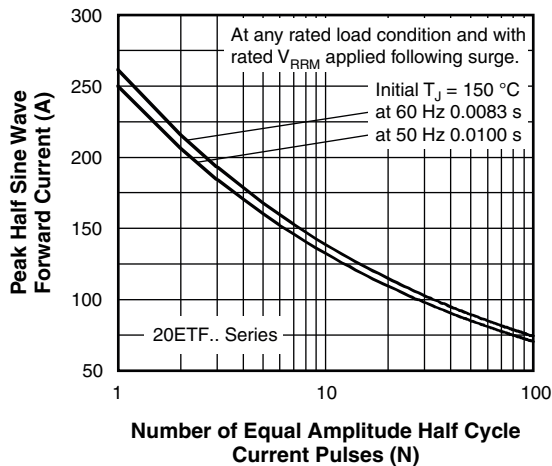


Fig. 5 - Maximum Non-Repetitive Surge Current

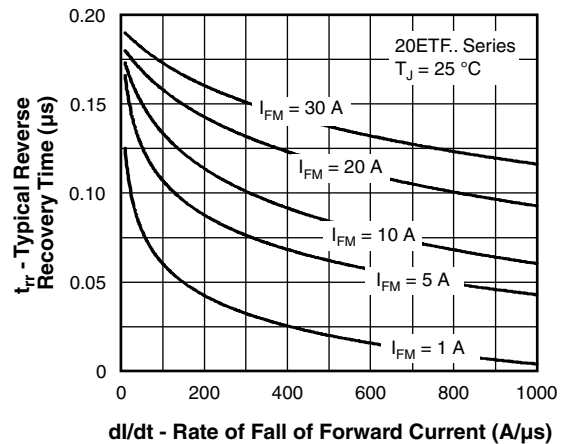


Fig. 8 - Recovery Time Characteristics,  $T_J = 25\text{ }^\circ\text{C}$

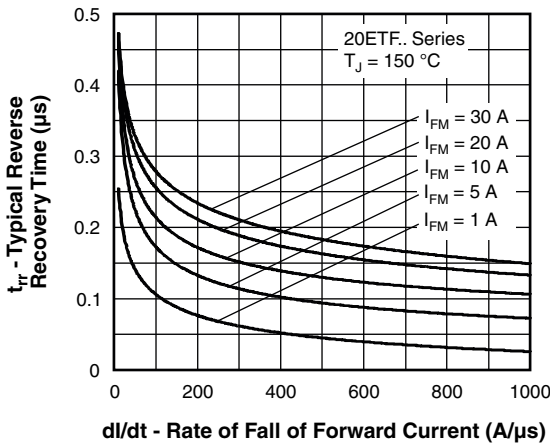


Fig. 9 - Recovery Time Characteristics,  $T_J = 150\text{ }^\circ\text{C}$

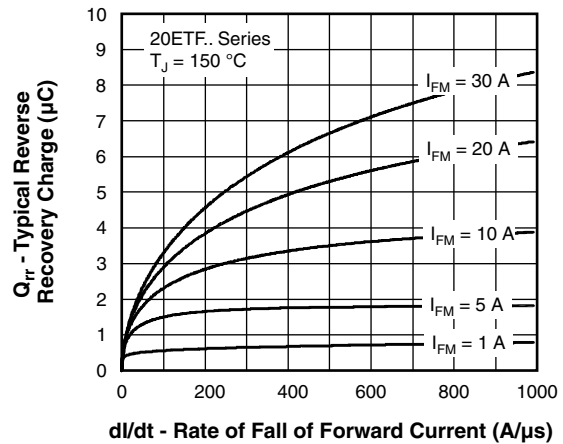


Fig. 11 - Recovery Charge Characteristics,  $T_J = 150\text{ }^\circ\text{C}$

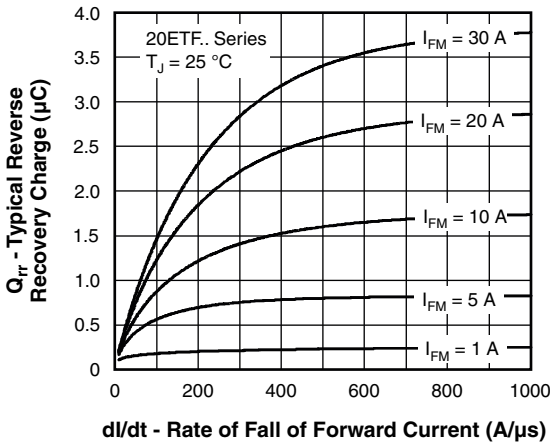


Fig. 10 - Recovery Charge Characteristics,  $T_J = 25\text{ }^\circ\text{C}$

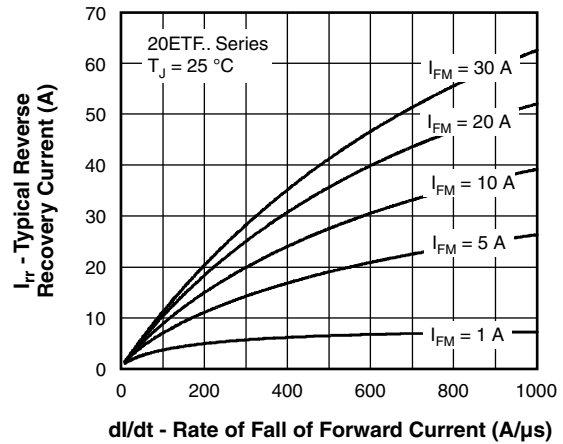


Fig. 12 - Recovery Current Characteristics,  $T_J = 25\text{ }^\circ\text{C}$

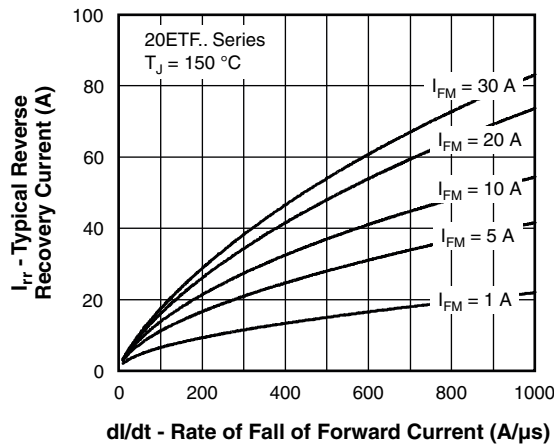


Fig. 13 - Recovery Current Characteristics,  $T_J = 150\text{ }^\circ\text{C}$

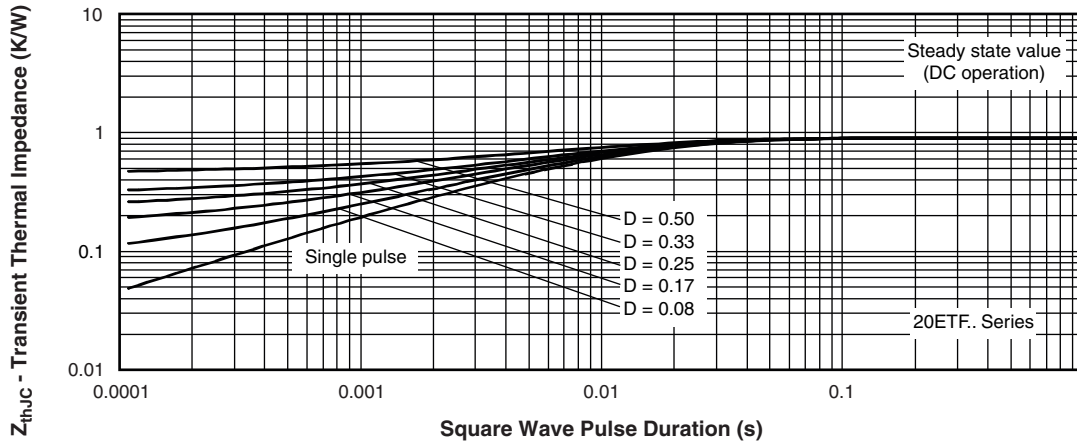


Fig. 14 - Thermal Impedance  $Z_{thJC}$  Characteristics

**ORDERING INFORMATION TABLE**

|             |            |           |          |          |          |           |          |            |            |
|-------------|------------|-----------|----------|----------|----------|-----------|----------|------------|------------|
| Device code | <b>VS-</b> | <b>20</b> | <b>E</b> | <b>T</b> | <b>F</b> | <b>06</b> | <b>S</b> | <b>TRL</b> | <b>-M3</b> |
|             | ①          | ②         | ③        | ④        | ⑤        | ⑥         | ⑦        | ⑧          | ⑨          |

- 1** - Vishay Semiconductors product
- 2** - Current rating (20 = 20 A)
- 3** - Circuit configuration:  
E = single
- 4** - Package:  
T = D<sup>2</sup>PAK (TO-263AB)
- 5** - Type of silicon:  
F = fast soft recovery rectifier
- 6** - Voltage code x 100 =  $V_{RRM}$ 

|            |
|------------|
| 02 = 200 V |
| 04 = 400 V |
| 06 = 600 V |
- 7** - S = surface mountable
- 8** -
  - None = tube
  - TRR = tape and reel (right oriented)
  - TRL = tape and reel (left oriented)
- 9** - -M3 = halogen-free, RoHS-compliant, and terminations lead (Pb)-free



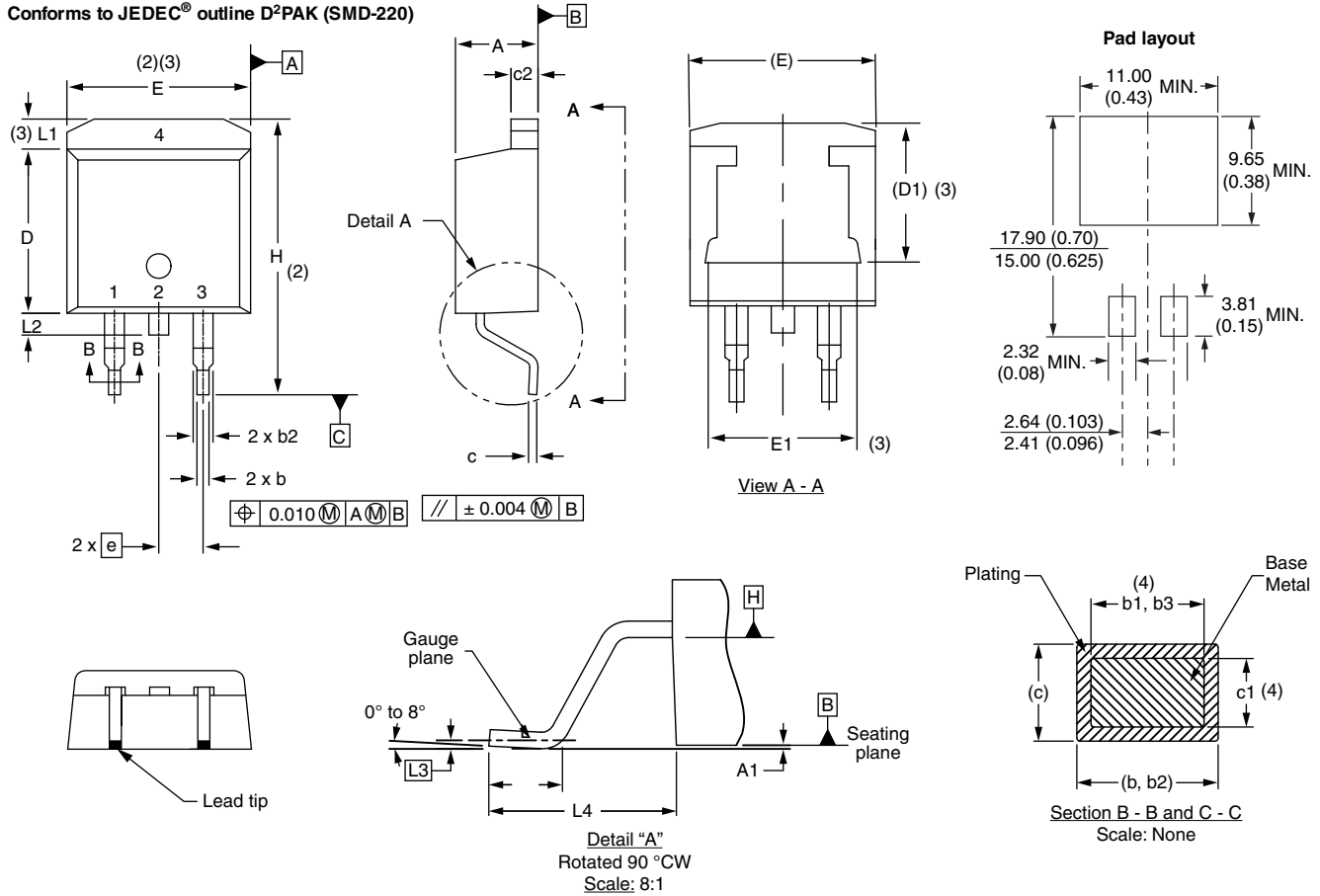
| <b>ORDERING INFORMATION</b> (Example) |                      |                              |
|---------------------------------------|----------------------|------------------------------|
| <b>PREFERRED P/N</b>                  | <b>BASE QUANTITY</b> | <b>PACKAGING DESCRIPTION</b> |
| VS-20ETF02S-M3                        | 50                   | Antistatic plastic tubes     |
| VS-20ETF02STRR-M3                     | 800                  | 13" diameter reel            |
| VS-20ETF02STRL-M3                     | 800                  | 13" diameter reel            |
| VS-20ETF04S-M3                        | 50                   | Antistatic plastic tubes     |
| VS-20ETF04STRR-M3                     | 800                  | 13" diameter reel            |
| VS-20ETF04STRL-M3                     | 800                  | 13" diameter reel            |
| VS-20ETF06S-M3                        | 50                   | Antistatic plastic tubes     |
| VS-20ETF06STRR-M3                     | 800                  | 13" diameter reel            |
| VS-20ETF06STRL-M3                     | 800                  | 13" diameter reel            |

| <b>LINKS TO RELATED DOCUMENTS</b> |  |
|-----------------------------------|--|
| Dimensions                        | <a href="http://www.vishay.com/doc?96164">www.vishay.com/doc?96164</a> |
| Part marking information          | <a href="http://www.vishay.com/doc?95444">www.vishay.com/doc?95444</a> |
| Packaging information             | <a href="http://www.vishay.com/doc?96424">www.vishay.com/doc?96424</a> |

### D<sup>2</sup>PAK

**DIMENSIONS** in millimeters and inches

Conforms to JEDEC<sup>®</sup> outline D<sup>2</sup>PAK (SMD-220)



| SYMBOL | MILLIMETERS |       | INCHES |       | NOTES | SYMBOL | MILLIMETERS |       | INCHES    |       | NOTES |
|--------|-------------|-------|--------|-------|-------|--------|-------------|-------|-----------|-------|-------|
|        | MIN.        | MAX.  | MIN.   | MAX.  |       |        | MIN.        | MAX.  | MIN.      | MAX.  |       |
| A      | 4.06        | 4.83  | 0.160  | 0.190 |       | D1     | 6.86        | 8.00  | 0.270     | 0.315 | 3     |
| A1     | 0.00        | 0.254 | 0.000  | 0.010 |       | E      | 9.65        | 10.67 | 0.380     | 0.420 | 2, 3  |
| b      | 0.51        | 0.99  | 0.020  | 0.039 |       | E1     | 7.90        | 8.80  | 0.311     | 0.346 | 3     |
| b1     | 0.51        | 0.89  | 0.020  | 0.035 | 4     | e      | 2.54 BSC    |       | 0.100 BSC |       |       |
| b2     | 1.14        | 1.78  | 0.045  | 0.070 |       | H      | 14.61       | 15.88 | 0.575     | 0.625 |       |
| b3     | 1.14        | 1.73  | 0.045  | 0.068 | 4     | L      | 1.78        | 2.79  | 0.070     | 0.110 |       |
| c      | 0.38        | 0.74  | 0.015  | 0.029 |       | L1     | -           | 1.65  | -         | 0.066 | 3     |
| c1     | 0.38        | 0.58  | 0.015  | 0.023 | 4     | L2     | 1.27        | 1.78  | 0.050     | 0.070 |       |
| c2     | 1.14        | 1.65  | 0.045  | 0.065 |       | L3     | 0.25 BSC    |       | 0.010 BSC |       |       |
| D      | 8.51        | 9.65  | 0.335  | 0.380 | 2     | L4     | 4.78        | 5.28  | 0.188     | 0.208 |       |

**Notes**

- (1) Dimensioning and tolerancing per ASME Y14.5 M-1994
- (2) Dimension D 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 outmost extremes of the plastic body
- (3) Thermal pad contour optional within dimension E, L1, D1 and E1
- (4) Dimension b1 and c1 apply to base metal only
- (5) Datum A and B to be determined at datum plane H
- (6) Controlling dimension: inches
- (7) Outline conforms to JEDEC<sup>®</sup> outline TO-263AB



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