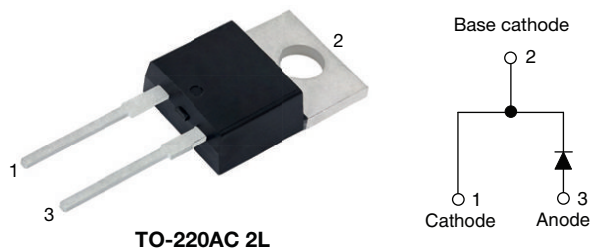


# 650 V Power SiC Gen 3 Merged PIN Schottky Diode, 12 A


**TO-220AC 2L**

## LINKS TO ADDITIONAL RESOURCES



3D Models



Application Notes

| PRIMARY CHARACTERISTICS      |             |
|------------------------------|-------------|
| $I_{F(AV)}$                  | 12 A        |
| $V_R$                        | 650 V       |
| $V_F$ at $I_F$ at 25°C, typ. | 1.3 V       |
| $T_J$ max.                   | 175 °C      |
| $I_R$ at $V_R$ at 175 °C     | 5 $\mu$ A   |
| $Q_C$ ( $V_R = 400$ V)       | 34 nC       |
| Package                      | TO-220AC 2L |
| Circuit configuration        | Single      |

## FEATURES

- Majority carrier diode using Schottky technology on SiC wide band gap material
- Improved  $V_F$  and efficiency by thin wafer technology
- Positive  $V_F$  temperature coefficient for easy paralleling
- Virtually no recovery tail and no switching losses
- Temperature invariant switching behavior
- 175 °C maximum operating junction temperature
- MPS structure for high ruggedness to forward current surge events
- Meets JESD 201 class 1A whisker test
- Solder bath temperature 275 °C maximum, 10 s per JESD 22-B106
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


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

## DESCRIPTION / APPLICATIONS

Wide band gap SiC based 650 V Schottky diode, designed for high performance and ruggedness.

Optimum choice for high speed hard switching and efficient operation over a wide temperature range, it is also recommended for all applications suffering from Silicon ultrafast recovery behavior.

Typical applications include AC/DC PFC and DC/DC ultra high frequency output rectification in FBPS and LLC converters.

## MECHANICAL DATA

**Case:** TO-220AC 2L

Molding compound meets UL 94 V-0 flammability rating  
Base P/N-M3 - halogen-free, RoHS-compliant

**Terminals:** matte tin plated leads, solderable per J-STD-002 and JESD 22-B102

**Mounting torque:** 10 in-lbs maximum

| MAXIMUM RATINGS ( $T_A = 25$ °C unless otherwise specified) |                      |                                                    |             |                  |
|-------------------------------------------------------------|----------------------|----------------------------------------------------|-------------|------------------|
| PARAMETER                                                   | SYMBOL               | TEST CONDITIONS                                    | VALUES      | UNITS            |
| Peak repetitive reverse voltage                             | $V_{RRM}$            |                                                    | 650         | V                |
| Continuous forward current                                  | $I_F^{(1)}$          | $T_C = 135$ °C (DC)                                | 12          | A                |
|                                                             | $I_F^{(2)}$          | $T_C = 145$ °C (DC)                                |             |                  |
| DC blocking voltage                                         | $V_{DC}$             |                                                    | 650         | V                |
| Repetitive peak forward current                             | $I_{FRM}$            | $T_C = 25$ °C, $f = 50$ Hz, square wave, DC = 25 % | 48          | A                |
| Non-repetitive peak forward surge current                   | $I_{FSM}$            | $T_C = 25$ °C, $t_p = 10$ ms, half sine wave       | 83          | A                |
|                                                             |                      | $T_C = 110$ °C, $t_p = 10$ ms, half sine wave      | 74          |                  |
| Power dissipation                                           | $P_{tot}^{(1)}$      | $T_C = 25$ °C                                      | 73          | W                |
|                                                             |                      | $T_C = 110$ °C                                     | 32          |                  |
|                                                             | $P_{tot}^{(2)}$      | $T_C = 25$ °C                                      | 94          | W                |
|                                                             |                      | $T_C = 110$ °C                                     | 40          |                  |
| $I^2t$ value                                                | $\int i^2 dt$        | $T_C = 25$ °C                                      | 34.5        | A <sup>2</sup> s |
|                                                             |                      | $T_C = 110$ °C                                     | 27          |                  |
| Operating junction and storage temperatures                 | $T_J^{(2)}, T_{Stg}$ |                                                    | -55 to +175 | °C               |

## Notes

(1) Based on maximum  $R_{th}$

(2) Based on typical  $R_{th}$

(3) The heat generated must be less than the thermal conductivity from junction-to-ambient:  $dP_D/dT_J < 1/R_{\theta JA}$



| ELECTRICAL SPECIFICATIONS ( $T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified) |        |                                                             |      |      |      |               |
|--------------------------------------------------------------------------------------------|--------|-------------------------------------------------------------|------|------|------|---------------|
| PARAMETER                                                                                  | SYMBOL | TEST CONDITIONS                                             | MIN. | TYP. | MAX. | UNITS         |
| Forward voltage                                                                            | $V_F$  | $I_F = 12\text{ A}$                                         | -    | 1.3  | 1.5  | V             |
|                                                                                            |        | $I_F = 12\text{ A}, T_J = 150\text{ }^{\circ}\text{C}$      | -    | 1.50 | 1.85 |               |
|                                                                                            |        | $I_F = 12\text{ A}, T_J = 175\text{ }^{\circ}\text{C}$      | -    | 1.58 | -    |               |
| Reverse leakage current                                                                    | $I_R$  | $V_R = V_R\text{ rated}$                                    | -    | 0.8  | 65   | $\mu\text{A}$ |
|                                                                                            |        | $V_R = V_R\text{ rated}, T_J = 150\text{ }^{\circ}\text{C}$ | -    | 3    | 150  |               |
|                                                                                            |        | $V_R = V_R\text{ rated}, T_J = 175\text{ }^{\circ}\text{C}$ | -    | 5    | -    |               |
| Total capacitance                                                                          | C      | $V_R = 1\text{ V}, f = 1\text{ MHz}$                        | -    | 535  | -    | pF            |
|                                                                                            |        | $V_R = 400\text{ V}, f = 1\text{ MHz}$                      | -    | 54   | -    |               |
| Total capacitive charge                                                                    | $Q_C$  | $V_R = 400\text{ V}, f = 1\text{ MHz}$                      | -    | 34   | -    | nC            |

| THERMAL - MECHANICAL SPECIFICATIONS ( $T_A = 25\text{ }^{\circ}\text{C}$ unless otherwise specified) |            |                 |      |           |      |                      |
|------------------------------------------------------------------------------------------------------|------------|-----------------|------|-----------|------|----------------------|
| PARAMETER                                                                                            | SYMBOL     | TEST CONDITIONS | MIN. | TYP.      | MAX. | UNITS                |
| Thermal resistance, junction-to-case                                                                 | $R_{thJC}$ |                 | -    | 1.6       | 2.1  | $^{\circ}\text{C/W}$ |
| Marking device                                                                                       |            |                 |      | 3C12ET07T |      |                      |

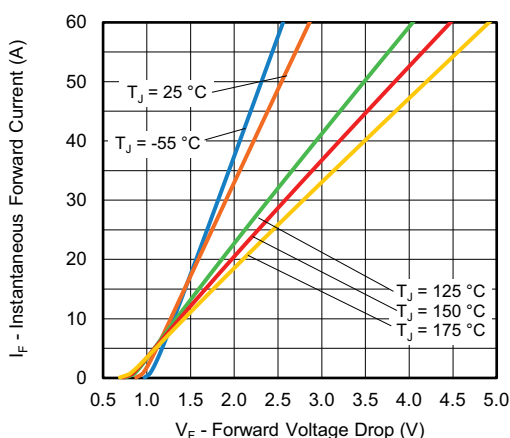


Fig. 1 - Typical Forward Voltage Drop Characteristics

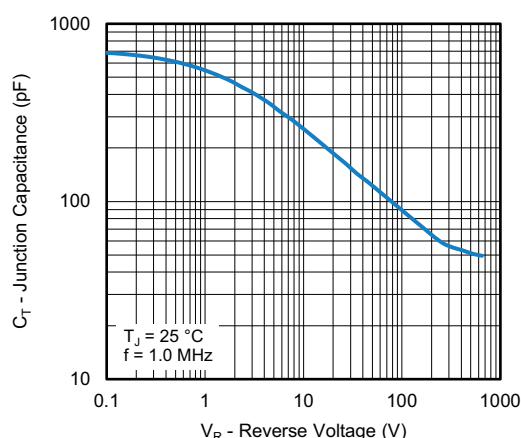


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

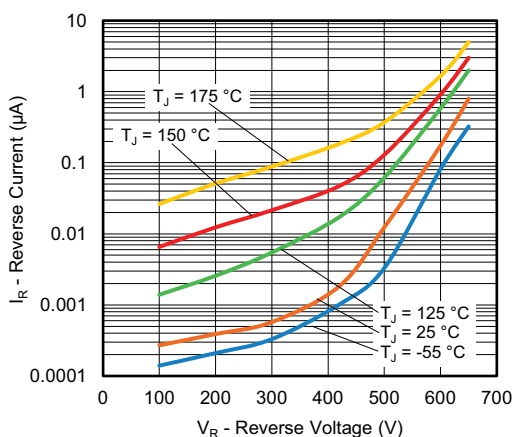


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

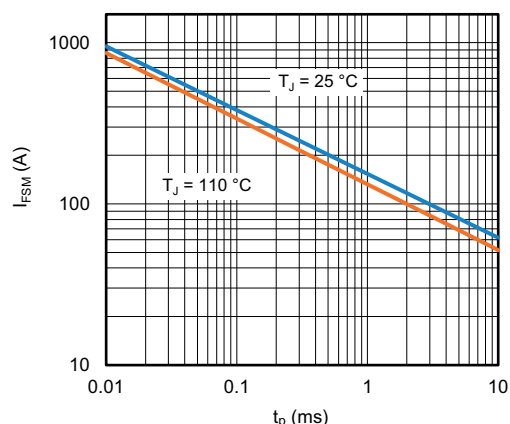


Fig. 4 - Non-Repetitive Peak Forward Surge Current vs. Pulse Duration (Square Wave)

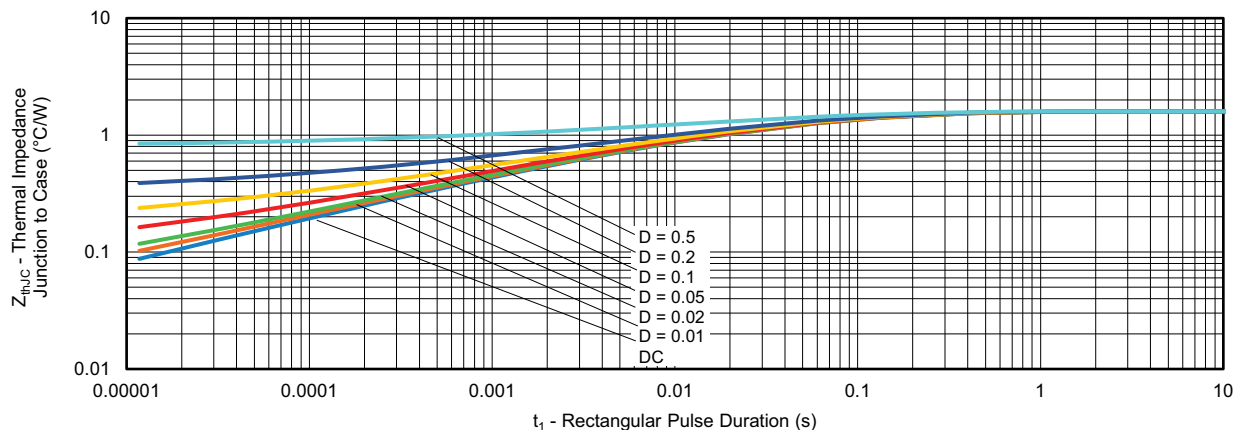
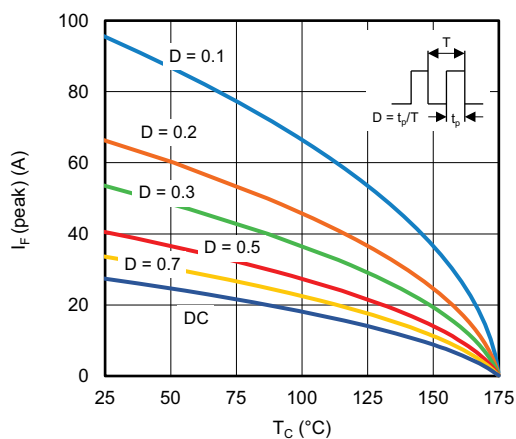

Fig. 5 - Typical Thermal Impedance  $Z_{thJC}$  Characteristics


Fig. 6 - Peak Forward Current vs. Maximum Allowable Case Temperature

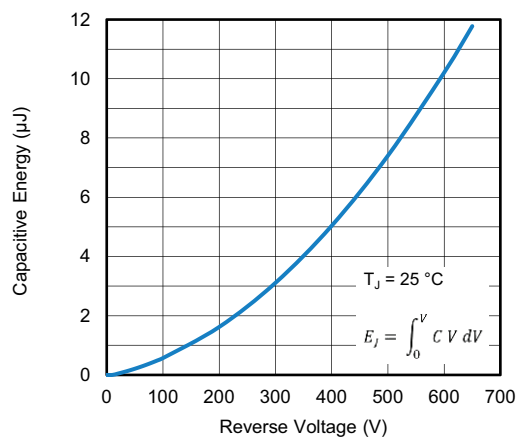


Fig. 8 - Typical Capacitive Energy vs. Reverse Voltage

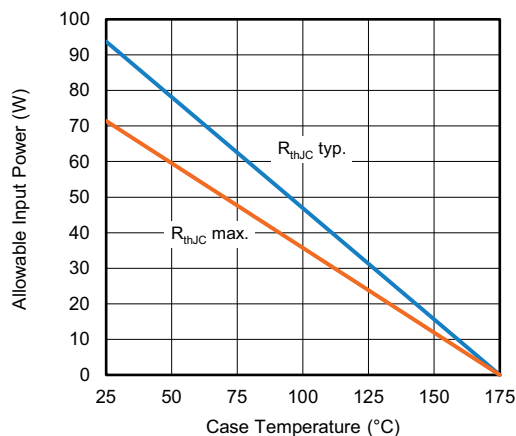


Fig. 7 - Forward Power Loss Characteristics

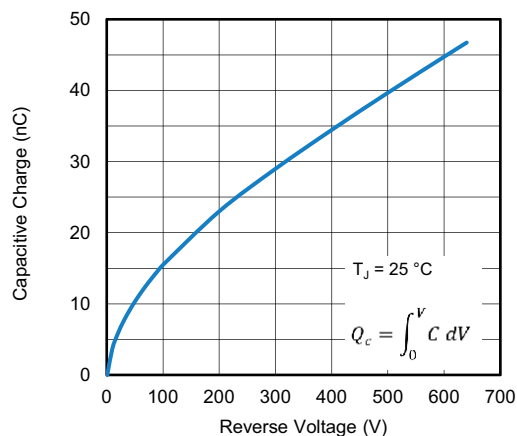


Fig. 9 - Typical Capacitive Charge vs. Reverse Voltage



ORDERING INFORMATION TABLE

|             |                                                                                            |    |    |   |   |    |   |     |
|-------------|--------------------------------------------------------------------------------------------|----|----|---|---|----|---|-----|
| Device code | VS-                                                                                        | 3C | 12 | E | T | 07 | T | -M3 |
|             | 1                                                                                          | 2  | 3  | 4 | 5 | 6  | 7 | 8   |
| 1           | Vishay Semiconductors product                                                              |    |    |   |   |    |   |     |
| 2           | 3C = SiC diode, Generation 3                                                               |    |    |   |   |    |   |     |
| 3           | Current rating (12 = 12 A)                                                                 |    |    |   |   |    |   |     |
| 4           | E = single diode                                                                           |    |    |   |   |    |   |     |
| 5           | Package TO-220                                                                             |    |    |   |   |    |   |     |
| 6           | Voltage rating: (07 = 650 V)                                                               |    |    |   |   |    |   |     |
| 7           | T = true 2 pin                                                                             |    |    |   |   |    |   |     |
| 8           | Environmental digit:<br>-M3 = halogen-free, RoHS-compliant, and termination lead (Pb)-free |    |    |   |   |    |   |     |

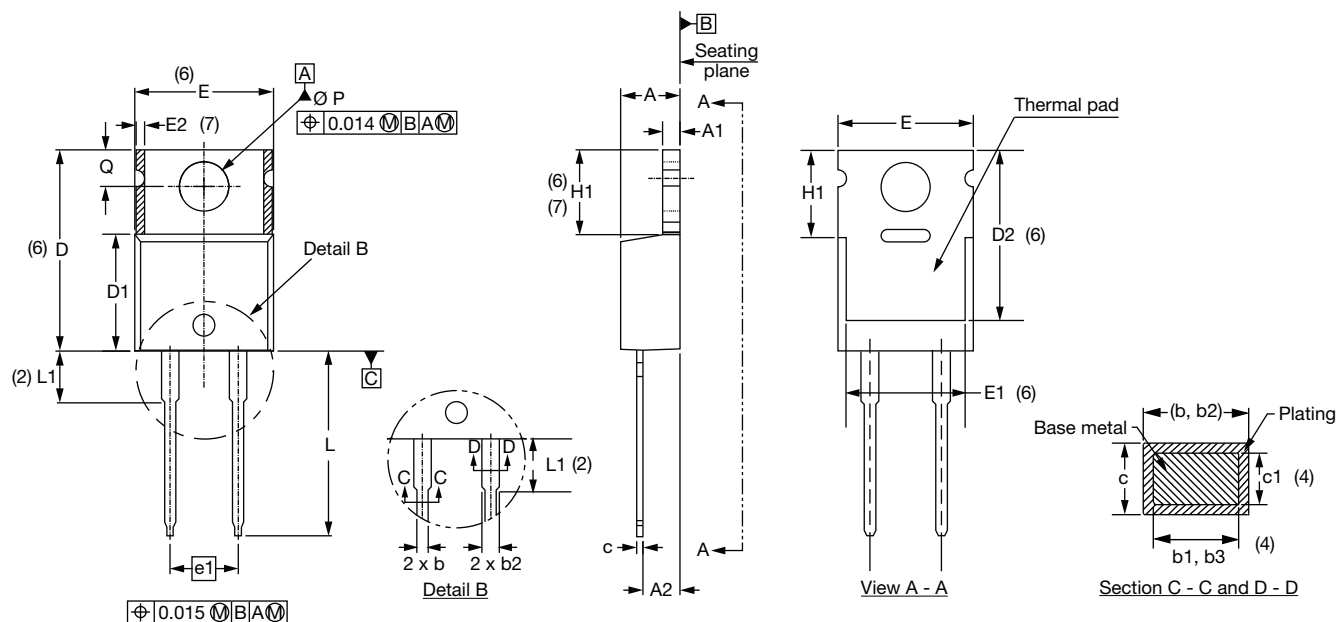
| ORDERING INFORMATION |               |                          |
|----------------------|---------------|--------------------------|
| PREFERRED P/N        | BASE QUANTITY | PACKAGING DESCRIPTION    |
| VS-3C12ET07T-M3      | 50/tube       | Antistatic plastic tubes |

| LINKS TO RELATED DOCUMENTS |                                                                        |
|----------------------------|------------------------------------------------------------------------|
| Dimensions                 | <a href="http://www.vishay.com/doc?96069">www.vishay.com/doc?96069</a> |
| Part marking information   | <a href="http://www.vishay.com/doc?95391">www.vishay.com/doc?95391</a> |



## TO-220AC 2L

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     |
| e1     | 4.88        | 5.28  | 0.192  | 0.208 |       |
| H1     | 5.84        | 6.86  | 0.230  | 0.270 | 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 |       |

## Notes

- Dimensioning and tolerancing as per ASME Y14.5M-1994
- Lead dimension and finish uncontrolled in L1
- 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
- Dimension b1, b3 and c1 apply to base metal only
- Controlling dimension: inches
- Thermal pad contour optional within dimensions E, H1, D2 and E1
- Dimension E2 x H1 define a zone where stamping and singulation irregularities are allowed
- Outline conforms to JEDEC® TO-220, except D2, where JEDEC® minimum is 0.480"



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