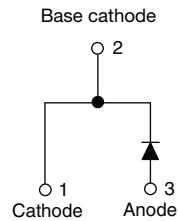


## Hyperfast Rectifier, 15 A FRED Pt® G5



TO-220AC 2L



### FEATURES

- Hyperfast and optimized  $Q_{rr}$
- Best in class forward voltage drop and switching losses trade off
- Optimized for high speed operation
- 175 °C maximum operating junction temperature
- Polyimide passivation
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



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

### LINKS TO ADDITIONAL RESOURCES



| PRIMARY CHARACTERISTICS  |             |
|--------------------------|-------------|
| $I_{F(AV)}$              | 15 A        |
| $V_R$                    | 1200 V      |
| $V_F$ at $I_F$ at 125 °C | 1.7 V       |
| $t_{rr}$                 | 37 ns       |
| $T_J$ max.               | 175 °C      |
| Package                  | TO-220AC 2L |
| Circuit configuration    | Single      |

### DESCRIPTION / APPLICATIONS

Featuring a unique combination of low conduction and switching losses, this rectifier is the right choice for high frequency converters, both soft switched / resonant. Specifically designed to improve efficiency of PFC and output rectification stages of EV / HEV battery charging stations, booster stage of solar inverters and UPS applications, these devices are perfectly matched to operate with MOSFETs or high speed IGBTs.

### MECHANICAL DATA

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

Molding compound meets UL 94 V-0 flammability rating

**Terminals:** matte tin plated leads, solderable per J-STD-002

**Polarity:** as per marking device details

| ABSOLUTE MAXIMUM RATINGS                   |                |   |             |       |
|--|----------------|---|-------------|-------|
| PARAMETER                                  | SYMBOL         | TEST CONDITIONS   | VALUES      | UNITS |
| Repetitive peak reverse voltage            | $V_{RRM}$      |   | 1200        | V     |
| Average rectified forward current          | $I_{F(AV)}$    | $T_C = 110\text{ °C}, D = 0.50$                             | 15          | A     |
| Repetitive peak forward current            | $I_{FRM}$      | $T_C = 110\text{ °C}, D = 0.50, f = 20\text{ kHz}$          | 30          |       |
| Non-repetitive peak surge current          | $I_{FSM}$      | $T_C = 45\text{ °C}, t_p = 10\text{ ms}, \text{ sine wave}$ | 125         |       |
| Operating junction and storage temperature | $T_J, T_{Stg}$ |   | -55 to +175 | °C    |

| ELECTRICAL SPECIFICATIONS ( $T_J = 25\text{ °C}$ unless otherwise specified) |               |  |      |      |      |               |
|--|---------------|--|------|------|------|---------------|
| PARAMETER  | SYMBOL        | TEST CONDITIONS                                | MIN. | TYP. | MAX. | UNITS         |
| Breakdown voltage, blocking voltage  | $V_{BR}, V_R$ | $I_R = 100\text{ }\mu\text{A}$                 | 1200 | -    | -    | V             |
| Forward voltage  | $V_F$         | $I_F = 15\text{ A}$                            | -    | 1.9  | 2.5  |               |
|  |               | $I_F = 15\text{ A}, T_J = 125\text{ °C}$       | -    | 1.7  | -    |               |
| Reverse leakage current  | $I_R$         | $V_R = V_R \text{ rated}$                      | -    | -    | 50   | $\mu\text{A}$ |
|  |               | $T_J = 125\text{ °C}, V_R = V_R \text{ rated}$ | -    | -    | 500  |               |
| Junction capacitance   | $C_T$         | $V_R = 200\text{ V}$                           | -    | 10   | -    | pF            |
| Series inductance  | $L_S$         | Measured to lead 5 mm from package body        | -    | 8    | -    | nH            |



| DYNAMIC RECOVERY CHARACTERISTICS (T <sub>J</sub> = 25 °C unless otherwise specified) |                  |   |      |      |      |       |
|--|------------------|---|------|------|------|-------|
| PARAMETER  | SYMBOL           | TEST CONDITIONS   | MIN. | TYP. | MAX. | UNITS |
| Reverse recovery time  | t <sub>rr</sub>  | I <sub>F</sub> = 1.0 A, di <sub>F</sub> /dt = 100 A/μs, V <sub>R</sub> = 30 V | -    | 37   | 50   | ns    |
|  |                  | T <sub>J</sub> = 25 °C  | -    | 95   | -    |       |
|  |                  | T <sub>J</sub> = 125 °C   | -    | 146  | -    |       |
| Peak recovery current  | I <sub>RRM</sub> | T <sub>J</sub> = 25 °C  | -    | 14   | -    | A     |
|  |                  | T <sub>J</sub> = 125 °C   | -    | 19   | -    |       |
| Reverse recovery charge  | Q <sub>rr</sub>  | T <sub>J</sub> = 25 °C  | -    | 545  | -    | nC    |
|  |                  | T <sub>J</sub> = 125 °C   | -    | 1200 | -    |       |
| Reverse recovery time  | t <sub>rr</sub>  | T <sub>J</sub> = 25 °C  | -    | 75.5 | -    | ns    |
|  |                  | T <sub>J</sub> = 125 °C   | -    | 100  | -    |       |
| Peak recovery current  | I <sub>RRM</sub> | T <sub>J</sub> = 25 °C  | -    | 23   | -    | A     |
|  |                  | T <sub>J</sub> = 125 °C   | -    | 35   | -    |       |
| Reverse recovery charge  | Q <sub>rr</sub>  | T <sub>J</sub> = 25 °C  | -    | 935  | -    | nC    |
|  |                  | T <sub>J</sub> = 125 °C   | -    | 1985 | -    |       |

| THERMAL - MECHANICAL SPECIFICATIONS            |                                   |                        |              |      |            |                        |
|--|-----------------------------------|------------------------|--------------|------|------------|------------------------|
| PARAMETER                                      | SYMBOL                            | TEST CONDITIONS        | MIN.         | TYP. | MAX.       | UNITS                  |
| Thermal resistance, junction-to-case           | R <sub>thJC</sub>                 |                        | -            | -    | 1.7        | °C/W                   |
| Weight   |                                   |                        | -            | 2.0  | -          | g                      |
| Mounting torque                                |                                   |                        | 6.0<br>(5.0) | -    | 12<br>(10) | kgf · cm<br>(lbf · in) |
| Maximum junction and storage temperature range | T <sub>J</sub> , T <sub>Stg</sub> |                        | -55          | -    | 175        | °C                     |
| Marking device                                 |                                   | Case style TO-220AC 2L | E5TH1512     |      |            |                        |

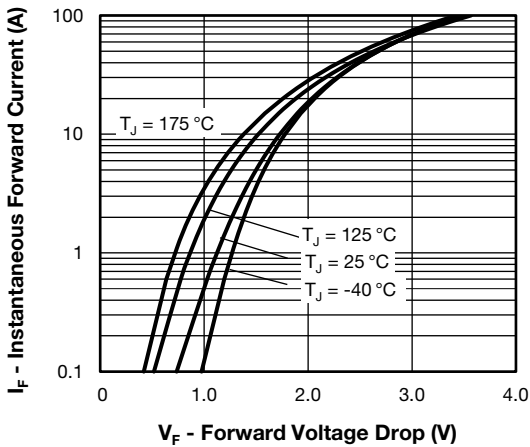


Fig. 1 - Forward Voltage Drop Characteristics

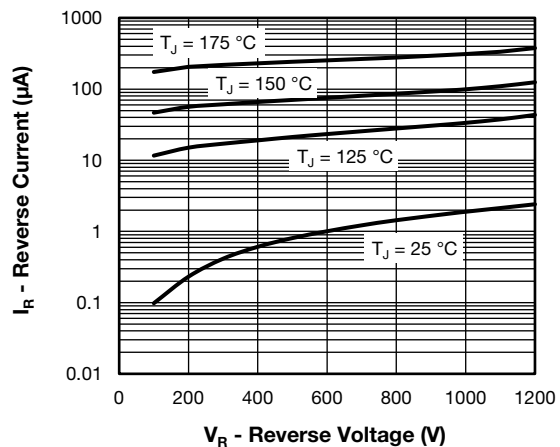


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

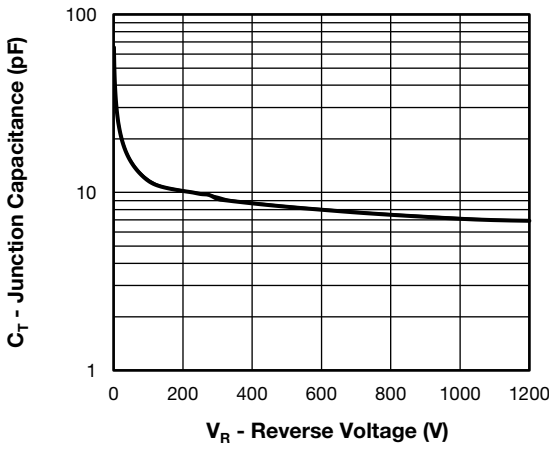


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

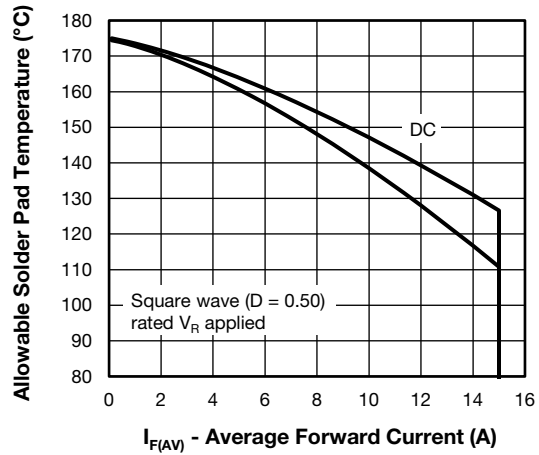


Fig. 4 - Maximum Allowable Case Temperature vs. Average Forward Current

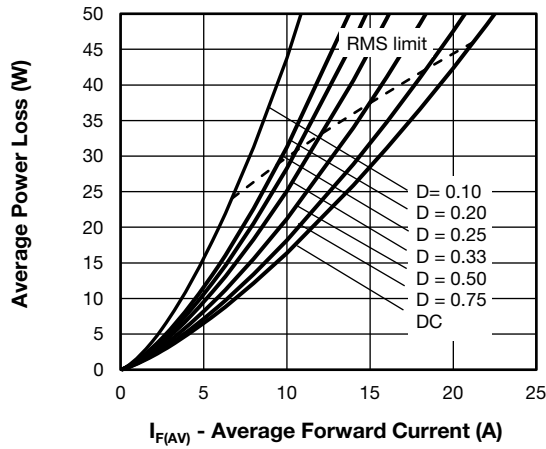


Fig. 5 - Forward Power Loss Characteristics

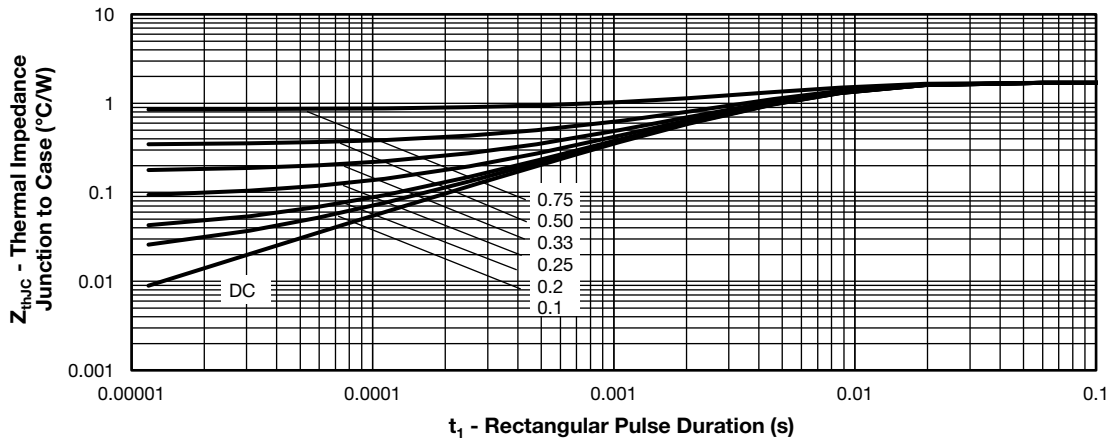


Fig. 6 - Transient Thermal Impedance, Junction to Case

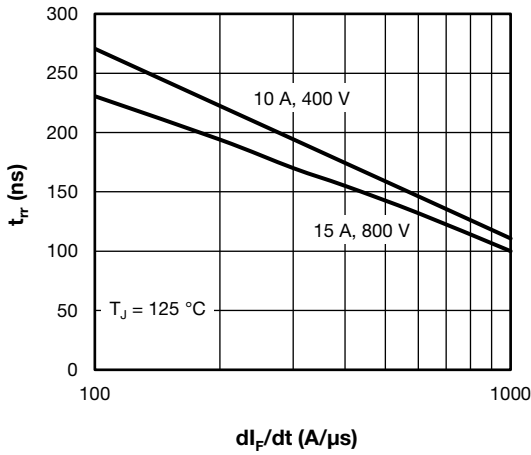


Fig. 7 - Typical Reverse Recovery Time vs.  $di_F/dt$

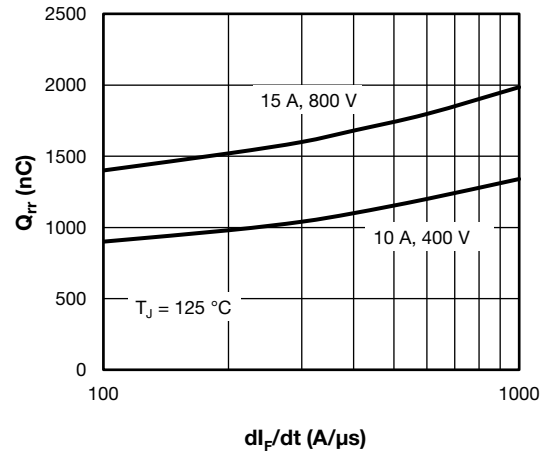


Fig. 8 - Typical Stored Charge vs.  $di_F/dt$

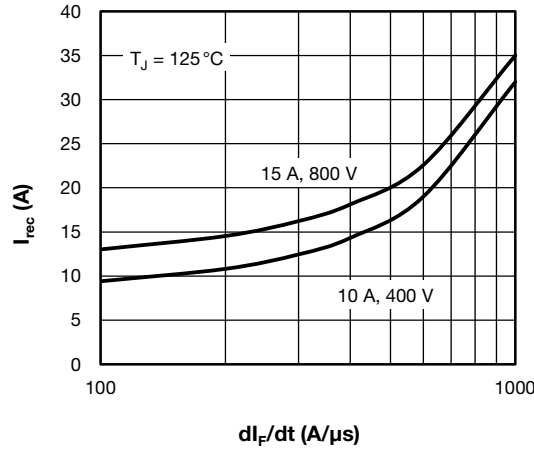


Fig. 9 - Typical Stored Charge vs.  $di_F/dt$

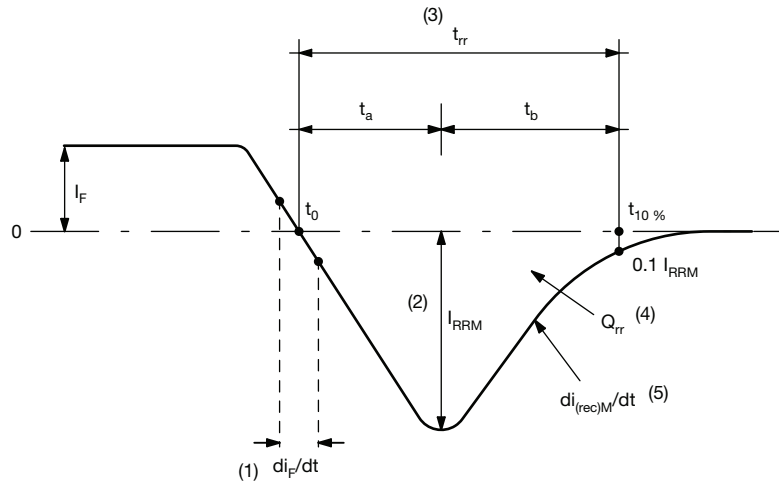


Fig. 10 - Reverse Recovery Waveform and Definitions

**Notes**

- (1)  $di_F/dt$  - rate of change of current through zero crossing
- (2)  $I_{RRM}$  - peak reverse recovery current
- (3)  $t_{rr}$  - reverse recovery time measured from  $t_0$ , crossing point of negative going  $I_F$ , to point  $t_{10\%}$ ,  $0.1 I_{RRM}$
- (4)  $Q_{rr}$  - area under curve defined by  $t_0$  and  $t_{10\%}$

$$Q_{rr} = \int_{t_0}^{t_{10\%}} I(t) dt$$

- (5)  $di_{(rec)}/dt$  - peak rate of change of current during  $t_b$  portion of  $t_{rr}$

**ORDERING INFORMATION TABLE**

|             |            |          |          |          |          |           |           |            |
|-------------|------------|----------|----------|----------|----------|-----------|-----------|------------|
| Device code | <b>VS-</b> | <b>E</b> | <b>5</b> | <b>T</b> | <b>H</b> | <b>15</b> | <b>12</b> | <b>-M3</b> |
|             | (1)        | (2)      | (3)      | (4)      | (5)      | (6)       | (7)       | (8)        |

- 1** - Vishay Semiconductors product
- 2** - E = single diode
- 3** - 5 = FRED generation 5
- 4** - Package:  
T = TO-220AC 2L
- 5** - H = hyperfast recovery
- 6** - Current rating (15 = 15 A)
- 7** - Voltage rating (12 = 1200 V)
- 8** - Environmental digit:  
-M3 = halogen-free, RoHS-compliant, and termination lead (Pb)-free

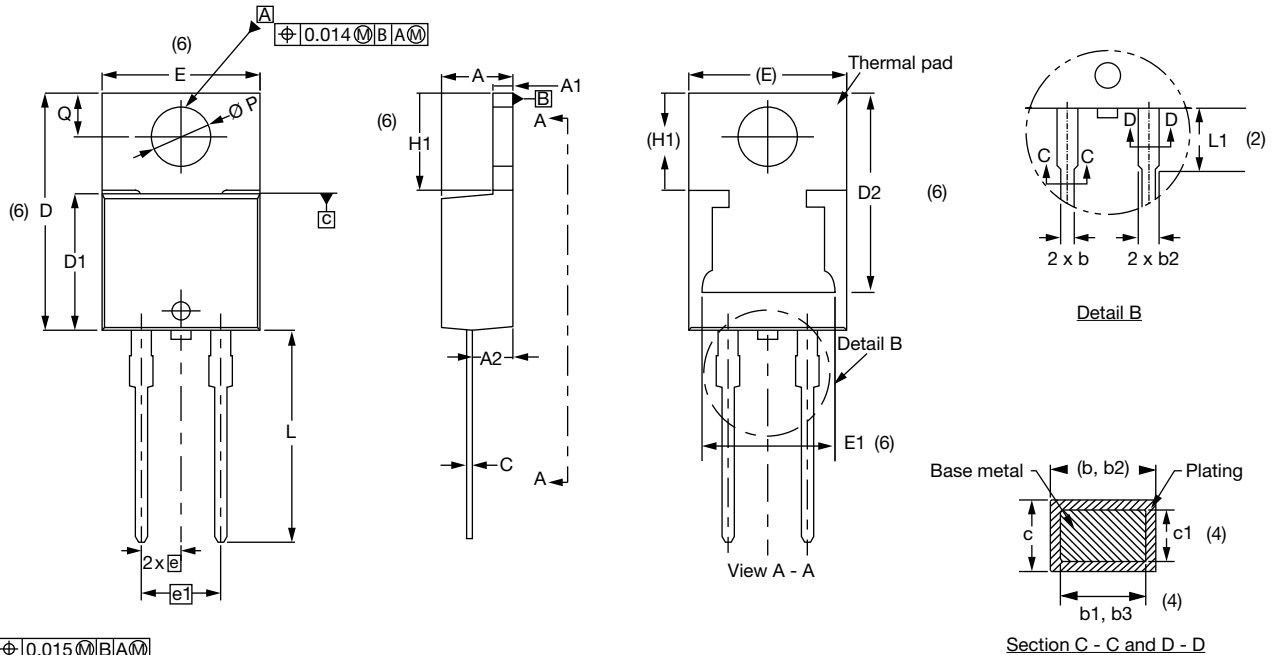
| ORDERING INFORMATION (Example) |               |                          |
|--------------------------------|---------------|--------------------------|
| PREFERRED P/N                  | BASE QUANTITY | PACKAGING DESCRIPTION    |
| VS-E5TH1512-M3                 | 50            | Antistatic plastic tubes |

| LINKS TO RELATED DOCUMENTS |  |
|----------------------------|--|
| Dimensions                 | <a href="http://www.vishay.com/doc?96156">www.vishay.com/doc?96156</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



Conforms to JEDEC® outline TO-220AC

| SYMBOL | MILLIMETERS |       | INCHES |       | NOTES | SYMBOL | MILLIMETERS |       | INCHES |       | NOTES |
|--------|-------------|-------|--------|-------|-------|--------|-------------|-------|--------|-------|-------|
|        | MIN.        | MAX.  | MIN.   | MAX.  |       |        | MIN.        | MAX.  | MIN.   | MAX.  |       |
| A      | 4.25        | 4.65  | 0.167  | 0.183 |       | D2     | 11.68       | 13.30 | 0.460  | 0.524 | 6, 7  |
| A1     | 1.14        | 1.40  | 0.045  | 0.055 |       | E      | 10.11       | 10.51 | 0.398  | 0.414 | 3, 6  |
| A2     | 2.50        | 2.92  | 0.098  | 0.115 |       | E1     | 6.86        | 8.89  | 0.270  | 0.350 | 6     |
| b      | 0.69        | 1.01  | 0.027  | 0.040 |       | e      | 2.41        | 2.67  | 0.095  | 0.105 |       |
| b1     | 0.38        | 0.97  | 0.015  | 0.038 | 4     | e1     | 4.88        | 5.28  | 0.192  | 0.208 |       |
| b2     | 1.20        | 1.73  | 0.047  | 0.068 |       | H1     | 6.09        | 6.48  | 0.240  | 0.255 | 6     |
| b3     | 1.14        | 1.73  | 0.045  | 0.068 | 4     | L      | 13.52       | 14.02 | 0.532  | 0.552 |       |
| c      | 0.36        | 0.61  | 0.014  | 0.024 |       | L1     | 3.32        | 3.82  | 0.131  | 0.150 | 2     |
| c1     | 0.36        | 0.56  | 0.014  | 0.022 | 4     | ∅ P    | 3.54        | 3.91  | 0.139  | 0.154 |       |
| D      | 14.85       | 15.35 | 0.585  | 0.604 | 3     | Q      | 2.60        | 3.00  | 0.102  | 0.118 |       |
| D1     | 8.38        | 9.02  | 0.330  | 0.355 |       |        |             |       |        |       |       |

**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) Outline conforms to JEDEC® TO-220, except D2



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