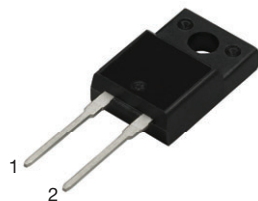
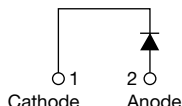


# Ultrafast Rectifier, 20 A FRED Pt®


**2L TO-220 FULL-PAK**


## FEATURES

- Low forward voltage drop
- Ultrafast soft recovery time
- 175 °C operating junction temperature
- Low leakage current
- Fully isolated package ( $V_{INS} = 2500 V_{RMS}$ )
- True 2 pin package
- 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)



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

## DESCRIPTION

Ultralow  $V_F$ , soft-switching ultrafast rectifiers optimized for Discontinuous (Critical) Mode (DCM) Power Factor Correction (PFC).

The minimized conduction loss, optimized stored charge and low recovery current minimized the switching losses and reduce over dissipation in the switching element and snubbers.

The device is also intended for use as a freewheeling diode in power supplies and other power switching applications.

## APPLICATIONS

AC/DC SMPS 70 W to 400 W

e.g. laptop and printer AC adaptors, desktop PC, TV and monitor, games units and DVD AC/DC power supplies.

## PRODUCT SUMMARY

|                 |             |
|-----------------|-------------|
| Package         | 2L TO-220FP |
| $I_{F(AV)}$     | 20 A        |
| $V_R$           | 600 V       |
| $V_F$ at $I_F$  | 1.26 V      |
| $t_{rr}$ (typ.) | 61 ns       |
| $T_J$ max.      | 175 °C      |
| Diode variation | Single die  |

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                   | SYMBOL         | TEST CONDITIONS       | VALUES      | UNITS |
|---|----------------|-----------------------|-------------|-------|
| Peak repetitive reverse voltage             | $V_{RRM}$      |                       | 600         | V     |
| Average rectified forward current in DC     | $I_{F(AV)}$    | $T_C = 102\text{ °C}$ | 20          | A     |
| Non-repetitive peak surge current           | $I_{FSM}$      | $T_J = 25\text{ °C}$  | 190         |       |
| Operating junction and storage temperatures | $T_J, T_{Stg}$ |                       | -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 | $V_{BR}, V_R$ | $I_R = 100\text{ }\mu\text{A}$               | 600  | -    | -    | V             |
| Forward voltage                     | $V_F$         | $I_F = 20\text{ A}$                          | -    | 1.4  | 1.63 |               |
|                                     |               | $I_F = 20\text{ A}, T_J = 125\text{ °C}$     | -    | 1.26 | 1.49 |               |
| Reverse leakage current             | $I_R$         | $V_R = V_R$ rated                            | -    | 0.3  | 15   | $\mu\text{A}$ |
|                                     |               | $T_J = 125\text{ °C}, V_R = V_R$ rated       | -    | 50   | 500  |               |
| Junction capacitance                | $C_T$         | $V_R = 600\text{ V}$                         | -    | 18   | -    | pF            |
| Series inductance                   | $L_S$         | Measured lead to lead 5 mm from package body | -    | 8    | -    | nH            |

**DYNAMIC RECOVERY CHARACTERISTICS** ( $T_J = 25\text{ }^{\circ}\text{C}$  unless otherwise specified)

| PARAMETER               | SYMBOL    | TEST CONDITIONS                     | MIN. | TYP. | MAX. | UNITS |
|-------------------------|-----------|-------------------------------------|------|------|------|-------|
| Reverse recovery time   | $t_{rr}$  | $T_J = 25\text{ }^{\circ}\text{C}$  | -    | 61   | -    | ns    |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$ | -    | 87   | -    |       |
| Peak recovery current   | $I_{RRM}$ | $T_J = 25\text{ }^{\circ}\text{C}$  | -    | 13   | -    | A     |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$ | -    | 21   | -    |       |
| Reverse recovery charge | $Q_{rr}$  | $T_J = 25\text{ }^{\circ}\text{C}$  | -    | 480  | -    | nC    |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$ | -    | 1080 | -    |       |

**THERMAL - MECHANICAL SPECIFICATIONS**

| PARAMETER                                      | SYMBOL         | TEST CONDITIONS                             | MIN.        | TYP. | MAX.       | UNITS                  |
|--|----------------|---|-------------|------|------------|------------------------|
| Maximum junction and storage temperature range | $T_J, T_{Stg}$ |   | -55         | -    | 175        | $^{\circ}\text{C}$     |
| Thermal resistance, junction to case           | $R_{thJC}$     |   | -           | 2.5  | 3          | $^{\circ}\text{C/W}$   |
| Thermal resistance, junction to ambient        | $R_{thJA}$     | Typical socket mount                        | -           | -    | 70         |                        |
| Typical thermal resistance, case to heatsink   | $R_{thCS}$     | Mounting surface, flat, smooth, and greased | -           | 0.5  | -          |                        |
| Weight   |                |   | -           | 2    | -          | g                      |
|  |                |   | -           | 0.07 | -          | oz.                    |
| Mounting torque                                |                |   | 6<br>(5)    | -    | 12<br>(10) | kgf · cm<br>(lbf · in) |
| Marking device                                 |                | Case style: 2L TO-220FP                     | E4TU2006TFP |      |            |                        |

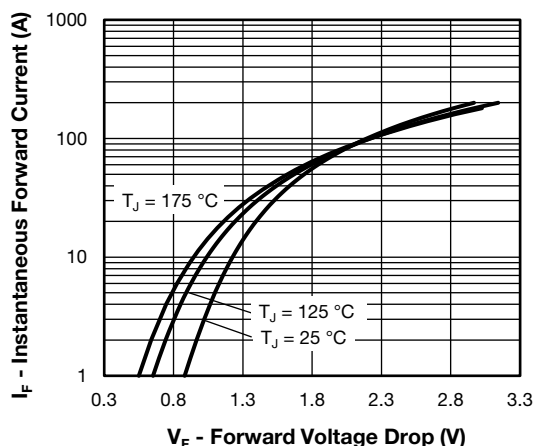


Fig. 1 - Typical Forward Voltage Drop Characteristics

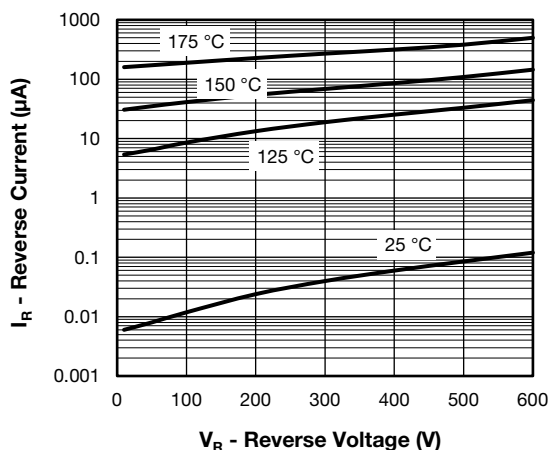


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

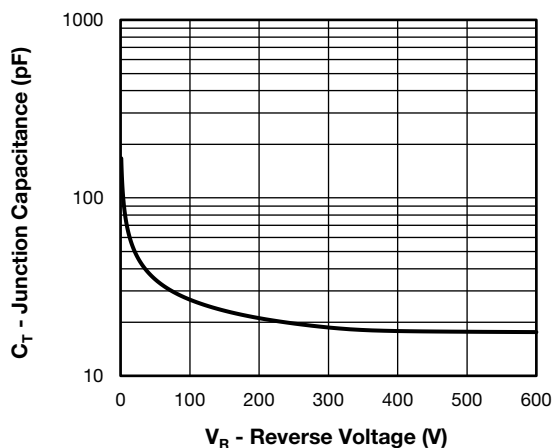


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

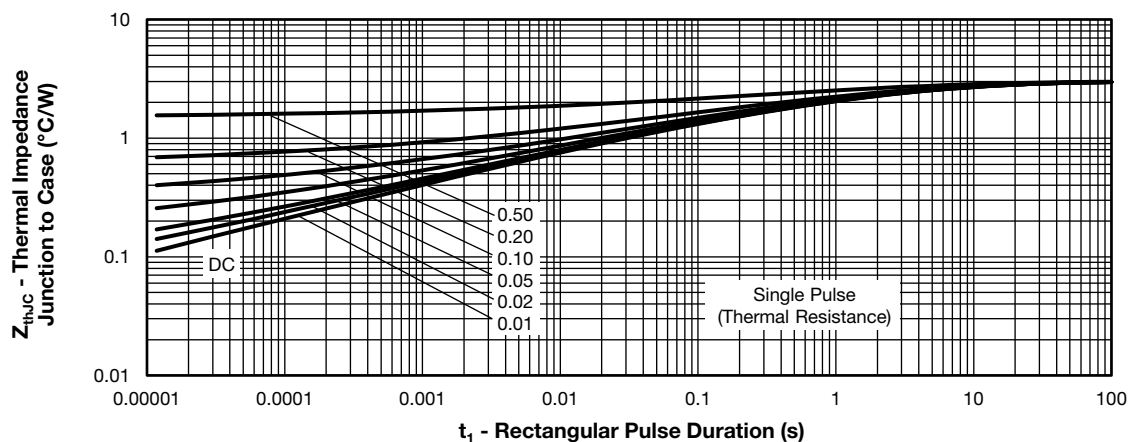
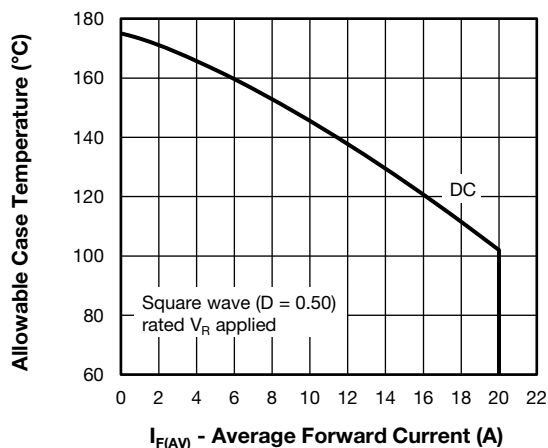

Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics


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

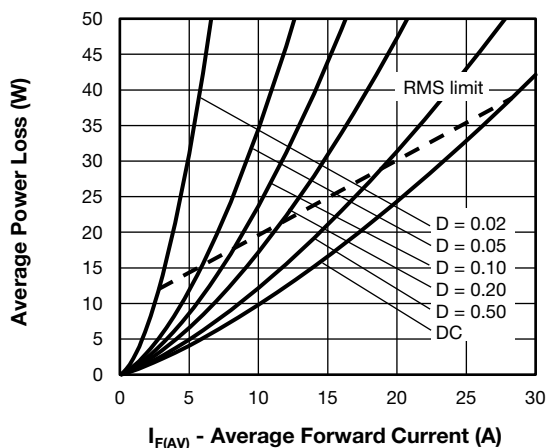
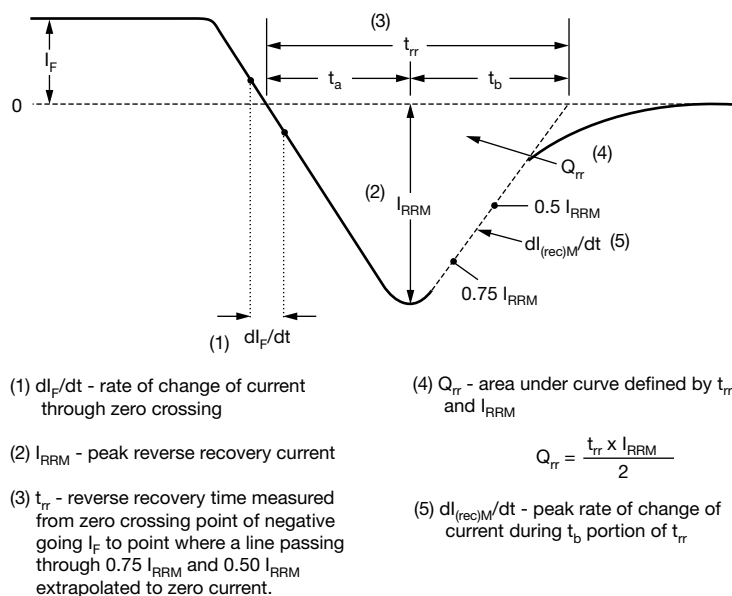


Fig. 6 - Forward Power Loss Characteristics



### Fig. 7 - Reverse Recovery Waveform and Definitions

## ORDERING INFORMATION TABLE

| Device code | VS- | E | 4 | T | U | 20 | 06 | T | FP | -N3 |
|-------------|-----|---|---|---|---|----|----|---|----|-----|
|             | 1   | 2 | 3 | 4 | 5 | 6  | 7  | 8 | 9  | 10  |

- 1 - Vishay Semiconductors product
- 2 - Circuit configuration:  
E = single diode
- 3 - 4 = Gen 4 FRED Pt
- 4 - T = TO-220
- 5 - U = ultrafast recovery time
- 6 - Current code: 20 = 20 A
- 7 - Voltage code: 06 = 600 V
- 8 -
  - None = TO-220
  - T = True 2 Pin TO-220
- 9 - FP = FULL-PAK
- 10 - Environmental digit:  
-N3 = halogen-free, RoHS-compliant, and terminations lead (Pb)-free

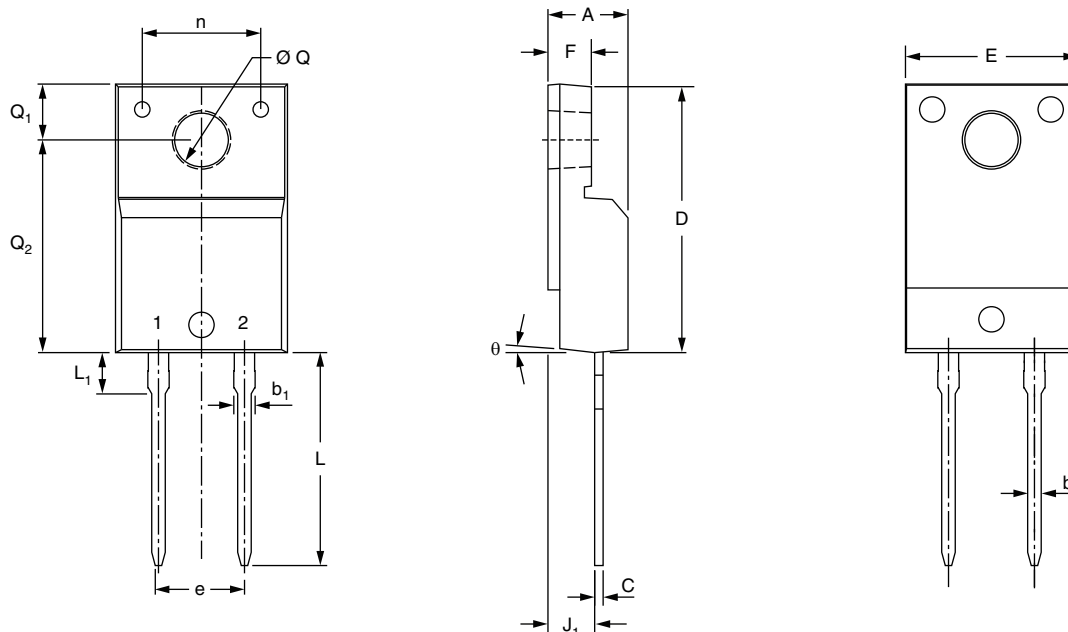
| ORDERING INFORMATION (Example) |                   |                        |                         |
|--------------------------------|-------------------|------------------------|-------------------------|
| PREFERRED P/N                  | QUANTITY PER TUBE | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION   |
| VS-E4TU2006TFP-N3              | 50                | 1000                   | Antistatic plastic tube |

| LINKS TO RELATED DOCUMENTS |             |  |
|----------------------------|-------------|--|
| Dimensions                 | 2L TO-220FP | <a href="http://www.vishay.com/doc?95681">www.vishay.com/doc?95681</a> |
| Part marking information   | 2L TO-220FP | <a href="http://www.vishay.com/doc?95392">www.vishay.com/doc?95392</a> |



## 2L TO-220 FULL-PAK

**DIMENSIONS** in millimeters and inches



| SYMBOL         | MILLIMETERS  |       | INCHES        |       |
|----------------|--------------|-------|---------------|-------|
|                | MIN.         | MAX.  | MIN.          | MAX.  |
| A              | 4.57         | 4.83  | 0.180         | 0.190 |
| b              | 0.62         | 0.89  | 0.024         | 0.035 |
| b <sub>1</sub> | 1.23         | 1.40  | 0.048         | 0.055 |
| C              | 0.44         | 0.63  | 0.017         | 0.025 |
| D              | 15.88        | 16.12 | 0.625         | 0.635 |
| E              | 10.36        | 10.63 | 0.408         | 0.418 |
| e              | 5.08 typical |       | 0.200 typical |       |
| F              | 2.57         | 2.83  | 0.101         | 0.111 |
| J <sub>1</sub> | 2.51         | 2.85  | 0.099         | 0.112 |
| L              | 14           | 14.2  | 0.551         | 0.559 |
| L <sub>1</sub> | 3.1          | 3.57  | 0.122         | 0.141 |
| Ø Q            | 3.05         | 3.45  | 0.120         | 0.136 |
| Q <sub>1</sub> | 2.96         | 3.82  | 0.117         | 0.150 |
| Q <sub>2</sub> | 12.3         | 12.92 | 0.484         | 0.509 |
| θ              | 0°           | 5°    | 0°            | 5°    |
| n              | 6.05         | 6.15  | 0.238         | 0.242 |



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