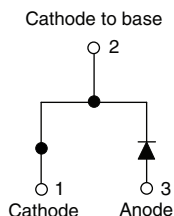
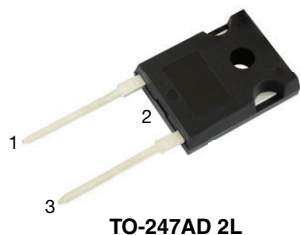


# Ultrafast Soft Recovery Diode, 60 A FRED Pt®



## FEATURES

- Ultrafast recovery time
- Low forward voltage drop
- 175 °C operating junction temperature
- Designed and qualified according to commercial qualification
- 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

VS-EPU60... series are the state of the art ultrafast recovery rectifiers designed with optimized performance of forward voltage drop and ultrafast recovery time.

The planar structure and the platinum doped life time control guarantee the best overall performance, ruggedness and reliability characteristics.

These devices are intended for use in the output rectification stage of SMPS, welding, UPS, DC/DC converters as well as freewheeling diodes in low voltage inverters and chopper motor drives.

Their extremely optimized stored charge and low recovery current minimize the switching losses and reduce over dissipation in the switching element and snubbers.

## PRODUCT SUMMARY

|                 |             |
|-----------------|-------------|
| Package         | TO-247AD 2L |
| $I_{F(AV)}$     | 60 A        |
| $V_R$           | 600 V       |
| $V_F$ at $I_F$  | 1.05 V      |
| $t_{rr}$ typ.   | 32 ns       |
| $T_J$ max.      | 175 °C      |
| Diode variation | Single die  |

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                   | SYMBOL            | TEST CONDITIONS                                               | MAX.        | UNITS |
|---------------------------------------------|-------------------|---------------------------------------------------------------|-------------|-------|
| Repetitive peak reverse voltage             | $V_{RRM}$         |                                                               | 600         | V     |
| Average rectified forward current in DC     | $I_{F(AV)}$       | $T_C = 116\text{ °C}$                                         | 60          | A     |
| Single pulse forward current                | $I_{FSM}$         | $T_C = 25\text{ °C}$ , $t_p = 8.3\text{ ms}$ ; half sine wave | 600         |       |
| 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                     | $V_F$            | $I_F = 60\text{ A}$                         | -    | 1.2  | 1.5  |               |
|                                     |                  | $I_F = 60\text{ A}$ , $T_J = 125\text{ °C}$ | -    | 1.1  | 1.3  |               |
|                                     |                  | $I_F = 60\text{ A}$ , $T_J = 175\text{ °C}$ | -    | 1.05 | 1.2  |               |
| Reverse leakage current             | $I_R$            | $V_R = V_R$ rated                           | -    | 0.2  | 30   | $\mu\text{A}$ |
|                                     |                  | $T_J = 150\text{ °C}$ , $V_R = V_R$ rated   | -    | -    | 200  |               |
| Junction capacitance                | $C_T$            | $V_R = 600\text{ V}$                        | -    | 38   | -    | pF            |

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

| PARAMETER               | SYMBOL    | TEST CONDITIONS                                                                 | MIN. | TYP. | MAX. | UNITS |
|-------------------------|-----------|---------------------------------------------------------------------------------|------|------|------|-------|
| Reverse recovery time   | $t_{rr}$  | $I_F = 1\text{ A}$ , $dI_F/dt = 200\text{ A}/\mu\text{s}$ , $V_R = 30\text{ V}$ | -    | 32   | -    | ns    |
|                         |           | $T_J = 25\text{ }^{\circ}\text{C}$                                              | -    | 110  | -    |       |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                             | -    | 200  | -    |       |
| Peak recovery current   | $I_{RRM}$ | $T_J = 25\text{ }^{\circ}\text{C}$                                              | -    | 10   | -    | A     |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                             | -    | 19   | -    |       |
| Reverse recovery charge | $Q_{rr}$  | $T_J = 25\text{ }^{\circ}\text{C}$                                              | -    | 530  | -    | nC    |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                             | -    | 1900 | -    |       |

**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           | $R_{thJC}$        |                                            | -        | -    | 0.65        | $^{\circ}\text{C}/\text{W}$ |
| Thermal resistance, junction to ambient        | $R_{thJA}$        | Typical socket mount                       | -        | -    | 70          |                             |
| Thermal resistance, case to heat sink          | $R_{thCS}$        | Mounting surface, flat, smooth and greased | -        | 0.5  | -           |                             |
| Weight                                         |                   |                                            | -        | 6    | -           | g                           |
|                                                |                   |                                            | -        | 0.21 | -           | oz.                         |
| Mounting torque                                |                   |                                            | 6<br>(5) | -    | 1.2<br>(10) | kgf. cm<br>(lbf · in)       |
| Marking device                                 |                   | Case style TO-247AD 2L                     | EPU6006L |      |             |                             |

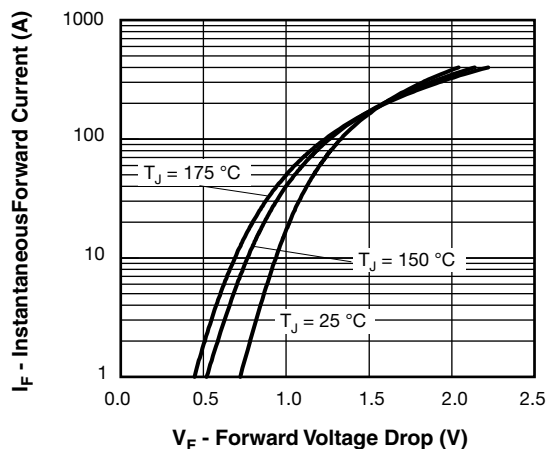


Fig. 1 - Typical Forward Voltage Drop Characteristics

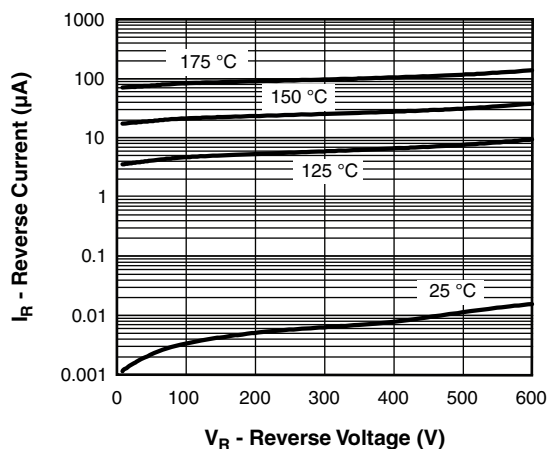


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

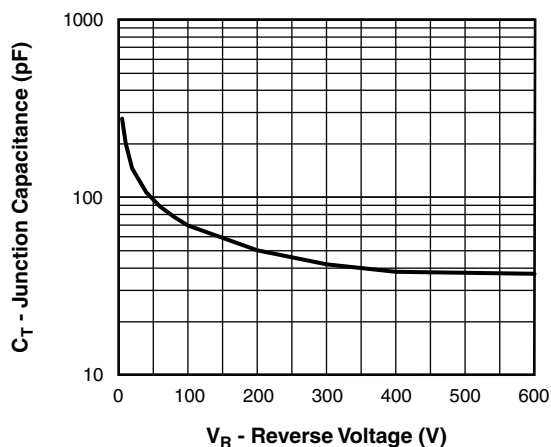


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

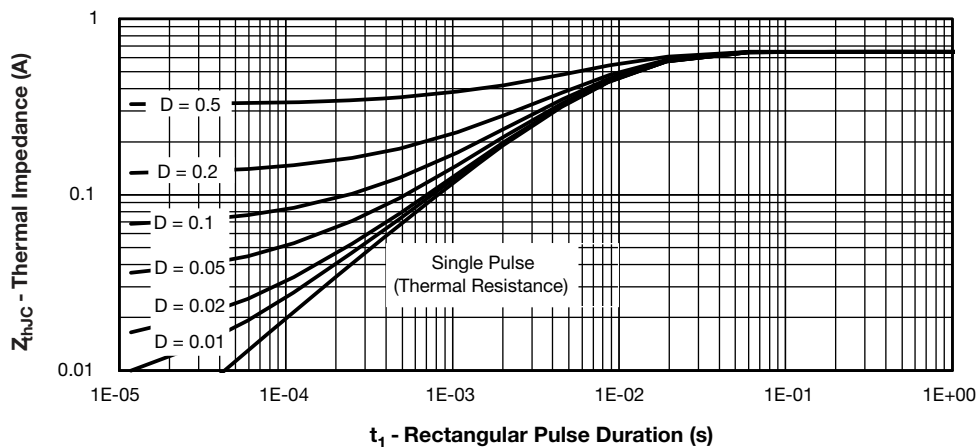


Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics

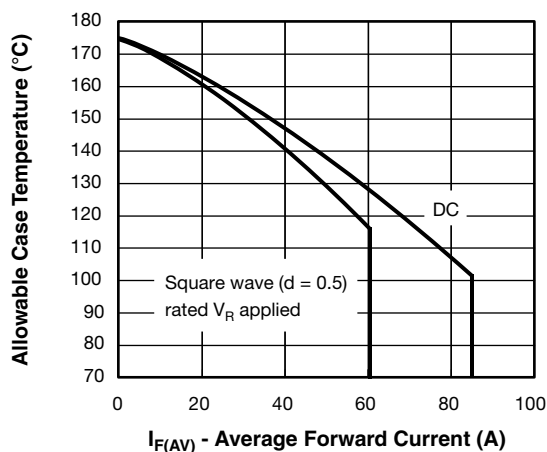


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

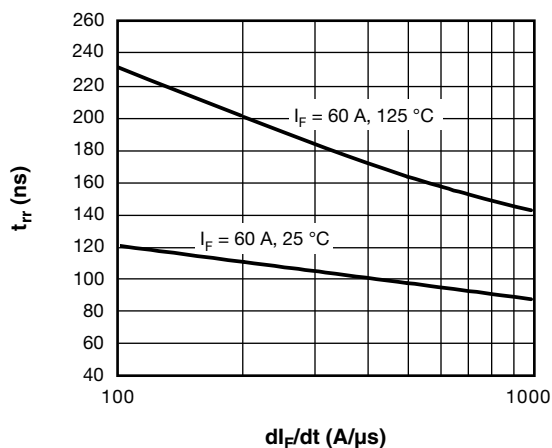


Fig. 7 - Typical Reverse Recovery Time vs.  $dI_F/dt$

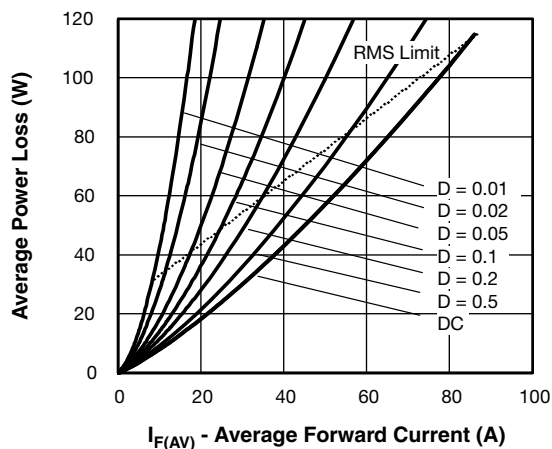


Fig. 6 - Forward Power Loss Characteristics

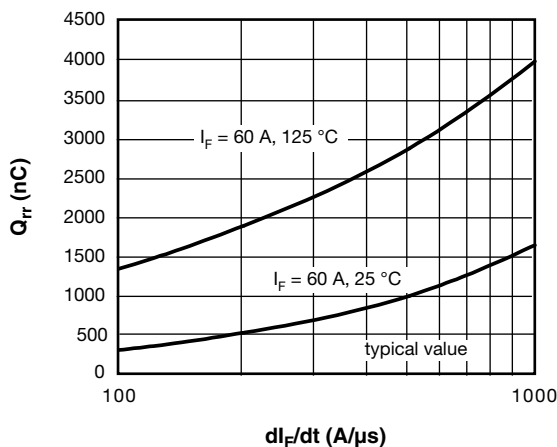


Fig. 8 - Typical Stored Charge vs.  $dI_F/dt$

#### Note

- (1) Formula used:  $T_C = T_J - (P_d + P_{dREV}) \times R_{thJC}$ ;  
 $P_d$  = forward power loss =  $I_{F(AV)} \times V_{FM}$  at  $(I_{F(AV)}/D)$  (see fig. 6);  
 $P_{dREV}$  = inverse power loss =  $V_{R1} \times I_R (1 - D)$ ;  $I_R$  at  $V_{R1} = 80\%$  rated  $V_R$

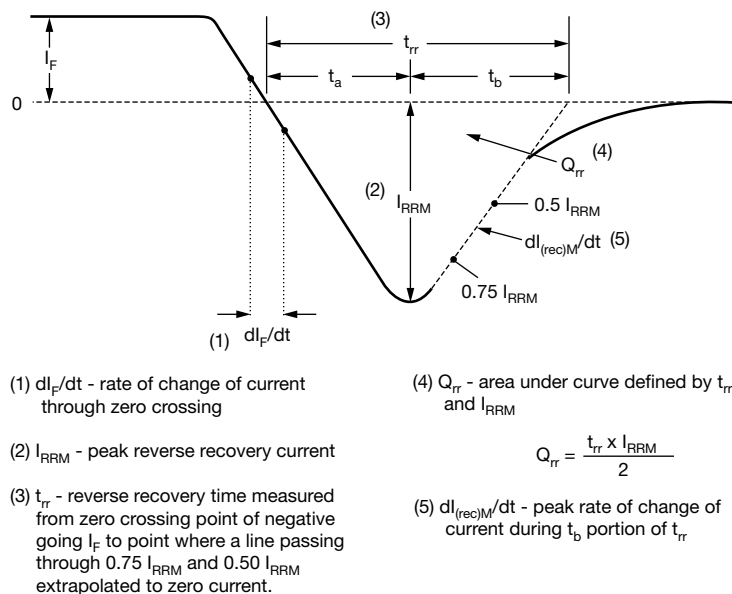


Fig. 9 - Reverse Recovery Waveform and Definitions

## ORDERING INFORMATION TABLE

| Device code | VS-                                                            | E | P | U | 60 | 06 | L | -N3 |
|-------------|----------------------------------------------------------------|---|---|---|----|----|---|-----|
|             | 1                                                              | 2 | 3 | 4 | 5  | 6  | 7 | 8   |
| 1           | Vishay Semiconductors product                                  |   |   |   |    |    |   |     |
| 2           | Circuit configuration:                                         |   |   |   |    |    |   |     |
|             | • E = single diode 2 pins                                      |   |   |   |    |    |   |     |
| 3           | P = TO-247                                                     |   |   |   |    |    |   |     |
| 4           | U = ultrafast recovery time                                    |   |   |   |    |    |   |     |
| 5           | Current code (60 = 60 A)                                       |   |   |   |    |    |   |     |
| 6           | Voltage code (06 = 600 V)                                      |   |   |   |    |    |   |     |
| 7           | L = long lead                                                  |   |   |   |    |    |   |     |
| 8           | Environmental digit:                                           |   |   |   |    |    |   |     |
|             | -N3 = halogen-free, RoHS-compliant, and totally lead (Pb)-free |   |   |   |    |    |   |     |

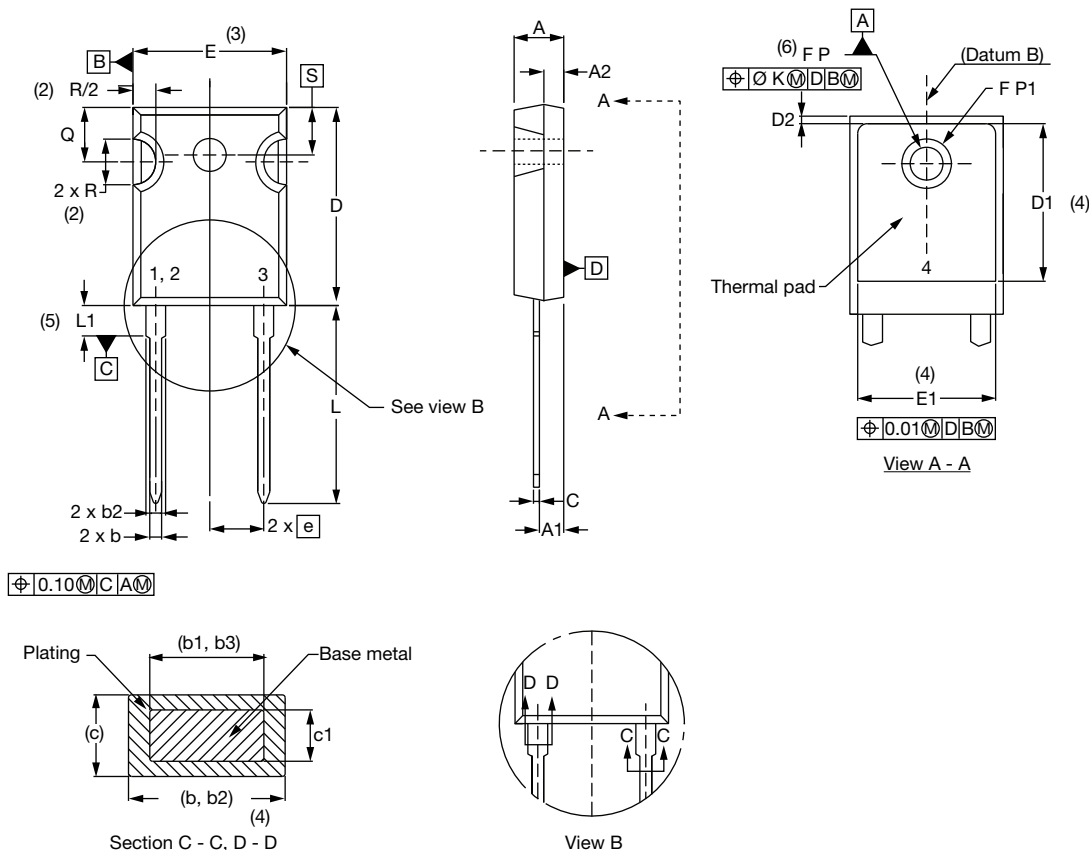
| ORDERING INFORMATION (Example) |                   |                        |                         |
|--------------------------------|-------------------|------------------------|-------------------------|
| PREFERRED P/N                  | QUANTITY PER TUBE | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION   |
| VS-EPU6006L-N3                 | 25                | 500                    | Antistatic plastic tube |

| LINKS TO RELATED DOCUMENTS |             |                                                                        |
|----------------------------|-------------|------------------------------------------------------------------------|
| Dimensions                 | TO-247AD 2L | <a href="http://www.vishay.com/doc?95536">www.vishay.com/doc?95536</a> |
| Part marking information   | TO-247AD 2L | <a href="http://www.vishay.com/doc?95648">www.vishay.com/doc?95648</a> |



### TO-247AD 2L

**DIMENSIONS** in millimeters and inches



| SYMBOL | MILLIMETERS |       | INCHES |       | NOTES |
|--------|-------------|-------|--------|-------|-------|
|        | MIN.        | MAX.  | MIN.   | MAX.  |       |
| A      | 4.65        | 5.31  | 0.183  | 0.209 |       |
| A1     | 2.21        | 2.59  | 0.087  | 0.102 |       |
| A2     | 1.50        | 2.49  | 0.059  | 0.098 |       |
| b      | 0.99        | 1.40  | 0.039  | 0.055 |       |
| b1     | 0.99        | 1.35  | 0.039  | 0.053 |       |
| b2     | 1.65        | 2.39  | 0.065  | 0.094 |       |
| b3     | 1.65        | 2.34  | 0.065  | 0.092 |       |
| c      | 0.38        | 0.89  | 0.015  | 0.035 |       |
| c1     | 0.38        | 0.84  | 0.015  | 0.033 |       |
| D      | 19.71       | 20.70 | 0.776  | 0.815 | 3     |
| D1     | 13.08       | -     | 0.515  | -     | 4     |
| D2     | 0.51        | 1.35  | 0.020  | 0.053 |       |

| SYMBOL    | MILLIMETERS |       | INCHES    |       | NOTES |
|-----------|-------------|-------|-----------|-------|-------|
|           | MIN.        | MAX.  | MIN.      | MAX.  |       |
| E         | 15.29       | 15.87 | 0.602     | 0.625 | 3     |
| E1        | 13.46       | -     | 0.53      | -     |       |
| e         | 5.46 BSC    |       | 0.215 BSC |       |       |
| $\phi K$  | 0.254       |       | 0.010     |       |       |
| L         | 19.81       | 20.32 | 0.780     | 0.800 |       |
| L1        | 3.71        | 4.29  | 0.146     | 0.169 |       |
| $\phi P$  | 3.56        | 3.66  | 0.14      | 0.144 |       |
| $\phi P1$ | -           | 6.98  | -         | 0.275 |       |
| Q         | 5.31        | 5.69  | 0.209     | 0.224 |       |
| R         | 4.52        | 5.49  | 0.178     | 0.216 |       |
| S         | 5.51 BSC    |       | 0.217 BSC |       |       |

#### Notes

- Dimensioning and tolerancing per ASME Y14.5M-1994
- Contour of slot optional
- Dimension D and E do not include mold flash. These dimensions are measured at the outermost extremes of the plastic body
- Thermal pad contour optional with dimensions D1 and E1
- Lead finish uncontrolled in L1
- $\phi P$  to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154")
- Outline conforms to JEDEC® outline TO-247 with exception of dimension A min., D, E min., Q min., S, and note 4



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