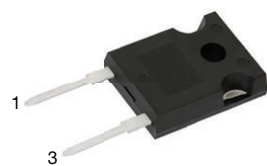
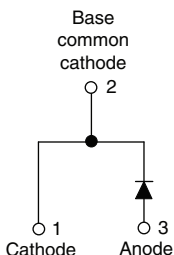
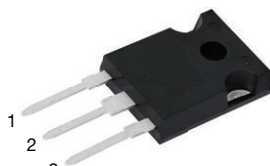
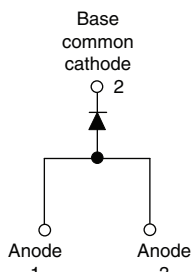


# Ultrafast Soft Recovery Diode, 60 A FRED Pt®


**TO-247AC 2L**

**VS-60EPU04-N3**

**TO-247AC 3L**

**VS-60APU04-N3**

## LINKS TO ADDITIONAL RESOURCES



3D Models

## PRIMARY CHARACTERISTICS

|                       |                          |
|-----------------------|--------------------------|
| $I_{F(AV)}$           | 60 A                     |
| $V_R$                 | 400 V                    |
| $V_F$ at $I_F$        | 0.87 V                   |
| $t_{rr}$ typ.         | See Recovery table       |
| $T_J$ max.            | 175 °C                   |
| Package               | TO-247AC 2L, TO-247AC 3L |
| Circuit configuration | Single                   |

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                   | SYMBOL            | TEST CONDITIONS                             | VALUES      | UNITS |
|---------------------------------------------|-------------------|---------------------------------------------|-------------|-------|
| Cathode to anode voltage                    | $V_R$             |                                             | 400         | V     |
| Continuous forward current                  | $I_{F(AV)}$       | $T_C = 127\text{ °C}$                       | 60          | A     |
| Single pulse forward current                | $I_{FSM}$         | $T_C = 25\text{ °C}$ , $t_p = 10\text{ ms}$ | 600         |       |
| Maximum repetitive forward current          | $I_{FRM}$         | Square wave, 20 kHz                         | 120         |       |
| 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 | $V_{BR}$ , $V_R$ | $I_R = 100\text{ }\mu\text{A}$               | 400  | -    | -    | V             |
| Forward voltage                     | $V_F$            | $I_F = 60\text{ A}$                          | -    | 1.05 | 1.25 |               |
|                                     |                  | $I_F = 60\text{ A}$ , $T_J = 175\text{ °C}$  | -    | 0.87 | 1.03 |               |
|                                     |                  | $I_F = 60\text{ A}$ , $T_J = 125\text{ °C}$  | -    | 0.93 | 1.10 |               |
| Reverse leakage current             | $I_R$            | $V_R = V_R$ rated                            | -    | -    | 50   | $\mu\text{A}$ |
|                                     |                  | $T_J = 150\text{ °C}$ , $V_R = V_R$ rated    | -    | -    | 2    | mA            |
| Junction capacitance                | $C_T$            | $V_R = 400\text{ V}$                         | -    | 50   | -    | pF            |
| Series inductance                   | $L_S$            | Measured lead to lead 5 mm from package body | -    | 3.5  | -    | nH            |

## FEATURES

- Ultrafast recovery time
- Low forward voltage drop
- 175 °C operating junction temperature
- 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)

## BENEFITS

- Reduced RFI and EMI
- Higher frequency operation
- Reduced snubbing
- Reduced parts count

## DESCRIPTION / APPLICATIONS

These diodes are optimized to reduce losses and EMI/RFI in high frequency power conditioning systems.

The softness of the recovery eliminates the need for a snubber in most applications. These devices are ideally suited for HF welding, power converters and other applications where switching losses are not significant portion of the total losses.

## MECHANICAL DATA

**Case:** TO-247AC 2L, TO-247AC 3L

Molding compound meets UL 94 V-0 flammability rating

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



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

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

| PARAMETER               | SYMBOL    | TEST CONDITIONS                                                                 | MIN. | TYP. | MAX. | UNITS |
|-------------------------|-----------|---------------------------------------------------------------------------------|------|------|------|-------|
| Reverse recovery time   | $t_{rr}$  | $I_F = 1\text{ A}$ , $di_F/dt = 200\text{ A}/\mu\text{s}$ , $V_R = 30\text{ V}$ | -    | 50   | 60   | ns    |
|                         |           | $T_J = 25\text{ }^{\circ}\text{C}$                                              | -    | 85   | -    |       |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                             | -    | 145  | -    |       |
| Peak recovery current   | $I_{RRM}$ | $T_J = 25\text{ }^{\circ}\text{C}$                                              | -    | 8.8  | -    | A     |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                             | -    | 15.4 | -    |       |
| Reverse recovery charge | $Q_{rr}$  | $T_J = 25\text{ }^{\circ}\text{C}$                                              | -    | 375  | -    | nC    |
|                         |           | $T_J = 125\text{ }^{\circ}\text{C}$                                             | -    | 1120 | -    |       |

**THERMAL - MECHANICAL SPECIFICATIONS**

| PARAMETER                                       | SYMBOL     | TEST CONDITIONS                             | MIN.    | TYP. | MAX. | UNITS                       |
|-------------------------------------------------|------------|---------------------------------------------|---------|------|------|-----------------------------|
| Thermal resistance, junction to case            | $R_{thJC}$ |                                             | -       | -    | 0.70 | K/W                         |
| Thermal resistance, junction to ambient per leg | $R_{thJA}$ | Typical socket mount                        | -       | -    | 40   | $^{\circ}\text{C}/\text{W}$ |
| Thermal resistance, case to heatsink            | $R_{thCS}$ | Mounting surface, flat, smooth, and greased | -       | 0.2  | -    | K/W                         |
| Weight                                          |            |                                             | -       | 5.5  | -    | g                           |
|                                                 |            |                                             | -       | 0.2  | -    | oz.                         |
| Mounting torque                                 |            |                                             | 1.2     | -    | 2.4  | N · m                       |
|                                                 |            |                                             | 10      | -    | 20   | lbf · in                    |
| Marking device                                  |            | Case style TO-247AC 2L                      | 60EPU04 |      |      |                             |
|                                                 |            | Case style TO-247AC 3L                      | 60APU04 |      |      |                             |

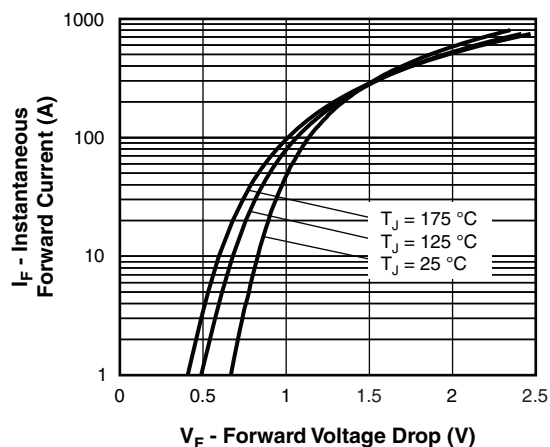


Fig. 1 - Typical Forward Voltage Drop Characteristics

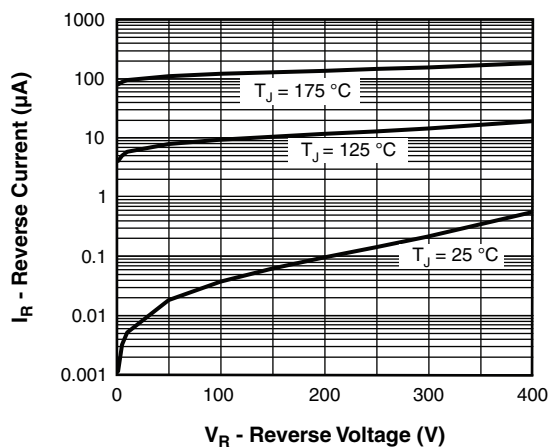


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

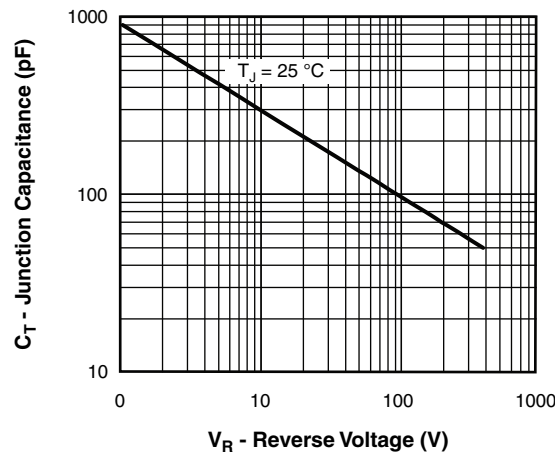


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

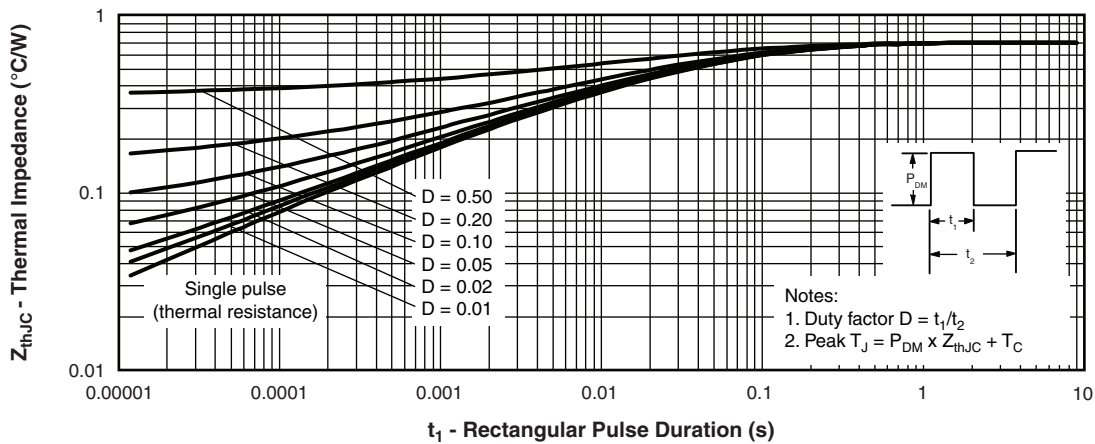
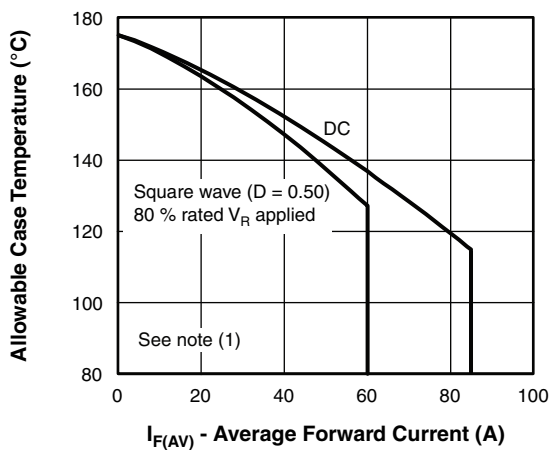

Fig. 4 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics


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

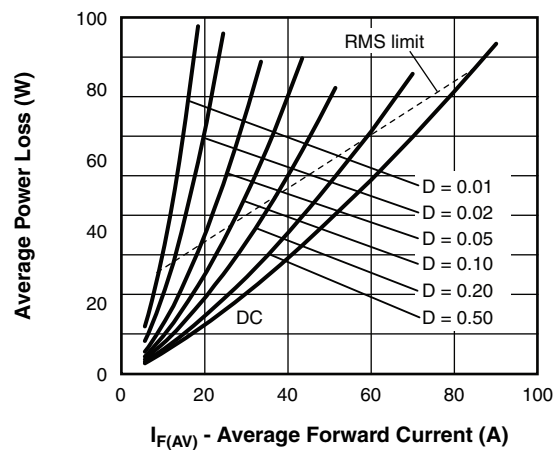


Fig. 6 - Forward Power Loss Characteristics

#### 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  $V_R$

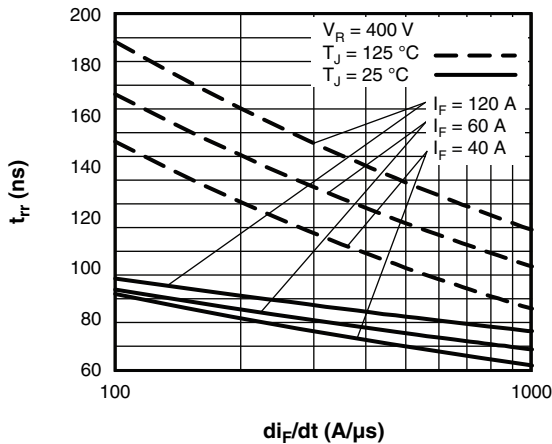
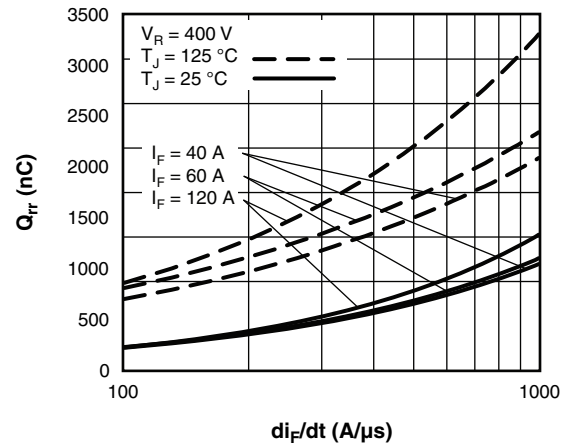
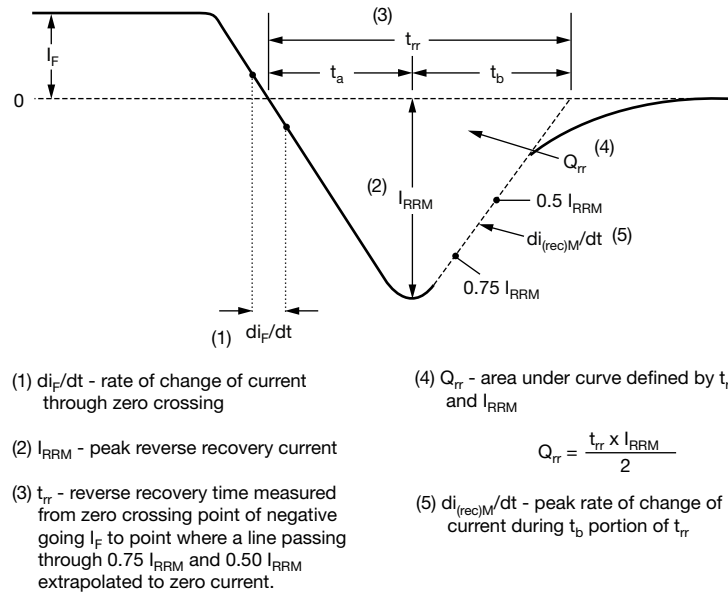

Fig. 7 - Typical Reverse Recovery Time vs.  $di_F/dt$ 

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


Fig. 9 - Reverse Recovery Waveform and Definitions



## ORDERING INFORMATION TABLE

| Device code | VS- | 60 | E | P | U | 04 | -N3                                                                                                                              |
|-------------|-----|----|---|---|---|----|----------------------------------------------------------------------------------------------------------------------------------|
|             | 1   | 2  | 3 | 4 | 5 | 6  | 7                                                                                                                                |
| 1           | -   |    |   |   |   |    | Vishay Semiconductors product                                                                                                    |
| 2           | -   |    |   |   |   |    | Current rating (60 = 60 A)                                                                                                       |
| 3           | -   |    |   |   |   |    | Circuit configuration: <ul style="list-style-type: none"><li>E = single diode, 2 pins</li><li>A = single diode, 3 pins</li></ul> |
| 4           | -   |    |   |   |   |    | Package:<br>P = TO-247AC                                                                                                         |
| 5           | -   |    |   |   |   |    | Type of silicon:<br>U = ultrafast recovery                                                                                       |
| 6           | -   |    |   |   |   |    | Voltage rating (04 = 400 V)                                                                                                      |
| 7           | -   |    |   |   |   |    | Environmental digit:<br>-N3 = halogen-free, RoHS-compliant, and totally lead (Pb)-free                                           |

### ORDERING INFORMATION (Example)

| PREFERRED P/N | QUANTITY PER T/R | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION   |
|---------------|------------------|------------------------|-------------------------|
| VS-60EPU04-N3 | 25               | 500                    | Antistatic plastic tube |
| VS-60APU04-N3 | 25               | 500                    | Antistatic plastic tube |

### LINKS TO RELATED DOCUMENTS

|                          |             |                                                                        |
|--------------------------|-------------|------------------------------------------------------------------------|
| Dimensions               | TO-247AC 2L | <a href="http://www.vishay.com/doc?96144">www.vishay.com/doc?96144</a> |
|                          | TO-247AC 3L | <a href="http://www.vishay.com/doc?96138">www.vishay.com/doc?96138</a> |
| Part marking information | TO-247AC 2L | <a href="http://www.vishay.com/doc?95648">www.vishay.com/doc?95648</a> |
|                          | TO-247AC 3L | <a href="http://www.vishay.com/doc?95007">www.vishay.com/doc?95007</a> |
| SPICE model              |             | <a href="http://www.vishay.com/doc?96899">www.vishay.com/doc?96899</a> |



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