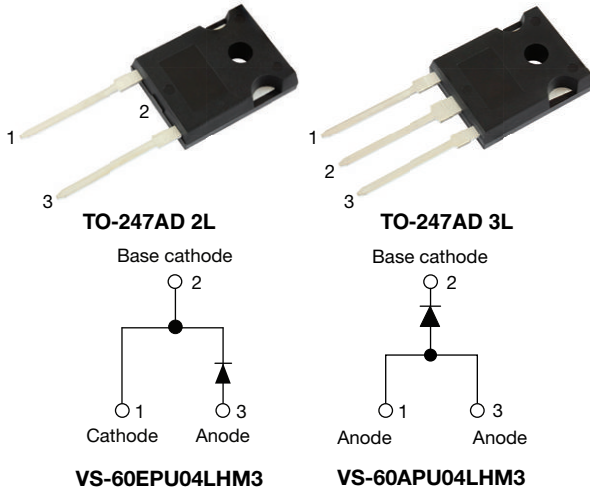


Ultrafast Soft Recovery Diode, 60 A FRED Pt®



FEATURES

- Ultrafast recovery time
- Low forward voltage drop
- 175 °C operating junction temperature
- AEC-Q101 qualified, meets JESD 201 class 1A whisker test
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE

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-247AD 2L, TO-247AD 3L

Molding compound meets UL 94 V-0 flammability rating

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

LINKS TO ADDITIONAL RESOURCES



PRIMARY CHARACTERISTICS

| | |
|-----------------------|--------------------------|
| $I_{F(AV)}$ | 60 A |
| V_R | 400 V |
| V_F at I_F | 0.87 V |
| t_{rr} typ. | 50 ns |
| T_J max. | 175 °C |
| Package | TO-247AD 2L, TO-247AD 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} | $T_C = 25\text{ °C}$ | 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 | μA |
| | | $T_J = 150\text{ °C}, V_R = V_R$ 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 |



| 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 | - | 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, case to heatsink | R_{thCS} | Mounting surface, flat, smooth, and greased | - | 0.2 | - | |
| Weight | | | - | 5.5 | - | g |
| | | | - | 0.2 | - | oz. |
| Mounting torque | | | 1.2 (10) | - | 2.4 (20) | N · m (lbf · in) |
| | | | | | | |
| Marking device | | Case style TO-247AD 2L | 60EPU04LH | | | |
| | | Case style TO-247AD 3L | 60APU04LH | | | |

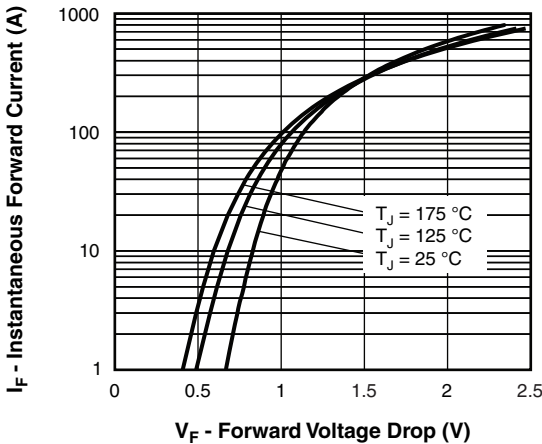


Fig. 1 - Typical Forward Voltage Drop Characteristics

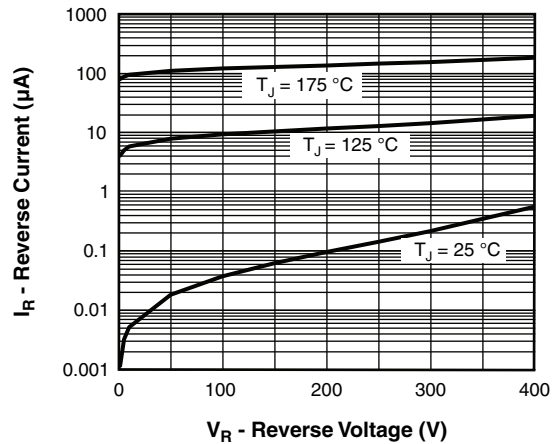


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

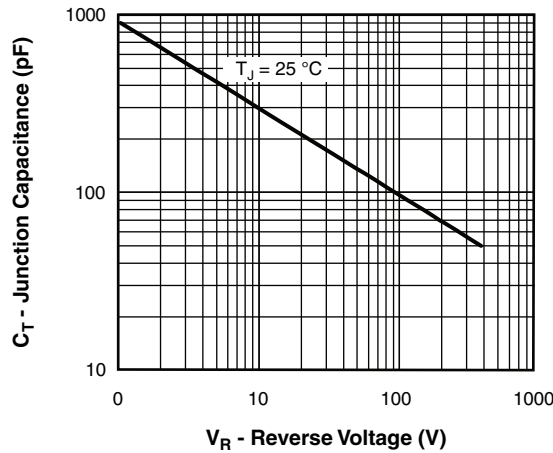


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

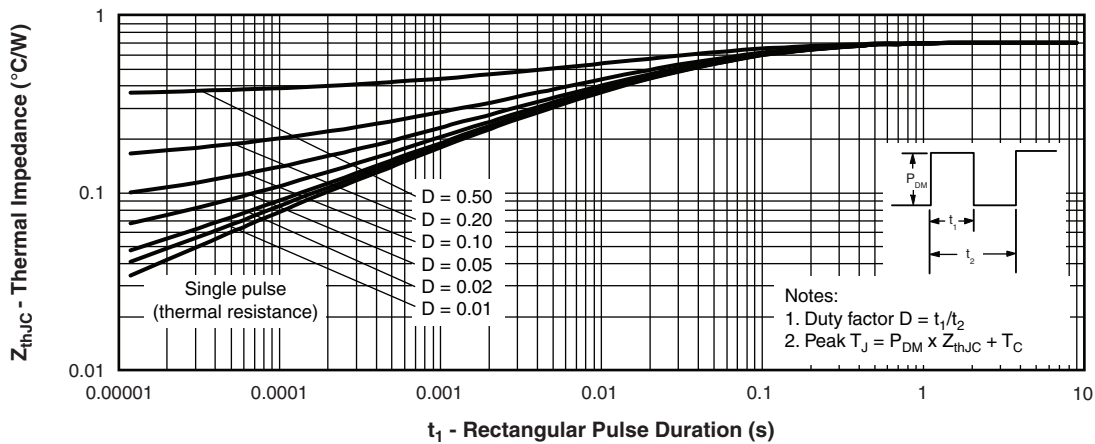


Fig. 4 - Maximum Thermal Impedance Z_{thJC} Characteristics

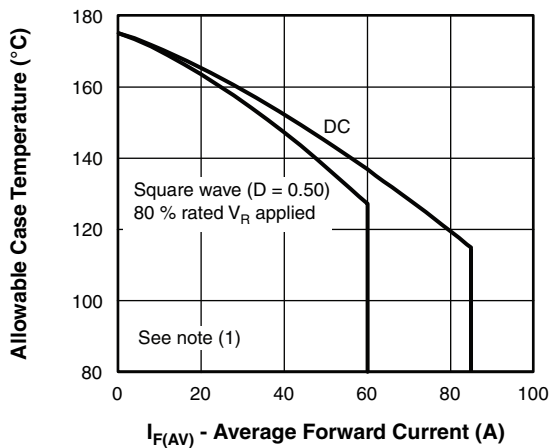


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

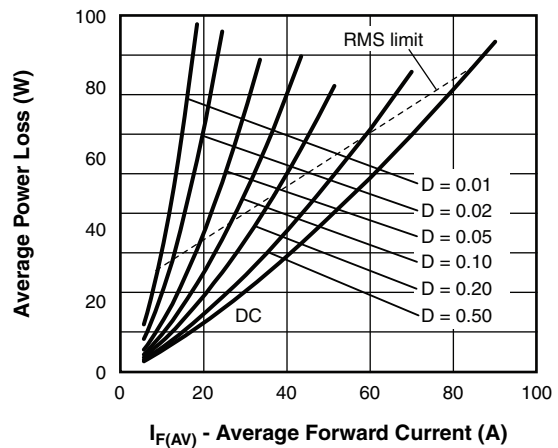


Fig. 6 - Forward Power Loss Characteristics

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

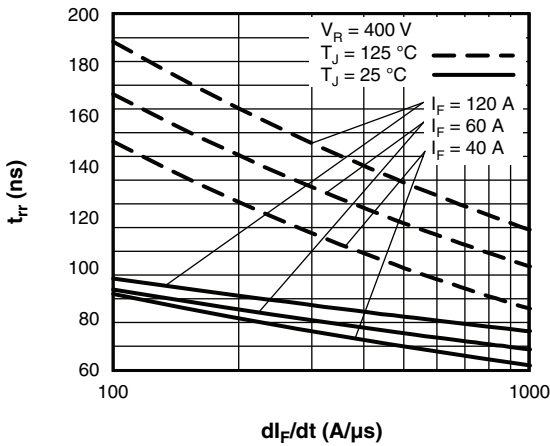


Fig. 7 - Typical Reverse Recovery Time vs. di_F/dt

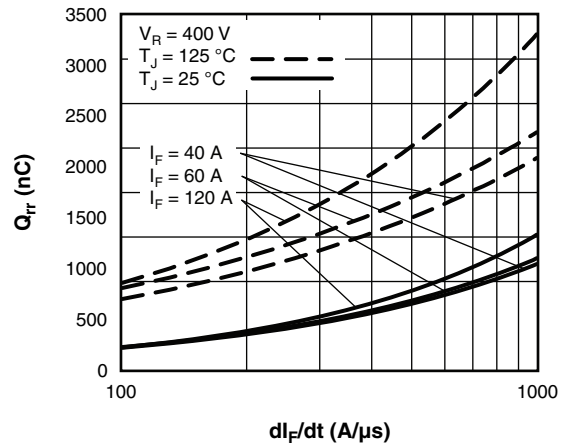


Fig. 8 - Typical Stored Charge vs. di_F/dt

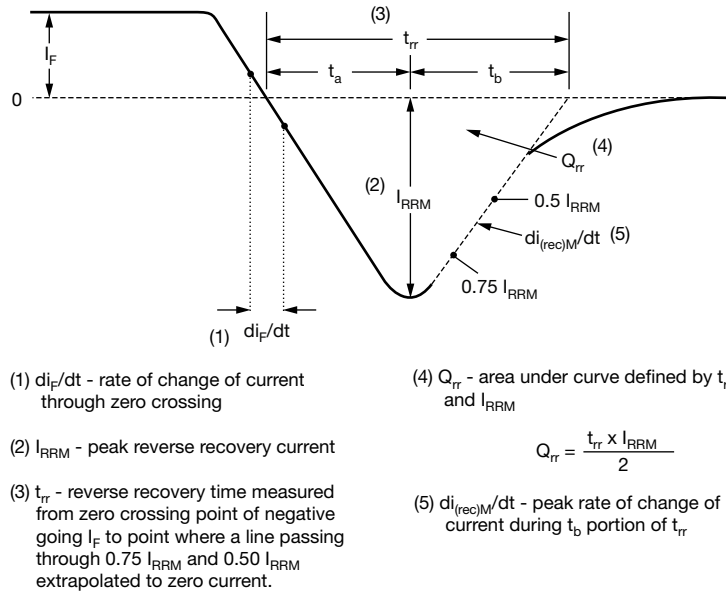
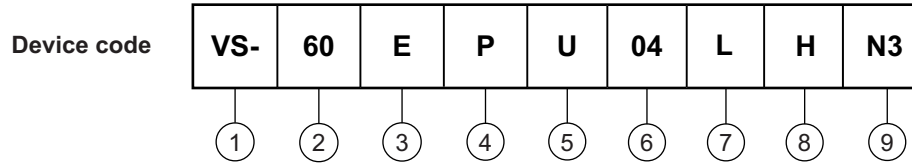


Fig. 9 - Reverse Recovery Waveform and Definitions



ORDERING INFORMATION TABLE



- 1** - Vishay Semiconductors product
- 2** - Current rating (60 = 60 A)
- 3** - Circuit configuration:
 - E = single diode
 - A = single diode, 3 pins
- 4** - Package:
 - P = TO-247AC (modified)
- 5** - Type of silicon:
 - U = ultrafast recovery
- 6** - Voltage rating (04 = 400 V)
- 7** - L = long lead (TO-247AD)
- 8** - H = AEC-Q101 qualified
- 9** - 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-60EPU04LHN3 | 25 | 500 | Antistatic plastic tube |
| VS-60APU04LHN3 | 25 | 500 | Antistatic plastic tube |

| LINKS TO RELATED DOCUMENTS | | |
|----------------------------|-------------|--|
| Dimensions | TO-247AD 2L | www.vishay.com/doc?95536 |
| | TO-247AD 3L | www.vishay.com/doc?95626 |
| Part marking information | TO-247AD 2L | www.vishay.com/doc?95648 |
| | TO-247AD 3L | www.vishay.com/doc?95007 |
| SPIICE model | | www.vishay.com/doc?96899 |

TO-247AD 3L

DIMENSIONS in millimeters and inches



| SYMBOL | MILLIMETERS | | INCHES | | NOTES | SYMBOL | MILLIMETERS | | INCHES | | NOTES |
|--------|-------------|-------|--------|-------|-------|--------|-------------|-------|-----------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. | | | MIN. | MAX. | MIN. | MAX. | |
| A | 4.65 | 5.31 | 0.183 | 0.209 | | D2 | 0.51 | 1.30 | 0.020 | 0.051 | |
| A1 | 2.21 | 2.59 | 0.087 | 0.102 | | E | 15.29 | 15.87 | 0.602 | 0.625 | 3 |
| A2 | 1.50 | 2.49 | 0.059 | 0.098 | | E1 | 13.46 | - | 0.53 | - | |
| b | 0.99 | 1.40 | 0.039 | 0.055 | | e | 5.46 BSC | | 0.215 BSC | | |
| b1 | 0.99 | 1.35 | 0.039 | 0.053 | | Ø K | 0.254 | | 0.010 | | |
| b2 | 1.65 | 2.39 | 0.065 | 0.094 | | L | 19.81 | 20.32 | 0.780 | 0.800 | |
| b3 | 1.65 | 2.34 | 0.065 | 0.092 | | L1 | 3.71 | 4.29 | 0.146 | 0.169 | |
| b4 | 2.59 | 3.43 | 0.102 | 0.135 | | Ø P | 3.56 | 3.66 | 0.14 | 0.144 | |
| b5 | 2.59 | 3.38 | 0.102 | 0.133 | | Ø P1 | - | 6.98 | - | 0.275 | |
| c | 0.38 | 0.89 | 0.015 | 0.035 | | Q | 5.31 | 5.69 | 0.209 | 0.224 | |
| c1 | 0.38 | 0.84 | 0.015 | 0.033 | | R | 4.52 | 5.49 | 0.178 | 0.216 | |
| D | 19.71 | 20.70 | 0.776 | 0.815 | 3 | S | 5.51 BSC | | 0.217 BSC | | |
| D1 | 13.08 | - | 0.515 | - | 4 | | | | | | |

Notes

- (1) Dimensioning and tolerancing per ASME Y14.5M-1994
- (2) Contour of slot optional
- (3) Dimension D and E do not include mold flash. These dimensions are measured at the outermost extremes of the plastic body
- (4) Thermal pad contour optional with dimensions D1 and E1
- (5) Lead finish uncontrolled in L1
- (6) Ø 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")
- (7) 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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