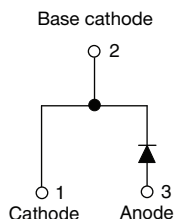
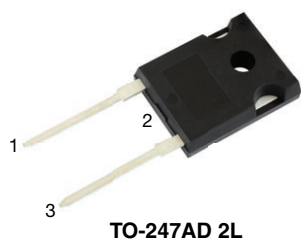


Hyperfast Rectifier, 60 A FRED Pt® G5



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
- AEC-Q101 qualified, meets JESD 201 class 2 whisker test
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE

LINKS TO ADDITIONAL RESOURCES



PRIMARY CHARACTERISTICS

| | |
|--------------------------|-------------|
| $I_{F(AV)}$ | 60 A |
| V_R | 1200 V |
| V_F at I_F at 125 °C | 1.7 V |
| t_{rr} | 38 ns |
| T_J max. | 175 °C |
| Package | TO-247AD 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-247AD 2L

Molding compound meets UL 94 V-0 flammability rating

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

ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | UNITS |
|--|-------------------|--|-------------|-------|
| Repetitive peak reverse voltage | V_{RRM} | | 1200 | V |
| Average rectified forward current | $I_{F(AV)}$ | $T_C = 111\text{ °C}$, $D = 0.50$ | 60 | A |
| Non-repetitive peak surge current | I_{FSM} | $T_C = 45\text{ °C}$, $t_p = 10\text{ ms}$, sine wave | 425 | |
| Repetitive peak forward current | I_{FRM} | $T_C = 111\text{ °C}$, $D = 0.50$, $f = 20\text{ kHz}$ | 120 | |
| 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 | $I_F = 60\text{ A}$ | - | 1.9 | 2.5 | |
| | | $I_F = 60\text{ A}$, $T_J = 125\text{ °C}$ | - | 1.7 | - | |
| Reverse leakage current | I_R | $V_R = V_R$ rated | - | - | 50 | μA |
| | | $T_J = 125\text{ °C}$, $V_R = V_R$ rated | - | - | 500 | |
| Junction capacitance | C_T | $V_R = 200\text{ V}$ | - | 32 | - | pF |
| Series inductance | L_S | Measured 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} | $I_F = 1.0\text{ A}$, $di_F/dt = 100\text{ A}/\mu\text{s}$, $V_R = 30\text{ V}$ | - | 38 | - | ns |
| | | $T_J = 25\text{ }^{\circ}\text{C}$ | - | 130 | - | |
| | | $T_J = 125\text{ }^{\circ}\text{C}$ | - | 200 | - | |
| Peak recovery current | I_{RRM} | $T_J = 25\text{ }^{\circ}\text{C}$ | - | 22 | - | A |
| | | $T_J = 125\text{ }^{\circ}\text{C}$ | - | 39 | - | |
| Reverse recovery charge | Q_{rr} | $T_J = 25\text{ }^{\circ}\text{C}$ | - | 1610 | - | nC |
| | | $T_J = 125\text{ }^{\circ}\text{C}$ | - | 4080 | - | |
| Reverse recovery time | t_{rr} | $T_J = 25\text{ }^{\circ}\text{C}$ | - | 100 | - | ns |
| | | $T_J = 125\text{ }^{\circ}\text{C}$ | - | 153 | - | |
| Peak recovery current | I_{RRM} | $T_J = 25\text{ }^{\circ}\text{C}$ | - | 40 | - | A |
| | | $T_J = 125\text{ }^{\circ}\text{C}$ | - | 67 | - | |
| Reverse recovery charge | Q_{rr} | $T_J = 25\text{ }^{\circ}\text{C}$ | - | 2590 | - | nC |
| | | $T_J = 125\text{ }^{\circ}\text{C}$ | - | 6150 | - | |

| THERMAL - MECHANICAL SPECIFICATIONS | | | | | | |
|--|-------------------|------------------------|--------------|------|------------|-----------------------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Thermal resistance, junction-to-case | R_{thJC} | | - | - | 0.4 | $^{\circ}\text{C}/\text{W}$ |
| Weight | | | - | 5.5 | - | g |
| Mounting torque | | | 6.0 (5.0) | - | 12 (10) | kgf · cm (lbf · in) |
| Maximum junction and storage temperature range | T_J , T_{Stg} | | -55 | - | 175 | $^{\circ}\text{C}$ |
| Marking device | | Case style TO-247AD 2L | E5PH6012LH | | | |

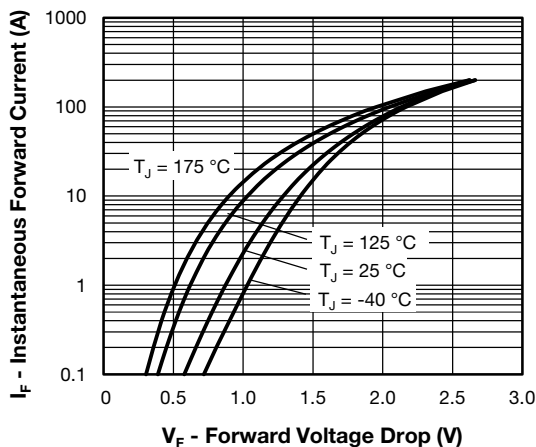


Fig. 1 - Typical Forward Voltage Drop Characteristics

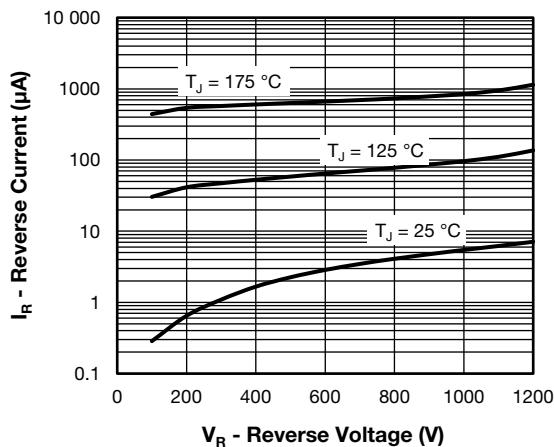


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

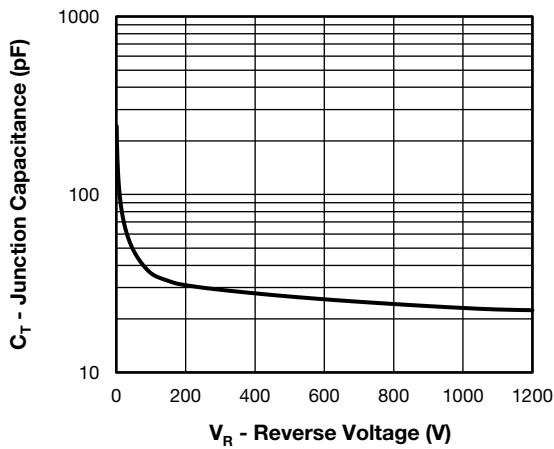


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

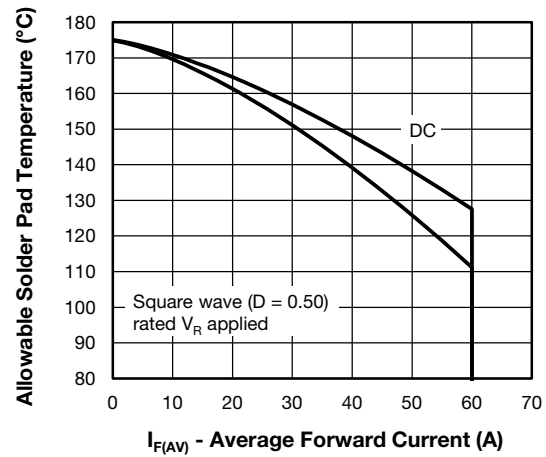
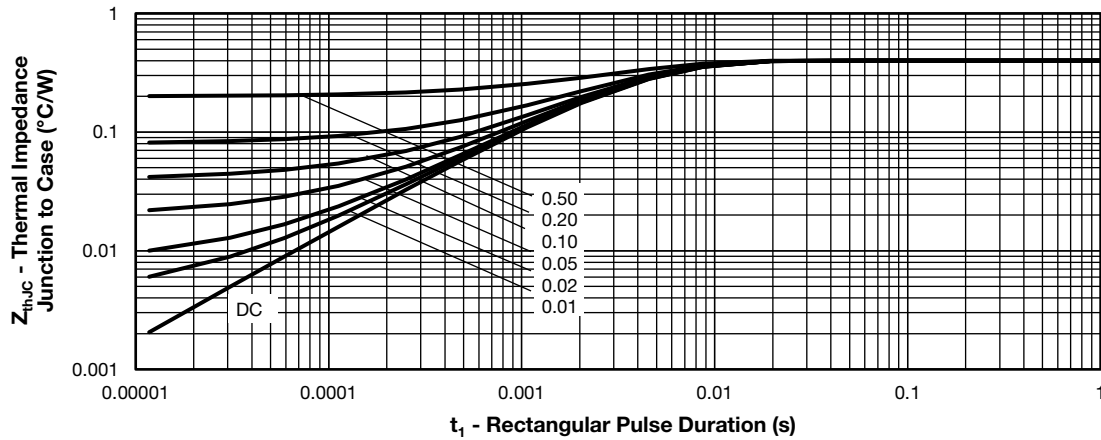
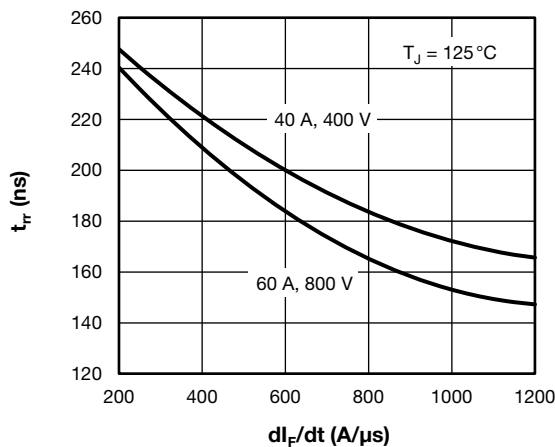
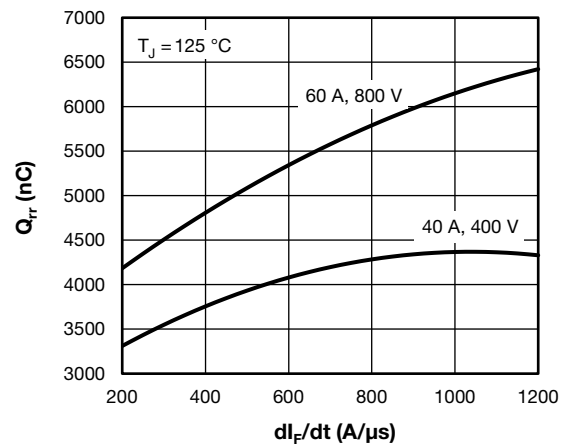


Fig. 4 - Maximum Allowable Case Temperature vs. Average Forward Current


Fig. 5 - Thermal Impedance Z_{thJC} Characteristics

Fig. 6 - Typical Reverse Recovery Time vs. dI_F/dt

Fig. 7 - Typical Stored Charge vs. dI_F/dt

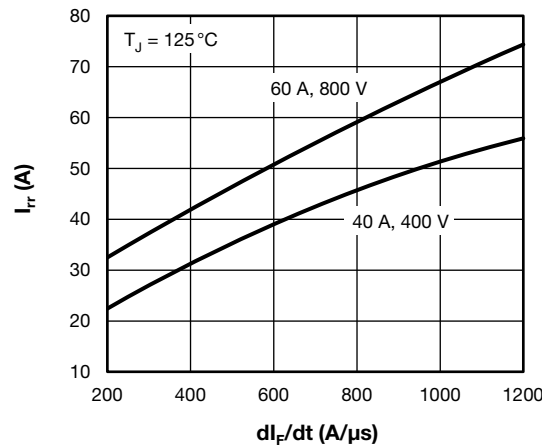


Fig. 8 - Typical Recovery Current vs. di_F/dt

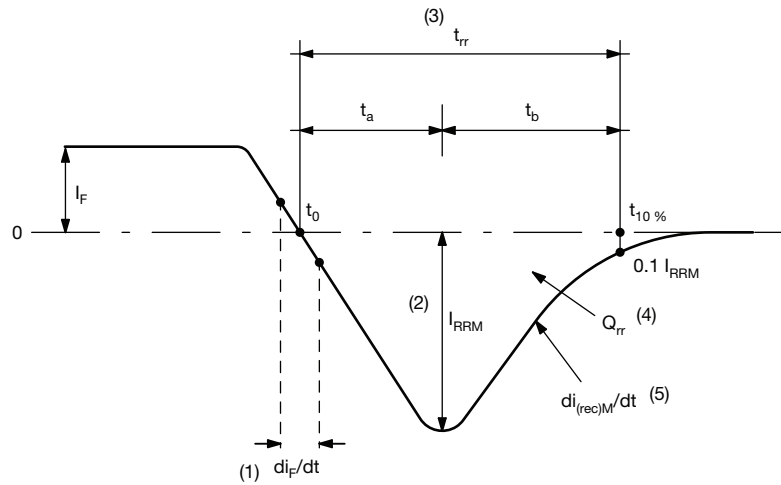


Fig. 9 - Reverse Recovery Waveform and Definitions

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



ORDERING INFORMATION TABLE

| | | | | | | | | | | |
|-------------|---|---|---|---|---|----|----|---|---|----|
| Device code | VS- | E | 5 | P | H | 60 | 12 | L | H | N3 |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | - Vishay Semiconductors product | | | | | | | | | |
| 2 | - Circuit configuration: E = single diode, 2 pins | | | | | | | | | |
| 3 | - FRED Pt Gen 5 | | | | | | | | | |
| 4 | - P = TO-247 package | | | | | | | | | |
| 5 | - Process type: H = hyperfast recovery | | | | | | | | | |
| 6 | - Current rating (60 = 60 A) | | | | | | | | | |
| 7 | - Voltage rating (12 = 1200 V) | | | | | | | | | |
| 8 | - L = long lead | | | | | | | | | |
| 9 | - H = AEC-Q101 qualified | | | | | | | | | |
| 10 | - Environmental digit: N3 = halogen-free, RoHS-compliant, and totally lead (Pb)-free | | | | | | | | | |

ORDERING INFORMATION (Example)

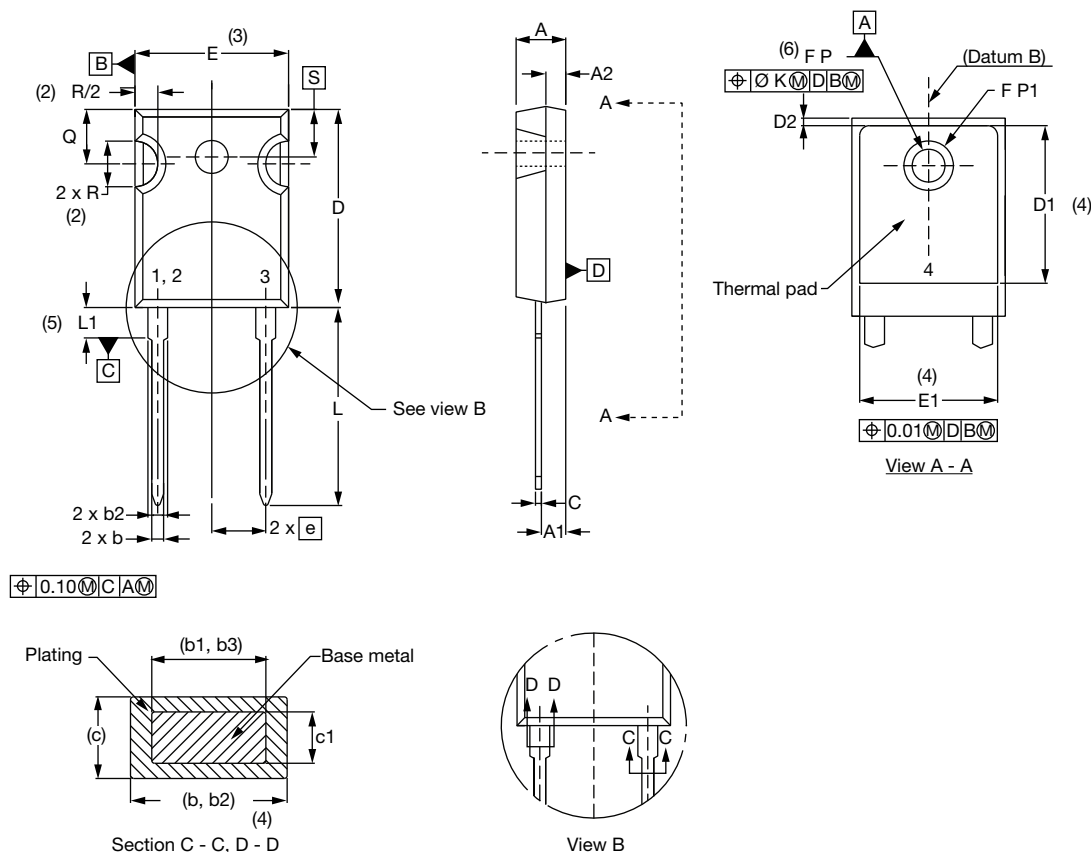
| PREFERRED P/N | QUANTITY PER TUBE | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION |
|-----------------|-------------------|------------------------|-------------------------|
| VS-E5PH6012LHN3 | 25 | 500 | Antistatic plastic tube |

LINKS TO RELATED DOCUMENTS

| | |
|--------------------------|--|
| Dimensions | www.vishay.com/doc?95536 |
| Part marking information | www.vishay.com/doc?95648 |
| SPICE model | www.vishay.com/doc?97086 |

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 | | |
| Ø K | 0.254 | | 0.010 | | |
| L | 19.81 | 20.32 | 0.780 | 0.800 | |
| L1 | 3.71 | 4.29 | 0.146 | 0.169 | |
| Ø P | 3.56 | 3.66 | 0.14 | 0.144 | |
| Ø 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

- (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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