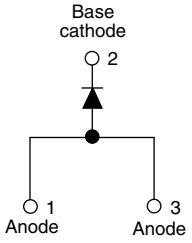
# Hyperfast Rectifier, 60 A FRED Pt®


TO-247AD 3L




## FEATURES

- Hyperfast recovery time
- Low forward voltage drop
- Low leakage current
- Soft recovery device
- 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

Pb-free

RoHS COMPLIANT

HALOGEN FREE

## DESCRIPTION / APPLICATIONS

VS-60APH03L-N3 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 PDP and use in the output rectification stage for SMPS, UPS, DC/DC converters as well as freewheeling diodes in low voltage inverters.

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

| PRIMARY CHARACTERISTICS | |
|---|---|
| $I_{F(AV)}$ | 60 A |
| $V_R$ | 300 V |
| $V_F$ at $I_F$ | 0.85 V |
| $t_{rr}$ typ. | 28 ns |
| $T_J$ max. | 175 °C |
| Package | TO-247AD 3L |
| Circuit configuration | Single |

| ABSOLUTE MAXIMUM RATINGS | | | | |
|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | UNITS |
| Cathode to anode voltage | $V_R$ | | 300 | V |
| Continuous forward current | $I_{F(AV)}$ | $T_C$ = 103 °C | 60 | A |
| Single pulse forward current | $I_{FSM}$ | $T_J$ = 25 °C, $t_p$ = 10 ms | 450 | |
| Operating junction and storage temperatures | $T_J$, $T_{Stg}$ | | -55 to +175 | °C |

| ELECTRICAL SPECIFICATIONS ($T_J$ = 25 °C unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Breakdown voltage, blocking voltage | $V_{BR}$, $V_R$ | $I_R$ = 100 µA | 300 | - | - | V |
| Forward voltage | $V_F$ | $I_F$ = 30 A | - | 1.0 | 1.25 | |
| | | $I_F$ = 60 A | - | - | 1.45 | |
| | | $I_F$ = 30 A, $T_J$ = 125 °C | - | 0.85 | 1.10 | |
| | | $I_F$ = 60 A, $T_J$ = 125 °C | - | - | 1.30 | |
| Reverse leakage current | $I_R$ | $V_R$ = $V_R$ rated | - | - | 10 | µA |
| | | $T_J$ = 125 °C, $V_R$ = $V_R$ rated | - | - | 100 | |
| Junction capacitance | $C_T$ | $V_R$ = 300 V | - | 70 | - | pF |
| Series inductance | $L_S$ | Measured lead to lead 5 mm from package body | - | 3.5 | - | nH |

| DYNAMIC RECOVERY CHARACTERISTICS ($T_J$ = 25 °C unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNITS |
| Reverse recovery time | $t_{rr}$ | $I_F$ = 1.0 A, $dI_F/dt$ = 100 A/µs, $V_R$ = 30 V | | - | 28 | - | ns |
| | | $I_F$ = 1.0 A, $dI_F/dt$ = 50 A/µs, $V_R$ = 30 V | | - | 34 | - | |
| | | $T_J$ = 25 °C | $I_F$ = 60 A<br>$dI_F/dt$ = 200 A/µs<br>$V_R$ = 200 V | - | 42 | - | |
| | | $T_J$ = 125 °C | | - | 64 | - | |
| Peak recovery current | $I_{RRM}$ | $T_J$ = 25 °C | | - | 3.0 | - | A |
| | | $T_J$ = 125 °C | | - | 8.5 | - | |
| Reverse recovery charge | $Q_{rr}$ | $T_J$ = 25 °C | | - | 65 | - | nC |
| | | $T_J$ = 125 °C | | - | 273 | - | |

| THERMAL - MECHANICAL SPECIFICATIONS | | | | | | |
|---|---|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Maximum junction and storage temperature range | $T_J$, $T_{Stg}$ | | -55 | - | 175 | °C |
| Thermal resistance, junction to case | $R_{thJC}$ | | - | 0.56 | 0.80 | °C/W |
| Thermal resistance, junction to ambient | $R_{thJA}$ | Typical socket mount | - | - | 40 | |
| Typical thermal resistance, case to heatsink | $R_{thCS}$ | Mounting surface, flat, smooth, and greased | - | 0.4 | - | |
| Approximate Weight | | | - | 6.0 | - | g |
| | | | - | 0.22 | - | oz. |
| Mounting torque | | | 6.0 | - | 12 | kgf. cm |
| | | | (12) | - | (10) | (lbf.in) |
| Marking device | | Case style TO-247AD 3L | 60APH03L | | | |

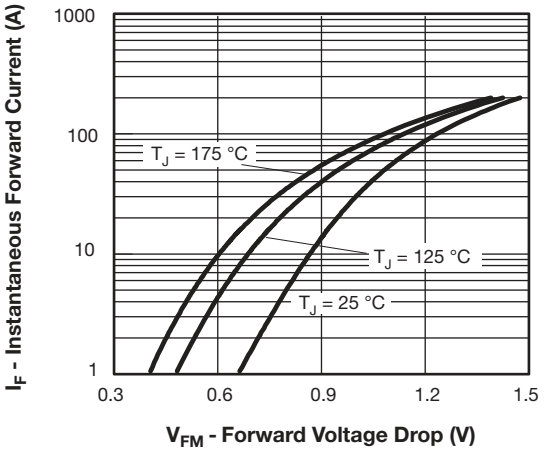



Fig. 1 - Typical Forward Voltage Drop Characteristics

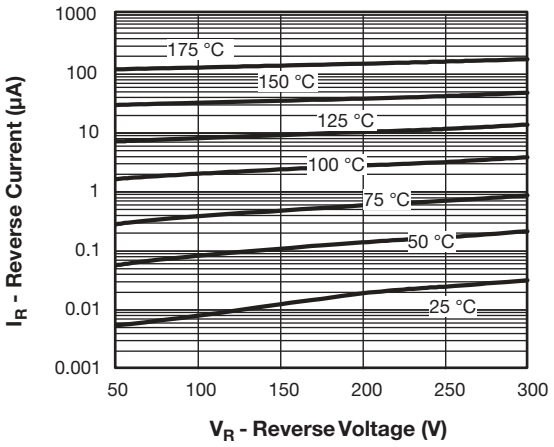



Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

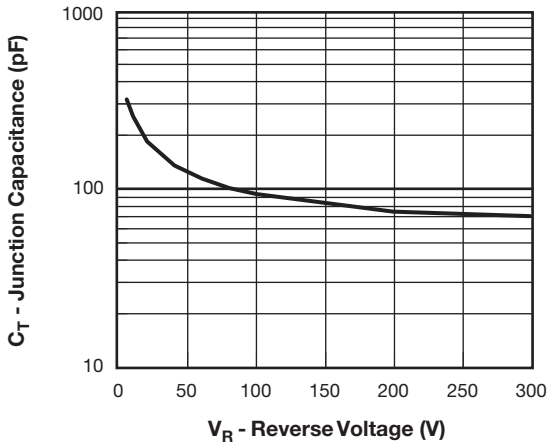



Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

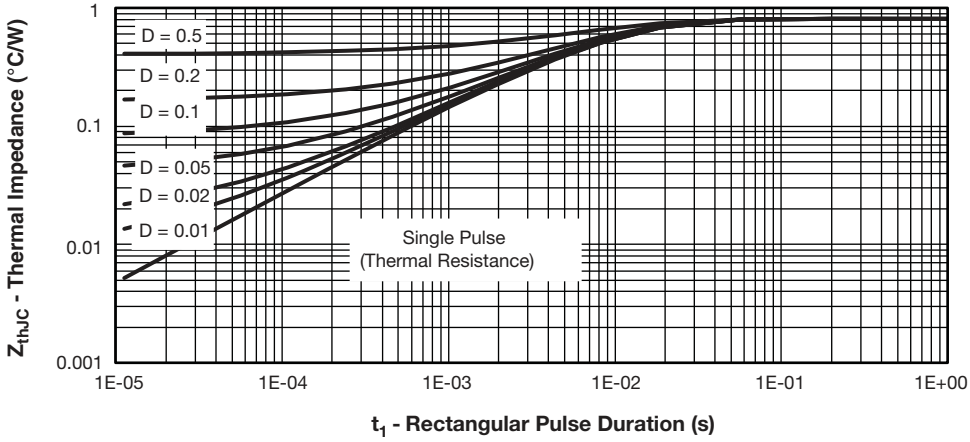



Fig. 4 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics

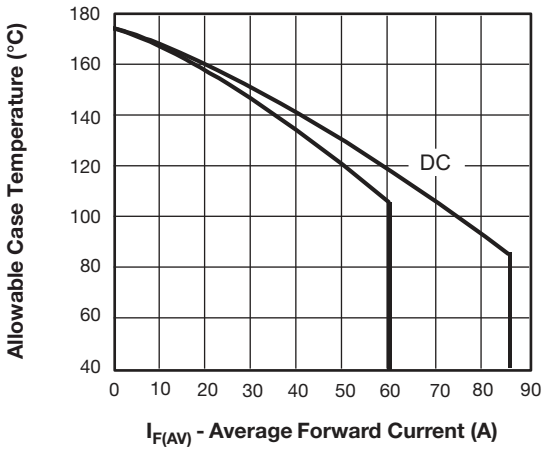



Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

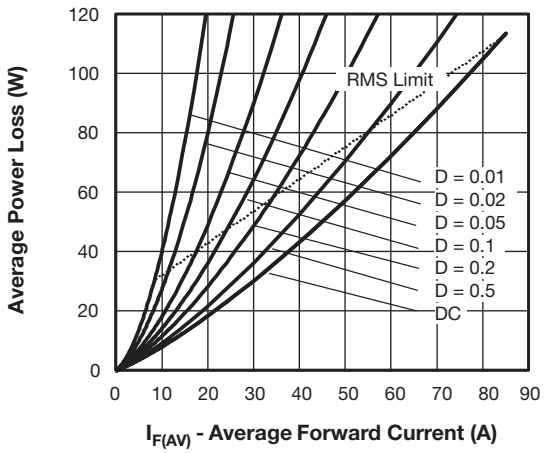



Fig. 6 - Forward Power Loss Characteristics

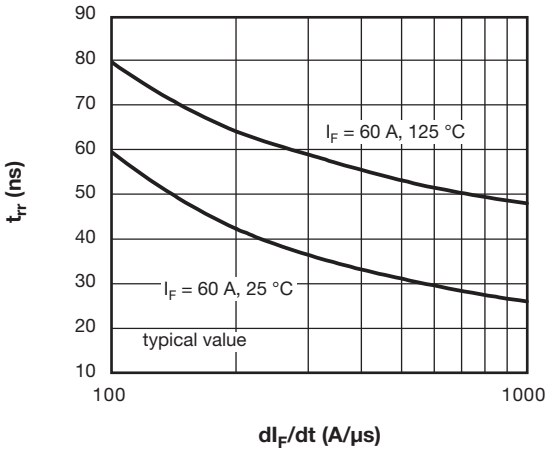



Fig. 7 - Typical Reverse Recovery vs. $dI_F/dt$

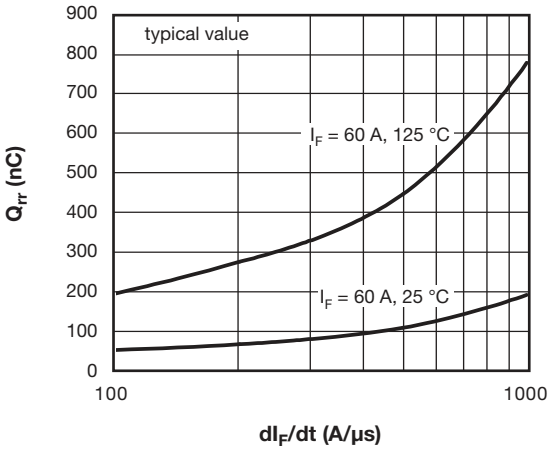
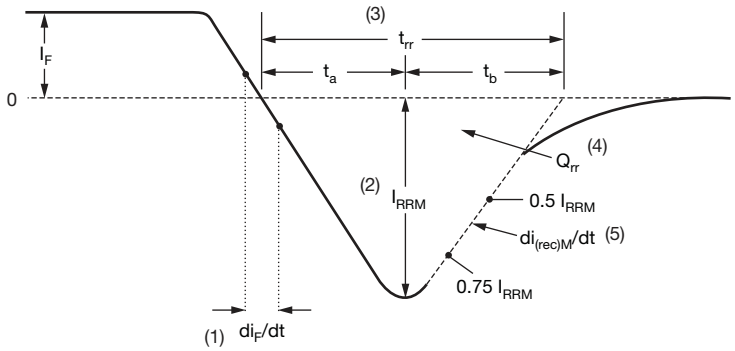



Fig. 8 - Typical Stored Charge vs. $dI_F/dt$




(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 zero crossing point of negative going $I_F$ to point where a line passing through 0.75 $I_{RRM}$ and 0.50 $I_{RRM}$ extrapolated to zero current.

(4) $Q_{rr}$ - area under curve defined by $t_{rr}$ and $I_{RRM}$

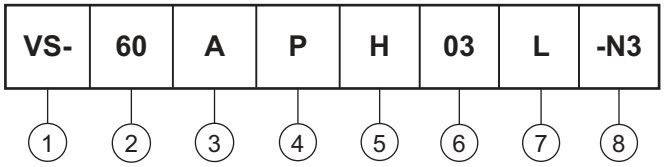
$$Q_{rr} = \frac{t_{rr} \times I_{RRM}}{2}$$

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

Fig. 9 - Reverse Recovery Waveform and Definitions

## ORDERING INFORMATION TABLE

Device code



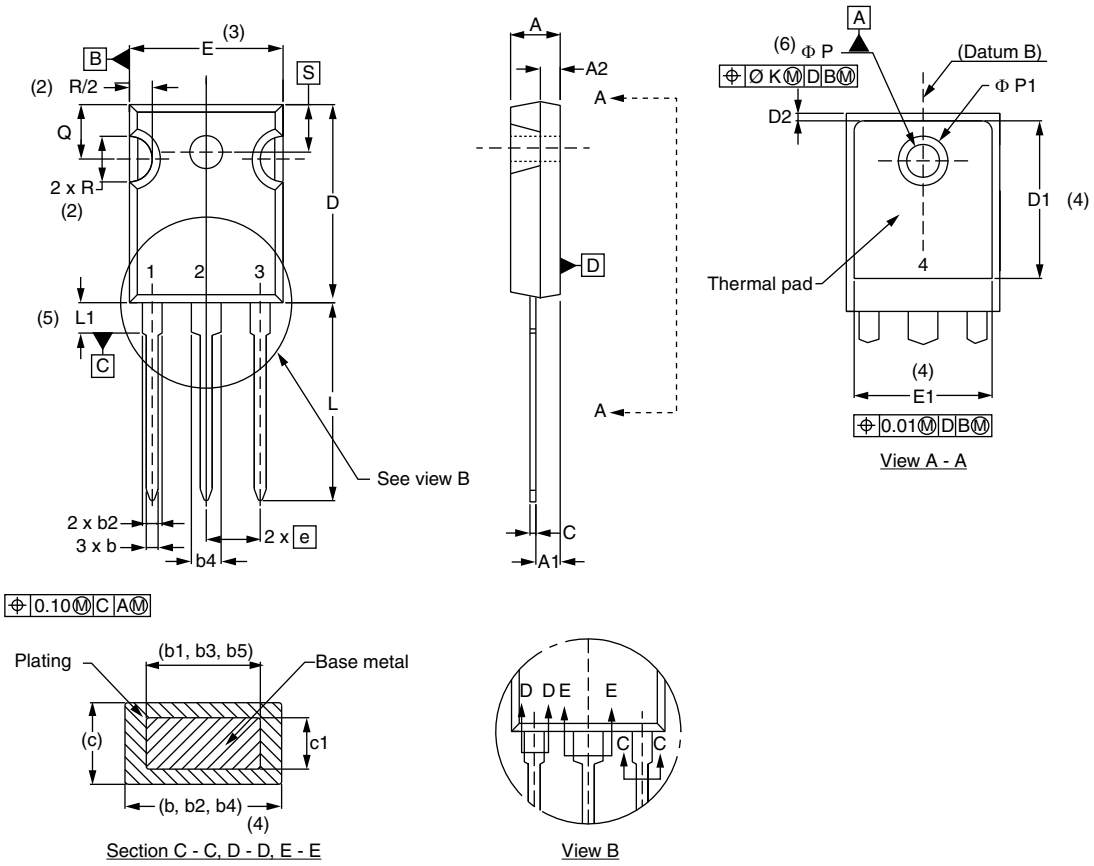

1 - Vishay Semiconductors product
2 - Current rating (60 = 60 A)
3 - Circuit configuration:
A = single diode
4 - P = TO-247
5 - H = hyperfast rectifier
6 - Voltage code (03 = 300 V)
7 - L = long lead
8 - -N3 = halogen-free, RoHS-compliant, and totally lead (Pb)-free

| **ORDERING INFORMATION** (Example) | | | |
|---|---|---|---|
| **PREFERRED P/N** | **QUANTITY PER TUBE** | **MINIMUM ORDER QUANTITY** | **PACKAGING DESCRIPTION** |
| VS-60APH03L-N3 | 25 | 500 | Antistatic plastic tube |

| **LINKS TO RELATED DOCUMENTS** | |
|---|---|
| Dimensions | www.vishay.com/doc?95626 |
| Part marking information | www.vishay.com/doc?95007 |
| SPICE model | www.vishay.com/doc?96075 |

# TO-247AD 3L

**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 | |
| b4 | 2.59 | 3.43 | 0.102 | 0.135 | |
| b5 | 2.59 | 3.38 | 0.102 | 0.133 | |
| 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 |

| SYMBOL | MILLIMETERS | | INCHES | | NOTES |
|---|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. | |
| D2 | 0.51 | 1.30 | 0.020 | 0.051 | |
| 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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