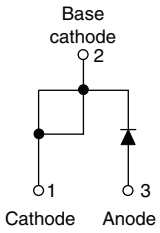
# HEXFRED®
# Ultrasoft Soft Recovery Diode, 16 A




**TO-220AC**

## FEATURES

- Ultrafast and ultrasoft recovery
- Very low $I_{RRM}$ and $Q_{rr}$
- Compliant to RoHS Directive 2002/95/EC
- Designed and qualified for industrial level

Pb-free

e3

RoHS COMPLIANT

## BENEFITS

- Reduced RFI and EMI
- Reduced power loss in diode and switching transistor
- Higher frequency operation
- Reduced snubbing
- Reduced parts count

## DESCRIPTION

VS-HFA16TB120PbF is a state of the art ultrafast recovery diode. Employing the latest in epitaxial construction and advanced processing techniques it features a superb combination of characteristics which result in performance which is unsurpassed by any rectifier previously available. With basic ratings of 1200 V and 16 A continuous current, the VS-HFA16TB120PbF is especially well suited for use as the companion diode for IGBTs and MOSFETs. In addition to ultrafast recovery time, the HEXFRED® product line features extremely low values of peak recovery current ($I_{RRM}$) and does not exhibit any tendency to "snap-off" during the $t_b$ portion of recovery. The HEXFRED features combine to offer designers a rectifier with lower noise and significantly lower switching losses in both the diode and the switching transistor. These HEXFRED advantages can help to significantly reduce snubbing, component count and heatsink sizes. The HEXFRED VS-HFA16TB120PbF is ideally suited for applications in power supplies and power conversion systems (such as inverters), motor drives, and many other similar applications where high speed, high efficiency is needed.

| PRODUCT SUMMARY | |
|---|---|
| Package | TO-220AC |
| $I_{F(AV)}$ | 16 A |
| $V_R$ | 1200 V |
| $V_F$ at $I_F$ | 3.0 V |
| $t_{rr}$ (typ.) | 30 ns |
| $T_J$ max. | 150 °C |
| Diode variation | Single die |

| ABSOLUTE MAXIMUM RATINGS | | | | |
|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **VALUES** | **UNITS** |
| Cathode to anode voltage | $V_R$ | | 1200 | V |
| Maximum continuous forward current | $I_F$ | $T_C$ = 100 °C | 16 | A |
| Single pulse forward current | $I_{FSM}$ | | 190 | |
| Maximum repetitive forward current | $I_{FRM}$ | | 64 | |
| Maximum power dissipation | $P_D$ | $T_C$ = 25 °C | 151 | W |
| | | $T_C$ = 100 °C | 60 | |
| Operating junction and storage temperature range | $T_J$, $T_{Stg}$ | | - 55 to + 150 | °C |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DiodesAmericas@vishay.com, DiodesAsia@vishay.com, DiodesEurope@vishay.com

| **ELECTRICAL SPECIFICATIONS** ($T_J$ = 25 °C unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Cathode to anode breakdown voltage | $V_{BR}$ | $I_R$ = 100 µA | | 1200 | - | - | V |
| Maximum forward voltage | $V_{FM}$ | $I_F$ = 16 A | See fig. 1 | - | 2.5 | 3.0 | |
| | | $I_F$ = 32 A | | - | 3.2 | 3.93 | |
| | | $I_F$ = 16 A, $T_J$ = 125 °C | | - | 2.3 | 2.7 | |
| Maximum reverse leakage current | $I_{RM}$ | $V_R$ = $V_R$ rated | See fig. 2 | - | 0.75 | 20 | µA |
| | | $T_J$ = 125 °C, $V_R$ = 0.8 x $V_R$ rated | | - | 375 | 2000 | |
| Junction capacitance | $C_T$ | $V_R$ = 200 V | See fig. 3 | - | 27 | 40 | pF |
| Series inductance | $L_S$ | Measured lead to lead 5 mm from package body | | - | 8.0 | - | nH |

| **DYNAMIC RECOVERY CHARACTERISTICS** ($T_J$ = 25 °C unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Reverse recovery time See fig. 5 and 10 | $t_{rr}$ | $I_F$ = 1.0 A, $dI_F/dt$ = 200 A/µs, $V_R$ = 30 V | | - | 30 | - | ns |
| | $t_{rr1}$ | $T_J$ = 25 °C | $I_F$ = 16 A<br>$dI_F/dt$ = 200 A/µs<br>$V_R$ = 200 V | - | 90 | 135 | |
| | $t_{rr2}$ | $T_J$ = 125 °C | | - | 164 | 245 | |
| Peak recovery current See fig. 6 | $I_{RRM1}$ | $T_J$ = 25 °C | | - | 5.8 | 10 | A |
| | $I_{RRM2}$ | $T_J$ = 125 °C | | - | 8.3 | 15 | |
| Reverse recovery charge See fig. 7 | $Q_{rr1}$ | $T_J$ = 25 °C | | - | 260 | 675 | nC |
| | $Q_{rr2}$ | $T_J$ = 125 °C | | - | 680 | 1838 | |
| Peak rate of fall of recovery current during $t_b$ See fig. 8 | $dI_{(rec)M}/dt1$ | $T_J$ = 25 °C | | - | 120 | - | A/µs |
| | $dI_{(rec)M}/dt2$ | $T_J$ = 125 °C | | - | 76 | - | |

| **THERMAL - MECHANICAL SPECIFICATIONS** | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Lead temperature | $T_{lead}$ | 0.063" from case (1.6 mm) for 10 s | - | - | 300 | °C |
| Thermal resistance, junction to case | $R_{thJC}$ | | - | - | 0.83 | K/W |
| Thermal resistance, junction to ambient | $R_{thJA}$ | Typical socket mount | - | - | 80 | |
| Thermal resistance, case to heatsink | $R_{thCS}$ | Mounting surface, flat, smooth and greased | - | 0.50 | - | |
| Weight | | | - | 2.0 | - | g |
| | | | - | 0.07 | - | oz. |
| Mounting torque | | | 6.0 (5.0) | - | 12 (10) | kgf · cm (lbf · in) |
| Marking device | | Case style TO-220AC | HFA16TB120 | | | |




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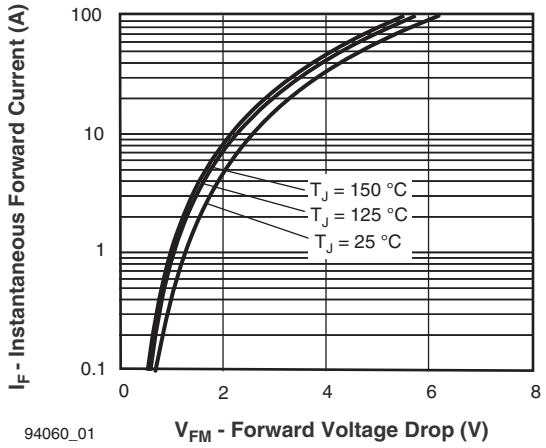


Fig. 1 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

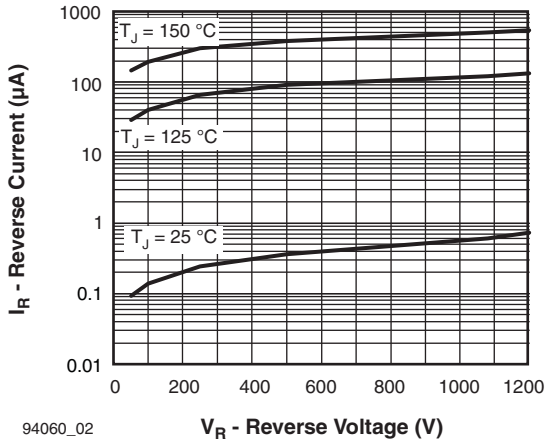


Fig. 2 - Typical Reverse Current vs. Reverse Voltage

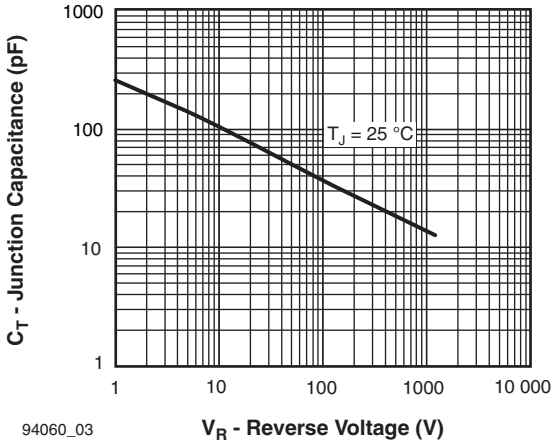


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

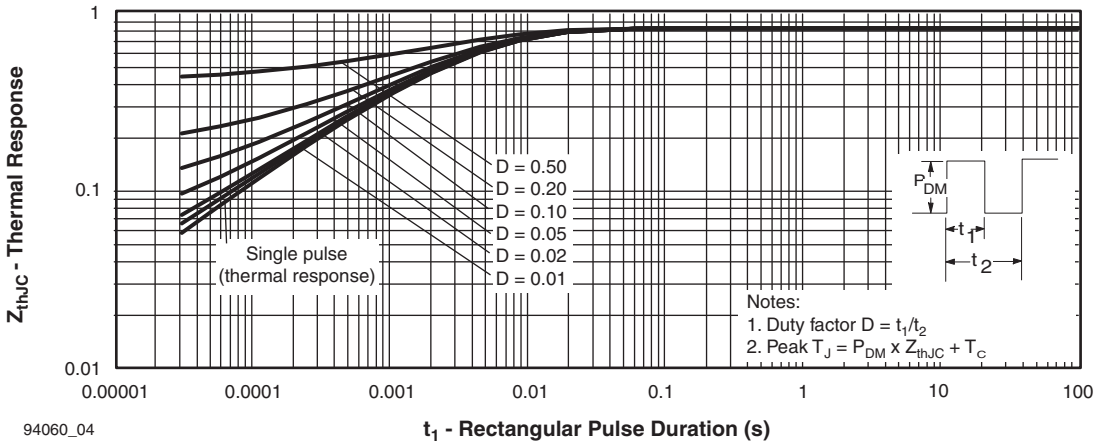


Fig. 4 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics

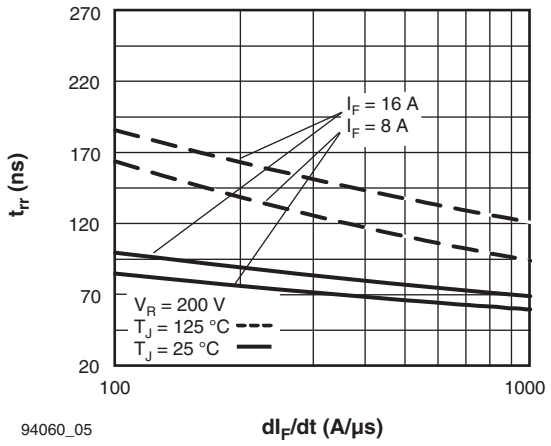


Fig. 5 - Typical Reverse Recovery Time vs. $dI_F/dt$ (Per Leg)

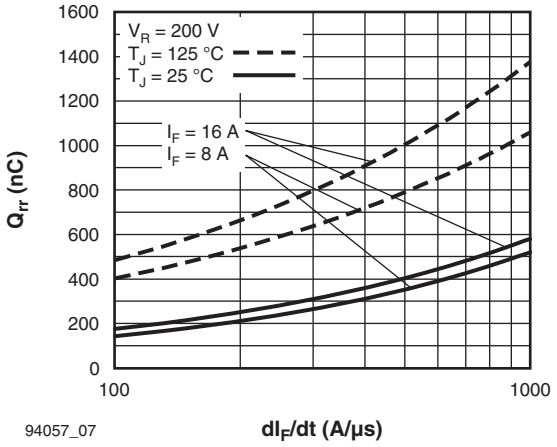


Fig. 7 - Typical Stored Charge vs. $dI_F/dt$ (Per Leg)

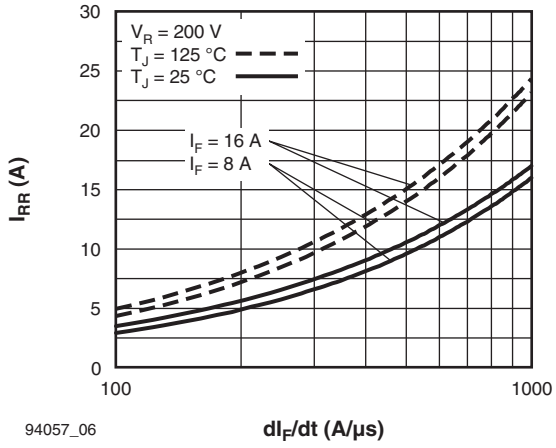


Fig. 6 - Typical Recovery Current vs. $di_F/dt$ (Per Leg)

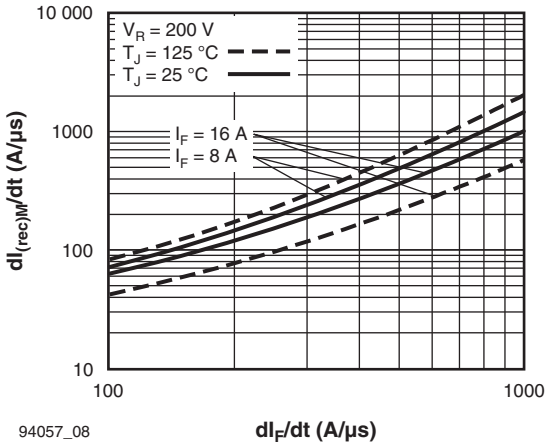


Fig. 8 - Typical $dI_{(rec)M}/dt$ vs. $dI_F/dt$ (Per Leg)


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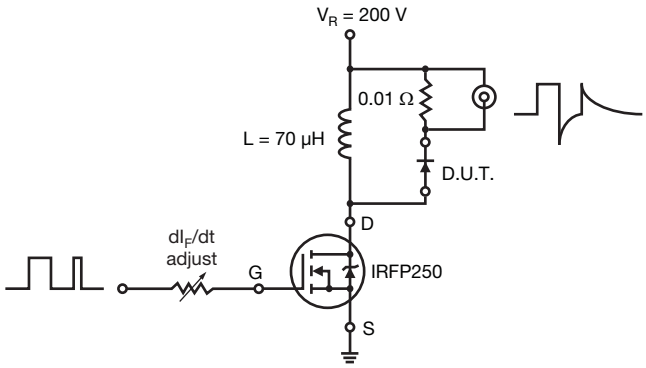
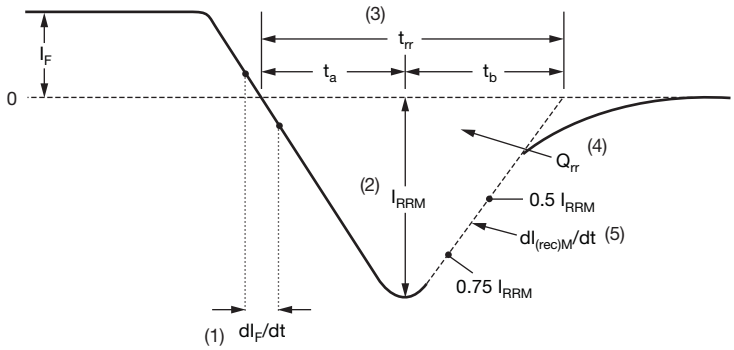



Fig. 9 - Reverse Recovery Parameter Test Circuit




(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 $I_{RRM}$

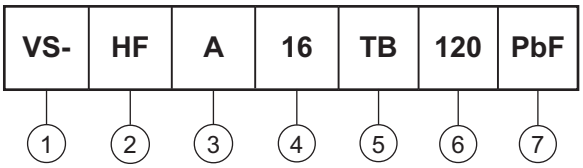
$$Q_{rr} = \frac{t_{rr} \times I_{RRM}}{2}$$

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

Fig. 10 - Reverse Recovery Waveform and Definitions

## ORDERING INFORMATION TABLE

Device code



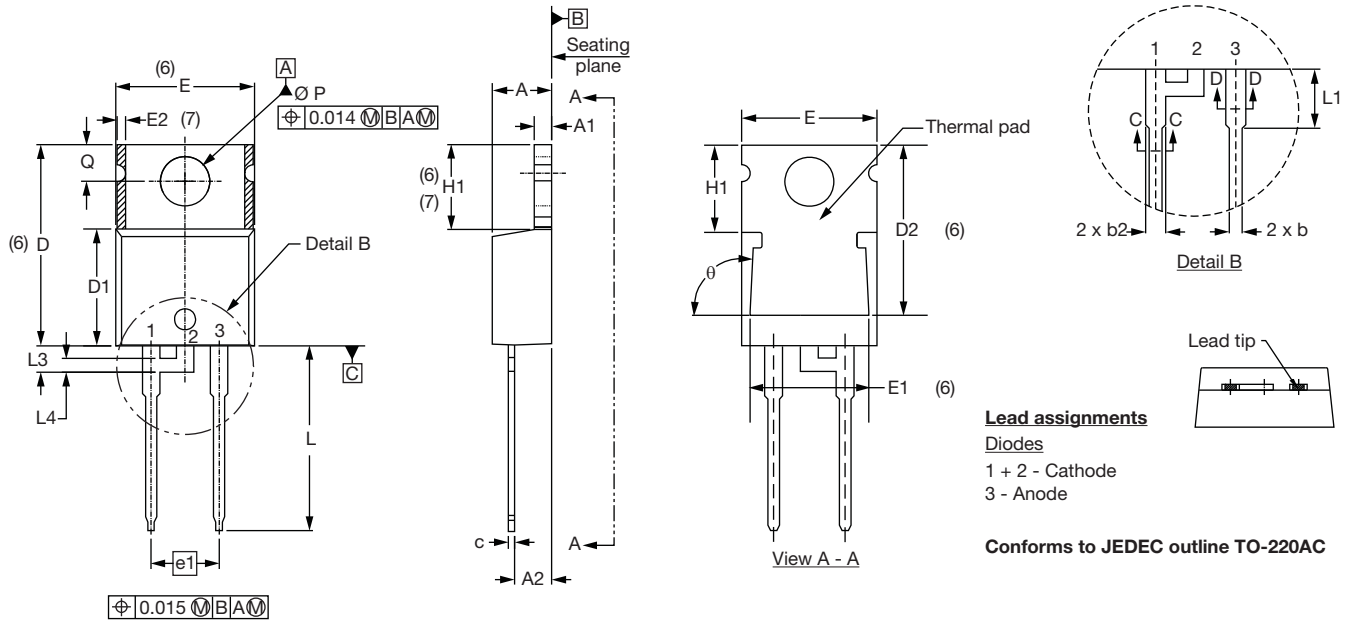

1 - Vishay Semiconductors product
2 - HEXFRED® family
3 - Electron irradiated
4 - Current rating (16 = 16 A)
5 - Package:
TB = TO-220AC
6 - Voltage rating (120 = 1200 V)
7 - PbF = Lead (Pb)-free

Tube standard pack quantity: 50 pieces

| LINKS TO RELATED DOCUMENTS | |
|---|---|
| Dimensions | www.vishay.com/doc?95221 |
| Part marking information | www.vishay.com/doc?95224 |

# TO-220AC

**DIMENSIONS** in millimeters and inches




**Lead assignments**
Diodes
1 + 2 - Cathode
3 - Anode

**Conforms to JEDEC outline TO-220AC**

| SYMBOL | MILLIMETERS | | INCHES | | NOTES |
|---|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. | |
| A | 4.25 | 4.65 | 0.167 | 0.183 | |
| A1 | 1.14 | 1.40 | 0.045 | 0.055 | |
| A2 | 2.56 | 2.92 | 0.101 | 0.115 | |
| b | 0.69 | 1.01 | 0.027 | 0.040 | |
| b1 | 0.38 | 0.97 | 0.015 | 0.038 | 4 |
| b2 | 1.20 | 1.73 | 0.047 | 0.068 | |
| b3 | 1.14 | 1.73 | 0.045 | 0.068 | 4 |
| c | 0.36 | 0.61 | 0.014 | 0.024 | |
| c1 | 0.36 | 0.56 | 0.014 | 0.022 | 4 |
| D | 14.85 | 15.25 | 0.585 | 0.600 | 3 |
| D1 | 8.38 | 9.02 | 0.330 | 0.355 | |
| D2 | 11.68 | 12.88 | 0.460 | 0.507 | 6 |
| E | 10.11 | 10.51 | 0.398 | 0.414 | 3, 6 |

| SYMBOL | MILLIMETERS | | INCHES | | NOTES |
|---|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. | |
| E1 | 6.86 | 8.89 | 0.270 | 0.350 | 6 |
| E2 | - | 0.76 | - | 0.030 | 7 |
| e | 2.41 | 2.67 | 0.095 | 0.105 | |
| e1 | 4.88 | 5.28 | 0.192 | 0.208 | |
| H1 | 6.09 | 6.48 | 0.240 | 0.255 | 6, 7 |
| L | 13.52 | 14.02 | 0.532 | 0.552 | |
| L1 | 3.32 | 3.82 | 0.131 | 0.150 | 2 |
| L3 | 1.78 | 2.13 | 0.070 | 0.084 | |
| L4 | 0.76 | 1.27 | 0.030 | 0.050 | 2 |
| Ø P | 3.54 | 3.73 | 0.139 | 0.147 | |
| Q | 2.60 | 3.00 | 0.102 | 0.118 | |
| θ | 90° to 93° | | 90° to 93° | | |

**Notes**

(1) Dimensioning and tolerancing as per ASME Y14.5M-1994
(2) Lead dimension and finish uncontrolled in L1
(3) Dimension D, D1 and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outermost extremes of the plastic body
(4) Dimension b1, b3 and c1 apply to base metal only
(5) Controlling dimension: inches
(6) Thermal pad contour optional within dimensions E, H1, D2 and E1
(7) Dimension E2 x H1 define a zone where stamping and singulation irregularities are allowed
(8) Outline conforms to JEDEC TO-220, D2 (minimum) where dimensions are derived from the actual package outline

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