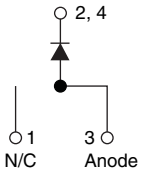
# Ultralow $V_F$ Ultrafast Rectifier, 6 A FRED Pt®

D-PAK (TO-252AA)




## FEATURES

- Ultrafast recovery time, extremely low $V_F$ and soft recovery
- 175 °C maximum operating junction temperature
- For PFC DCM operation
- Low leakage current
- Meets MSL level 1, per J-STD-020, LF maximum peak of 260 °C
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

HALOGEN FREE

## DESCRIPTION/APPLICATIONS

State of the art hyperfast recovery rectifiers designed with optimized performance of forward voltage drop, hyperfast recovery time, and soft recovery.

The planar structure and the platinum doped life time control guarantee the best overall performance, ruggedness and reliability characteristics.

These devices are intended for use in PFC boost stage in the AC/DC section of SMPS inverters or as freewheeling diodes. Their extremely optimized stored charge and low recovery current minimize the switching losses and reduce over dissipation in the switching element and snubbers.

| PRODUCT SUMMARY | |
|---|---|
| Package | D-PAK (TO-252AA) |
| $I_{F(AV)}$ | 6 A |
| $V_R$ | 600 V |
| $V_F$ at $I_F$ | 1.25 V |
| $t_{rr}$ (typ.) | 59 ns |
| $T_J$ max. | 175 °C |
| Diode variation | Single die |

| ABSOLUTE MAXIMUM RATINGS | | | | |
|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | UNITS |
| Peak repetitive reverse voltage | $V_{RRM}$ | | 600 | V |
| Average rectified forward current | $I_{F(AV)}$ | $T_C$ = 156 °C | 6 | A |
| Non-repetitive peak surge current | $I_{FSM}$ | $T_J$ = 25 °C | 80 | |
| Peak repetitive forward current | $I_{FM}$ | $T_C$ = 156 °C, f = 20 kHz, d = 50 % | 12 | |
| Operating junction and storage temperatures | $T_J$, $T_{Stg}$ | | -65 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 | 600 | - | - | V |
| Forward voltage | $V_F$ | $I_F$ = 6 A | - | 0.99 | 1.25 | |
| | | $I_F$ = 6 A, $T_J$ = 150 °C | - | 0.87 | 1.05 | |
| Reverse leakage current | $I_R$ | $V_R$ = $V_R$ rated | - | - | 5 | µA |
| | | $T_J$ = 150 °C, $V_R$ = $V_R$ rated | - | - | 125 | |
| Junction capacitance | $C_T$ | $V_R$ = 600 V | - | 3.5 | - | pF |
| Series inductance | $L_S$ | Measured lead to lead 5 mm from package body | - | 8 | - | nH |



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| 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 A, $dI_F/dt$ = 100 A/µs, $V_R$ = 30 V | | - | 59 | 70 | ns |
| | | $I_F$ = 1 A, $dI_F/dt$ = 50 A/µs, $V_R$ = 30 V | | - | 75 | - | |
| | | $T_J$ = 25 °C | $I_F$ = 6A<br>$dI_F/dt$ = 200 A/µs<br>$V_R$ = 390 V | - | 154 | - | |
| | | $T_J$ = 125 °C | | - | 215 | - | |
| Peak recovery current | $I_{RRM}$ | $T_J$ = 25 °C | | - | 13.3 | - | A |
| | | $T_J$ = 125 °C | | - | 15.4 | - | |
| Reverse recovery charge | $Q_{rr}$ | $T_J$ = 25 °C | | - | 1055 | - | nC |
| | | $T_J$ = 125 °C | | - | 1600 | - | |

| THERMAL - MECHANICAL SPECIFICATIONS | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Maximum junction and storage temperature range | $T_J$, $T_{Stg}$ | | -65 | - | +175 | °C |
| Thermal resistance, junction to case per leg | $R_{thJC}$ | | - | - | 3 | °C/W |
| Approximate weight | | | 0.3 | | | g |
| | | | 0.01 | | | oz. |
| Marking device | | Case style D-PAK (TO-252AA) | 6EWL06FN | | | |


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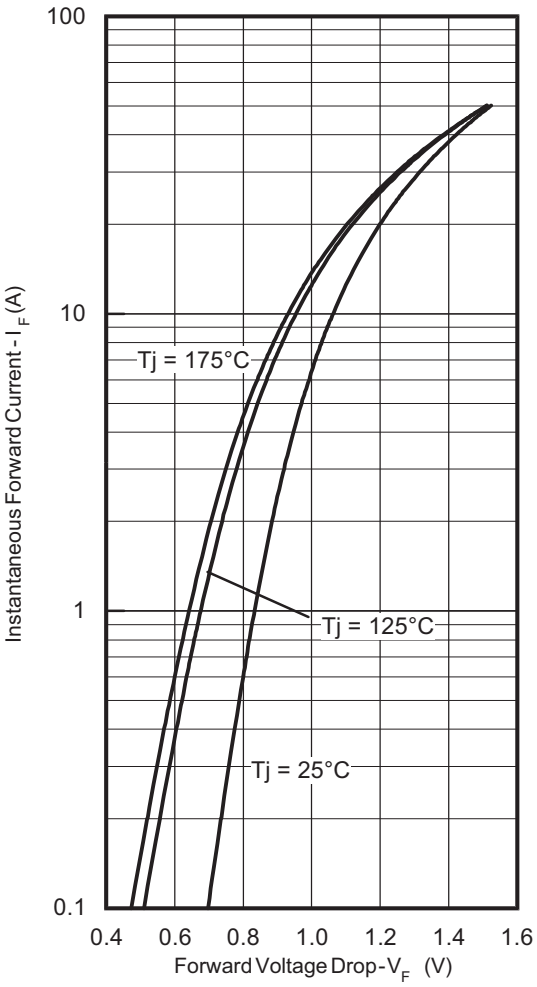


Fig. 1 - Typical Forward Voltage Drop Characteristics

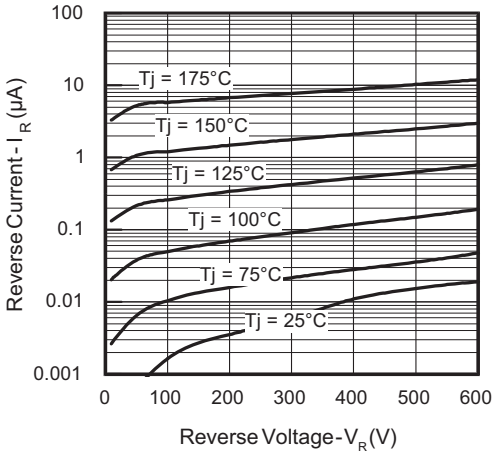


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

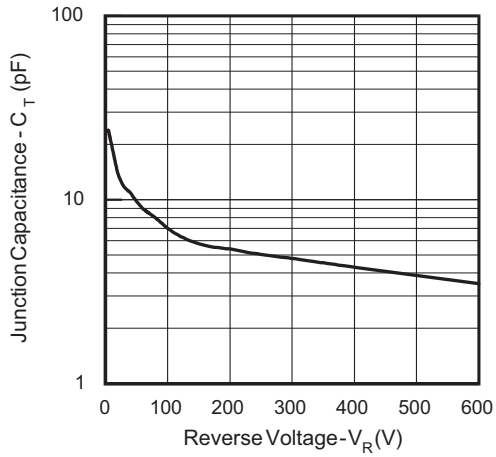


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

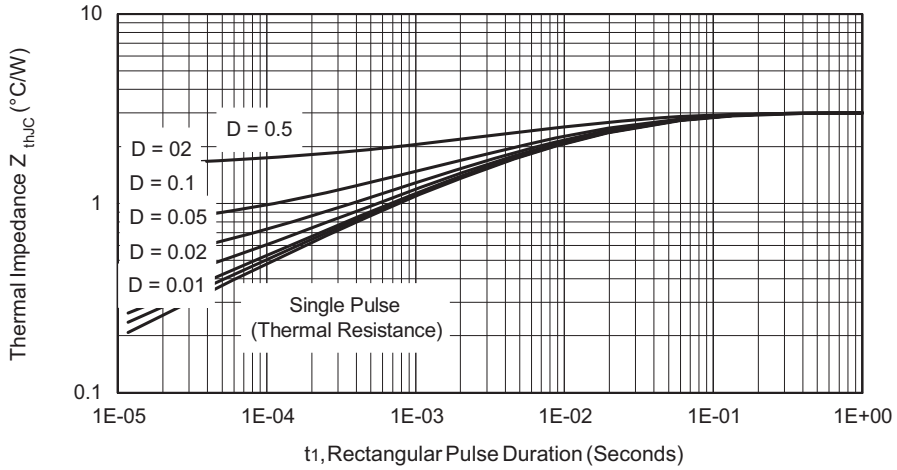


Fig. 4 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics


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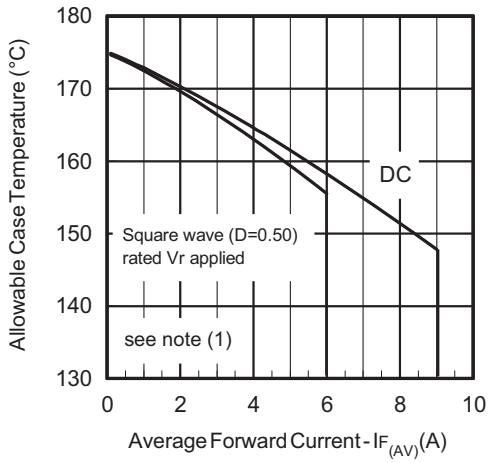


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

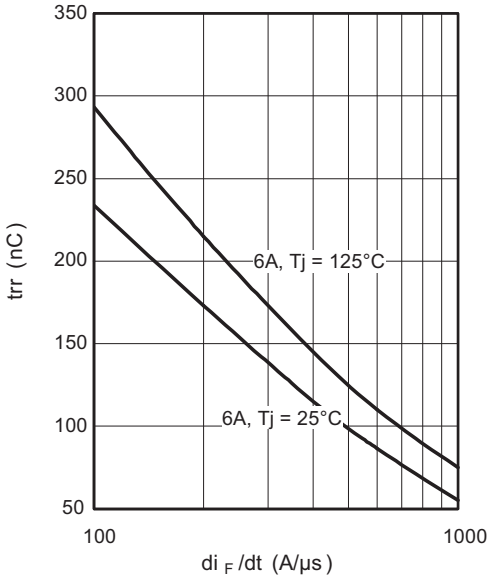


Fig. 7 - Typical Reverse Recovery Time vs. $dI_F/dt$

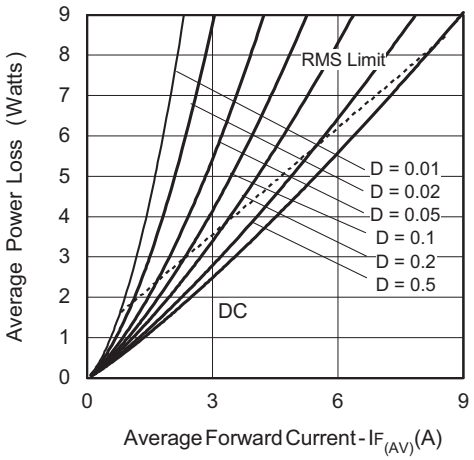


Fig. 6 - Forward Power Loss Characteristics

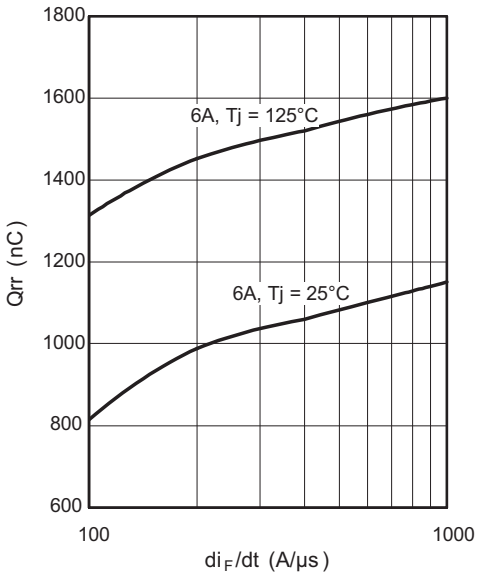


Fig. 8 - Typical Stored Charge vs. $dI_F/dt$

**Note**

(1) Formula used: $T_C = T_J - (Pd + Pd_{REV}) \times R_{thJC}$;
Pd = Forward power loss = $I_{F(AV)} \times V_{FM}$ at ($I_{F(AV)}$/D) (see fig. 6);
$Pd_{REV}$ = Inverse power loss = $V_{R1} \times I_R (1 - D)$; $I_R$ at $V_{R1}$ = Rated $V_R$


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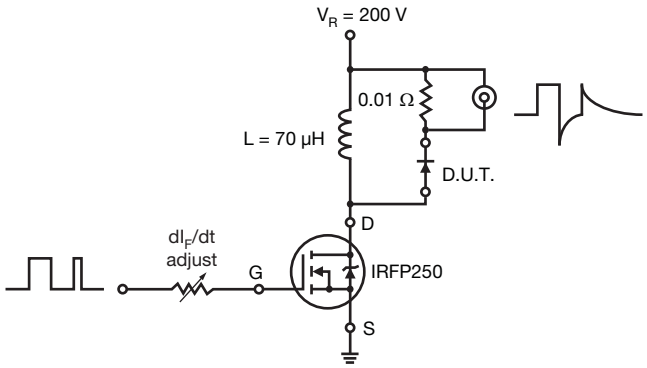
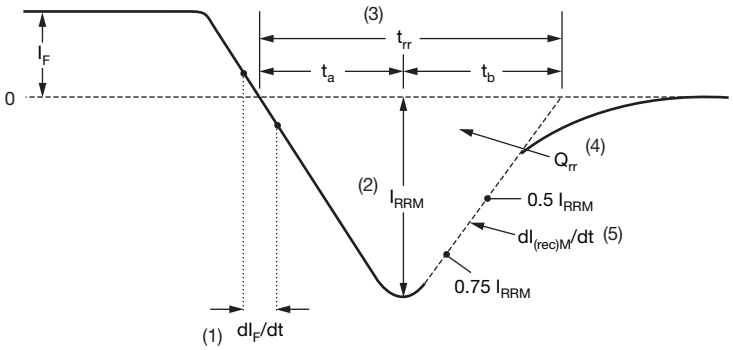



Fig. 9 - Reverse Recovery Parameter Test Circuit




(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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## ORDERING INFORMATION TABLE

Device code

| VS- | 6 | E | W | L | 06 | FN | TRL | -M3 |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

1 - Vishay Semiconductors product

2 - Current rating (6 = 6 A)

3 - Circuit configuration:
E = Single diode

4 - Package identifier:
W = D-PAK

5 - L = Low $V_F$, fast recovery

6 - Voltage rating (06 = 600 V)

7 - FN = TO-252AA

8 -
- None = Tube
- TR = Tape and reel
- TRL = Tape and reel (left oriented)
- TRR = Tape and reel (right oriented)

9 - Environmental digit:
-M3 = Halogen-free, RoHS compliant and terminations lead (Pb)-free

| **ORDERING INFORMATION** (Example) | | | |
|---|---|---|---|
| **PREFERRED P/N** | **QUANTITY PER T/R** | **MINIMUM ORDER QUANTITY** | **PACKAGING DESCRIPTION** |
| VS-6EWL06FN-M3 | 75 | 3000 | Antistatic plastic tube |
| VS-6EWL06FNTR-M3 | 2000 | 2000 | 13" diameter reel |
| VS-6EWL06FNTRL-M3 | 3000 | 3000 | 13" diameter reel |
| VS-6EWL06FNTRR-M3 | 3000 | 3000 | 13" diameter reel |

| **LINKS TO RELATED DOCUMENTS** | |
|---|---|
| Dimensions | www.vishay.com/doc?95016 |
| Part marking information | www.vishay.com/doc?95176 |
| SPICE model | www.vishay.com/doc?95218 |


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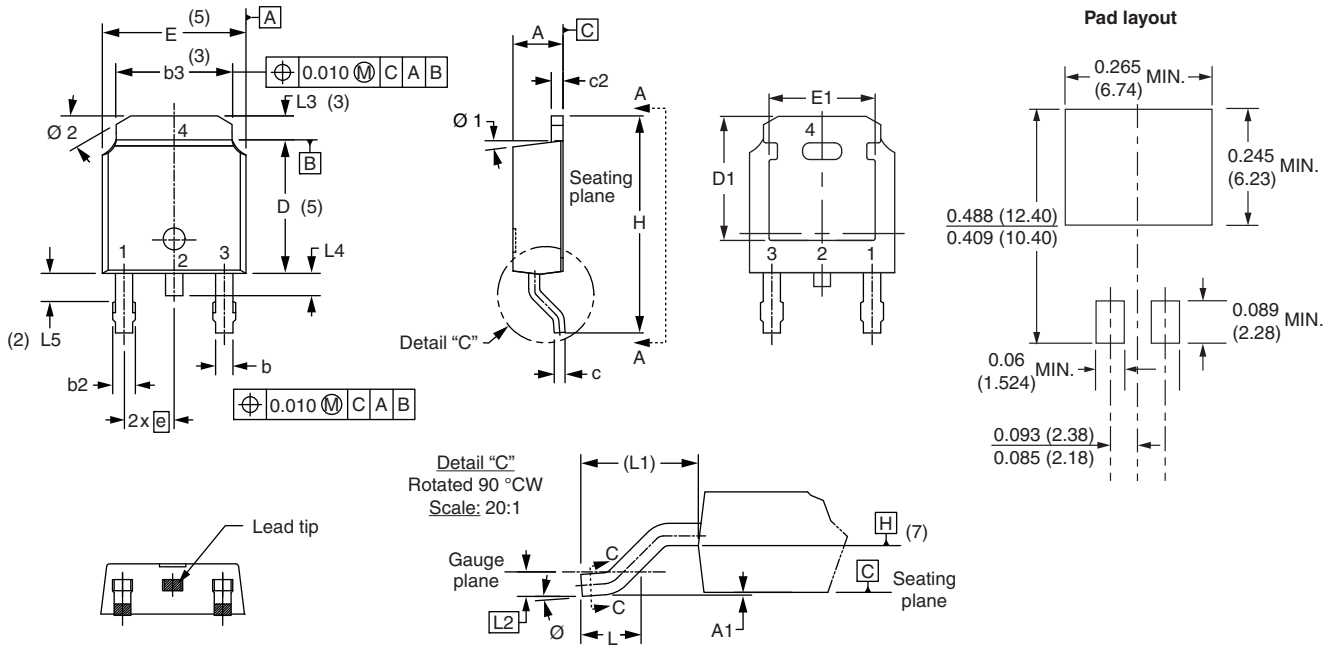
# D-PAK (TO-252AA)

**DIMENSIONS** in millimeters and inches




| SYMBOL | MILLIMETERS | | INCHES | | NOTES |
|---|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. | |
| A | 2.18 | 2.39 | 0.086 | 0.094 | |
| A1 | - | 0.13 | - | 0.005 | |
| b | 0.64 | 0.89 | 0.025 | 0.035 | |
| b2 | 0.76 | 1.14 | 0.030 | 0.045 | |
| b3 | 4.95 | 5.46 | 0.195 | 0.215 | 3 |
| c | 0.46 | 0.61 | 0.018 | 0.024 | |
| c2 | 0.46 | 0.89 | 0.018 | 0.035 | |
| D | 5.97 | 6.22 | 0.235 | 0.245 | 5 |
| D1 | 5.21 | - | 0.205 | - | 3 |
| E | 6.35 | 6.73 | 0.250 | 0.265 | 5 |
| E1 | 4.32 | - | 0.170 | - | 3 |

| SYMBOL | MILLIMETERS | | INCHES | | NOTES |
|---|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. | |
| e | 2.29 BSC | | 0.090 BSC | | |
| H | 9.40 | 10.41 | 0.370 | 0.410 | |
| L | 1.40 | 1.78 | 0.055 | 0.070 | |
| L1 | 2.74 BSC | | 0.108 REF. | | |
| L2 | 0.51 BSC | | 0.020 BSC | | |
| L3 | 0.89 | 1.27 | 0.035 | 0.050 | 3 |
| L4 | - | 1.02 | - | 0.040 | |
| L5 | 1.14 | 1.52 | 0.045 | 0.060 | 2 |
| Ø | 0° | 10° | 0° | 10° | |
| Ø1 | 0° | 15° | 0° | 15° | |
| Ø2 | 25° | 35° | 25° | 35° | |

**Notes**

(1) Dimensioning and tolerancing as per ASME Y14.5M-1994
(2) Lead dimension uncontrolled in L5
(3) Dimension D1, E1, L3 and b3 establish a minimum mounting surface for thermal pad
(4) Section C - C dimension apply to the flat section of the lead between 0.13 and 0.25 mm (0.005 and 0.10") from the lead tip
(5) Dimension D, 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
(6) Dimension b1 and c1 applied to base metal only
(7) Datum A and B to be determined at datum plane H
(8) Outline conforms to JEDEC outline TO-252AA



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