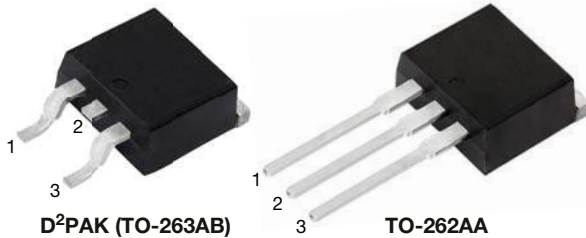
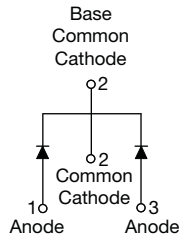
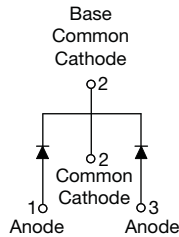


Ultrafast Rectifier, 16 A FRED Pt®

D²PAK (TO-263AB)
TO-262AA

VS-16CTU04S-M3

VS-16CTU04-1-M3
FEATURES

- Ultrafast recovery time
- Low forward voltage drop
- Low leakage current
- 175 °C operating junction temperature
- Meets MSL level 1, per J-STD-020, LF maximum peak of 245 °C
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


RoHS
 COMPLIANT
 HALOGEN
FREE
DESCRIPTION / APPLICATIONS

Vishay Semiconductors FRED Pt® series are the state of the art ultrafast recovery rectifiers specifically 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 use in the output rectification stage of SMPS, UPS, DC/DC converters as well as freewheeling diode in low voltage inverters and chopper motor drives.

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

| | |
|-----------------------|---|
| $I_{F(AV)}$ | 2 x 8 A |
| V_R | 400 V |
| V_F at I_F | 0.94 V |
| t_{rr} typ. | 35 ns |
| T_J max. | 175 °C |
| Package | D ² PAK (TO-263AB), TO-262AA |
| Circuit configuration | Common cathode |

ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | UNITS |
|---|----------------|---|-------------|-------|
| Peak repetitive reverse voltage | V_{RRM} | | 400 | V |
| Average rectified forward current <small>per leg</small> / <small>total device</small> | $I_{F(AV)}$ | | 8 | A |
| | | Rated V_R , $T_C = 155$ °C | 16 | |
| Non-repetitive peak surge current | I_{FSM} | $T_C = 25$ °C | 100 | |
| Peak repetitive forward current | I_{FRM} | Rated V_R , square wave, 20 kHz, $T_C = 155$ °C | 16 | |
| Operating junction and storage temperatures | T_J, T_{Stg} | | -65 to +175 | °C |

ELECTRICAL SPECIFICATIONS PER LEG ($T_J = 25$ °C unless otherwise specified)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
|-------------------------------------|---------------|--|------|------|------|---------|
| Breakdown voltage, blocking voltage | V_{BR}, V_R | $I_R = 100$ μ A | 400 | - | - | V |
| Forward voltage | V_F | $I_F = 8$ A | - | 1.19 | 1.3 | |
| | | $I_F = 8$ A, $T_J = 150$ °C | - | 0.94 | 1.0 | |
| Reverse leakage current | I_R | $V_R = V_R$ rated | - | 0.2 | 10 | μ A |
| | | $T_J = 150$ °C, $V_R = V_R$ rated | - | 20 | 500 | |
| Junction capacitance | C_T | $V_R = 400$ V | - | 14 | - | pF |
| Series inductance | L_S | Measured lead to lead 5 mm from package body | - | 8.0 | - | nH |



| DYNAMIC RECOVERY CHARACTERISTICS PER LEG ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified) | | | | | | | |
|---|-----------|--|--|------|------|------|-------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNITS |
| Reverse recovery time | t_{rr} | $I_F = 1.0\text{ A}$, $di_F/dt = 50\text{ A}/\mu\text{s}$, $V_R = 30\text{ V}$ | | - | 35 | 60 | ns |
| | | $T_J = 25\text{ }^\circ\text{C}$ | $I_F = 8\text{ A}$ $di_F/dt = 200\text{ A}/\mu\text{s}$ $V_R = 200\text{ V}$ | - | 43 | - | |
| | | $T_J = 125\text{ }^\circ\text{C}$ | | - | 67 | - | |
| Peak recovery current | I_{RRM} | $T_J = 25\text{ }^\circ\text{C}$ | $I_F = 8\text{ A}$ $di_F/dt = 200\text{ A}/\mu\text{s}$ $V_R = 200\text{ V}$ | - | 2.8 | - | A |
| | | $T_J = 125\text{ }^\circ\text{C}$ | | - | 6.3 | - | |
| Reverse recovery charge | Q_{rr} | $T_J = 25\text{ }^\circ\text{C}$ | $I_F = 8\text{ A}$ $di_F/dt = 200\text{ A}/\mu\text{s}$ $V_R = 200\text{ V}$ | - | 60 | - | nC |
| | | $T_J = 125\text{ }^\circ\text{C}$ | | - | 210 | - | |

| THERMAL - MECHANICAL SPECIFICATIONS | | | | | | |
|---|----------------|--|--------------|------|------------|---------------------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Maximum junction and storage temperature range | T_J, T_{Stg} | | -65 | - | 175 | $^\circ\text{C}$ |
| Thermal resistance, junction to case per leg | R_{thJC} | | - | 1.8 | 2.0 | $^\circ\text{C}/\text{W}$ |
| Thermal resistance, junction to ambient per leg | R_{thJA} | Typical socket mount | - | - | 50 | |
| Thermal resistance, case to heatsink | R_{thCS} | Mounting surface, flat, smooth and greased | - | 0.5 | - | |
| Weight | | | - | 2.0 | - | g |
| | | | - | 0.07 | - | oz. |
| Mounting torque | | | 6.0 (5.0) | - | 12 (10) | kgf · cm (lbf · in) |
| Marking device | | Case style D ² PAK (TO-263AB) | 16CTU04S | | | |
| | | Case style TO-262AA | 16CTU04-1 | | | |

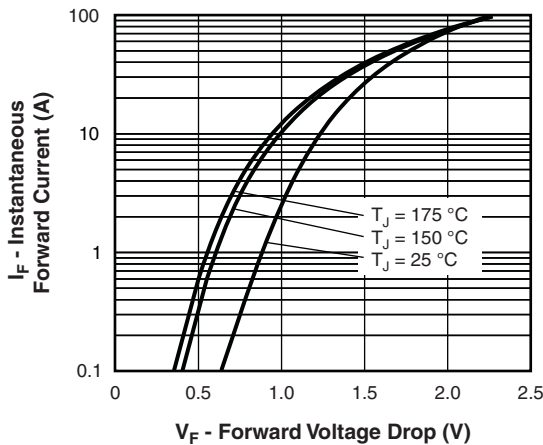


Fig. 1 - Typical Forward Voltage Drop Characteristics

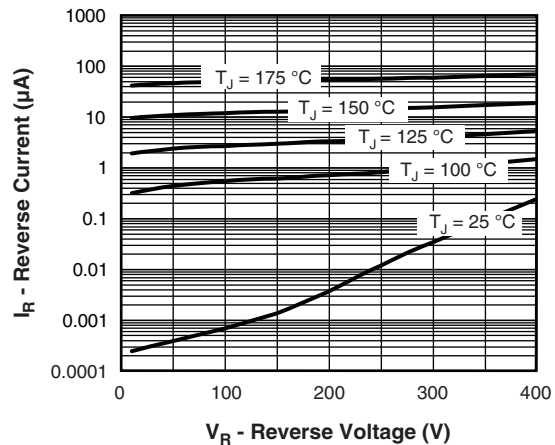


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage

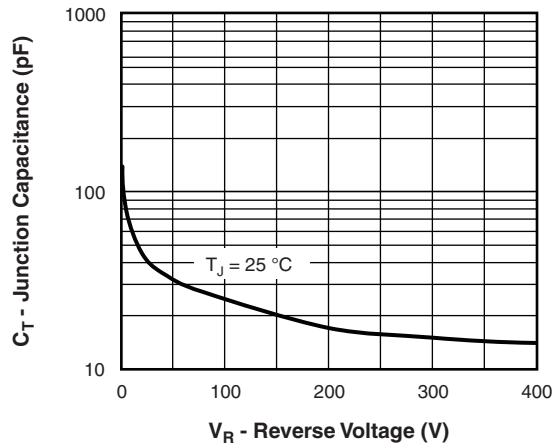


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

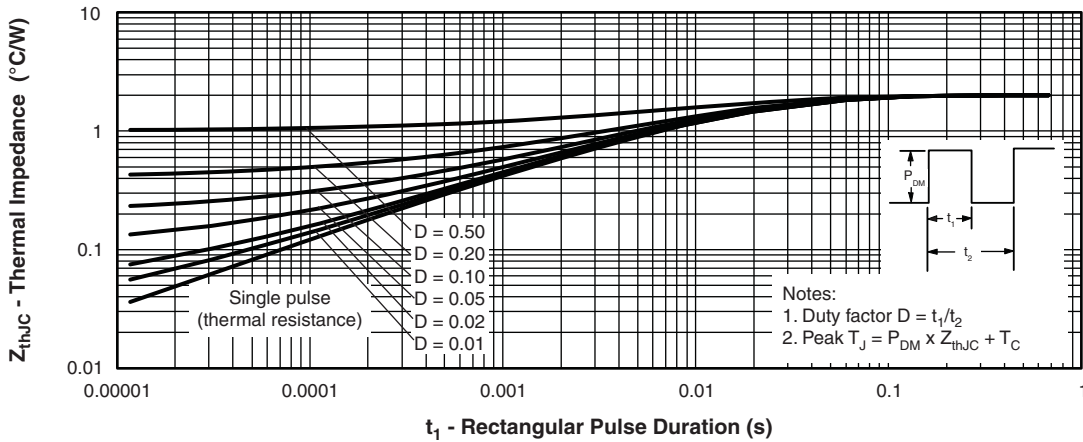


Fig. 4 - Maximum Thermal Impedance Z_{thJC} Characteristics

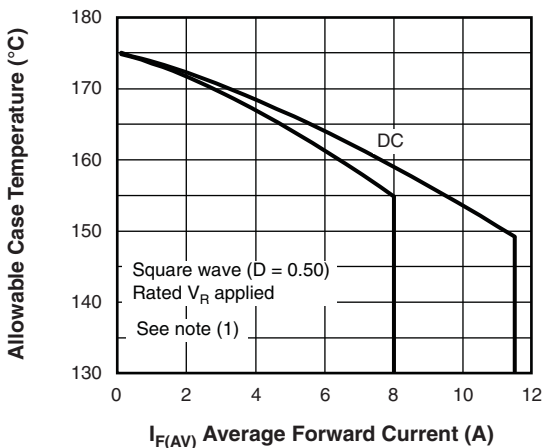


Fig. 5 - Maximum Allowable Case Temperature vs. Average Forward Current

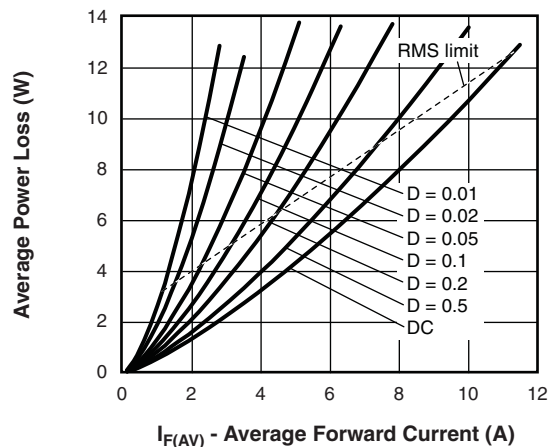


Fig. 6 - Forward Power Loss Characteristics

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} = rated V_R

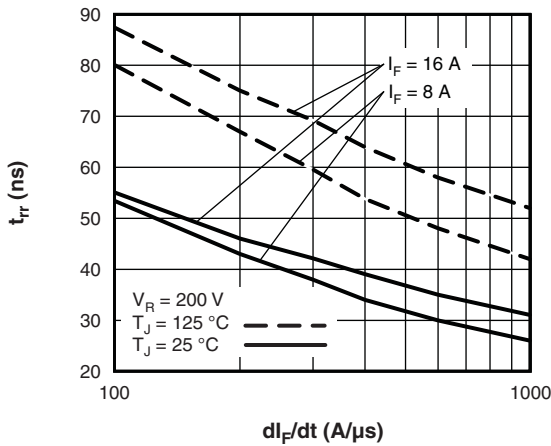


Fig. 7 - Typical Reverse Recovery Time vs. di_F/dt

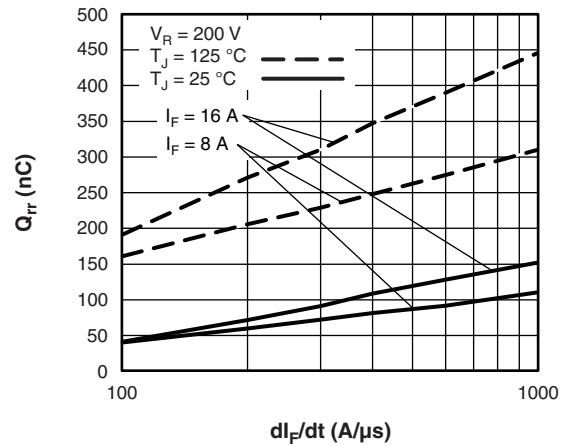
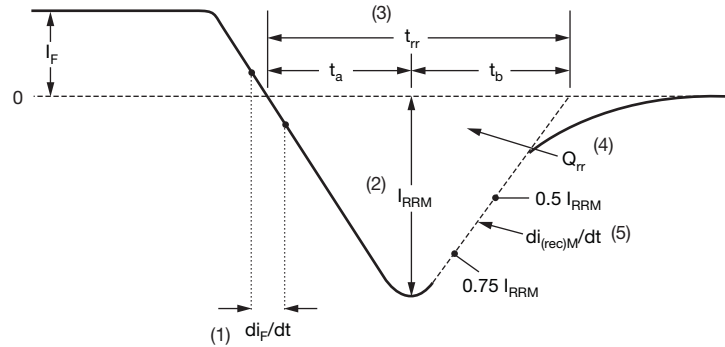


Fig. 8 - Typical Stored Charge vs. di_F/dt



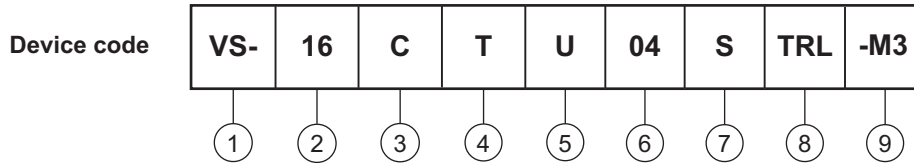
- (1) di_F/dt - rate of change of current through zero crossing
- (2) I_{RRM} - peak reverse recovery current
- (3) t_{rr} - reverse recovery time measured from zero crossing point of negative going I_F to point where a line passing through $0.75 I_{RRM}$ and $0.50 I_{RRM}$ extrapolated to zero current.
- (4) Q_{rr} - area under curve defined by t_{rr} and I_{RRM}
- (5) $di_{(rec)M}/dt$ - peak rate of change of current during t_b portion of t_{rr}

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

Fig. 9 - Reverse Recovery Waveform and Definitions



ORDERING INFORMATION TABLE



- 1** - Vishay Semiconductors product
- 2** - Current rating (16 A)
- 3** - C = common cathode
- 4** - T = TO-220, D²PAK (TO-263AB)
- 5** - U = ultrafast recovery
- 6** - Voltage rating (04 = 400 V)
- 7** -
 - S = D²PAK (TO-263AB)
 - -1 = TO-262AA
- 8** -
 - None = tube (50 pieces)
 - TRL = tape and reel (left oriented, for D²PAK (TO-263AB) package)
 - TRR = tape and reel (right oriented, for D²PAK (TO-263AB) package)
- 9** - Environmental digit:
 - M3 = halogen-free, RoHS-compliant, and terminations lead (Pb)-free

| LINKS TO RELATED DOCUMENTS | | |
|----------------------------|-------------------------------|--|
| Dimensions | D ² PAK (TO-263AB) | www.vishay.com/doc?96164 |
| | TO-262AA | www.vishay.com/doc?96165 |
| Part marking information | D ² PAK (TO-263AB) | www.vishay.com/doc?95444 |
| | TO-262AA | www.vishay.com/doc?95443 |
| SPIICE model | | www.vishay.com/doc?96565 |

TO-262AA

DIMENSIONS in millimeters and inches

Modified JEDEC® outline TO-262



| SYMBOL | MILLIMETERS | | INCHES | | NOTES |
|--------|-------------|-------|-----------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. | |
| A | 4.06 | 4.83 | 0.160 | 0.190 | |
| A1 | 2.03 | 3.02 | 0.080 | 0.119 | |
| b | 0.51 | 0.99 | 0.020 | 0.039 | |
| b1 | 0.51 | 0.89 | 0.020 | 0.035 | 4 |
| b2 | 1.14 | 1.78 | 0.045 | 0.070 | |
| b3 | 1.14 | 1.73 | 0.045 | 0.068 | 4 |
| c | 0.38 | 0.74 | 0.015 | 0.029 | |
| c1 | 0.38 | 0.58 | 0.015 | 0.023 | 4 |
| c2 | 1.14 | 1.65 | 0.045 | 0.065 | |
| D | 8.51 | 9.65 | 0.335 | 0.380 | 2 |
| D1 | 6.86 | 8.00 | 0.270 | 0.315 | 3 |
| E | 9.65 | 10.67 | 0.380 | 0.420 | 2, 3 |
| E1 | 7.90 | 8.80 | 0.311 | 0.346 | 3 |
| e | 2.54 BSC | | 0.100 BSC | | |
| L | 13.46 | 14.10 | 0.530 | 0.555 | |
| L1 | - | 1.65 | - | 0.065 | 3 |
| L2 | 3.56 | 3.71 | 0.140 | 0.146 | |

Notes

- (1) Dimensioning and tolerancing as per ASME Y14.5M-1994
- (2) 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 outmost extremes of the plastic body
- (3) Thermal pad contour optional within dimension E, L1, D1 and E1
- (4) Dimension b1 and c1 apply to base metal only
- (5) Controlling dimension: inches
- (6) Outline conform to JEDEC® TO-262 except A1 (max.), b (min., max.), b1 (min.), b2 (max.), c (min.), c1(min.), c2 (max.), D (min.), E (max.), L1 (max.), L2 (min., max.)



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