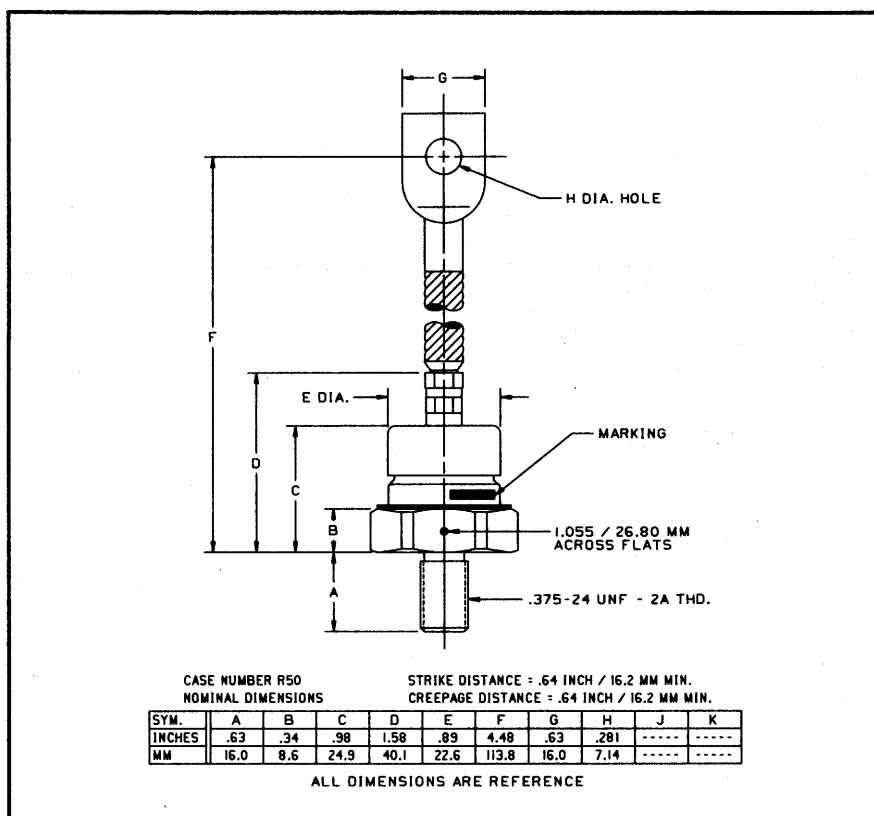


Powerex, Inc., 200 Hillis Street, Youngwood, Pennsylvania 15697-1800 (412) 925-7272  
Powerex, Europe, S.A. 428 Avenue G. Durand, BP107, 72003 Le Mans, France (43) 41.14.14

**Fast Recovery  
Rectifier**  
125 Amperes Average  
1400 Volts



R502\_\_13/R503\_\_13 (Outline Drawing)



R502\_\_13/R503\_\_13  
Fast Recovery Rectifier  
125 Amperes Average, 1400 Volts

## Features:

- ☐ Fast Recovery Times
- ☐ Soft Recovery Characteristics
- ☐ Standard and Reverse Polarities
- ☐ Flag Lead and Stud Top Terminals Available
- ☐ High Surge Current Ratings
- ☐ High Rated Blocking Voltages
- ☐ Special Electrical Selection for Parallel and Series Operation
- ☐ Glazed Ceramic Seal Gives High Voltage Creepage and Strike Paths

## Applications:

- ☐ Inverters
- ☐ Choppers
- ☐ Transmitters
- ☐ Free Wheeling Diode

## Ordering Information:

Select the complete part number you desire from the following table:

| Type                           | Voltage                     |      | Current                   |      | Recovery Time             |      | Leads |      |
|--------------------------------|-----------------------------|------|---------------------------|------|---------------------------|------|-------|------|
|                                | V <sub>RRM</sub><br>(Volts) | Code | I <sub>F(av)</sub><br>(A) | Code | t <sub>rr</sub><br>(μsec) | Code | Case  | Code |
| R502<br>(Standard<br>Polarity) | 200                         | 02   | 125                       | 13   | 0.7                       | LS   | DO-8  | WA   |
|                                | 400                         | 04   |                           |      |                           |      |       |      |
|                                | 600                         | 06   |                           |      |                           |      |       |      |
|                                | 800                         | 08   |                           |      |                           |      |       |      |
| R503<br>(Reverse<br>Polarity)  | 1000                        | 10   |                           |      |                           |      |       |      |
|                                | 1200                        | 12   |                           |      |                           |      |       |      |
|                                | 1400                        | 14   |                           |      |                           |      |       |      |

**Example:** Type R502 rated at 125A average with V<sub>RRM</sub> = 1400V,  
Recovery Time = 0.7 μsec and standard flexible lead, order as:

| Type    | Voltage | Current | Time | Leads |
|---------|---------|---------|------|-------|
| R 5 0 2 | 1 4     | 1 3     | LS   | W A   |



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### Absolute Maximum Ratings

| Characteristics                                    | Symbol       | R502__13/R503__13 | Units       |
|----------------------------------------------------|--------------|-------------------|-------------|
| RMS Forward Current                                | $I_{F(rms)}$ | 195               | Amperes     |
| Average Forward Current                            | $I_{F(av)}$  | 125               | Amperes     |
| One-half Cycle Surge Current                       | $I_{FSM}$    | 2500              | Amperes     |
| $I^2t$ (for Fusing), Times $\geq 8.3$ milliseconds | $I^2t$       | 26000             | $A^2sec$    |
| Storage Temperature                                | $T_{stg}$    | -40 to +190       | $^{\circ}C$ |
| Operating Temperature                              | $T_j$        | -40 to +150       | $^{\circ}C$ |
| Mounting Torque                                    |              | 120               | in-lb       |

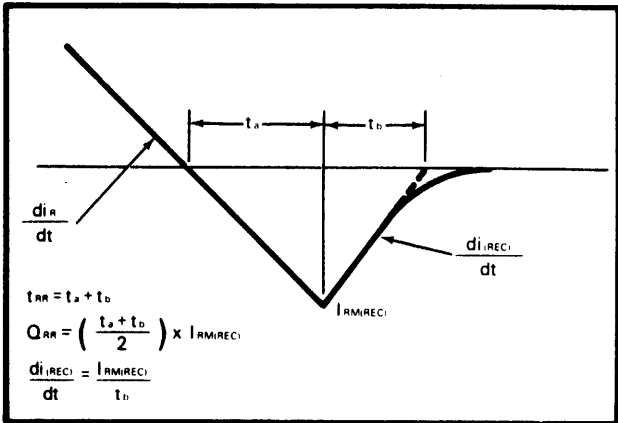
### Electrical and Thermal Characteristics

| Characteristics                                 | Symbol            | Test Conditions                                                                        | R502__13/R503__13 | Units            |
|-------------------------------------------------|-------------------|----------------------------------------------------------------------------------------|-------------------|------------------|
| <b>Current - Conducting State Maximums</b>      |                   |                                                                                        |                   |                  |
| Forward Voltage Drop                            | $V_{FM}$          | $T_j = 25^{\circ}C$ , $I_{FM} = 470A$                                                  | 2.5               | Volts            |
| <b>Voltage - Blocking State Maximums</b>        |                   |                                                                                        |                   |                  |
| Repetitive Peak Reverse Voltage (Rated Limit)   | $V_{RRM}$         |                                                                                        | 1400              | Volts            |
| Non-rep. Trans. Peak Rev. Voltage (Rated Limit) | $V_{RSM}$         | $V \leq 5.0msec$                                                                       | 1600              | Volts            |
| Reverse Leakage Current, mA peak                | $I_{RRM}$         | $T_j$ at max., $V_{RRM} = \text{Rated}$                                                | 45                | mA               |
| <b>Switching</b>                                |                   |                                                                                        |                   |                  |
| Maximum Reverse Recovery Time                   | $t_{rr}$          | $I_{FM} = 314A$ , $t_p = 40\mu sec$ ,<br>$di_R/dt = 25A/\mu sec$ , $T_C = 25^{\circ}C$ | 0.7               | $\mu sec$        |
| <b>Thermal</b>                                  |                   |                                                                                        |                   |                  |
| Maximum Resistance, Junction to Case            | $R_{\theta(j-c)}$ |                                                                                        | 0.28              | $^{\circ}C/Watt$ |
| Maximum Resistance, Case to Sink (Lubricated)   | $R_{\theta(c-s)}$ |                                                                                        | 0.12              | $^{\circ}C/Watt$ |

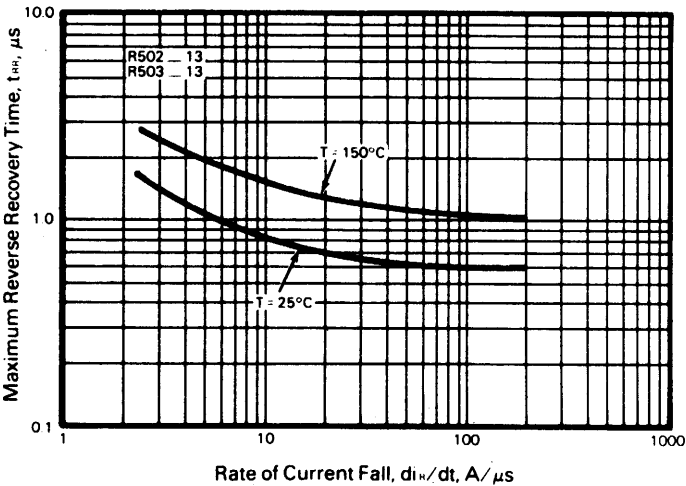
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**R502 \_13/R503 \_13**  
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 125 Amperes Average, 1400 Volts

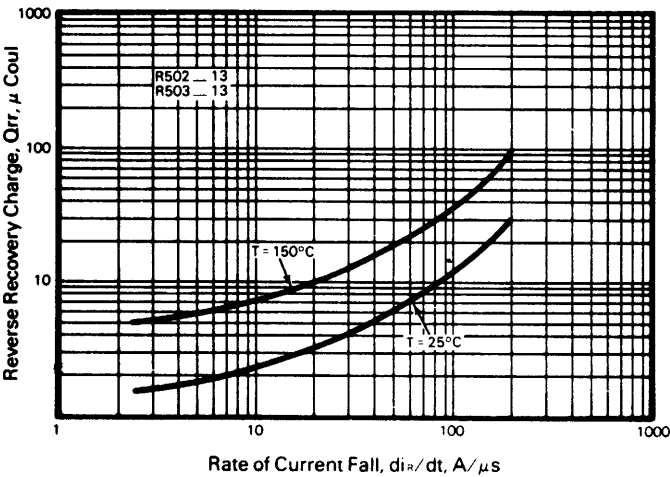
Reverse Recovery Wave Form



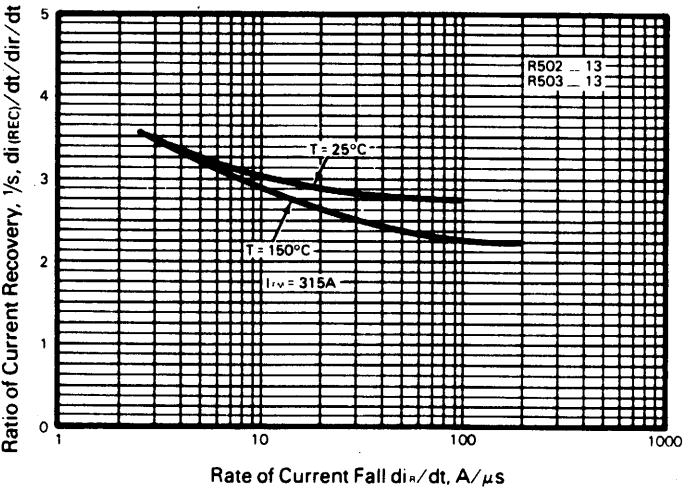
Typical Reverse Recovery Charge Vs. Rate of Current Fall



Typical Reverse Recovery Time Vs. Rate of Current Fall



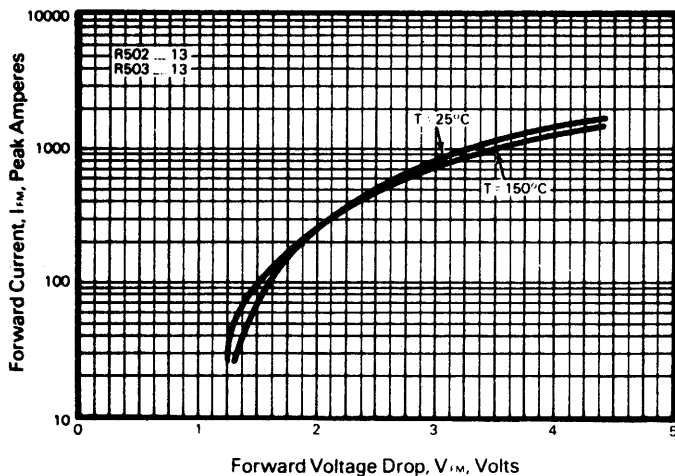
Typical Ratio of Current Recovery to Rate of Current Fall



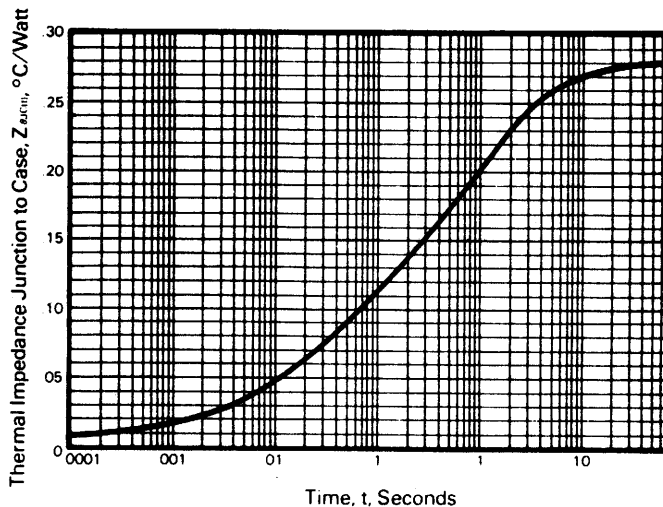
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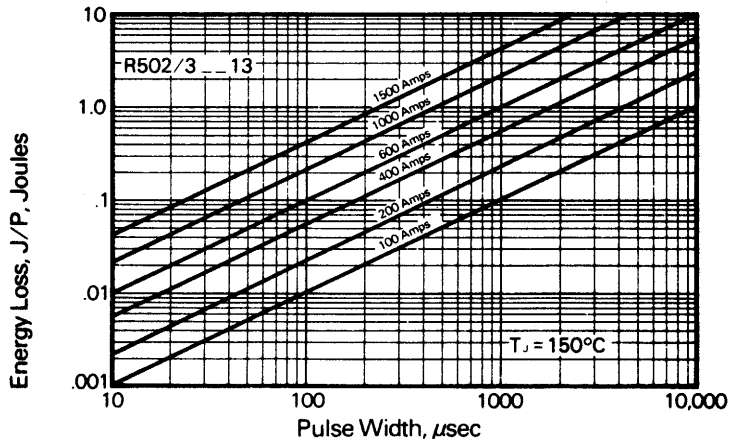
Forward Current Vs. Forward Voltage Drop



Transient Thermal Impedance Vs. Time



Energy Loss Per Pulse for Sinusoidal Pulses



## Calculation of Fast Recovery Diodes and Allowable Case Temperature

### 1. Conduction Losses

$$P_{av(cond)} = J/P \times F$$

### 2. Reverse Recovery Losses (Approximate)

$$P_{av(sw)} = 1/4 \times V_R \times \frac{di_R}{dt} \times T_{rr}^2 \times \left( \frac{1/s}{1 + 1/s} \right)^2 \times F \times 1 \times 10^{-6}$$

### 3. Maximum Allowable Case Temperature

$$T_{C(max)} = T_j - (P_{av(cond)} + P_{av(sw)} \times R_{\theta(j-c)})$$

Where:

$P_{av(cond)}$  = Forward Conduction Power Loss in Watts

$P_{av(sw)}$  = Reverse Recovery Power Loss in Watts

$J/P$  = Energy Loss per Pulse in Joules

$F$  = Frequency in Hertz

$V_R$  = Steady State Reverse Operating Voltage in Volts

$di_R/dt$  = Rate of Decay of Forward Current in Amperes/μsec

$T_{rr}$  = Reverse Recovery Time in Microseconds

$\frac{1}{S}$  = Ratio of Recovery  $di/dt$   $\left( \frac{di_F/dt}{di_R/dt} \right)$

$F$  = Operating Frequency in Hertz

$T_{C(max)}$  = Maximum Allowable Case Temperature in °C.

$T_j$  = Maximum Operating Junction Temperature in °C.

$R_{\theta(j-c)}$  = DC Junction to Case Thermal Impedance in °C/Watt.