

# Rectifier Diode

## Type W0428##250-320

Development Type No.: WX171##250-320

**Absolute Maximum Ratings**

|                  | VOLTAGE RATINGS                               | MAXIMUM LIMITS | UNITS |
|------------------|---|----------------|-------|
| V <sub>RRM</sub> | Repetitive peak reverse voltage, (note 1)     | 2500-3200      | V     |
| V <sub>RSM</sub> | Non-repetitive peak reverse voltage, (note 1) | 2600-3300      | V     |

|                      | OTHER RATINGS  | MAXIMUM LIMITS      | UNITS            |
|----------------------|--|---------------------|------------------|
| I <sub>F(AV)M</sub>  | Maximum average forward current, T <sub>case</sub> =55°C, (note 2)   | 428                 | A                |
| I <sub>F(AV)M</sub>  | Maximum average forward current. T <sub>case</sub> =70°C, (note 2)   | 380                 | A                |
| I <sub>F(AV)M</sub>  | Maximum average forward current. T <sub>case</sub> =100°C, (note 2)  | 271                 | A                |
| I <sub>F(RMS)</sub>  | Nominal RMS forward current, T <sub>case</sub> =100°C, (note 2)  | 425                 | A                |
| I <sub>F(RMS)</sub>  | Nominal RMS forward current, T <sub>case</sub> =25°C, (note 2)   | 809                 | A                |
| I <sub>F(d.c.)</sub> | D.C. forward current, T <sub>case</sub> =25°C  | 675                 | A                |
| I <sub>FSM</sub>     | Peak non-repetitive surge t <sub>p</sub> =10ms, V <sub>rm</sub> =60%V <sub>RRM</sub> , (note 3)            | 5500                | A                |
| I <sub>FSM2</sub>    | Peak non-repetitive surge t <sub>p</sub> =10ms, V <sub>rm</sub> ≤10V, (note 3)                             | 6050                | A                |
| I <sup>2</sup> t     | I <sup>2</sup> t capacity for fusing t <sub>p</sub> =10ms, V <sub>rm</sub> =60%V <sub>RRM</sub> , (note 3) | 151×10 <sup>3</sup> | A <sup>2</sup> s |
| I <sup>2</sup> t     | I <sup>2</sup> t capacity for fusing t <sub>p</sub> =10ms, V <sub>rm</sub> ≤10V, (note 3)                  | 183×10 <sup>3</sup> | A <sup>2</sup> s |
| T <sub>j op</sub>    | Operating temperature range  | -40 to +150         | °C               |
| T <sub>stg</sub>     | Storage temperature range  | -40 to +150         | °C               |

Notes:-

- 1) De-rating factor of 0.13% per °C is applicable for T<sub>j</sub> below 25°C.
- 2) Single phase; 50Hz, 180° half-sinewave.
- 3) Half-sinewave, 150°C T<sub>j</sub> initial.

**Characteristics**

|                              | PARAMETER                            | MIN. | TYP. | MAX.  | TEST CONDITIONS (Note 1)  | UNITS |
|------------------------------|--------------------------------------|------|------|-------|---|-------|
| V <sub>FM</sub>              | Maximum peak forward voltage         | -    | -    | 1.60  | I <sub>TM</sub> =900A   | V     |
| V <sub>FM</sub>              | Maximum peak forward voltage         | -    | -    | 1.80  | I <sub>TM</sub> =1180A  | V     |
| V <sub>T0</sub>              | Threshold voltage                    | -    | -    | 0.926 |   | V     |
| r <sub>T</sub>               | Slope resistance                     | -    | -    | 0.739 |   | mΩ    |
| I <sub>R<sub>RRM</sub></sub> | Peak reverse current                 | -    | -    | 15    | Rated V <sub>RRM</sub>  | mA    |
| Q <sub>rr</sub>              | Recovered charge                     | -    | 1000 | -     |   | μC    |
| Q <sub>ra</sub>              | Recovered charge, 50% chord          | -    | 700  | 900   | I <sub>TM</sub> =100A, t <sub>P</sub> =500μs, di/dt=10A/μs, V <sub>r</sub> =50V | μC    |
| I <sub>rr</sub>              | Reverse recovery current             | -    | 75   | -     |   | A     |
| t <sub>rr</sub>              | Reverse recovery time, 50% chord     | -    | 19   | -     |   | μs    |
| R <sub>thJC</sub>            | Thermal resistance, junction to case | -    | -    | 0.13  |   | K/W   |
| R <sub>thCK</sub>            | Thermal resistance, case to heatsink | -    | -    | 0.04  |   | K/W   |
| F                            | Mounting torque                      | 24   | -    | 30    |   | Nm    |
| W <sub>t</sub>               | Weight                               | -    | 175  | -     | Outline E   | g     |
|                              |                                      | -    | 250  | -     | Outline F   |       |

Notes:-

 1) Unless otherwise indicated T<sub>j</sub>=150°C.

## Notes on Ratings and Characteristics

### 1.0 Voltage Grade Table

| Voltage Grade | $V_{RRM}$<br>V | $V_{RSM}$<br>V | $V_R$<br>DC V |
|---------------|----------------|----------------|---------------|
| 25            | 2500           | 2600           | 1500          |
| 28            | 2800           | 2900           | 1650          |
| 32            | 3200           | 3300           | 1850          |

### 2.0 Extension of Voltage Grades

This report is applicable to other voltage grades when supply has been agreed by Sales/Production.

### 3.0 De-rating Factor

A blocking voltage de-rating factor of 0.13%/°C is applicable to this device for  $T_j$  below 25°C.

### 4.0 Snubber Components

When selecting snubber components, care must be taken not to use excessively large values of snubber capacitor or excessively small values of snubber resistor. Such excessive component values may lead to device damage due to the large resultant values of snubber discharge current. If required, please consult the factory for assistance.

### 5.0 Computer Modelling Parameters

#### 5.1 Device Dissipation Calculations

$$I_{AV} = \frac{-V_{T0} + \sqrt{V_{T0}^2 + 4 \cdot ff^2 \cdot r_T \cdot W_{AV}}}{2 \cdot ff^2 \cdot r_T} \quad \text{and:} \quad W_{AV} = \frac{\Delta T}{R_{th}}$$

$$\Delta T = T_{j\max} - T_K$$

Where  $V_{T0}=0.926V$ ,  $r_T=0.739m\Omega$ ,

$R_{th}$  = Supplementary thermal impedance, see table below and

$ff$  = Form factor, see table below.

| Supplementary Thermal Impedance |               |                |               |       |
|---------------------------------|---------------|----------------|---------------|-------|
| Conduction Angle                | 6 phase (60°) | 3 phase (120°) | ½ wave (180°) | d.c.  |
| Square wave                     | 0.174         | 0.153          | 0.143         | 0.130 |
| Sine wave                       | 0.172         | 0.153          | 0.149         |       |

| Form Factors     |               |                |               |      |
|------------------|---------------|----------------|---------------|------|
| Conduction Angle | 6 phase (60°) | 3 phase (120°) | ½ wave (180°) | d.c. |
| Square wave      | 2.449         | 1.732          | 1.414         | 1    |
| Sine wave        | 2.778         | 1.879          | 1.57          |      |

### 5.2 Calculating $V_F$ using ABCD Coefficients

The on-state characteristic  $I_F$  vs.  $V_F$ , on page 6 is represented in two ways;

- (i) the well established  $V_{T0}$  and  $r_T$  tangent used for rating purposes and
- (ii) a set of constants A, B, C, D, forming the coefficients of the representative equation for  $V_F$  in terms of  $I_F$  given below:

$$V_F = A + B \cdot \ln(I_F) + C \cdot I_F + D \cdot \sqrt{I_F}$$

The constants, derived by curve fitting software, are given below for both hot and cold characteristics. The resulting values for  $V_F$  agree with the true device characteristic over a current range, which is limited to that plotted.

| 25°C Coefficients |                          | 150°C Coefficients |                           |
|-------------------|--------------------------|--------------------|---------------------------|
| A                 | 0.7795642                | A                  | 0.6340984                 |
| B                 | 0.04590695               | B                  | 0.04112559                |
| C                 | $4.64903 \times 10^{-4}$ | C                  | $5.72979 \times 10^{-4}$  |
| D                 | $2.19035 \times 10^{-3}$ | D                  | $5.790022 \times 10^{-3}$ |

### 6.0 Reverse recovery ratings

- (i)  $Q_{rr}$  is based on 50%  $I_{RM}$  chord as shown in Fig. 1

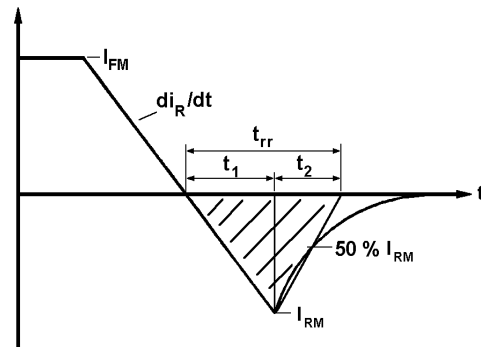


Fig. 1

- (ii)  $Q_{rr}$  is based on a  $150\mu s$  integration time i.e.

$$Q_{rr} = \int_0^{150\mu s} i_{rr} \cdot dt$$

- (iii)

$$K \text{ Factor} = \frac{t_1}{t_2}$$

**Curves**

Figure 1 - Forward characteristics of Limit device

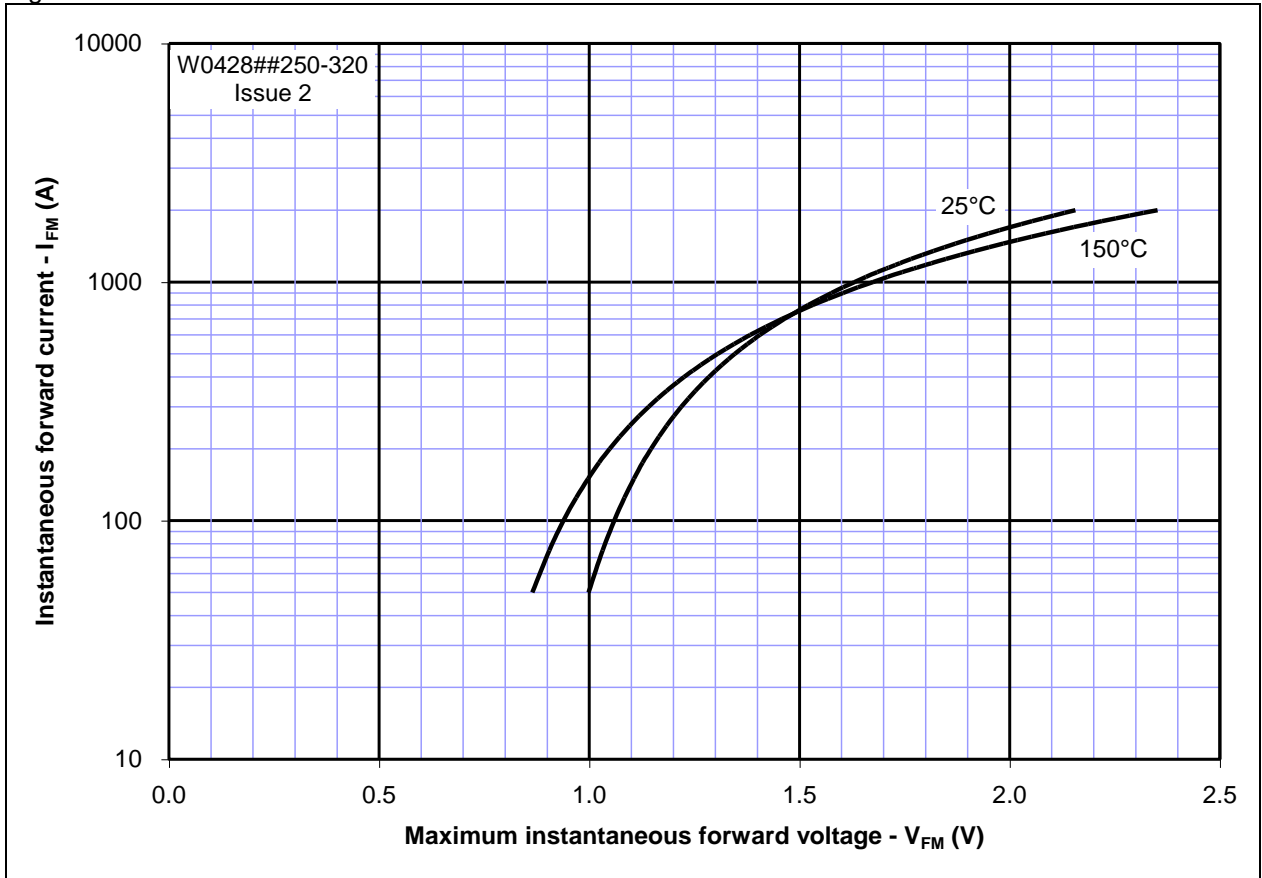


Figure 2 - Maximum surge and  $I^2t$  ratings

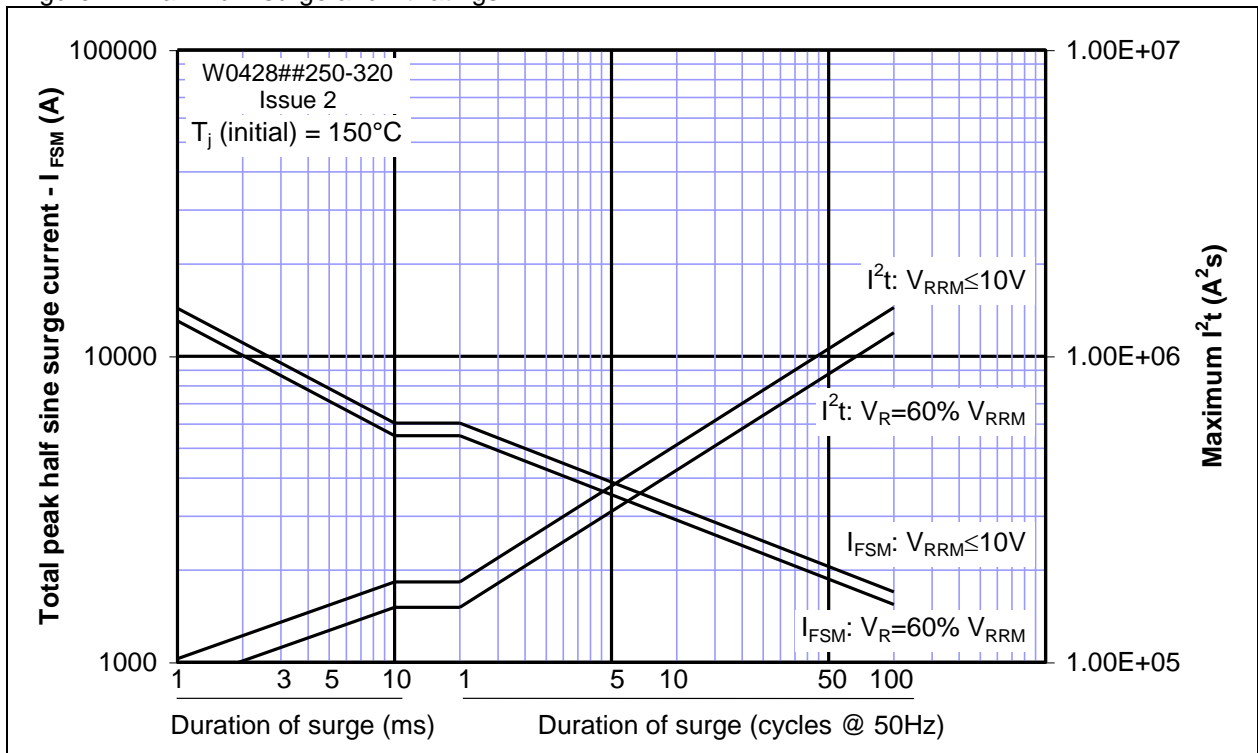


Figure 3 – Total recovered charge,  $Q_{rr}$

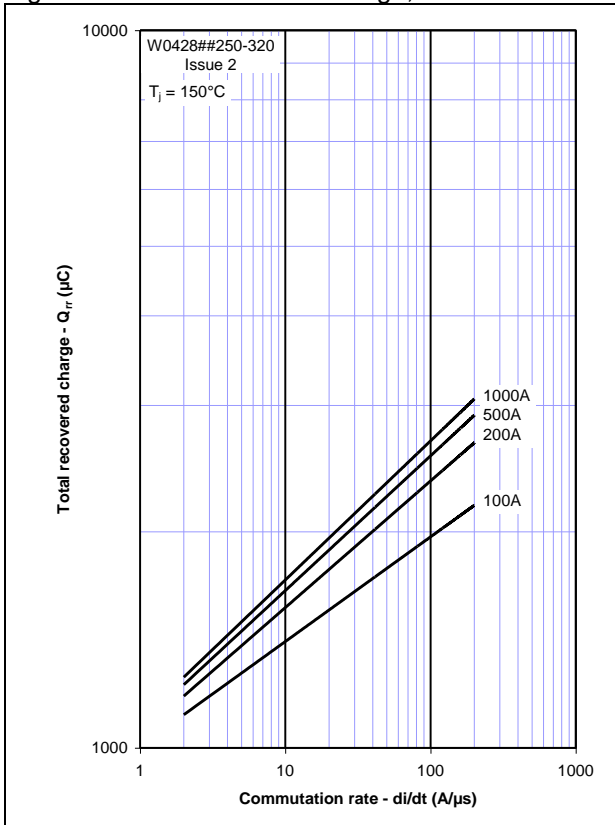


Figure 4 – Recovered charge,  $Q_{ra}$  (50% chord)

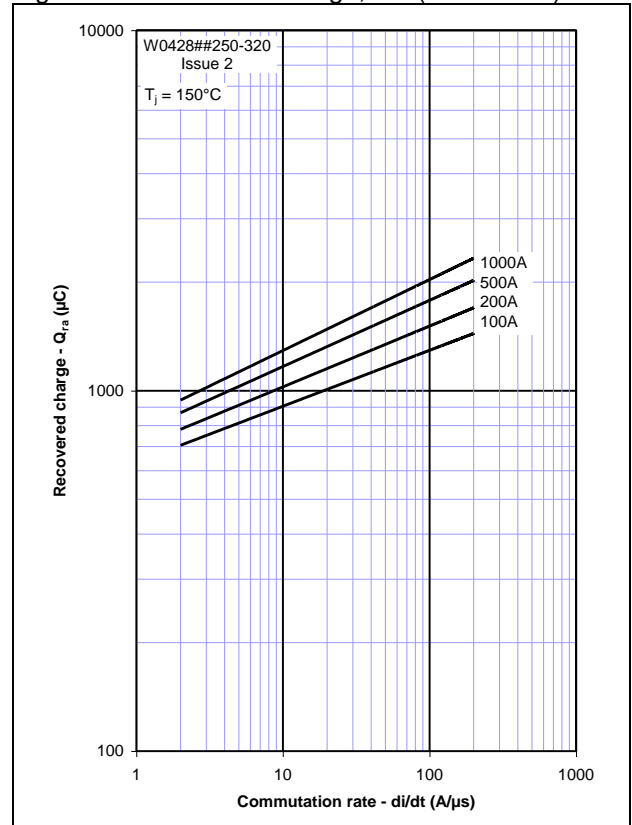


Figure 5 – Peak reverse recovery current,  $I_{rm}$

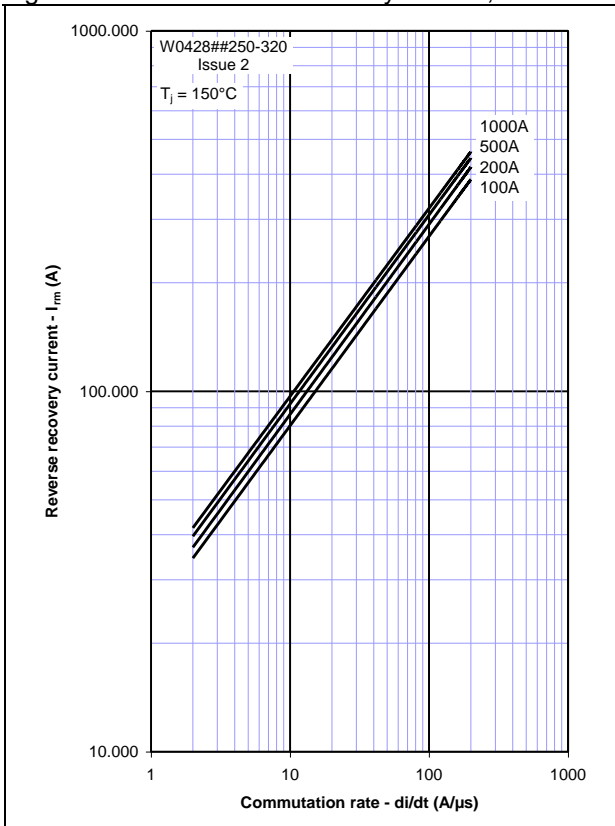


Figure 6 – Maximum recovery time,  $t_{rr}$  (50% chord)

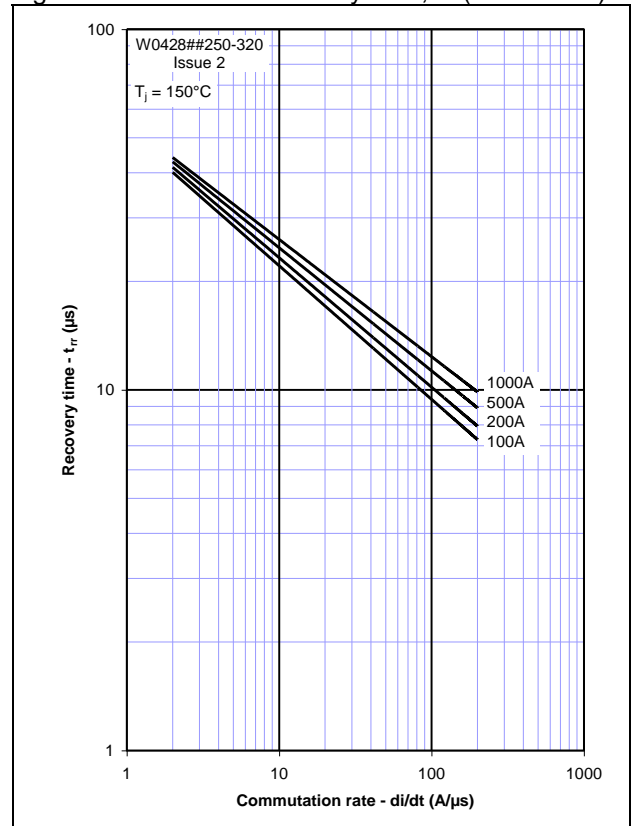


Figure 7 – Forward current vs. Power dissipation

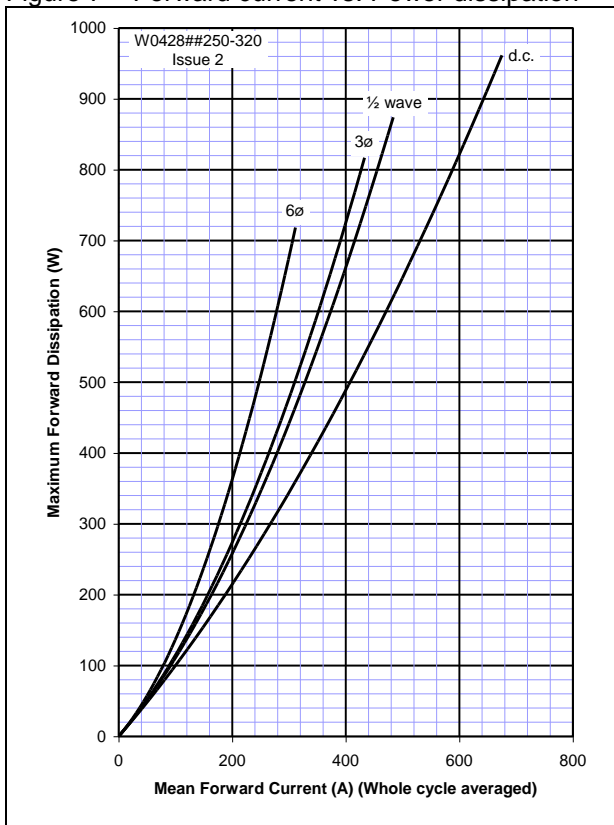


Figure 8 – Forward current vs. Heatsink temperature

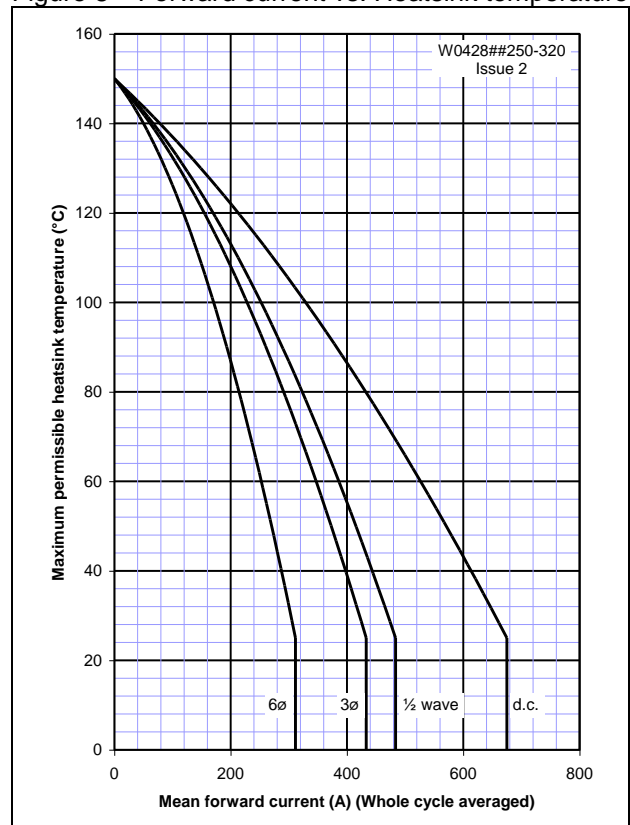
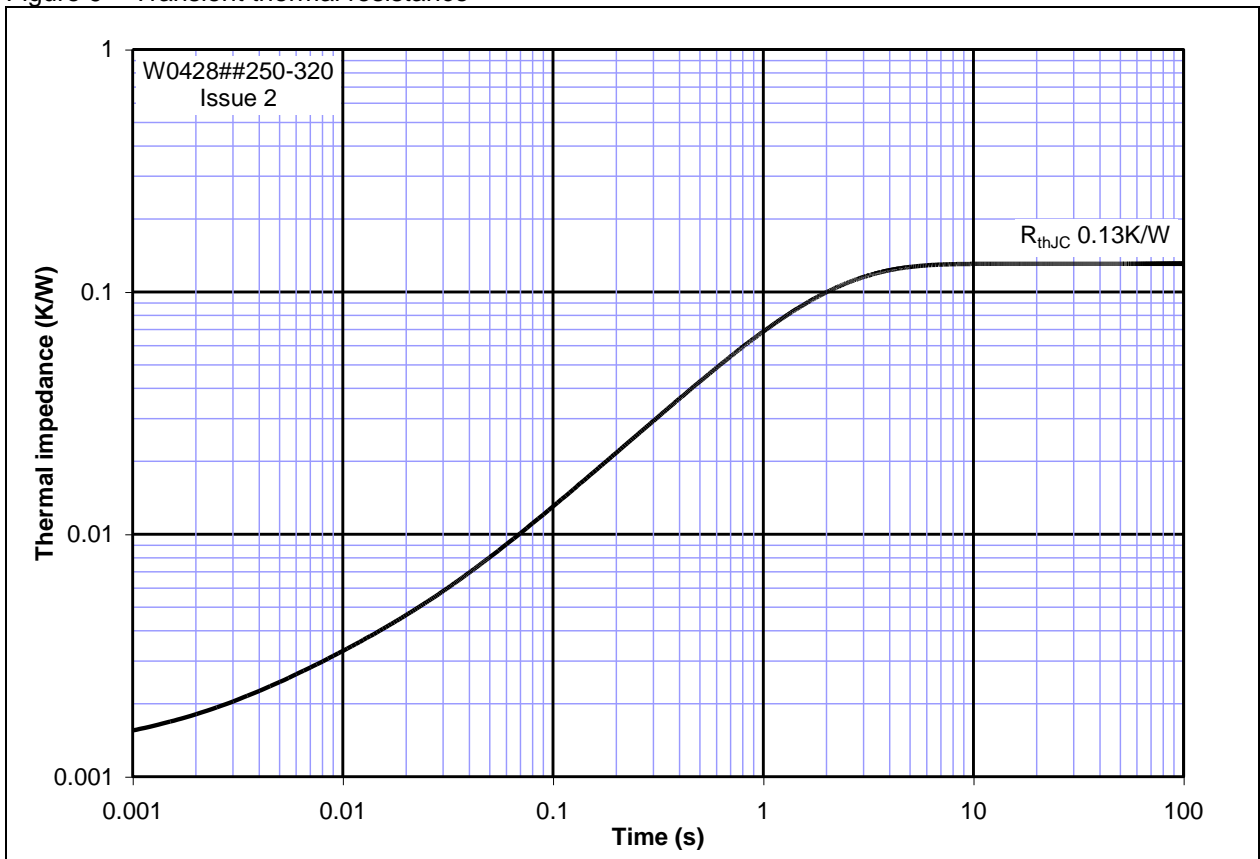
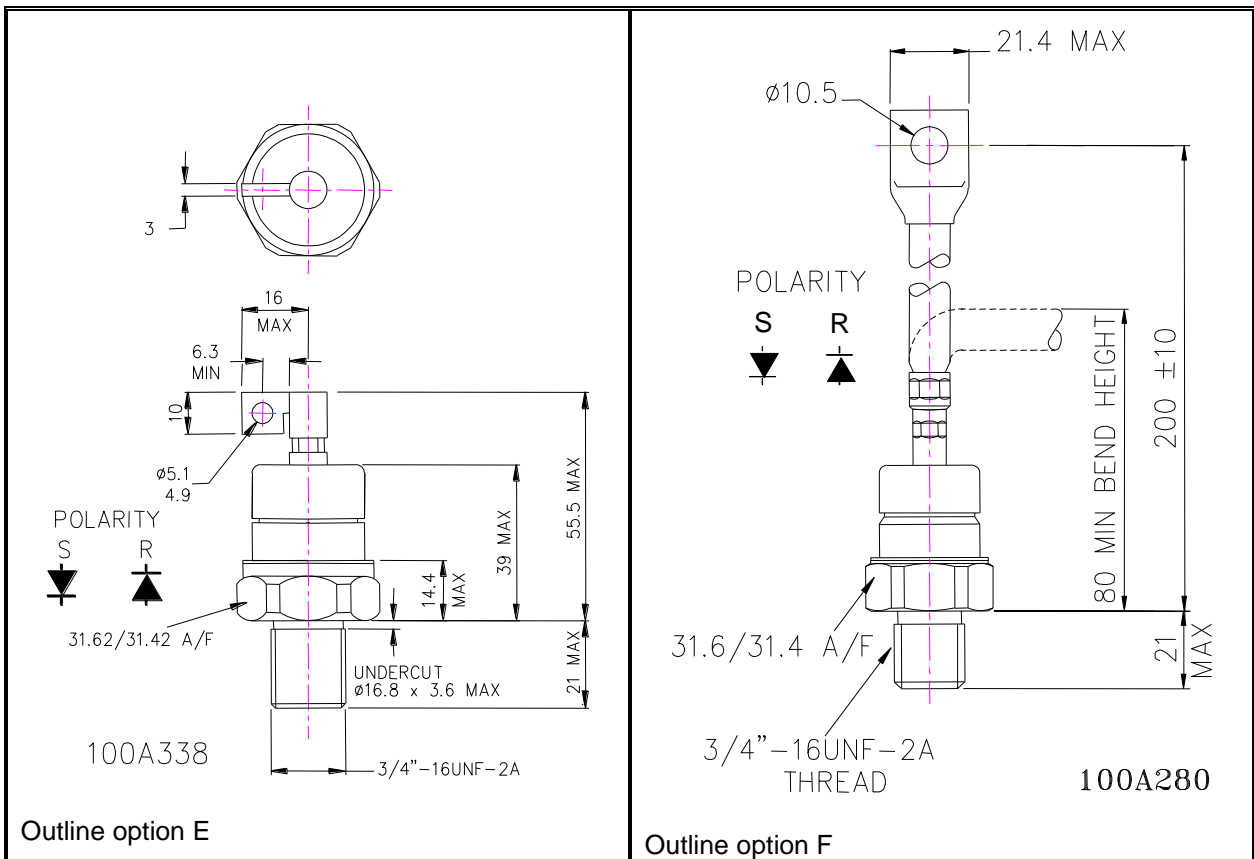


Figure 9 – Transient thermal resistance



**Outline Drawing & Ordering Information**



Outline option E

Outline option F

**ORDERING INFORMATION**

(Please quote 13 digit code as below)

|                 |   |  |  |            |
|-----------------|---|--|--|------------|
| <b>W0428</b>    | <b>#</b>  | <b>#</b>   | <b>♦♦</b>                                      | <b>0</b>   |
| Fixed Type Code | Polarity code<br>R = Base Anode<br>S = Base Cathode | Outline code<br>E=3/4" HV ceramic stud + lug<br>F=3/4" HV ceramic stud | Voltage Code<br>V <sub>DRM</sub> /100<br>25-32 | Fixed code |

Typical order code: W0428SE250 – 2500V V<sub>RRM</sub>, cathode base, 3/4" high voltage stud, ceramic housing with lug

**IXYS Semiconductor GmbH**  
Edisonstraße 15  
D-68623 Lampertheim  
Tel: +49 6206 503-0  
Fax: +49 6206 503-627  
E-mail: [marcom@ixys.de](mailto:marcom@ixys.de)



**IXYS UK Westcode Ltd**  
Langley Park Way, Langley Park,  
Chippenham, Wiltshire, SN15 1GE.  
Tel: +44 (0)1249 455500  
Fax: +44 (0)1249 659448  
E-mail: [sales@ixysuk.com](mailto:sales@ixysuk.com)

**IXYS Corporation**  
1590 Buckeye Drive  
Milpitas CA 95035 7418 USA  
Tel: +1 (408) 547 9000  
Fax: +1 (408) 496 0670  
E-mail: [sales@ixys.net](mailto:sales@ixys.net)

[www.ixysuk.com](http://www.ixysuk.com)

[www.ixys.com](http://www.ixys.com)

**IXYS Long Beach Inc**  
2500 Mira Mar Ave, Long Beach  
CA 90815  
Tel: +1 (562) 296 6584  
Fax: +1 (562) 296 6585  
E-mail: [service@ixyslongbeach.com](mailto:service@ixyslongbeach.com)

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