

# Rectifier Diode

## Types W3743Z#400 to W3743Z#500

**Absolute Maximum Ratings**

	VOLTAGE RATINGS	MAXIMUM LIMITS	UNITS
$V_{RRM}$	Repetitive peak reverse voltage, (note 1)	4000-5000	V
$V_{RSM}$	Non-repetitive peak reverse voltage, (note 1)	4100-5100	V

	OTHER RATINGS	MAXIMUM LIMITS	UNITS
$I_{F(AV)M}$	Maximum average forward current, $T_{sink}=55^{\circ}C$ , (note 2)	3750	A
$I_{F(AV)M}$	Maximum average forward current. $T_{sink}=100^{\circ}C$ , (note 2)	2625	A
$I_{F(AV)M}$	Maximum average forward current. $T_{sink}=100^{\circ}C$ , (note 3)	1640	A
$I_{F(RMS)M}$	Nominal RMS forward current, $T_{sink}=25^{\circ}C$ , (note 2)	6860	A
$I_{F(d.c.)}$	D.C. forward current, $T_{sink}=25^{\circ}C$ , (note 4)	6100	A
$I_{FSM}$	Peak non-repetitive surge $t_p=10ms$ , $V_{rm}=60\%V_{RRM}$ , (note 5)	35	kA
$I_{FSM2}$	Peak non-repetitive surge $t_p=10ms$ , $V_{rm}\leq 10V$ , (note 5)	39	kA
$I^2t$	$I^2t$ capacity for fusing $t_p=10ms$ , $V_{rm}=60\%V_{RRM}$ , (note 5)	$6.13 \times 10^6$	$A^2s$
$I^2t$	$I^2t$ capacity for fusing $t_p=10ms$ , $V_{rm}\leq 10V$ , (note 5)	$7.61 \times 10^6$	$A^2s$
$T_{j op}$	Operating temperature range	-55 to +160	$^{\circ}C$
$T_{stg}$	Storage temperature range	-55 to +160	$^{\circ}C$

Notes:-

- 1) De-rating factor of 0.13% per  $^{\circ}C$  is applicable for  $T_j$  below  $25^{\circ}C$ .
- 2) Double side cooled, single phase; 50Hz,  $180^{\circ}$  half-sinewave.
- 3) Single side cooled, single phase; 50Hz,  $180^{\circ}$  half-sinewave.
- 4) Double side cooled.
- 5) Half-sinewave,  $160^{\circ}C$   $T_j$  initial.

### Characteristics

	PARAMETER	MIN.	TYP.	MAX.	TEST CONDITIONS (Note 1)	UNITS
V <sub>FM</sub>	Maximum peak forward voltage	-	-	2.00	I <sub>FM</sub> =6000A	V
V <sub>FM</sub>	Maximum peak forward voltage	-	-	2.90	I <sub>FM</sub> =11250A	V
V <sub>T0</sub>	Threshold voltage	-	-	0.976	Valid from 5000A to 15000A	V
r <sub>T</sub>	Slope resistance	-	-	0.170		mΩ
I <sub>RRM</sub>	Peak reverse current	-	-	200	Rated V <sub>RRM</sub>	mA
Q <sub>rr</sub>	Recovered charge	-	12000	13000	I <sub>TM</sub> =2000A, t <sub>p</sub> =1000μs, di/dt=10A/μs, V <sub>r</sub> =100V	μC
Q <sub>ra</sub>	Recovered charge, 50% Chord	-	7150	-		μC
I <sub>rm</sub>	Reverse recovery current	-	263	-		A
t <sub>rr</sub>	Reverse recovery time, 50% chord	-	55	-		μs
R <sub>thJK</sub>	Thermal resistance, junction to heatsink	-	-	0.011	Double side cooled	K/W
		-	-	0.022	Single side cooled	K/W
F	Mounting force	27	-	47	Note 2	kN
W <sub>t</sub>	Weight	-	1.7	-	Outline option ZC, ZT and ZY	Kg
		-	1.2	-	Outline Option ZD and ZV	

Notes:-

- 1) Unless otherwise indicated T<sub>j</sub>=160°C.
- 2) For other clamp forces, please consult factory.

Notes on rupture rated packages.

This product is available with a non-rupture rated package.

For additional details on these products, please consult factory.

## Notes on Ratings and Characteristics

### 1.0 Voltage Grade Table

Voltage Grade	$V_{RRM}$ V	$V_{RSM}$ V	$V_R$ DC V
40	4000	4100	2400
45	4500	4600	2700
50	5000	5100	3000

### 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  $V_{T0}=0.976V$ ,  $r_T=0.17m\Omega$ ,

$R_{th}$  = 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 Double Side Cooled	0.0144	0.0132	0.0126	0.0116
Square wave Cathode Side Cooled	0.0262	0.0251	0.0244	0.0235
Sine wave Double Side Cooled	0.0133	0.0124	0.0115	
Sine wave Cathode Side Cooled	0.0253	0.0244	0.0234	

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		160°C Coefficients	
A	0.686301	A	0.217584
B	0.0361394	B	0.084283
C	$8.485046 \times 10^{-5}$	C	$1.511744 \times 10^{-4}$
D	$3.117855 \times 10^{-3}$	D	$1.851405 \times 10^{-3}$

5.3 D.C. Thermal Impedance Calculation

$$r_t = \sum_{p=1}^{p=n} r_p \cdot \left( 1 - e^{\frac{-t}{\tau_p}} \right)$$

Where  $p = 1$  to  $n$ ,  $n$  is the number of terms in the series and:

$t$  = Duration of heating pulse in seconds.

$r_t$  = Thermal resistance at time  $t$ .

$r_p$  = Amplitude of  $p_{th}$  term.

$\tau_p$  = Time Constant of  $r_{th}$  term.

The coefficients for this device are shown in the tables below:

D.C. Double Side Cooled				
Term	1	2	3	4
$r_p$	0.01551	$2.7827 \times 10^{-3}$	$4.2105 \times 10^{-3}$	$0.9443 \times 10^{-3}$
$\tau_p$	10.04275	1.783567	0.2231307	$3.428 \times 10^{-3}$

D.C. Double Side Cooled					
Term	1	2	3	4	5
$r_p$	$6.4176 \times 10^{-3}$	$2.7472 \times 10^{-3}$	$1.2515 \times 10^{-3}$	$0.6336 \times 10^{-3}$	$0.59597 \times 10^{-3}$
$\tau_p$	1.785337	0.34595	0.099651	0.014214	$2.298151 \times 10^{-3}$

6.0 Reverse recovery ratings

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

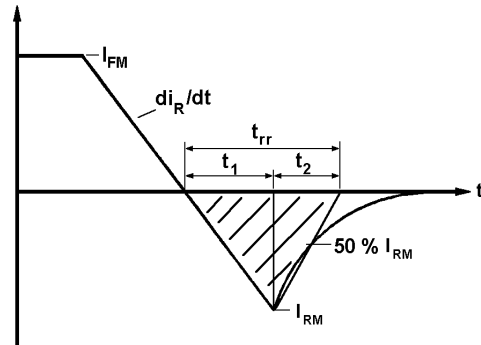


Fig. 1

(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

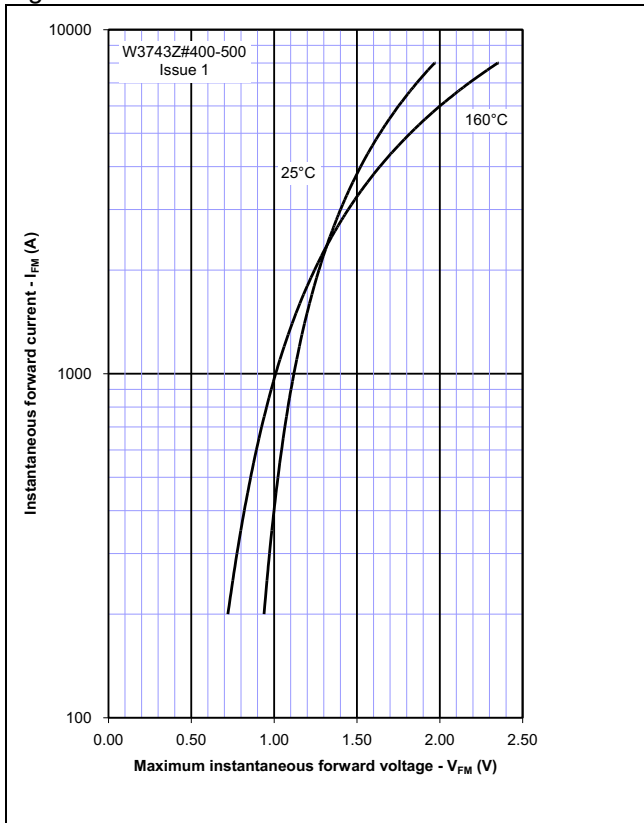


Figure 2 – Transient thermal impedance

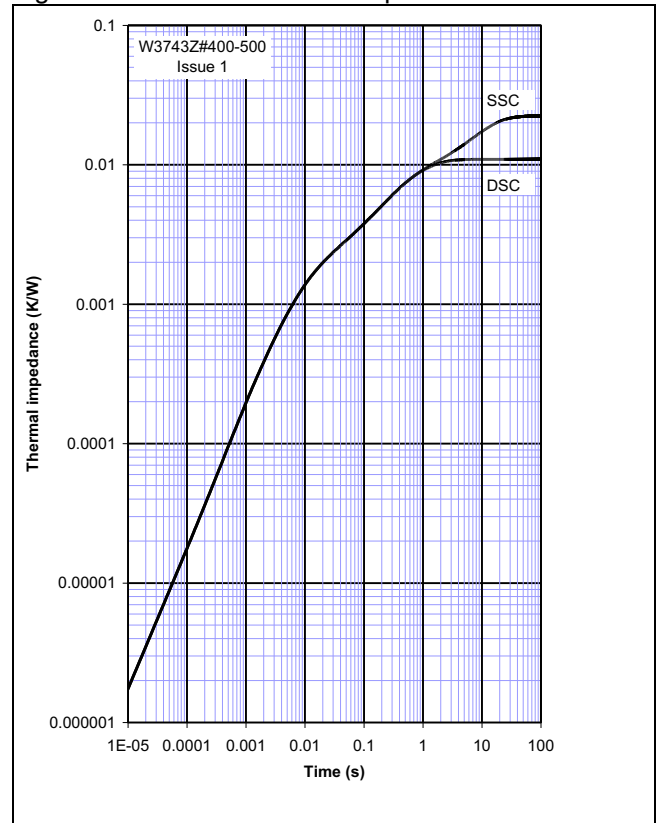


Figure 3 – Maximum Surge Rating

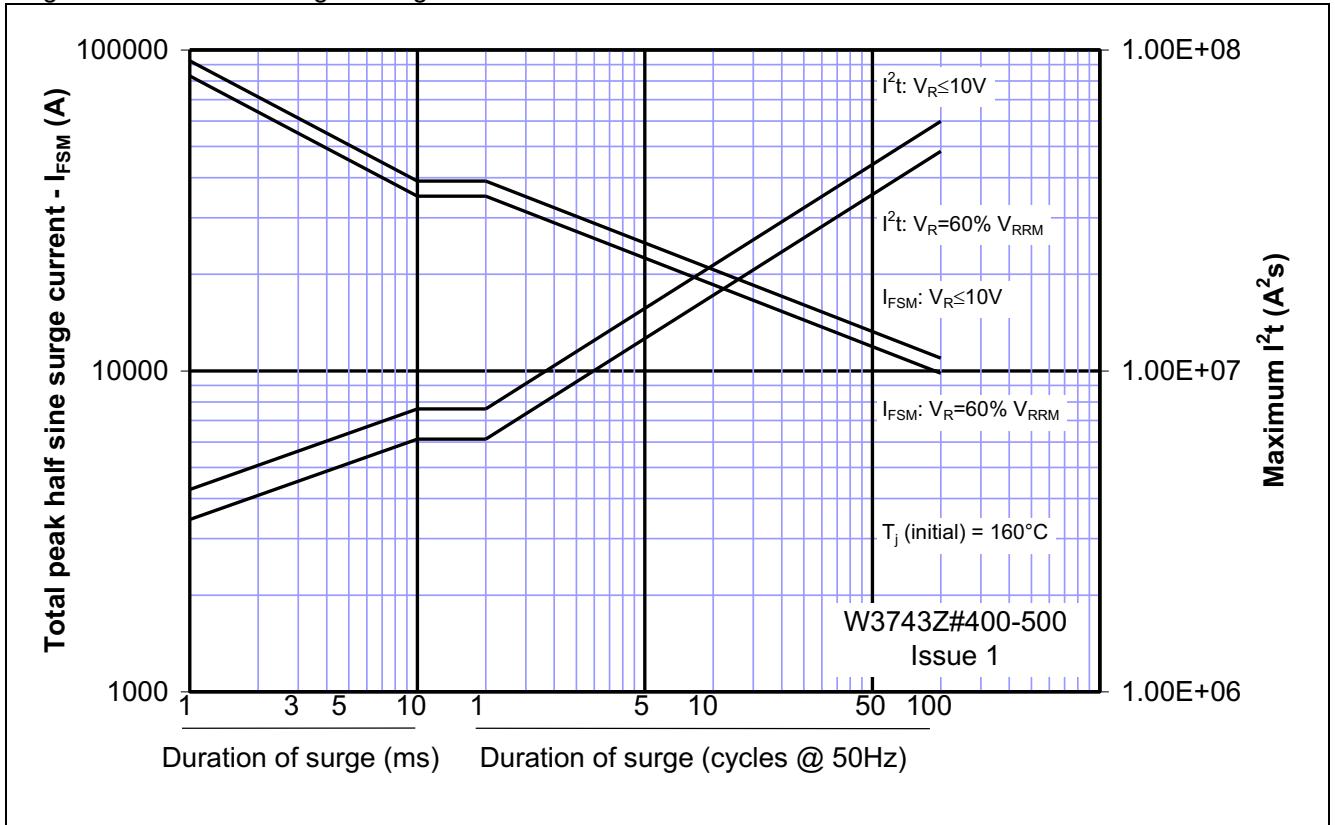


Figure 4 – Total recovered charge,  $Q_{rr}$

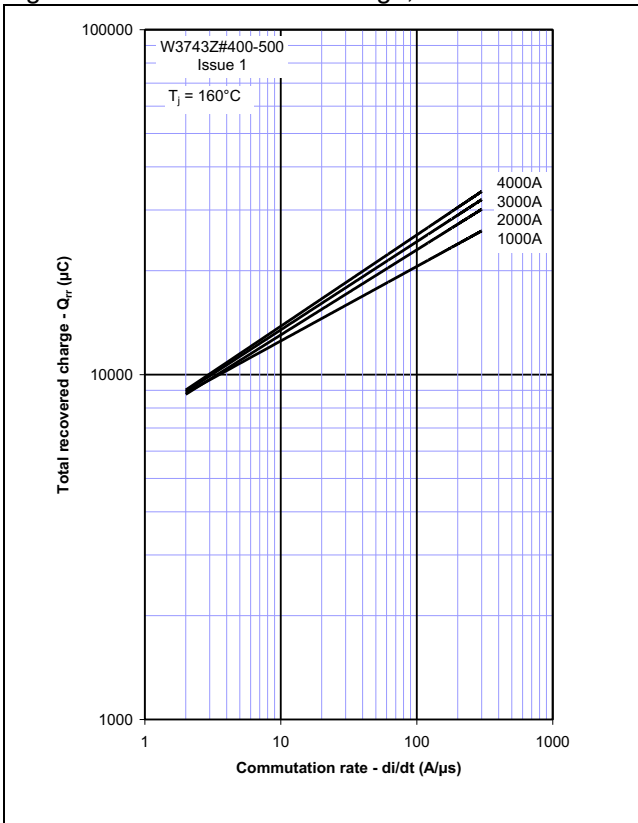


Figure 5 – Recovered charge,  $Q_{ra}$  (50% chord)

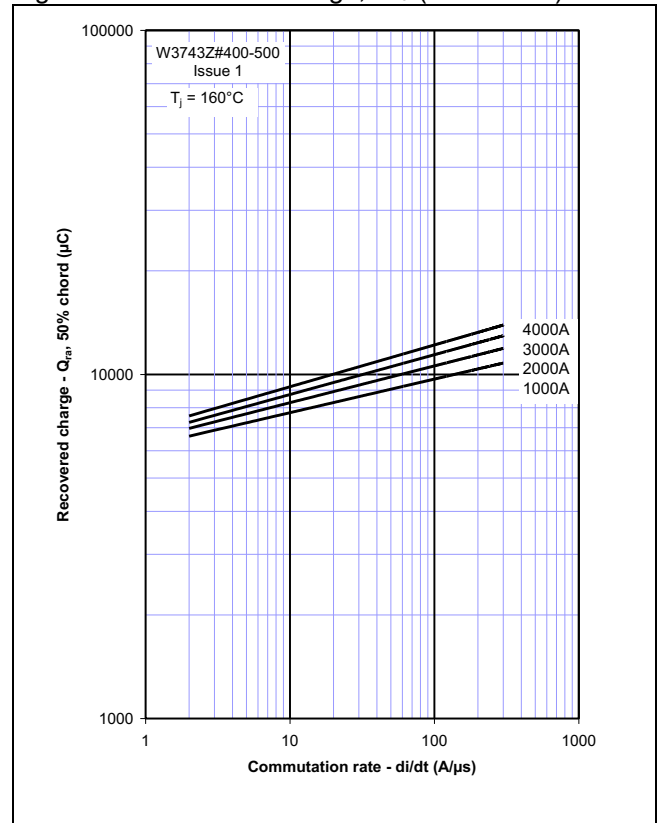


Figure 6 – Peak reverse recovery current,  $I_{rm}$

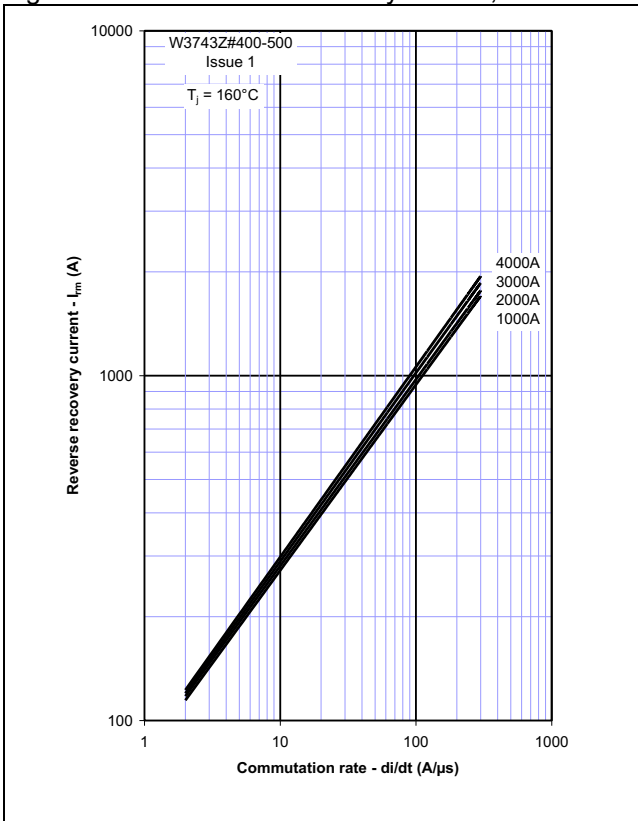


Figure 7 – Maximum recovery time,  $t_{rr}$  (50% chord)

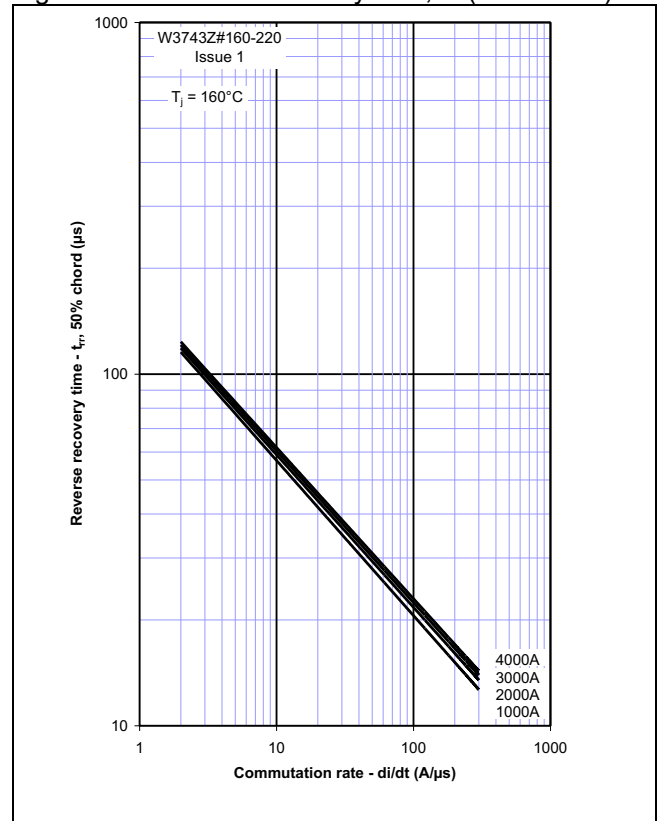


Figure 8 – Forward current vs. Power dissipation – Double Side Cooled

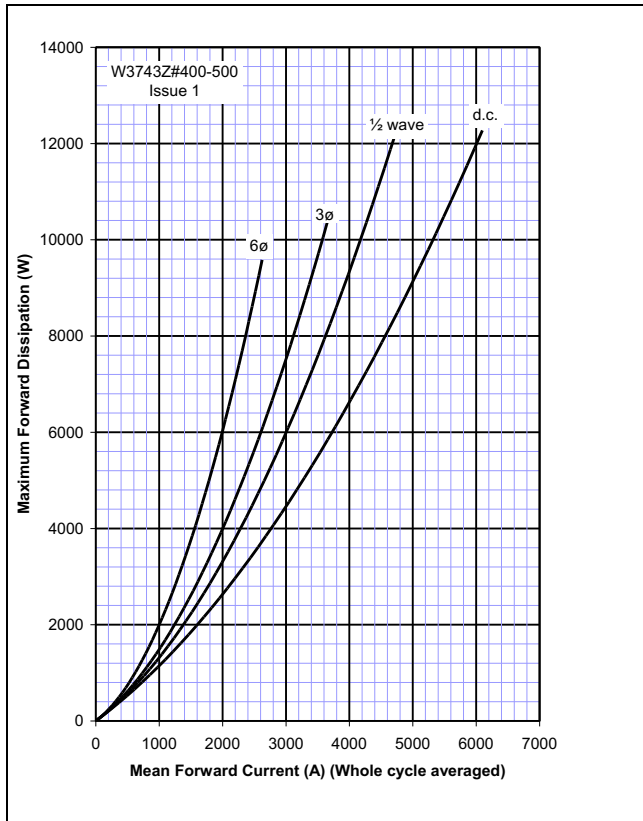


Figure 9 – Forward current vs. Heatsink temperature – Double Side Cooled

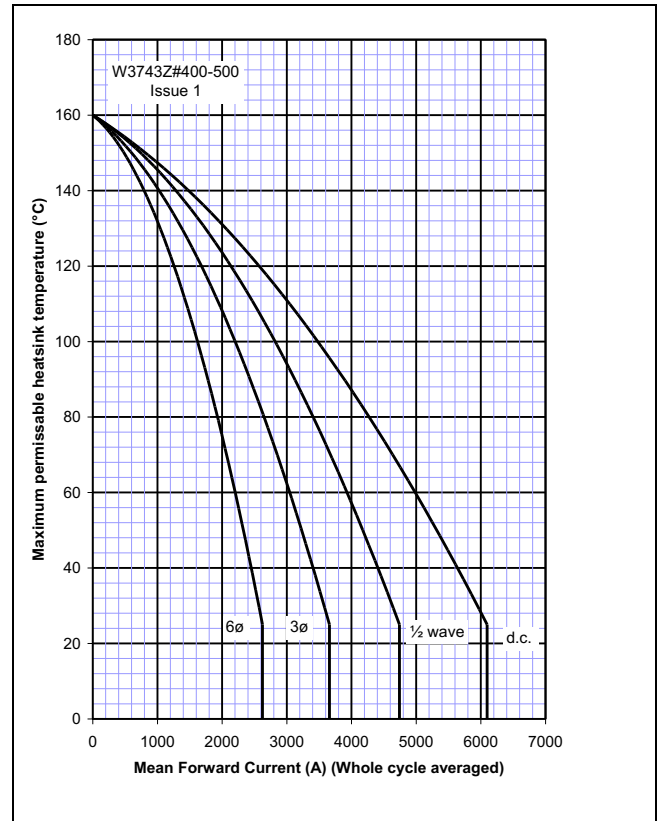


Figure 10 – Forward current vs. Power dissipation – Cathode Side Cooled

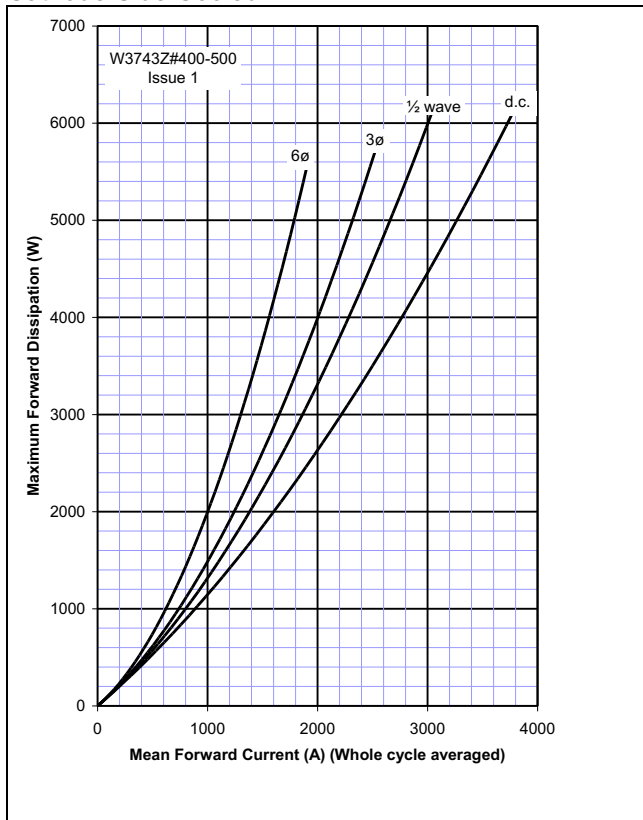
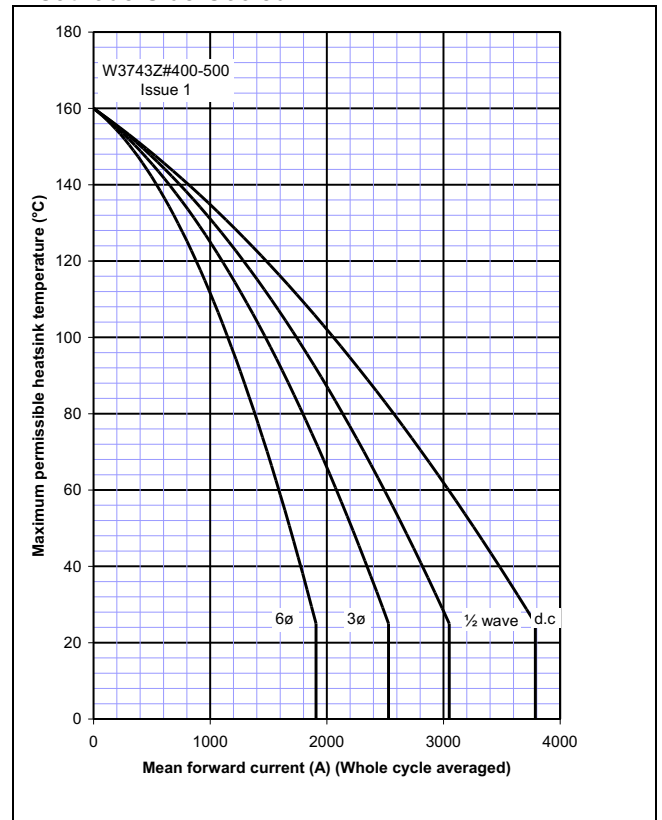
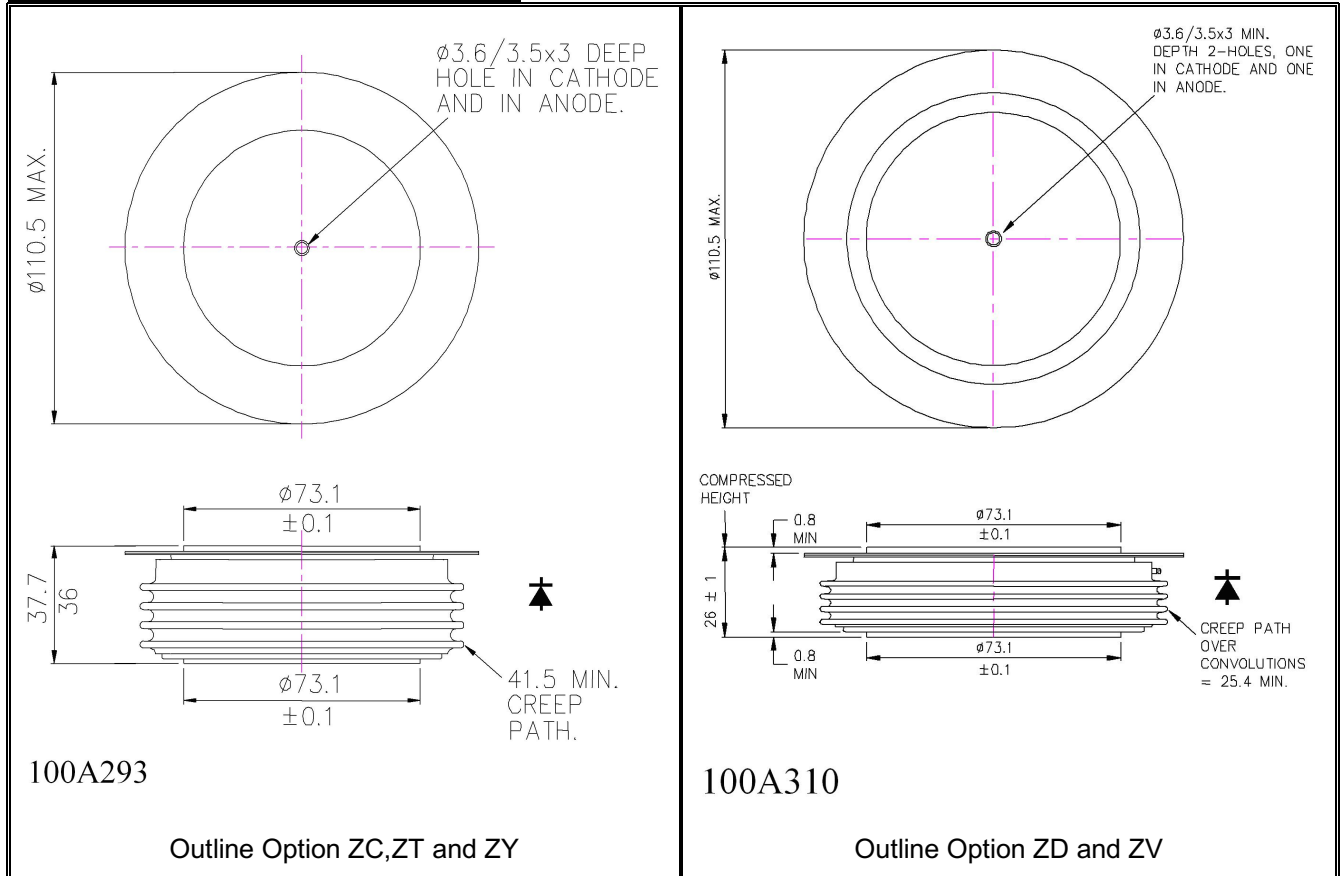


Figure 11 – Forward current vs. Heatsink temperature – Cathode Side Cooled





**Outline Drawing & Ordering Information**



ORDERING INFORMATION			
(Please quote 10 digit code as below)			
<b>W3743</b>	<b>Z#</b>	<b>◆◆</b>	<b>0</b>
Fixed Type Code	Fixed outline code ZC = 37.7mm Clamp height, ZT = 37.7mm rupture rated capsule, ZY = 37.7mm extended rupture rated capsule ZD = 26mm Clamp height, ZV = 26mm rupture rated capsule	Voltage code V <sub>RRM</sub> /100 40-50	Fixed code
Order code: W3743ZD440 – 4400V V <sub>RRM</sub> , 26mm clamp height capsule.			

**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 444524  
Fax: +44 (0)1249 659448  
E-mail: [sales@ixysuk.com](mailto:sales@ixysuk.com)

**IXYS Corporation**  
1590 Buckeye Drive  
Milpitas CA 95035-7418  
Tel: +1 (408) 457 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**  
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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