



Date: 12.01.2006

Data Sheet Issue: 1

# Rectifier Diode Module Types MDO1200-20N1 to MDO1200-22N1

# **Absolute Maximum Ratings**

V <sub>RRM</sub> [V]	Туре
2000	MDO1200-20N1
2200	MDO1200-22N1

	VOLTAGE RATINGS	MAXIMUM LIMITS	UNITS
$V_{RRM}$	Repetitive peak reverse voltage 1)	2000-2200	V
$V_{RSM}$	Non-repetitive peak reverse voltage 1)	2100-2300	V

	OTHER RATINGS	MAXIMUM LIMITS	UNITS
I <sub>F(AV)M</sub>	Maximum average forward current, T <sub>c</sub> =55°C <sup>2)</sup>	1888	
$I_{F(AV)M}$	Maximum average forward current, T <sub>c</sub> =102°C <sup>2)</sup>	1200	
I <sub>F(AV)M</sub>	Maximum average forward current. T <sub>c</sub> =85°C <sup>2)</sup>	1468	Α
I <sub>F(RMS)M</sub>	Nominal RMS forward current, T <sub>c</sub> =25°C <sup>2)</sup>	3557	
I <sub>T(d.c.)</sub>	D.C. forward current, T <sub>c</sub> =25°C <sup>2)</sup>	2836	
I <sub>FSM</sub>	Peak non-repetitive surge t <sub>p</sub> =10ms, V <sub>rm</sub> =60%V <sub>RRM</sub> <sup>3)</sup>	36.4	kA
I <sub>FSM2</sub>	Peak non-repetitive surge t <sub>p</sub> =10ms, V <sub>rm</sub> ≤10V <sup>3)</sup>	40.0	kA
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> <sup>3)</sup>	6.62×10 <sup>6</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 <sup>3)</sup>	8.00×10 <sup>6</sup>	A <sup>2</sup> s
V <sub>ISOL</sub>	Isolation Voltage 4)	3500	V
T <sub>vj op</sub>	Operating temperature range	-40 to +160	°C
T <sub>stg</sub>	Storage temperature range	-55 to +160	°C

- 1) De-rating factor of 0.13% per  $^{\circ}$ C is applicable for  $T_{\nu j}$  below 25 $^{\circ}$ C.
- 2) Single phase; 50 Hz, 180° half-sinewave.
  3) Half-sinewave, 160°C T<sub>vj</sub> initial.
- 4) AC RMS voltage, 50 Hz, 1min test



# **Characteristics**

	PARAMETER	MIN.	TYP.	MAX.	TEST CONDITIONS 1)	UNITS
V	Maximum pook forward voltage	-	-	1.35	I <sub>FM</sub> =3000A	V
$V_{FM}$	Maximum peak forward voltage	-	-	1.44	I <sub>FM</sub> =3600A	V
$V_{T0}$	Threshold voltage	-	-	0.872		V
r <sub>T</sub>	Slope resistance	-	-	0.107		mΩ
	Darly managed and the state of	-	-	2	Rated V <sub>RRM</sub> , T <sub>j</sub> =25°C	
I <sub>RRM</sub>	Peak reverse current	_	-	100	Rated V <sub>RRM</sub>	
Qrr	Recovered Charge	-	4000	-		μC
Q <sub>ra</sub>	Recovered Charge, 50% chord	_	3300	3800	  I <sub>FM</sub> =1000A, t <sub>p</sub> =1000μs, di/dt=10A/μs,	μC
I <sub>rm</sub>	Reverse recovery current	_	200	-	V <sub>r</sub> =50V	Α
t <sub>rr</sub>	Reverse recovery time, 50% chord	_	33	_		μs
$R_{thJC}$	Thermal resistance, junction to case	-	-	0.0405		K/W
$R_{thCH}$	Thermal resistance, case to heatsink	_	-	0.0100		K/W
F <sub>1</sub>	Mounting torque (to heatsink)	5.1	-	6.9		Nm
$F_2$	Mounting torque (to terminals)	16.2	-	19.8		Nm
$W_t$	Weight	-	2.2	-		kg

#### Notes:

1) Unless otherwise indicated  $T_{vj}$ =160°C.



# **Notes on Ratings and Characteristics**

#### 1.0 Voltage Grade Table

Voltage Grade	V <sub>RRM</sub> V	V <sub>RSM</sub> V	V <sub>R</sub> DC V
20	2000	2100	1250
22	2200	2300	1350

# 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<sub>vi</sub> below 25°C.

# 4.0 Repetitive dv/dt

Standard dv/dt is 1000V/µs.

# 5.0 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.

#### 6.0 Computer Modelling Parameters

#### 6.1 Diode dissipation calculations

$$I_{AV} = \frac{-V_{T0} + \sqrt{{V_{T0}}^2 + 4 \cdot f\!f^2 \cdot r_T \cdot W_{AV}}}{2 \cdot f\!f^2 \cdot r_T} \qquad \qquad W_{AV} = \frac{\Delta T}{R_{th}}$$
 and: 
$$\Delta T = T_{j\,\mathrm{max}} - T_C$$

Where  $V_{T0} = 0.872 \text{ V}$ ,  $r_T = 0.107 \text{ m}\Omega$ .

 $R_{th}$  = 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	0.0449	0.0433	0.0423	0.0405			
Sine wave	0.0439	0.0421	0.0409				

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				



6.2 Calculating diode V<sub>F</sub> using ABCD coefficients – For loss calculations

The forward characteristic, I<sub>F</sub> vs. V<sub>F</sub>, is represented in two ways;

- (i) the well established V<sub>T0</sub> and r<sub>T</sub> tangent used for rating purposes and
- (ii) a set of constants A, B, C, D, forming the coefficients of the equation for V<sub>F</sub> in terms of I<sub>T</sub> given below:

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

The ABCD constants are given below for both hot and cold characteristics. The resulting values for V<sub>F</sub> agree with the true device characteristic over a current range, which is limited to that plotted.

	25°C Coefficients		160°C Coefficients
Α	0.8219376	Α	0.6177319
В	0.02800357	В	0.02398102
С	4.58252×10 <sup>-5</sup>	С	4.93957×10 <sup>-5</sup>
D	2.125018×10 <sup>-3</sup>	D	4.419761×10 <sup>-3</sup>

# 6.3 D.C. Thermal Impedance Calculation

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

n = 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. Junction to Case							
Term	1	2	3	4	5	6	
$r_p$	1.0×10 <sup>-5</sup>	0.016708	0.018317	4.346771×10 <sup>-3</sup>	1.004820×10 <sup>-3</sup>	1.0×10 <sup>-5</sup>	
$ au_{\!p}$	2.460066	0.999836	21.998376	9.793053×10 <sup>-3</sup>	2.003674	5.007343	

### 7.0 Reverse recovery ratings

(i) Q<sub>ra</sub> is based on 50% I<sub>RM</sub> chord as shown in Fig. 1

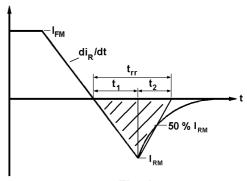


Fig. 1

(ii) Q<sub>rr</sub> is based on a 150 µs integration time i.e.

$$Q_{rr} = \int_{0}^{150 \,\mu s} i_{rr}.dt$$

(iii) 
$$K Factor = \frac{t_1}{t_2}$$



# **Curves**

Figure 1 – Forward Characteristics of Limit Device

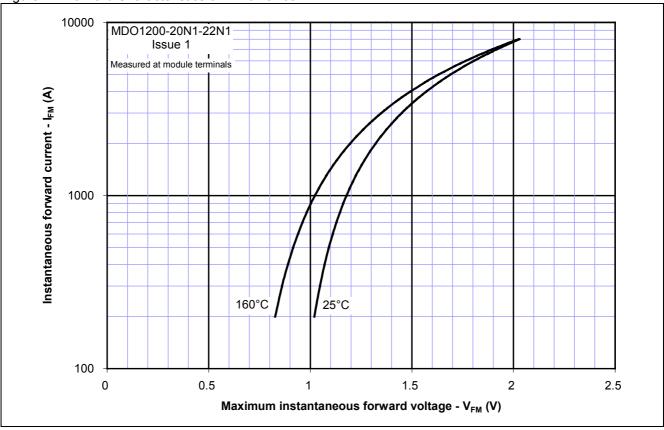


Figure 2 - Transient Thermal Impedance

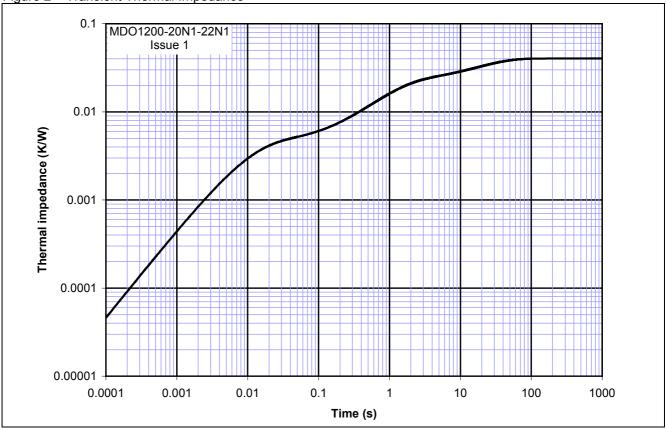




Figure 3 – Total recovered charge, Q<sub>rr</sub>

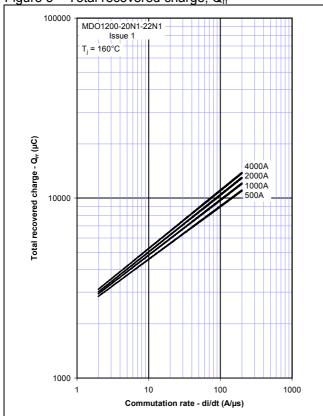
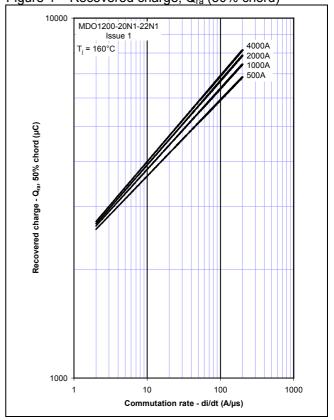


Figure 4 – Recovered charge, Q<sub>ra</sub> (50% chord)



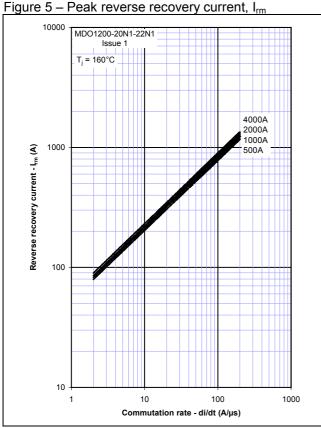


Figure 6 – Maximum recovery time, t<sub>rr</sub> (50% chord)

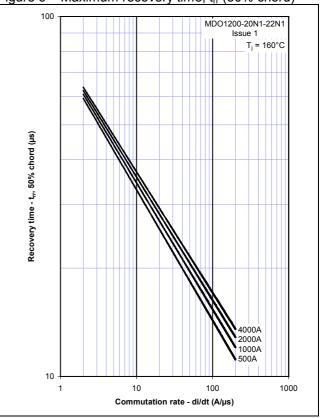




Figure 7 – Forward current vs. Power dissipation

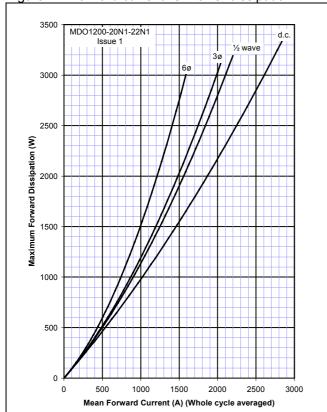


Figure 8 – Forward current vs. Heatsink temperature

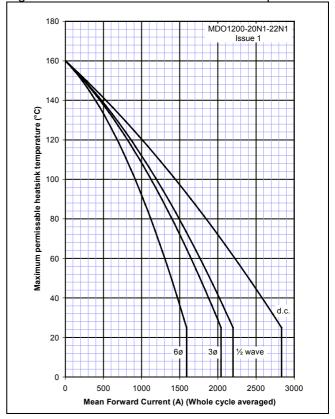
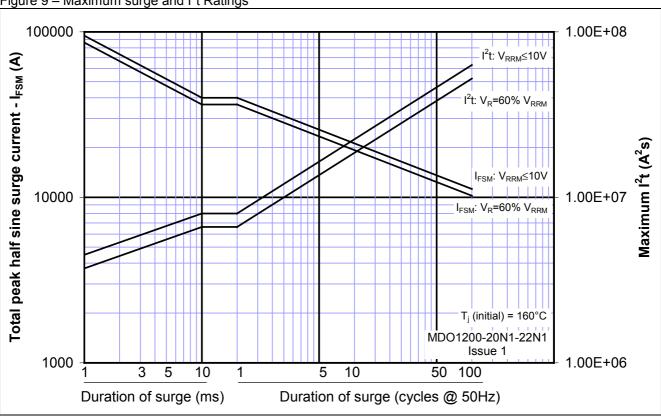
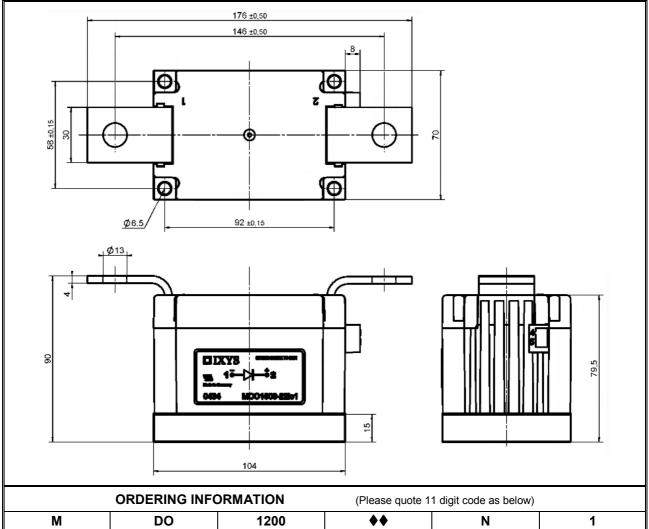


Figure 9 – Maximum surge and I<sup>2</sup>t Ratings





# **Outline Drawing & Ordering Information**



	ORDERING INFO	DRMATION	(Please quote 11 digit code as below)		
M	DO	1200	**	N	1
Fixed Type Code	Fixed Configuration code	Nominal Current Rating	Voltage code V <sub>RRM</sub> /100 20-22	Standard diode	Fixed Version Code

Typical order code: MDO1200-22N1, 1600V V<sub>RRM</sub> Rectifier Diode Module

### **IXYS Semiconductor GmbH**

Edisonstraße 15 D-68623 Lampertheim Tel: +49 6206 503-0 Fax: +49 6206 503-627

E-mail: marcom@ixys.de

#### **IXYS** Corporation

3540 Bassett Street Santa Clara CA 95054 USA Tel: +1 (408) 982 0700 Fax: +1 (408) 496 0670

E-mail: sales@ixys.net



www.ixys.com



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#### **Westcode Semiconductors Ltd**

Langley Park Way, Langley Park, Chippenham, Wiltshire, SN15 1GE. Tel: +44 (0)1249 444524 Fax: +44 (0)1249 659448

E-mail: WSL.sales@westcode,com

#### **Westcode Semiconductors Inc**

3270 Cherry Avenue Long Beach CA 90807 USA Tel: +1 (562) 595 6971 Fax: +1 (562) 595 8182 E-mail: WSI.sales@westcode.com

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