

Date: 15th Oct, 2014

Data Sheet Issue: 5

# Rectifier Diode Module Types MDO1201-14N1 to MDO1201-22N1

# **Absolute Maximum Ratings**

V <sub>RRM</sub> [V]	Type
1400	MDO1201-14N1
1800	MDO1201-18N1
2200	MDO1201-22N1



	VOLTAGE RATINGS	MAXIMUM LIMITS	UNITS
$V_{RRM}$	Repetitive peak reverse voltage 1)	1400-2200	V
V <sub>RSM</sub>	Non-repetitive peak reverse voltage 1)	1500-2300	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>	1950	
I <sub>F(AV)M</sub>	Maximum average forward current, T <sub>c</sub> =100°C <sup>2)</sup>	1280	
I <sub>F(AV)M</sub>	Maximum average forward current. T <sub>c</sub> =85°C <sup>2)</sup>	1520	Α
I <sub>F(RMS)M</sub>	Nominal RMS forward current, T <sub>c</sub> =25°C <sup>2)</sup>	3665	
I <sub>T(d.c.)</sub>	D.C. forward current, T <sub>c</sub> =25°C	2940	
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	kA
I <sub>FSM2</sub>	Peak non-repetitive surge t <sub>p</sub> =10ms, V <sub>rm</sub> ≤10V <sup>3)</sup>	40	kA
l <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>	6.48×10 <sup>6</sup>	A <sup>2</sup> s
I <sup>2</sup> t	I²t capacity for fusing t <sub>p</sub> =10ms, V <sub>rm</sub> ≤10V ³)	8.00×10 <sup>6</sup>	A <sup>2</sup> s
Visol	Isolation Voltage 4)	3000	V
T <sub>vj op</sub>	Operating temperature range	-40 to +160	°C
T <sub>stg</sub>	Storage temperature range	-55 to +160	°C

## Notes:

- 1) De-rating factor of 0.13% per °C is applicable for  $T_{\nu j}$  below 25°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	
\/	Maximum wash famusand valta :-		-	0.97	I <sub>FM</sub> =1700A	V	
V <sub>FM</sub>	Maximum peak forward voltage	-	-	1.15	I <sub>FM</sub> =3400A	V	
V <sub>T0</sub>	Threshold voltage	-	-	0.80		V	
r⊤	Slope resistance	-	-	0.10		mΩ	
		-	-	5	Rated V <sub>RRM</sub> , T <sub>j</sub> =25°C	4	
IRRM	Peak reverse current	-	-	70	Rated V <sub>RRM</sub>	mA	
RthJC	Thermal resistance, junction to case	-	-	0.042		K/W	
R <sub>thCH</sub>	Thermal resistance, case to heatsink	-	-	0.010		K/W	
F <sub>1</sub>	Mounting torque (to heatsink)	5.1	-	6.9		Nm	
F <sub>2</sub>	Mounting torque (to terminals)	16.2	-	19.8		Nm	
Wt	Weight	-	2.8	-		kg	

## Notes:

1) Unless otherwise indicated  $T_{\nu j}$ =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
14	1400	1500	800
18	1800	1900	1000
20	2000	2100	1100
22	2200	2300	1200

## 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>vj</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

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

Where  $V_{T0} = 0.80V$ ,  $r_T = 0.10 \text{m}\Omega$ .

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

ff = Form factor, see table below.

Supplementary Thermal Impedance							
Conduction Angle	Conduction Angle 6 phase (60°) 3 phase (120°) ½ wave (180°) d.c.						
Square wave	0.0460	0.0448	0.0439	0.0420			
Sine wave	0.0453	0.0442	0.0428				

Form Factors						
Conduction Angle	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, IF vs. VF, 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	0.7455207	Α	0.4701738
В	0.04542294	В	0.05180998
С	7.02344×10 <sup>-5</sup>	С	8.913584×10 <sup>-5</sup>
D	-1.458635×10 <sup>-3</sup>	D	-8.375765×10 <sup>-4</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					
rp	0.01904887	0.01751398	5.364393×10 <sup>-3</sup>			
$ au_{\mathcal{P}}$	21.99824	1.079638	0.0132514			



# **Curves**

Figure 1 – Forward Characteristics of Limit Device

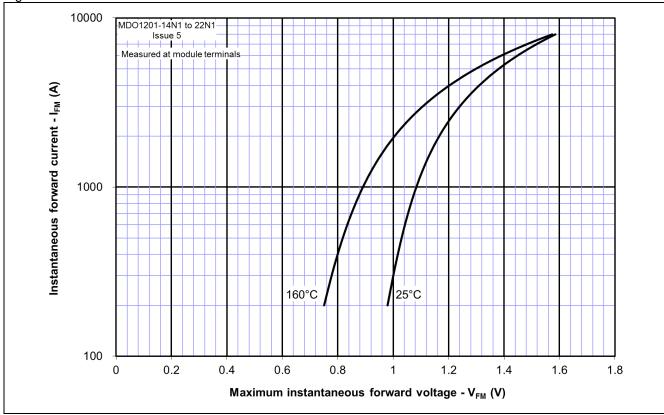


Figure 2 – Transient Thermal Impedance

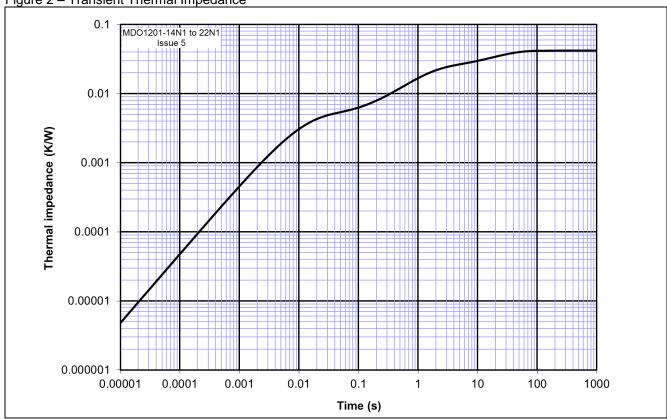




Figure 3 – Forward current vs. Power dissipation

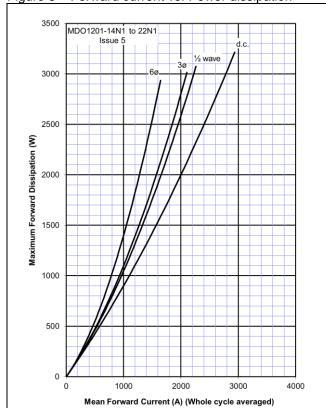


Figure 4 – Forward current vs. Heatsink temperature

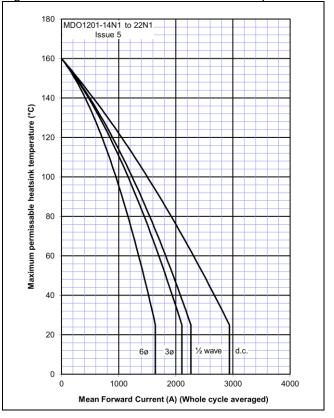
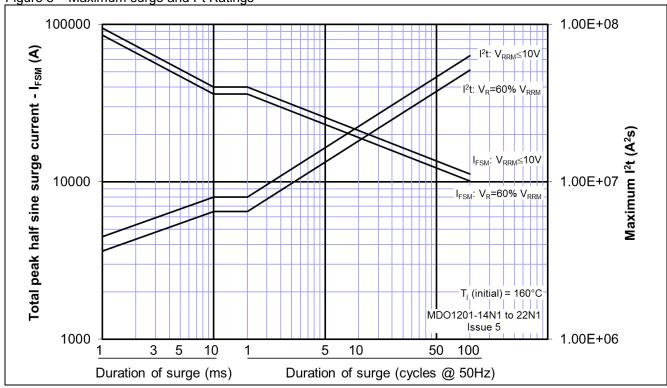
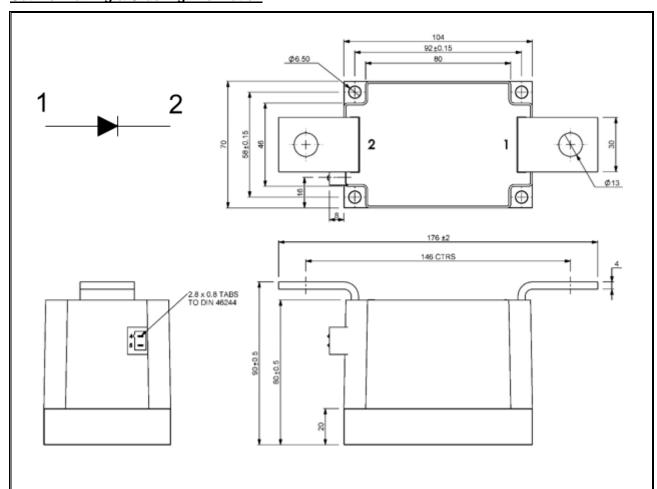


Figure 5 – Maximum surge and I2t Ratings





## **Outline Drawing & Ordering Information**



ORDERING INFORMATION			(Please quote 11 digit code as below)		
М	DO	1201	**	N	1
Fixed Type Code	Fixed Configuration code	Nominal Current Rating	Voltage code V <sub>RRM</sub> /100 16-22	Standard diode	Fixed Version Code

Typical order code: MDO1201-22N1, 2200V 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** 

1590 Buckeye Drive

Milpitas CA 95035-7418

Tel: +1 (408) 547 9000 Fax: +1 (408) 496 0670

E-mail: sales@ixys.net



www.ixysuk.com

www.ixys.com

#### 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

## IXYS Long Beach, Inc

IXYS Long Beach, Inc 2500 Mira Mar Ave, Long Beach CA 90815

Tel: +1 (562) 296 6584 Fax: +1 (562) 296 6585 E-mail: <u>service@ixyslongbeach.com</u>

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