

## 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 <sub>RRM</sub>	Repetitive peak reverse voltage <sup>1)</sup>	1400-2200	V
V <sub>RSM</sub>	Non-repetitive peak reverse voltage <sup>1)</sup>	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	A
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	
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
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>	6.48×10 <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 <sup>4)</sup>	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<sub>vj</sub> 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 <sup>1)</sup>	UNITS
V <sub>FM</sub>	Maximum peak forward voltage	-	-	0.97	I <sub>FM</sub> =1700A	V
		-	-	1.15	I <sub>FM</sub> =3400A	V
V <sub>T0</sub>	Threshold voltage	-	-	0.80		V
r <sub>T</sub>	Slope resistance	-	-	0.10		mΩ
I <sub>RRM</sub>	Peak reverse current	-	-	5	Rated V <sub>RRM</sub> , T <sub>J</sub> =25°C	mA
		-	-	70	Rated V <sub>RRM</sub>	
R <sub>thJC</sub>	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
W <sub>t</sub>	Weight	-	2.8	-		kg

**Notes:**

1) Unless otherwise indicated T<sub>vj</sub>=160°C.

**Notes on Ratings and Characteristics****1.0 Voltage Grade Table**

Voltage Grade	$V_{RRM}$ V	$V_{RSM}$ V	$V_R$ 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  $T_{vj}$  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**

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

$$\Delta T = T_{jmax} - T_C$$

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

$R_{th}$  = 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	0.0460	0.0448	0.0439	0.0420
Sine wave	0.0453	0.0442	0.0428	

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 $V_F$ using ABCD coefficients – For loss calculations

The forward characteristic,  $I_F$  vs.  $V_F$ , 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 equation for  $V_F$  in terms of  $I_T$  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  $V_F$  agree with the true device characteristic over a current range, which is limited to that plotted.

25°C Coefficients		160°C Coefficients	
A	0.7455207	A	0.4701738
B	0.04542294	B	0.05180998
C	$7.02344 \times 10^{-5}$	C	$8.913584 \times 10^{-5}$
D	$-1.458635 \times 10^{-3}$	D	$-8.375765 \times 10^{-4}$

## 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
$r_p$	0.01904887	0.01751398	$5.364393 \times 10^{-3}$
$\tau_p$	21.99824	1.079638	0.0132514

## Curves

Figure 1 – Forward Characteristics of Limit Device

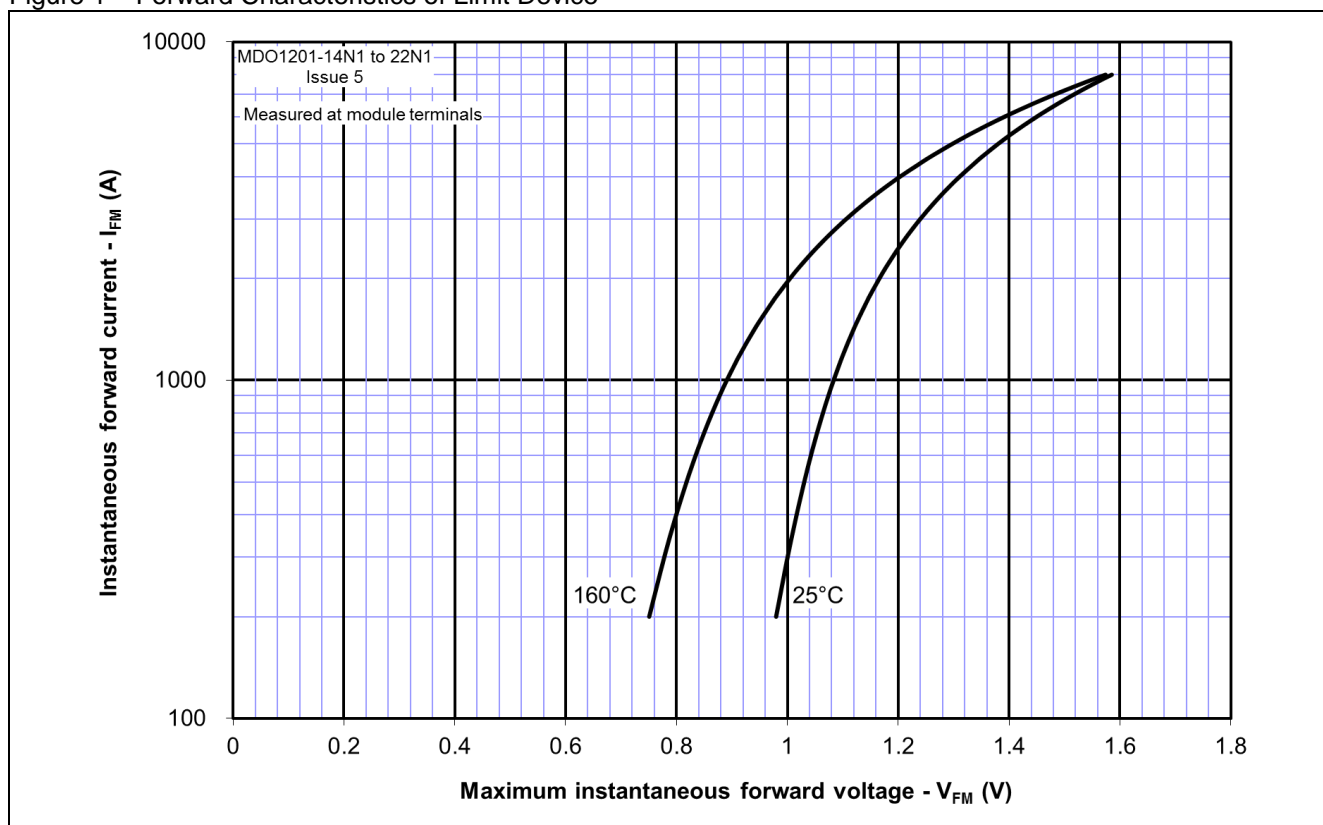


Figure 2 – Transient Thermal Impedance

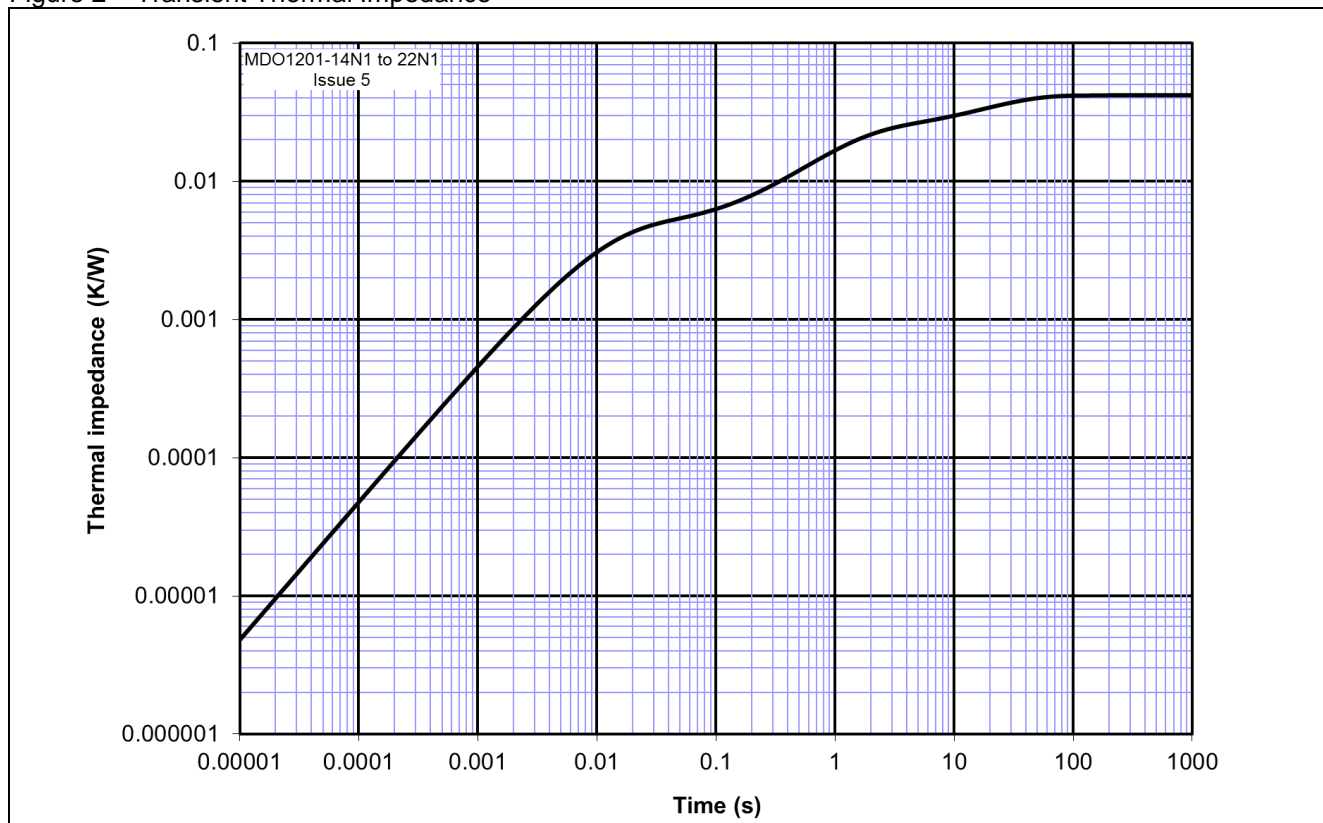


Figure 3 – Forward current vs. Power dissipation

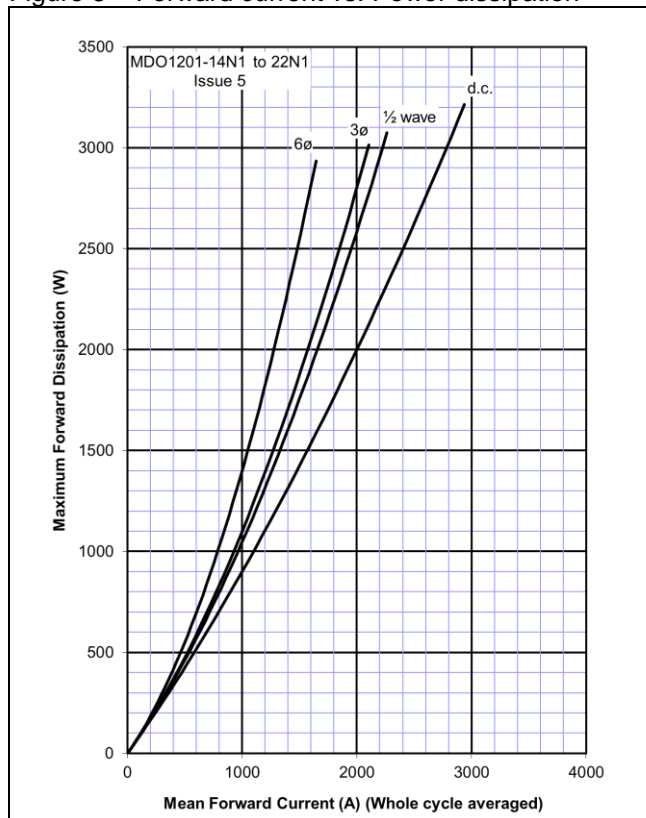
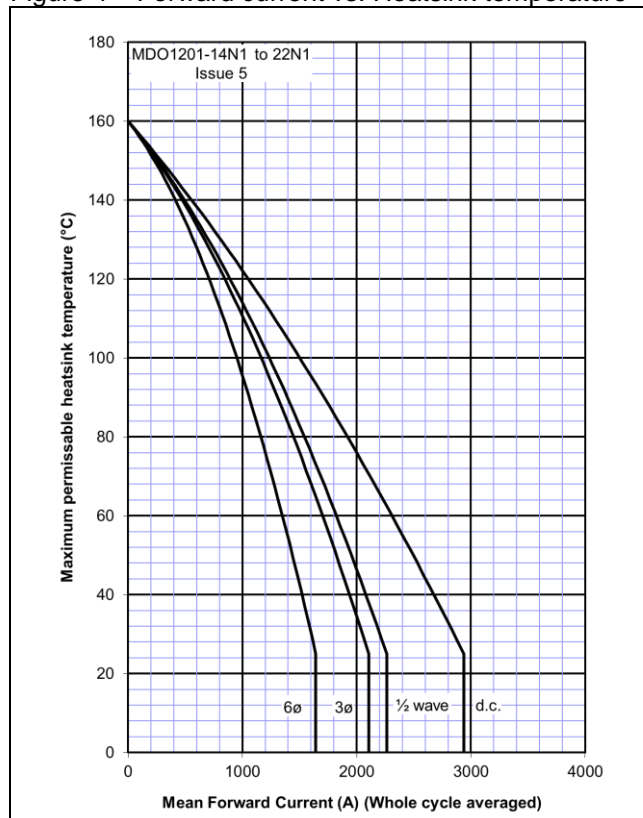
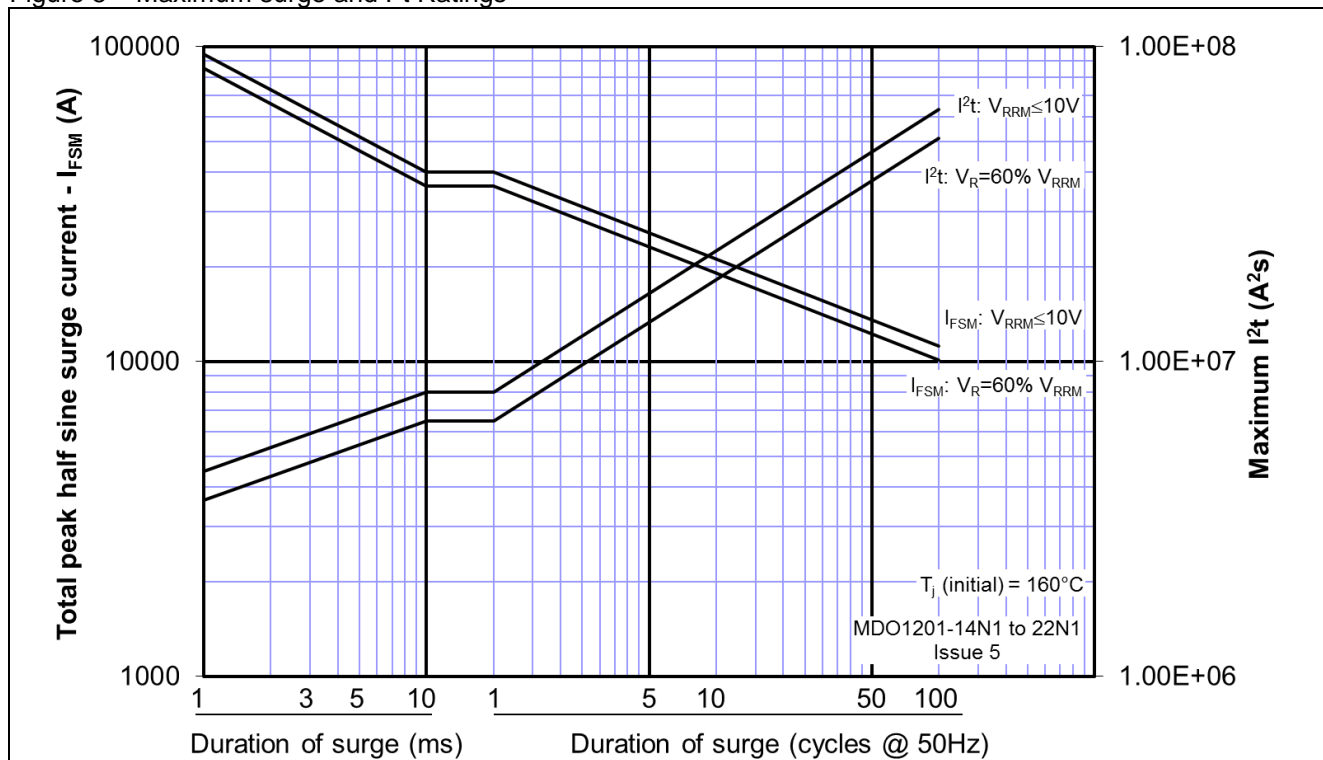


Figure 4 – Forward current vs. Heatsink temperature

Figure 5 – Maximum surge and  $I^2t$  Ratings

## Outline Drawing &amp; Ordering Information

