

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

Absolute Maximum Ratings

V_{RRM} [V]	Type
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
$I_{F(AV)M}$	Maximum average forward current, $T_c=55^\circ\text{C}$ ²⁾	1888	A
$I_{F(AV)M}$	Maximum average forward current, $T_c=102^\circ\text{C}$ ²⁾	1200	
$I_{F(AV)M}$	Maximum average forward current, $T_c=85^\circ\text{C}$ ²⁾	1468	
$I_{F(RMS)M}$	Nominal RMS forward current, $T_c=25^\circ\text{C}$ ²⁾	3557	
$I_{T(d.c.)}$	D.C. forward current, $T_c=25^\circ\text{C}$ ²⁾	2836	
I_{FSM}	Peak non-repetitive surge $t_p=10\text{ms}$, $V_{rm}=60\%V_{RRM}$ ³⁾	36.4	kA
I_{FSM2}	Peak non-repetitive surge $t_p=10\text{ms}$, $V_{rm}\leq 10\text{V}$ ³⁾	40.0	kA
I^2t	I^2t capacity for fusing $t_p=10\text{ms}$, $V_{rm}=60\%V_{RRM}$ ³⁾	6.62×10^6	A^2s
I^2t	I^2t capacity for fusing $t_p=10\text{ms}$, $V_{rm}\leq 10\text{V}$ ³⁾	8.00×10^6	A^2s
V_{ISOL}	Isolation Voltage ⁴⁾	3500	V
$T_{vj\text{ op}}$	Operating temperature range	-40 to +160	$^\circ\text{C}$
T_{stg}	Storage temperature range	-55 to +160	$^\circ\text{C}$

Notes:

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

Characteristics

	PARAMETER	MIN.	TYP.	MAX.	TEST CONDITIONS ¹⁾	UNITS
V _{FM}	Maximum peak forward voltage	-	-	1.35	I _{FM} =3000A	V
		-	-	1.44	I _{FM} =3600A	V
V _{T0}	Threshold voltage	-	-	0.872		V
r _T	Slope resistance	-	-	0.107		mΩ
I _{R_{RM}}	Peak reverse current	-	-	2	Rated V _{RRM} , T _J =25°C	
		-	-	100	Rated V _{RRM}	
Q _{rr}	Recovered Charge	-	4000	-		μC
Q _{ra}	Recovered Charge, 50% chord	-	3300	3800	I _{FM} =1000A, t _p =1000μs, di/dt=10A/μs, V _i =50V	μC
I _{rm}	Reverse recovery current	-	200	-		A
t _{rr}	Reverse recovery time, 50% chord	-	33	-		μs
R _{thJC}	Thermal resistance, junction to case	-	-	0.0405		
R _{thCH}	Thermal resistance, case to heatsink	-	-	0.0100		K/W
F ₁	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_{RRM} V	V_{RSM} V	V_R 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_{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

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

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

Where $V_{T0} = 0.872$ V, $r_T = 0.107$ mΩ.

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_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	0.8219376	A	0.6177319
B	0.02800357	B	0.02398102
C	4.58252×10^{-5}	C	4.93957×10^{-5}
D	2.125018×10^{-3}	D	4.419761×10^{-3}

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.
 τ_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^{-5}	0.016708	0.018317	4.346771×10^{-3}	1.004820×10^{-3}	1.0×10^{-5}
τ_p	2.460066	0.999836	21.998376	9.793053×10^{-3}	2.003674	5.007343

7.0 Reverse recovery ratings

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

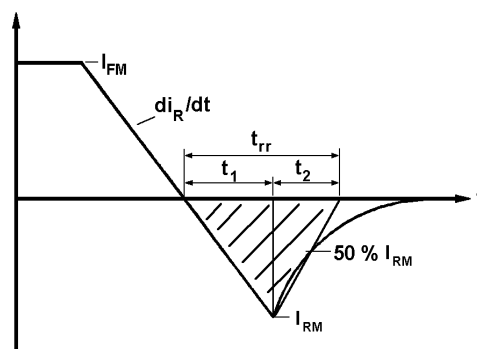


Fig. 1

- (ii) Q_{rr} is based on a 150 μs 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

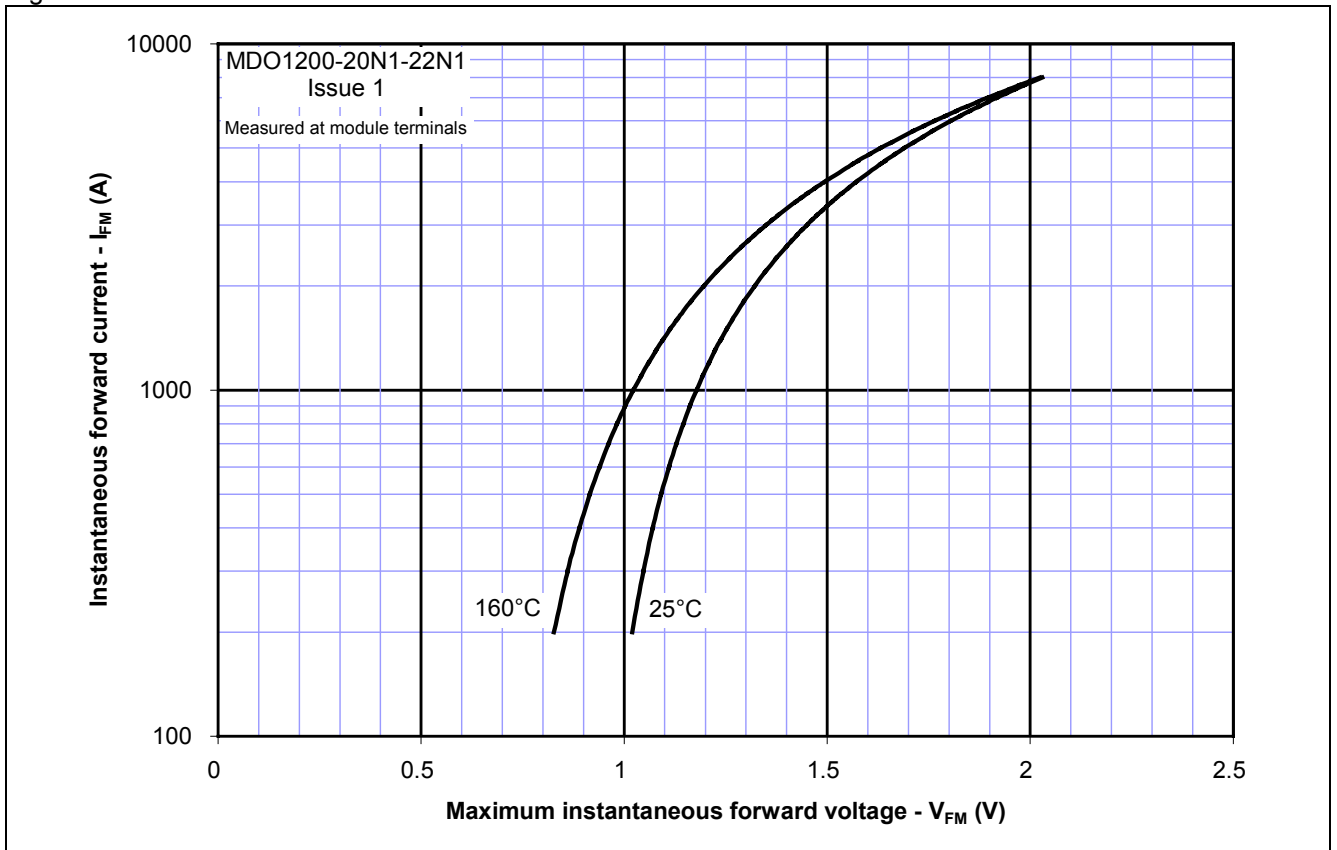


Figure 2 – Transient Thermal Impedance

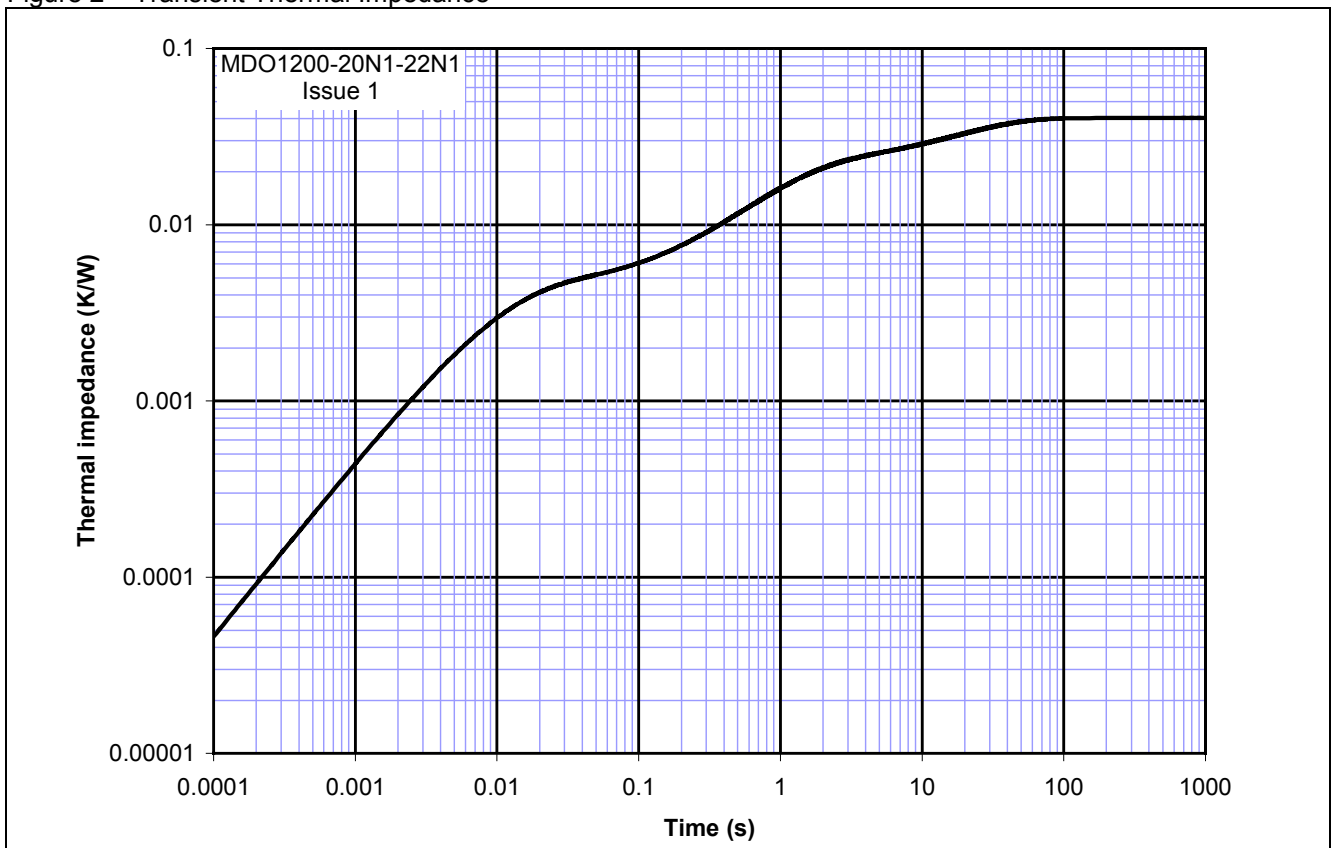


Figure 3 – Total recovered charge, Q_{rr}

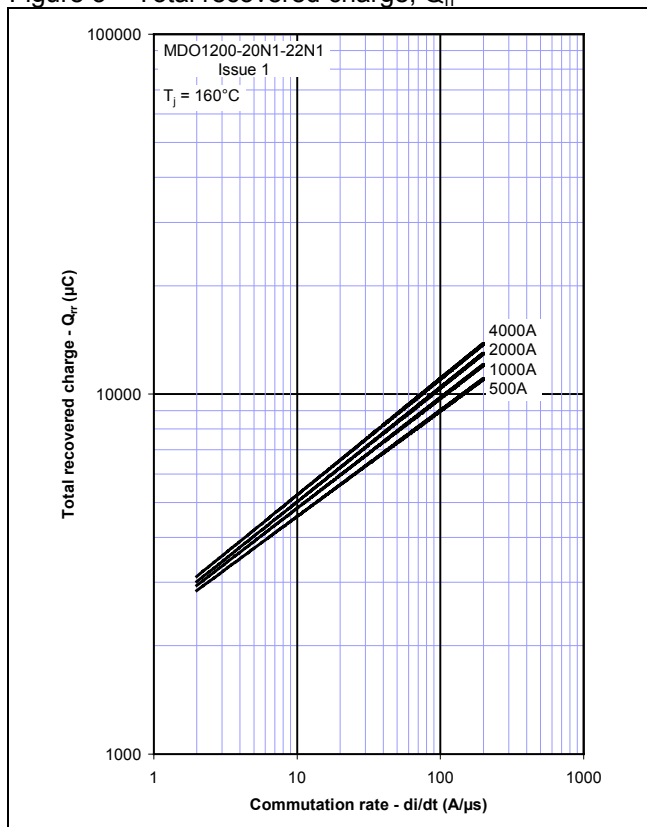


Figure 4 – Recovered charge, Q_{ra} (50% chord)

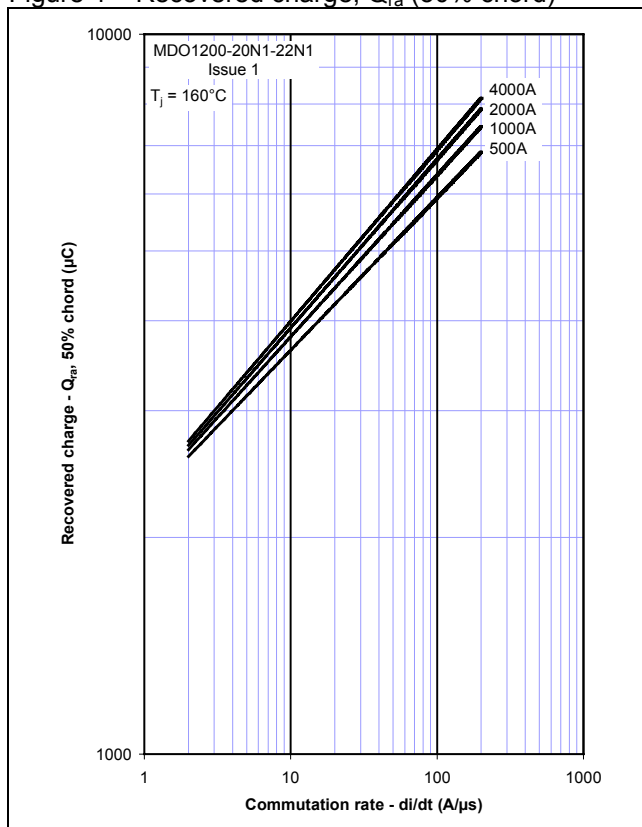


Figure 5 – Peak reverse recovery current, I_{rm}

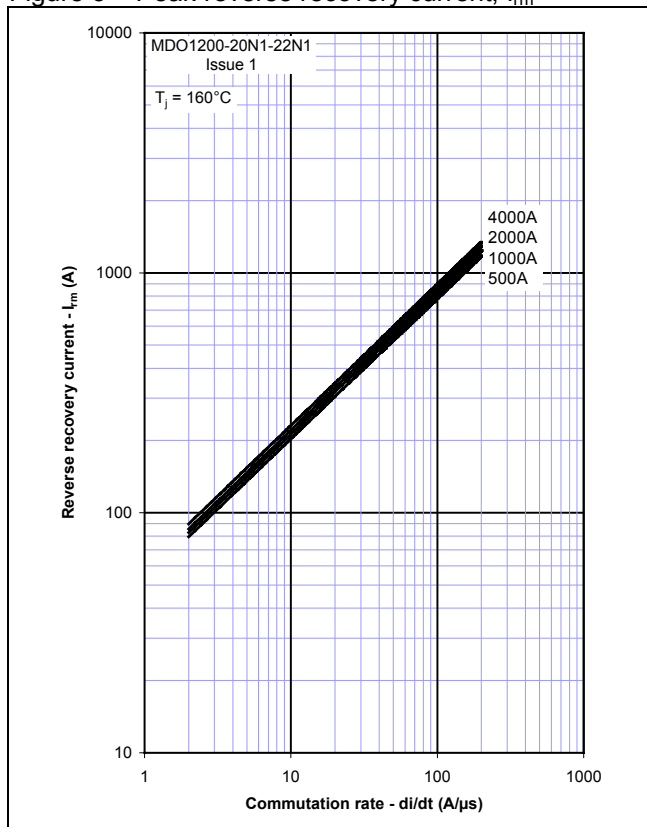


Figure 6 – Maximum recovery time, t_{rr} (50% chord)

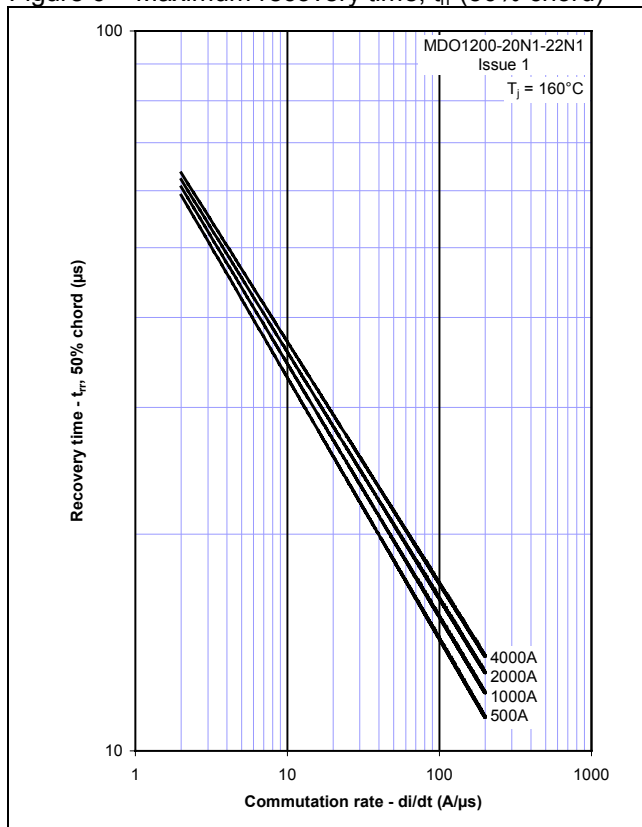


Figure 7 – Forward current vs. Power dissipation

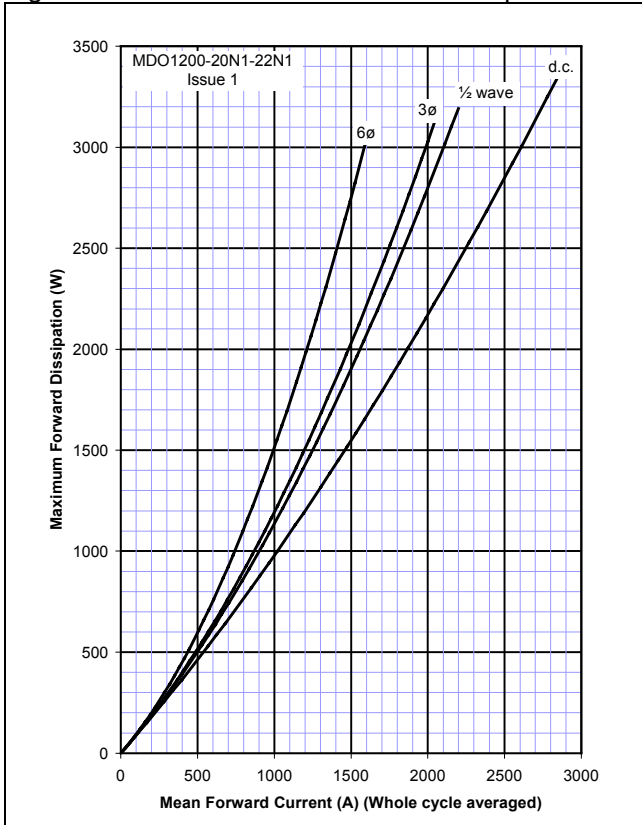


Figure 8 – Forward current vs. Heatsink temperature

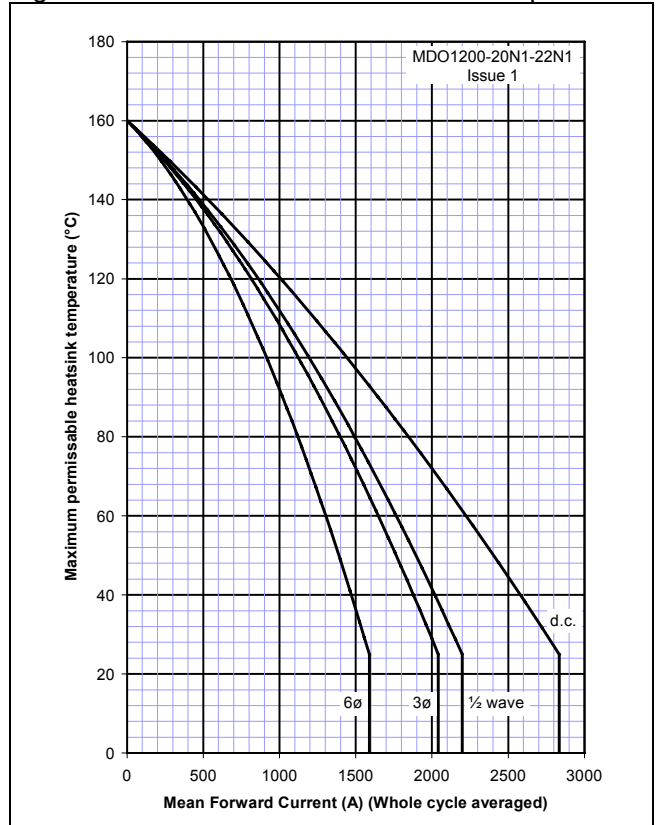
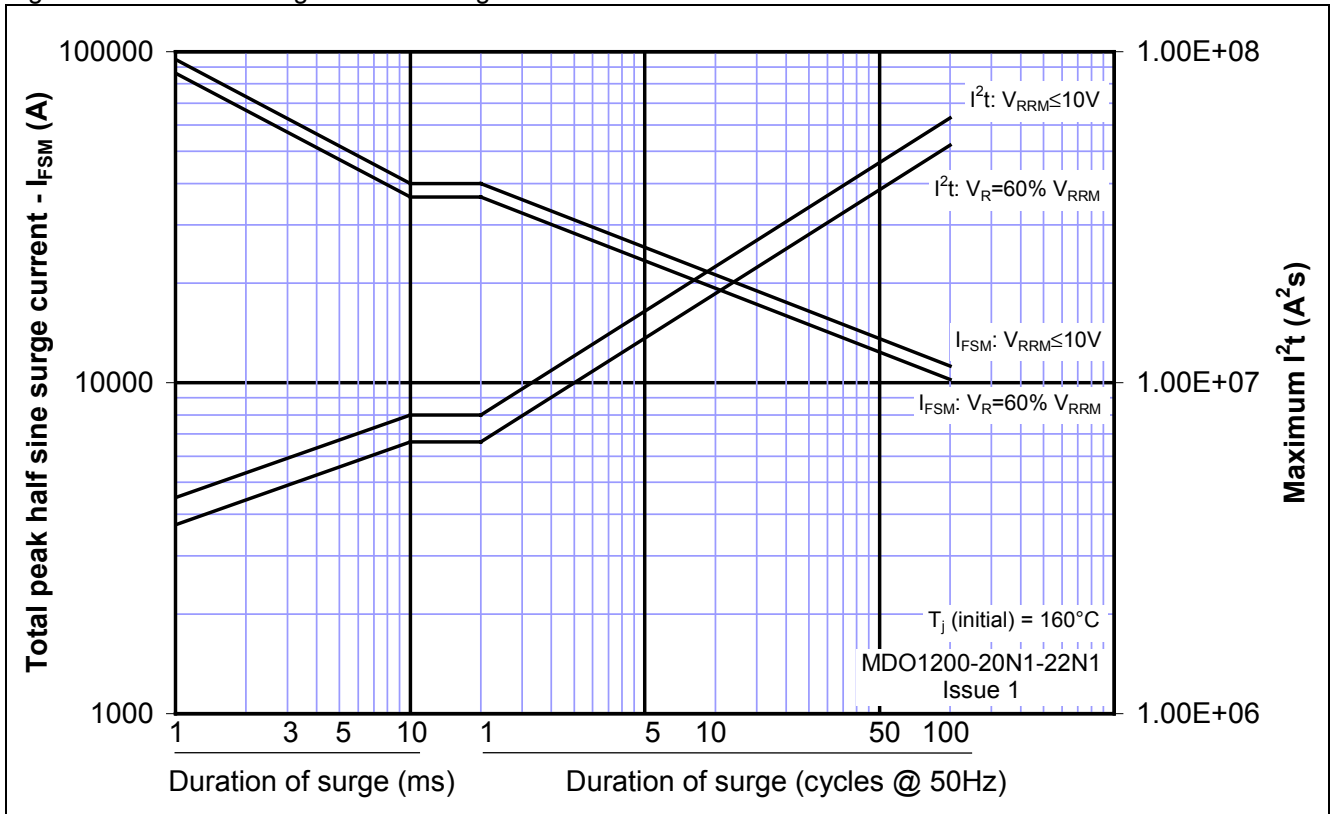
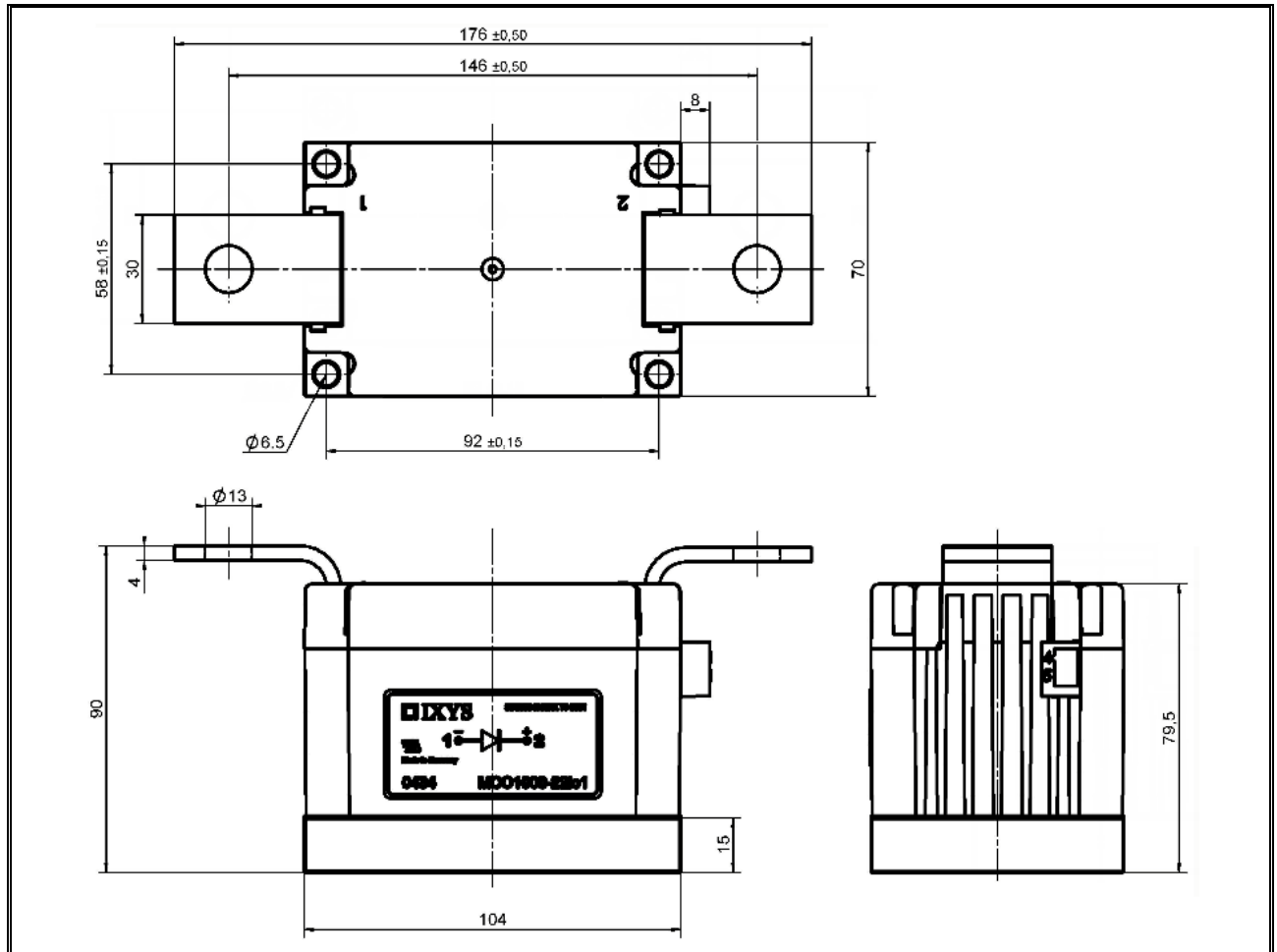


Figure 9 – Maximum surge and I²t Ratings



Outline Drawing & Ordering Information



ORDERING INFORMATION

(Please quote 11 digit code as below)

M	DO	1200	◆◆	N	1
Fixed Type Code	Fixed Configuration code	Nominal Current Rating	Voltage code $V_{RRM}/100$ 20-22	Standard diode	Fixed Version Code

Typical order code: MDO1200-22N1, 1600V V_{RRM} Rectifier Diode Module

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