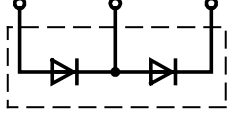
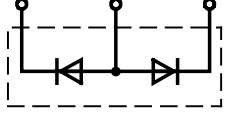
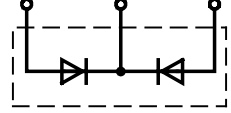


## Dual Diode Modules MD#810-12N1-18N1

### Absolute Maximum Ratings

$V_{RRM}$ $V_{DRM}$ [V]	 MDD	 MDA	 MDK
1200	810-12N1	810-12N1	810-12N1
1400	810-14N1	810-14N1	810-14N1
1600	810-16N1	810-16N1	810-16N1
1800	810-18N1	810-18N1	810-18N1

	VOLTAGE RATINGS	MAXIMUM LIMITS	UNITS
$V_{DRM}$	Repetitive peak off-state voltage <sup>1)</sup>	1200-1800	V
$V_{DSM}$	Non-repetitive peak off-state voltage <sup>1)</sup>	1300-1900	V
$V_{RRM}$	Repetitive peak reverse voltage <sup>1)</sup>	1200-1800	V
$V_{RSM}$	Non-repetitive peak reverse voltage <sup>1)</sup>	1300-1900	V

	OTHER RATINGS	MAXIMUM LIMITS	UNITS
$I_{F(AV)M}$	Maximum average on-state current, $T_C = 85^\circ\text{C}$ <sup>2)</sup>	807	A
$I_{F(AV)M}$	Maximum average on-state current, $T_C = 100^\circ\text{C}$ <sup>2)</sup>	664	A
$I_{F(RMS)M}$	Nominal RMS on-state current, $T_C = 55^\circ\text{C}$ <sup>2)</sup>	1661	A
$I_{F(d.c.)}$	D.C. on-state current, $T_C = 55^\circ\text{C}$	1342	A
$I_{FSM}$	Peak non-repetitive surge $t_p = 10$ ms, $V_{RM} = 60\%V_{RRM}$ <sup>3)</sup>	17.3	kA
$I_{FSM2}$	Peak non-repetitive surge $t_p = 10$ ms, $V_{RM} \leq 10\text{V}$ <sup>3)</sup>	19	kA
$I^2t$	$I^2t$ capacity for fusing $t_p = 10$ ms, $V_{RM} = 60\%V_{RRM}$ <sup>3)</sup>	$1.48 \times 10^6$	$\text{A}^2\text{s}$
$I^2t$	$I^2t$ capacity for fusing $t_p = 10$ ms, $V_{RM} \leq 10\text{V}$ <sup>3)</sup>	$1.81 \times 10^6$	$\text{A}^2\text{s}$
$V_{ISOL}$	Isolation Voltage <sup>4)</sup>	3000	V
$T_{vj\text{ op}}$	Operating temperature range	-40 to +150	$^\circ\text{C}$
$T_{stg}$	Storage temperature range	-40 to +150	$^\circ\text{C}$

#### Notes:

- De-rating factor of 0.13% per  $^\circ\text{C}$  is applicable for  $T_{vj}$  below  $25^\circ\text{C}$ .
- Single phase; 50 Hz,  $180^\circ$  half-sinewave.
- Half-sinewave,  $150^\circ\text{C}$   $T_{vj}$  initial.
- AC RMS voltage, 50 Hz, 1min test

**Characteristics**

	PARAMETER	MIN.	TYP.	MAX.	TEST CONDITIONS <sup>1)</sup>	UNITS
V <sub>FM</sub>	Maximum peak on-state voltage	-	-	1.24	I <sub>FM</sub> = 2000 A	V
V <sub>TO</sub>	Threshold voltage	-	-	0.78		V
r <sub>T</sub>	Slope resistance	-	-	0.23		mΩ
I <sub>R<sub>RRM</sub></sub>	Peak reverse current	-	-	50	Rated V <sub>RRM</sub>	mA
Q <sub>rr</sub>	Recovered Charge	-	1250	1400		μC
Q <sub>ra</sub>	Recovered Charge, 50% chord	-	1000	-		μC
I <sub>rm</sub>	Reverse recovery current	-	115	-	I <sub>TM</sub> = 1260 A, t <sub>p</sub> = 1ms, di/dt = 10A/μs, V <sub>R</sub> = 100 V	A
t <sub>rr</sub>	Reverse recovery time, 50% chord	-	16.5	-		μs
R <sub>thJC</sub>	Thermal resistance, junction to case	-	-	0.062	Single Thyristor	K/W
		-	-	0.031	Whole Module	K/W
R <sub>thCH</sub>	Thermal resistance, case to heatsink	-	-	0.02	Single Thyristor	K/W
		-	-	0.01	Whole Module	K/W
F <sub>1</sub>	Mounting force (to heatsink) <sup>2)</sup>	5.1	-	6.9		Nm
F <sub>2</sub>	Mounting force (to terminals) <sup>2)</sup>	10.8	-	13.2		Nm
W <sub>t</sub>	Weight	-	1.5	-		kg

**Notes:**

- 1) Unless otherwise indicated T<sub>vj</sub> = 150°C.
- 2) Screws must be lubricated.

## Notes on Ratings and Characteristics

### 1.0 Voltage Grade Table

Voltage Grade	$V_{RRM}$ V	$V_{RSM}$ V	$V_R$ DC V
1200	1200	1300	900
1400	1400	1500	1050
1600	1600	1700	1200
1800	1800	1900	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 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 Thyristor 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  $V_{T0} = 0.78$  V,  $r_T = 0.23$  mΩ.

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

$ff$  = Form factor, see table below.

Supplementary Thermal Impedance							
Conduction Angle	30°	60°	90°	120°	180°	270°	d.c.
Square wave	0.0702	0.0685	0.0679	0.0668	0.0658	0.0637	0.0620
Sine wave	0.0677	0.0673	0.0664	0.0655	0.0650		

Form Factors							
Conduction Angle	30°	60°	90°	120°	180°	270°	d.c.
Square wave	3.464	2.449	2	1.732	1.414	1.149	1
Sine wave	3.98	2.778	2.22	1.879	1.57		

## 5.2 Calculating thyristor $V_F$ using ABCD Coefficients

The on-state characteristic  $I_F$  vs.  $V_F$ , on page 6 is represented by 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		150°C Coefficients	
A	1.007759	A	0.4900846
B	6.648416e <sup>-3</sup>	B	0.04757313
C	1.01095e <sup>-4</sup>	C	2.158905e <sup>-4</sup>
D	3.204619e <sup>-3</sup>	D	-1.076607e <sup>-3</sup>

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  $n$  and:

- $n$  = number of terms in the series
- $t$  = 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 table below:

D.C.					
Term	1	2	3	4	5
$r_p$	$1.37 \times 10^{-3}$	$4.86 \times 10^{-3}$	0.0114	0.0223	0.0221
$\tau_p$	$7.6 \times 10^{-4}$	$8.6 \times 10^{-3}$	0.101	0.56	3.12

6.0 Reverse recovery ratings

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

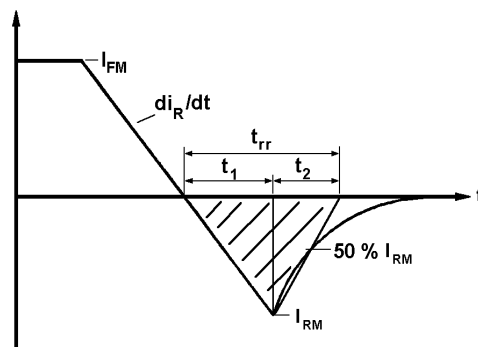


Fig. 1

(ii)  $Q_{rr}$  is based on a  $150 \mu s$  integration time i.e.

$$Q_{rr} = \int_0^{150 \mu s} i_{rr} . dt$$

(iii)

$$K \text{ Factor} = \frac{t_1}{t_2}$$

**Curves**

Figure 1 – On-state characteristics of Limit device

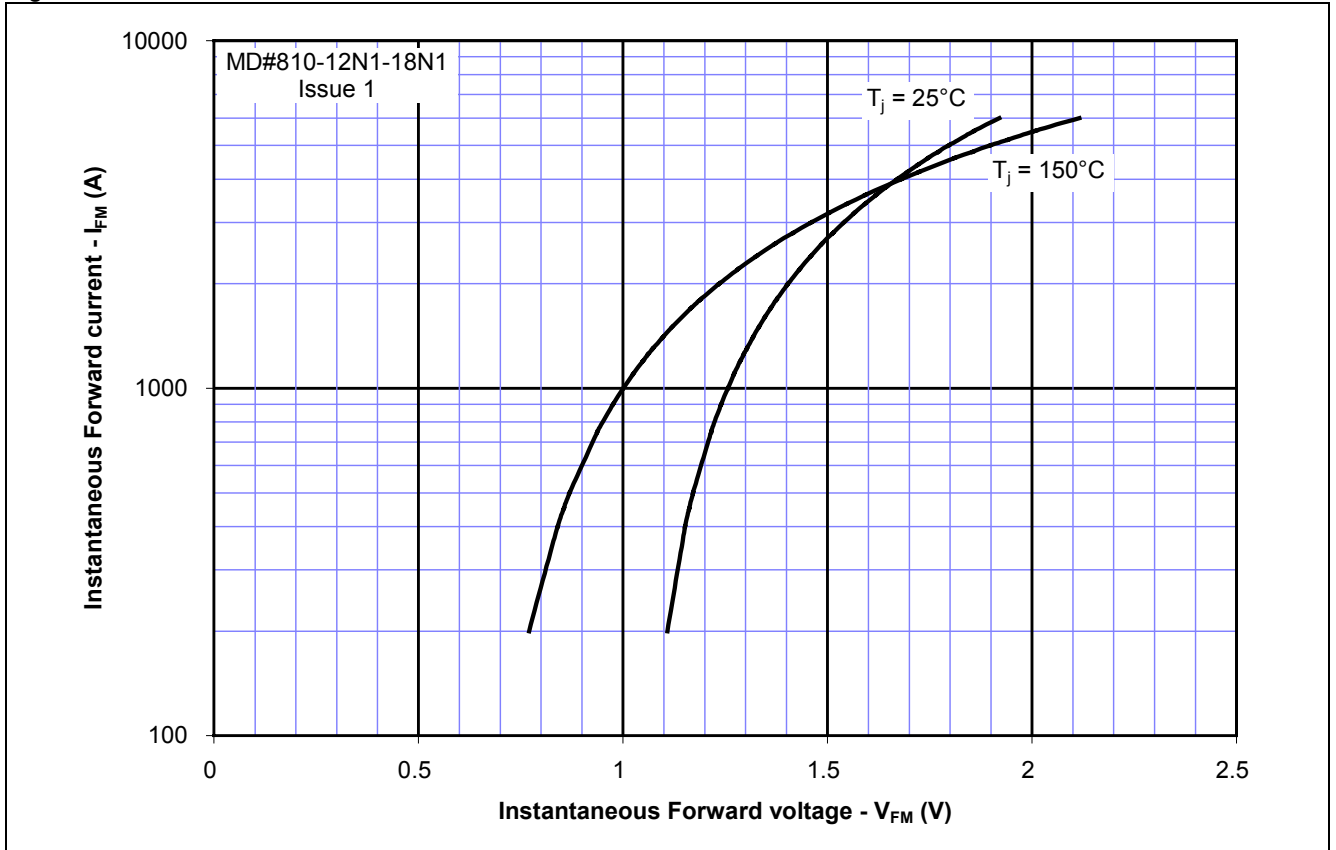


Figure 2 – Maximum surge and  $I^2t$  Ratings

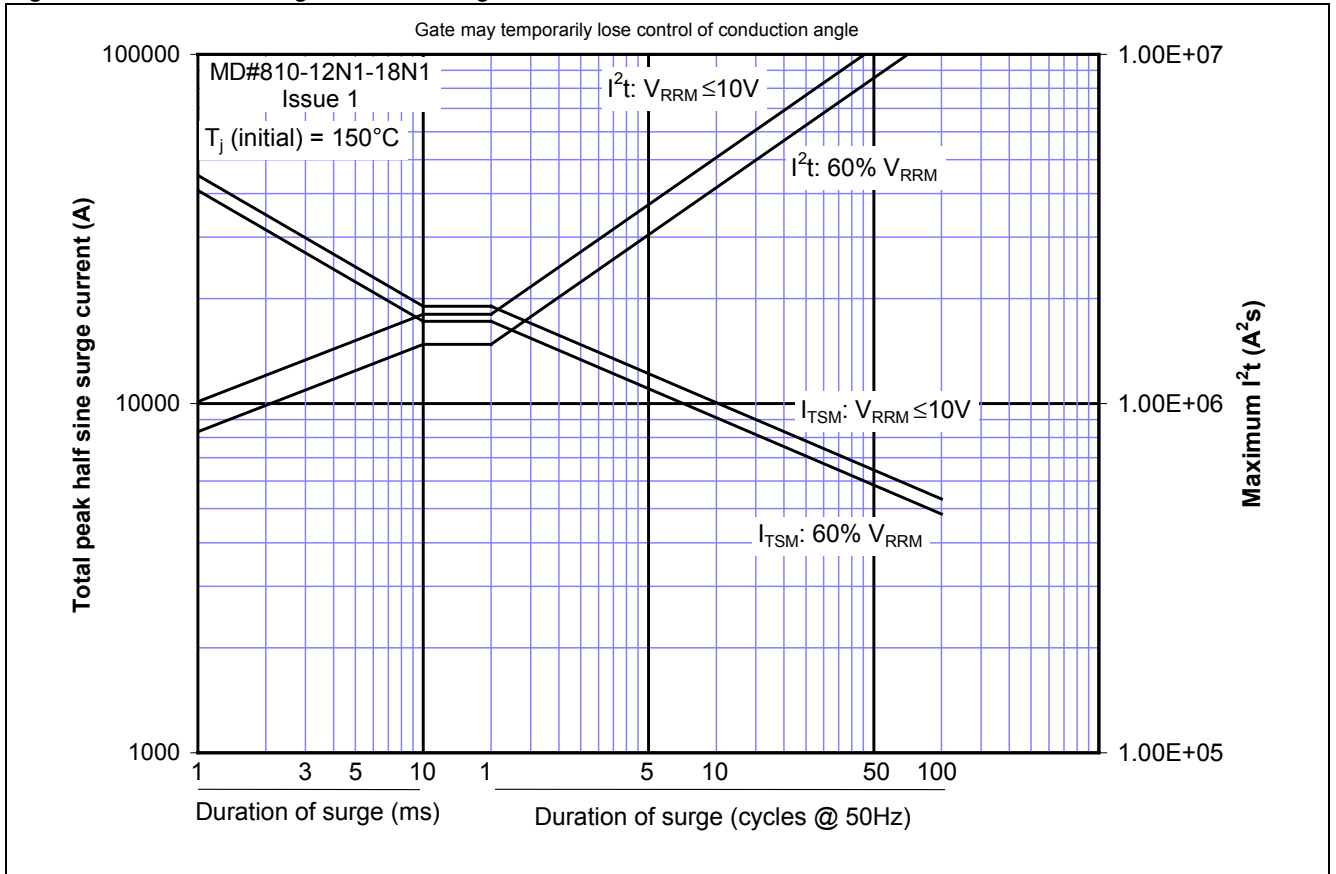


Figure 3 - Total recovered charge,  $Q_{rr}$

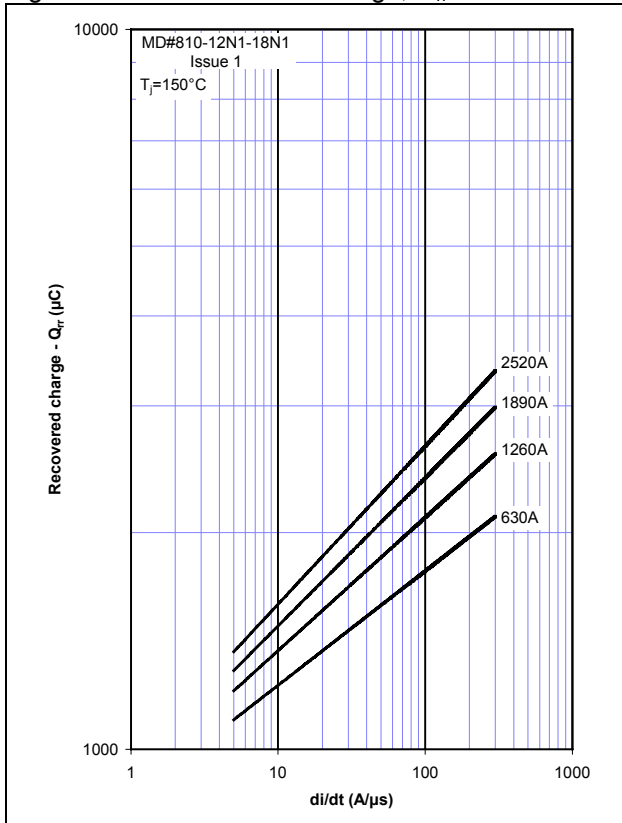


Figure 4 - Recovered charge,  $Q_{ra}$  (50% chord)

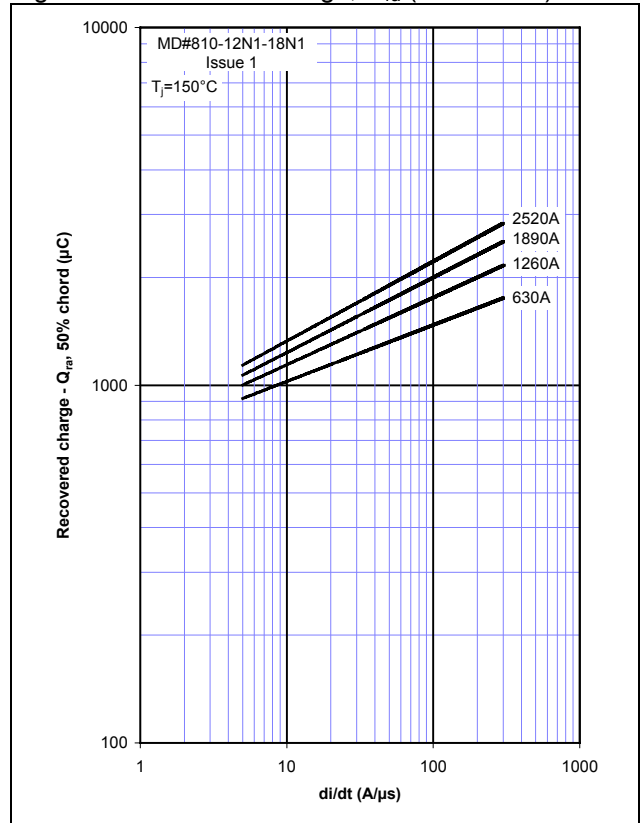


Figure 5 - Peak reverse recovery current,  $I_{rm}$

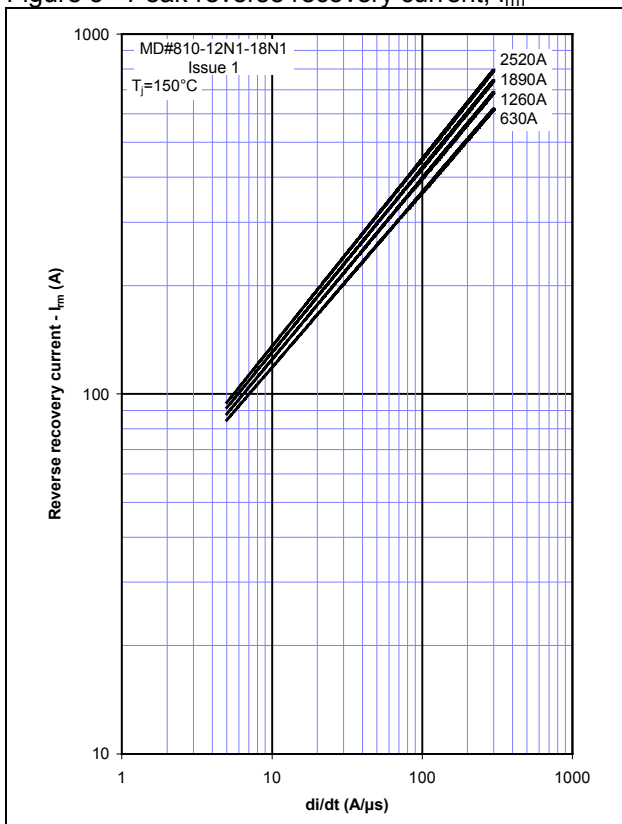


Figure 6 - Maximum recovery time,  $t_{rr}$  (50% chord)

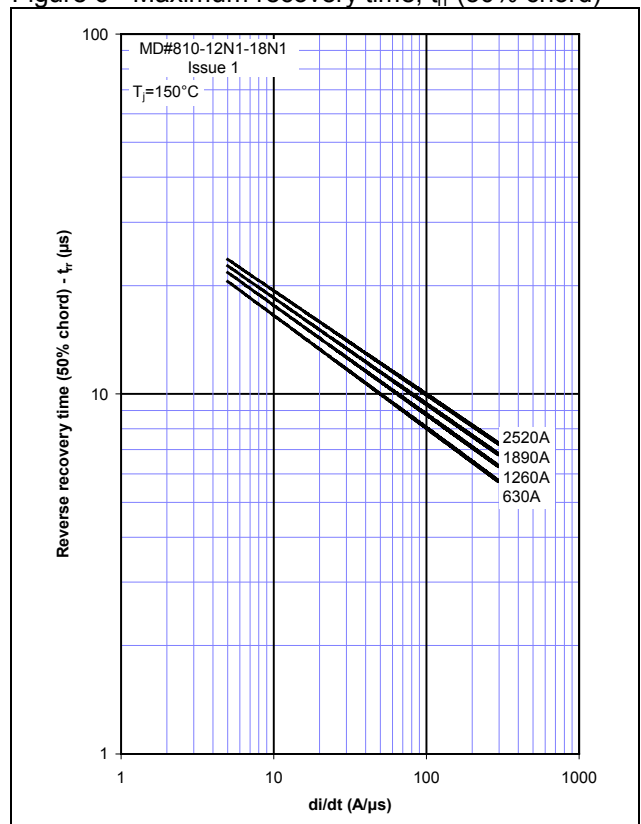


Figure 7 – On-state current vs. Power dissipation

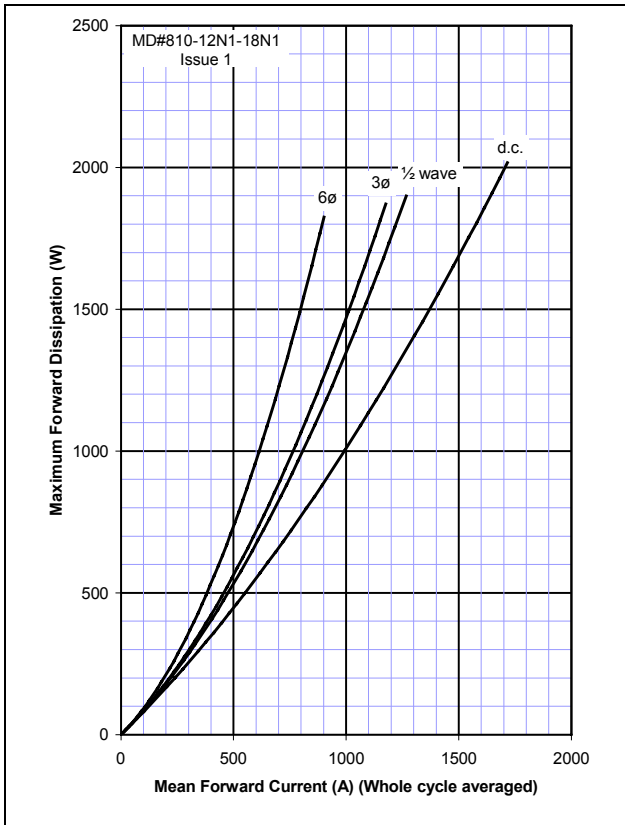


Figure 8 – On-state current vs. Heatsink temperature

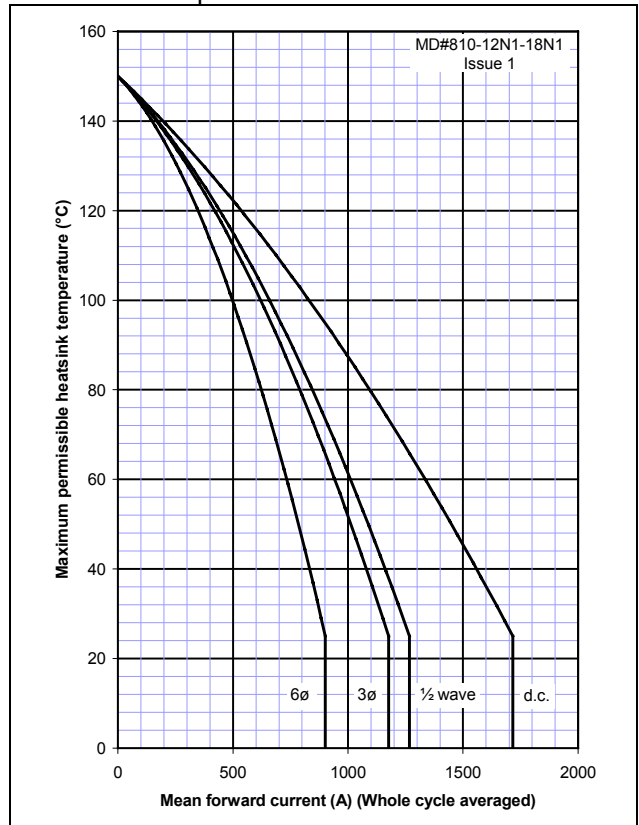
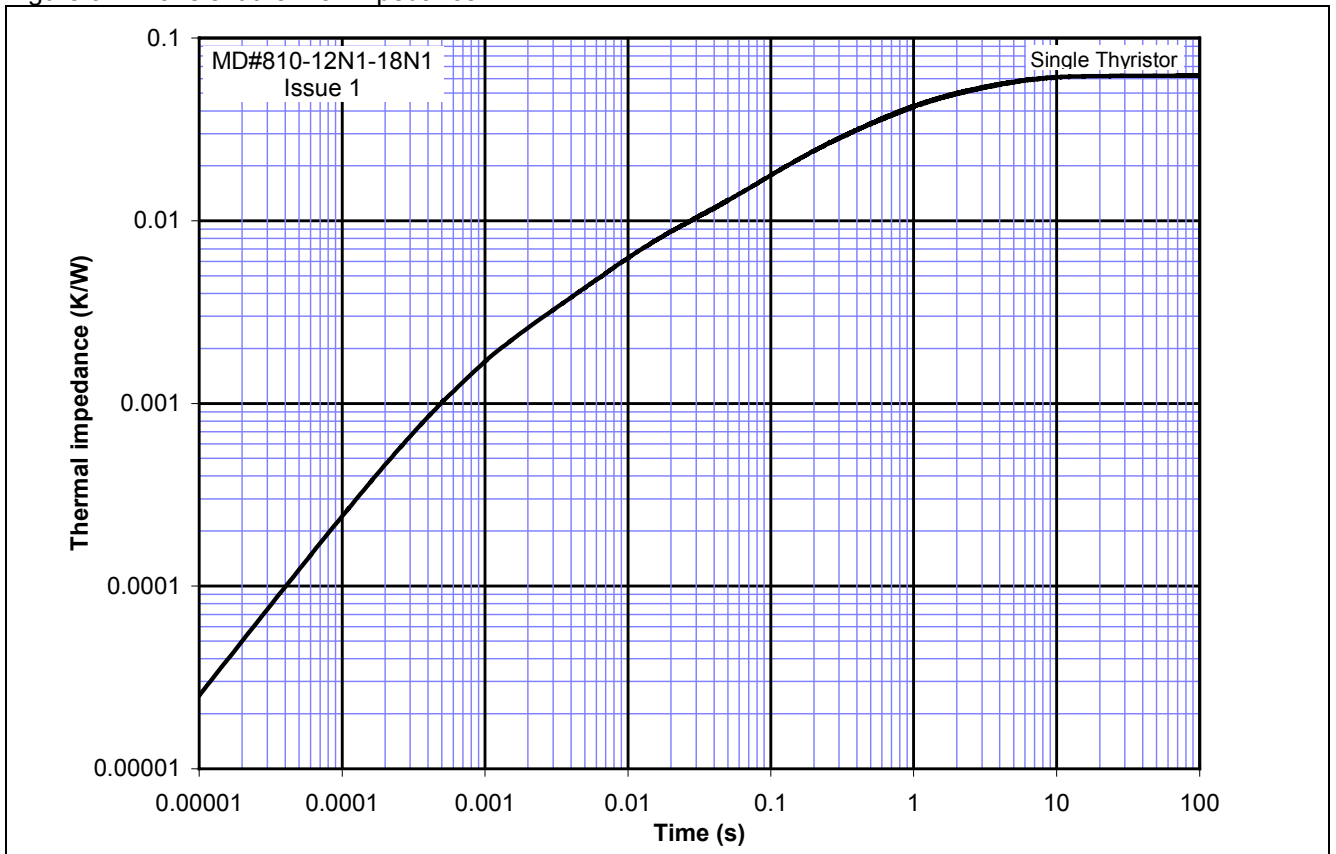
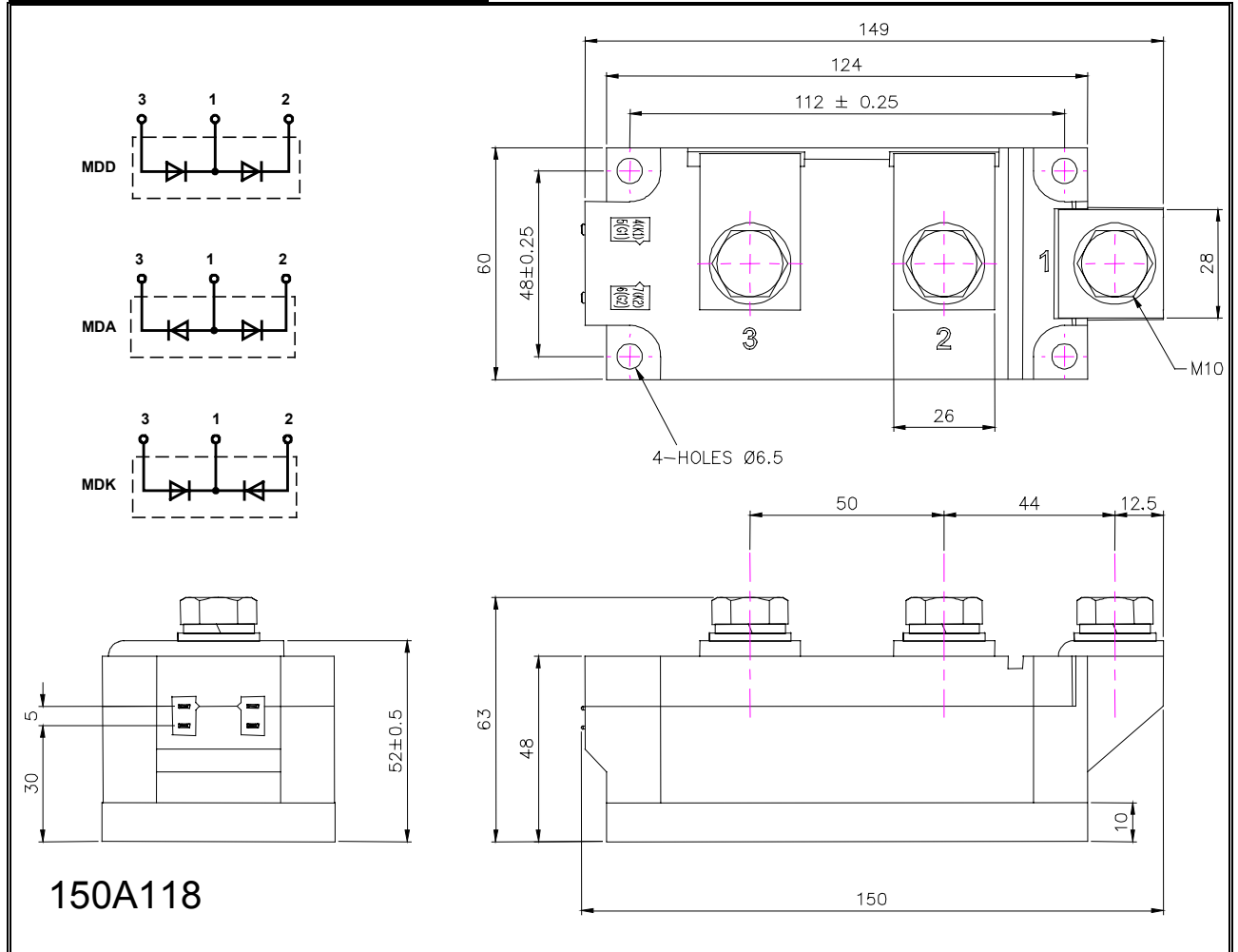


Figure 9 – Transient thermal impedance



Outline Drawing & Ordering Information



150A118

ORDERING INFORMATION

(Please quote 11 digit code as below)

<b>M</b>	<b>D#</b>	<b>810</b>	<b>◆◆</b>	<b>N</b>	<b>1</b>
Fixed Type Code	Configuration code DD, DA, DK	Fixed Type Code	Voltage code $V_{RRM}/100$ 12-18	Standard Diode	Fixed Version Code

Typical order code: MDA810-16N1- MDA configuration, 1600V  $V_{RRM}$

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