

## Diode Modules MD#1080

### Absolute Maximum Ratings

$V_{RRM}$ $V_{DRM}$ [V]	 MDD	 MDA	 MDK
1800	1080-18N7	1080-18N7	1080-18N7
2400	1080-24N7	1080-24N7	1080-24N7
2800	1080-28N7	1080-28N7	1080-28N7

	VOLTAGE RATINGS	MAXIMUM LIMITS	UNITS
$V_{RRM}$	Repetitive peak reverse voltage <sup>1)</sup>	1800-2800	V
$V_{RSM}$	Non-repetitive peak reverse voltage <sup>1)</sup>	1900-2900	V

	OTHER RATINGS	MAXIMUM LIMITS	UNITS
$I_{F(AV)M}$	Maximum average forward current, $T_C = 85^\circ\text{C}$ <sup>2)</sup>	1080	A
$I_{F(AV)M}$	Maximum average forward current, $T_C = 100^\circ\text{C}$ <sup>2)</sup>	887	A
$I_{F(RMS)M}$	Nominal RMS forward current, $T_C = 55^\circ\text{C}$ <sup>2)</sup>	2235	A
$I_{F(d.c.)}$	D.C. forward current, $T_C = 55^\circ\text{C}$	1788	A
$I_{FSM}$	Peak non-repetitive surge $t_p = 10$ ms, $V_{RM} = 60\%V_{RRM}$ <sup>3)</sup>	29.1	kA
$I_{FSM2}$	Peak non-repetitive surge $t_p = 10$ ms, $V_{RM} \leq 10\text{V}$ <sup>3)</sup>	32.0	kA
$I^2t$	$I^2t$ capacity for fusing $t_p = 10$ ms, $V_{RM} = 60\%V_{RRM}$ <sup>3)</sup>	$4.23 \times 10^3$	$\text{kA}^2\text{s}$
$I^2t$	$I^2t$ capacity for fusing $t_p = 10$ ms, $V_{RM} \leq 10\text{V}$ <sup>3)</sup>	$5.12 \times 10^3$	$\text{kA}^2\text{s}$
$(di/dt)_{cr}$	Critical rate of rise of on-state current (repetitive) <sup>4)</sup>	200	$\text{A}/\mu\text{s}$
	Critical rate of rise of on-state current (non-repetitive) <sup>4)</sup>	400	$\text{A}/\mu\text{s}$
$V_{ISOL}$	Isolation Voltage <sup>5)</sup>	3000	V
$T_{vj\ op}$	Operating temperature range	-40 - +150	$^\circ\text{C}$
$T_{stg}$	Storage temperature range	-40 - +130	$^\circ\text{C}$

#### 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.
- $V_D = 67\% V_{DRM}$ ,  $I_{FG} = 2$  A,  $t_r \leq 0.5\mu\text{s}$ ,  $T_C = 150^\circ\text{C}$ .
- 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	-	-	0.95	I <sub>FM</sub> = 1080A, T <sub>vj</sub> = T <sub>vjMAX</sub>	V
V <sub>FM</sub>	Maximum peak forward voltage	-	-	1.29	I <sub>FM</sub> = 3240A, T <sub>vj</sub> = T <sub>vjMAX</sub>	V
V <sub>T0</sub>	Threshold voltage	-	-	0.782		V
r <sub>T</sub>	Slope resistance	-	-	0.157		mΩ
I <sub>R</sub> RM	Peak reverse current	-	-	70	Rated V <sub>RRM</sub>	mA
Q <sub>rr</sub>	Recovered Charge	-	-	4000		μC
Q <sub>ra</sub>	Recovered Charge, 50% chord	-	-	3300	I <sub>FM</sub> = 1000A, di/dt = 10A/μs, V <sub>R</sub> = 100 V	μC
I <sub>rm</sub>	Reverse recovery current	-	-	205		A
t <sub>rr</sub>	Reverse recovery time, 50% chord	-	-	32		μs
R <sub>thJC</sub>	Thermal resistance, junction to case	-	-	0.050	Single Diode	K/W
		-	-	0.025	Whole Module	K/W
R <sub>thCH</sub>	Thermal resistance, case to heatsink	-	-	0.016	Single Diode	K/W
		-	-	0.008	Whole Module	K/W
F <sub>1</sub>	Mounting force (to heatsink)		-	9.00		Nm
F <sub>2</sub>	Mounting force (to terminals)		-	18.00	<sup>2)</sup>	Nm
W <sub>t</sub>	Weight	-	3.5	-		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 <sub>RRM</sub> V	V <sub>RSM</sub> V	V <sub>R</sub> DC V
18	1800	1900	1350
24	2400	2500	1800
28	2800	2900	2100

### 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 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 Diode Dissipation Calculations

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

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

Where V<sub>T0</sub> = 0.782 V, r<sub>T</sub> = 0.157 mΩ.

R<sub>th</sub> = 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	0.0595	0.0561	0.0547	0.0537	0.0525	0.0511	0.0500
Sine wave	0.0536	0.0527	0.0522	0.0518	0.0500		

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 diode $V_F$ 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	7.498609E-01	A	4.871119E-01
B	4.491977E-02	B	4.816888E-02
C	1.266823E-04	C	1.411432E-04
D	-2.353395E-03	D	-7.437492E-04

## 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	6
$r_p$	0.02506	0.009643	0.00348	0.009712	0.001719	0.0004399
$\tau_p$	8.474	1.110	0.2289	0.04529	0.009524	0.0002414

## 6.0 Reverse recovery ratings

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

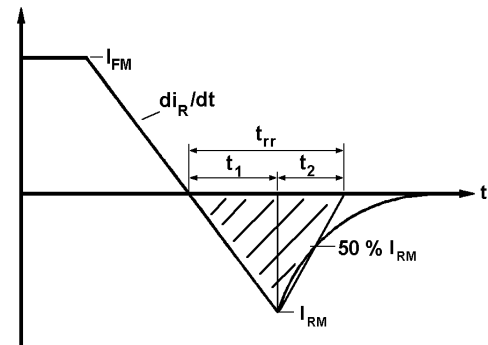


Fig. 1

(ii)  $Q_{rr}$  is based on a  $150 \mu s$  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

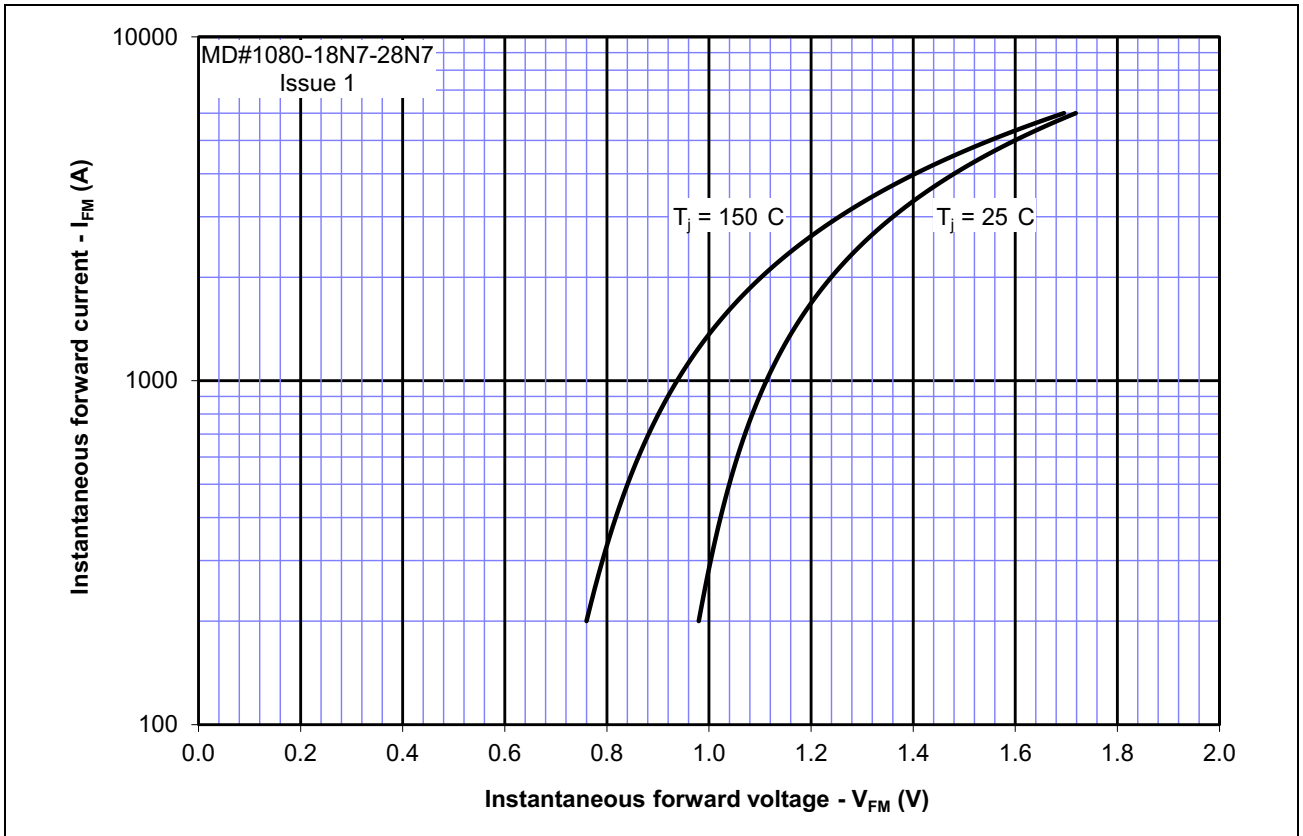


Figure 2 – Maximum surge and  $I^2t$  Ratings

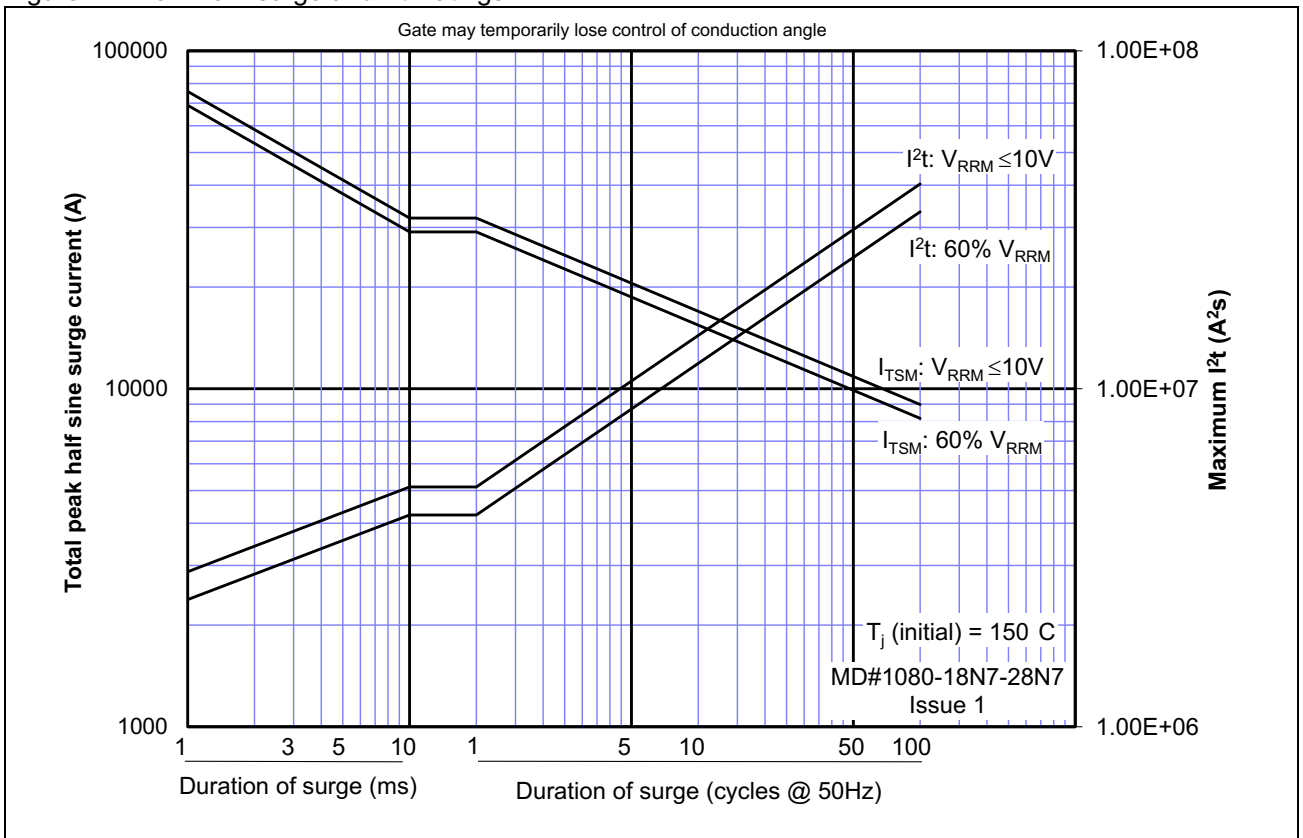


Figure 3 – Recovered charge,  $Q_{rr}$

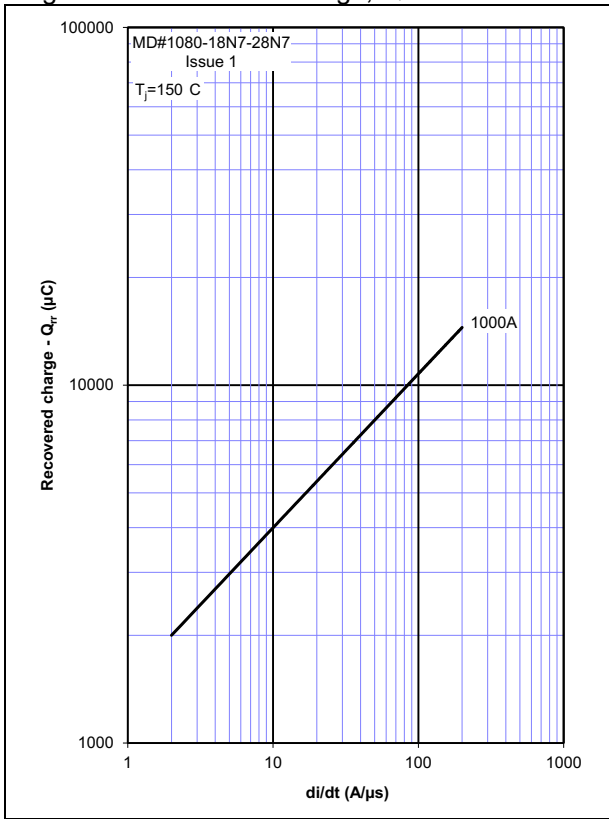


Figure 4 – Recovered charge,  $Q_{ra}$  (50% Chord)

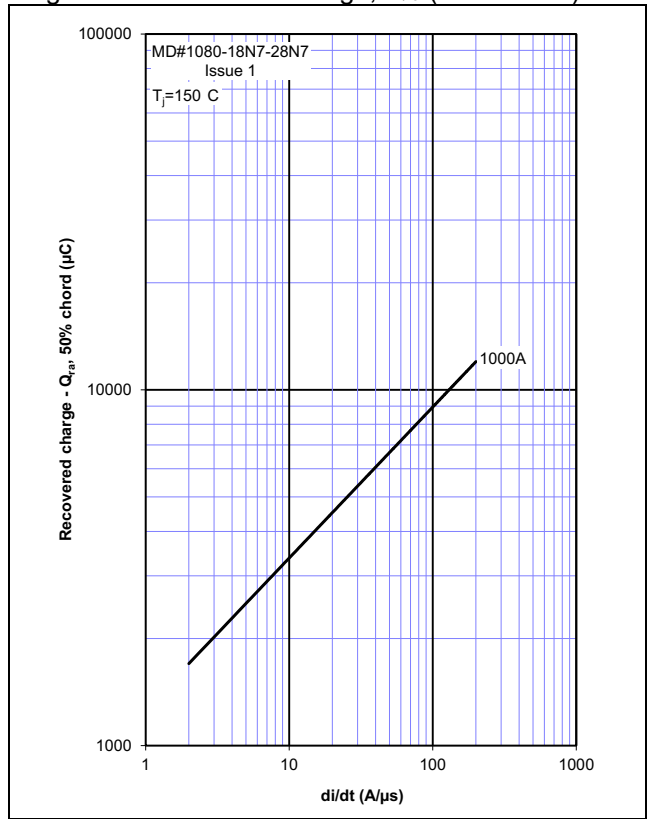


Figure 5 – Reverse recovery current,  $I_{rm}$

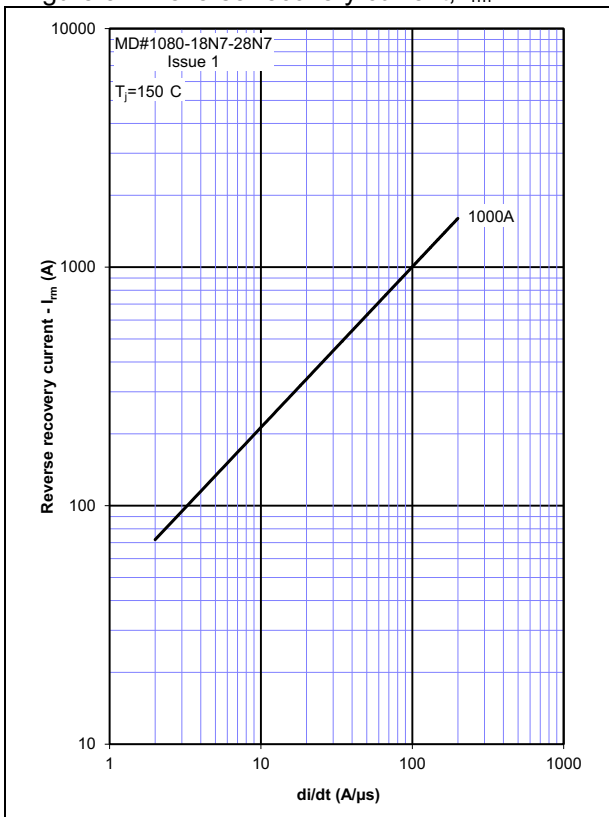


Figure 6 – Reverse recovery time,  $t_{rr}$

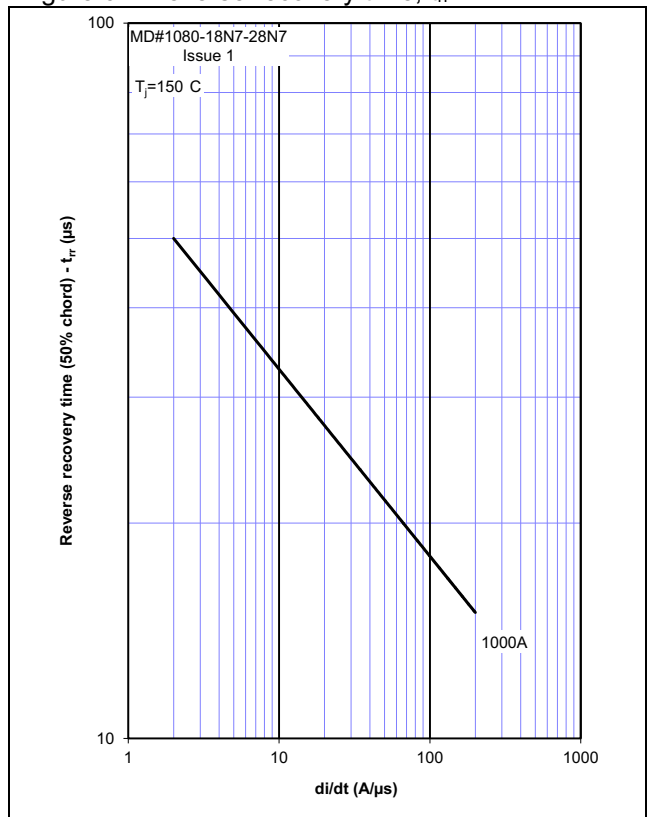


Figure 7 – On-state current vs. Power dissipation – Sine wave

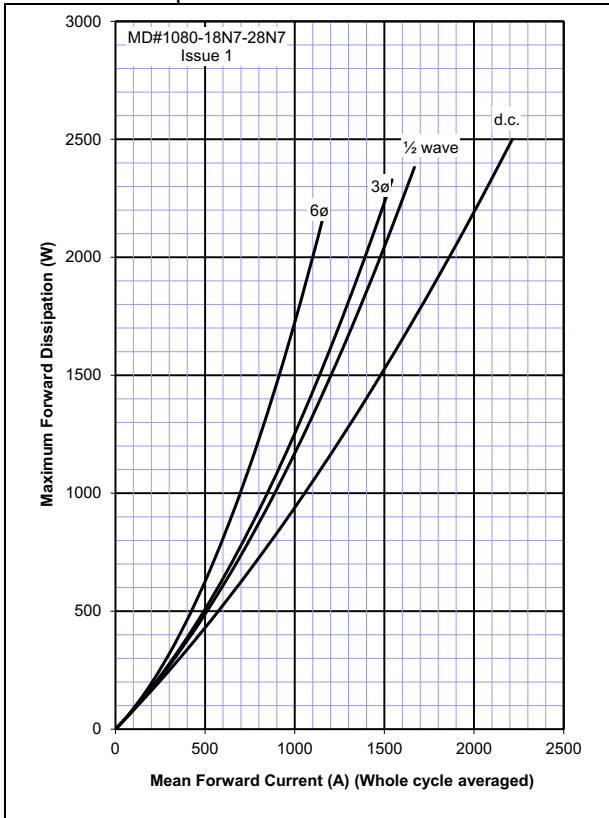


Figure 8 – On-state current vs. case temperature – Sine wave

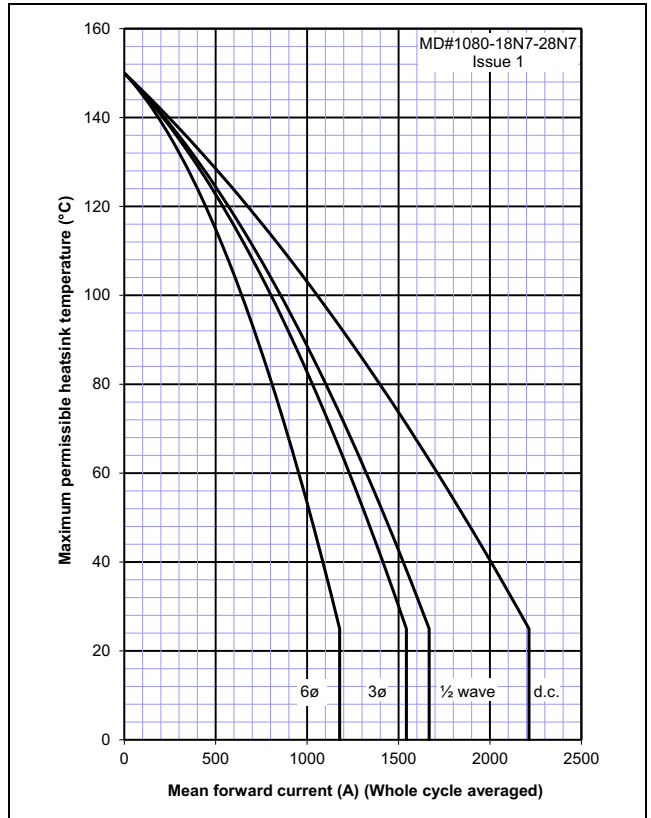
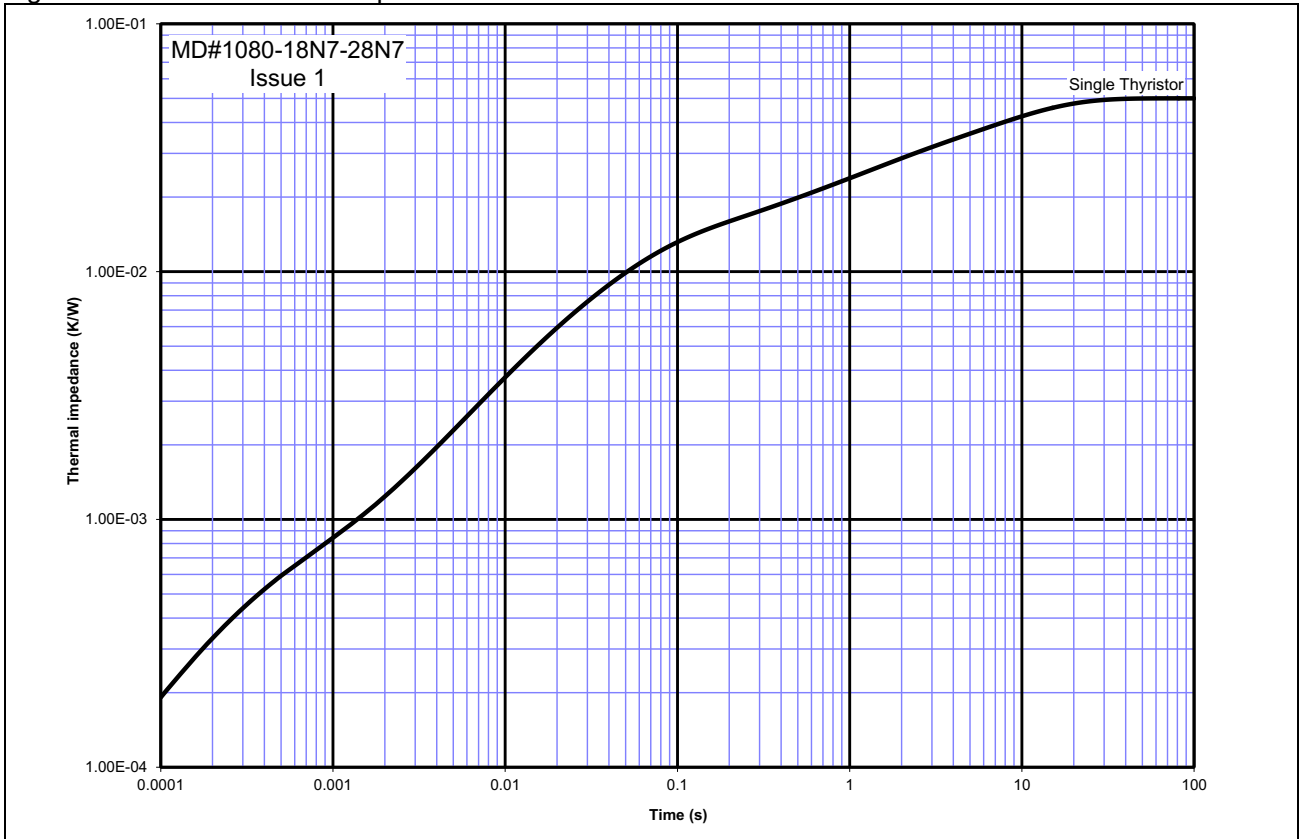
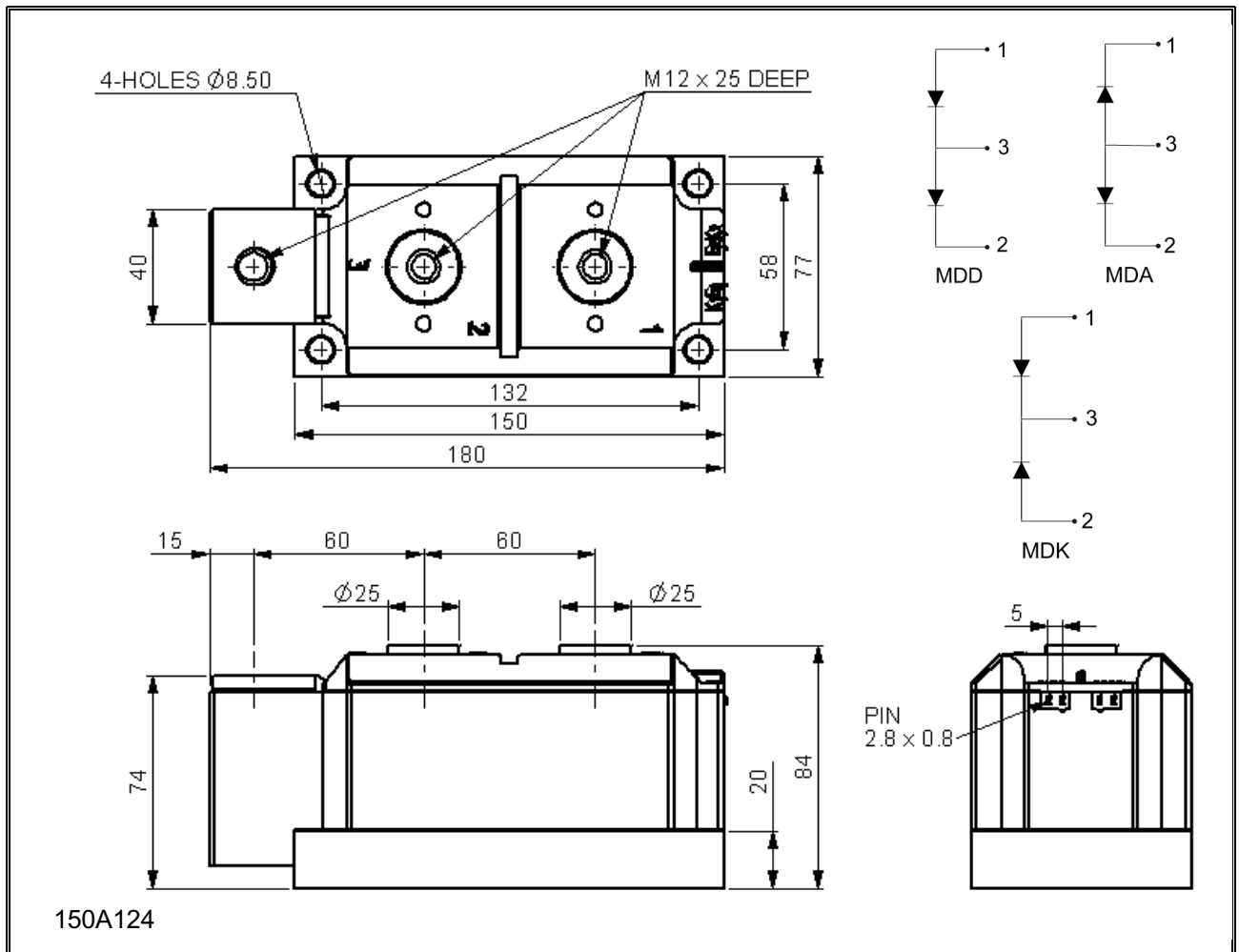


Figure 9 – Transient thermal impedance





**Outline Drawing & Ordering Information**



**ORDERING INFORMATION**

(Please quote 11 digit code as below)

<b>M</b>	<b>D#</b>	<b>1080</b>	<b>◆◆</b>	<b>N</b>	<b>7</b>
Fixed Type Code	Configuration code DD, DA or DK	Fixed Type Code	Voltage code $V_{RRM}/100$ 18-28	Standard Diode	Fixed Version Code

Typical order code: MDD1080-18N7- MDD configuration, 1800V  $V_{RRM}$

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