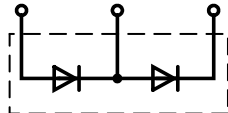
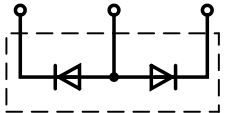
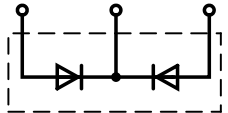


Dual Diode Modules

MD#410-24N3 & MD#410-28N3

Absolute Maximum Ratings

V_{RRM} [V]			
	MDD	MDA	MDK
2400	410-24N3	410-24N3	410-24N3
2800	410-28N3	410-28N3	410-28N3

	VOLTAGE RATINGS	MAXIMUM LIMITS	UNITS
V_{RRM}	Repetitive peak reverse voltage ¹⁾	2400-2800	V
V_{RSM}	Non-repetitive peak reverse voltage ¹⁾	2500-2900	V

	OTHER RATINGS	MAXIMUM LIMITS	UNITS
$I_{F(AV)M}$	Maximum average on-state current, $T_C = 85^\circ\text{C}$ ²⁾	440	A
$I_{F(AV)M}$	Maximum average on-state current, $T_C = 100^\circ\text{C}$ ²⁾	360	A
$I_{F(RMS)M}$	Nominal RMS on-state current, $T_C = 55^\circ\text{C}$	910	A
$I_{F(d.c.)}$	D.C. on-state current, $T_C = 55^\circ\text{C}$	730	A
I_{FSM}	Peak non-repetitive surge $t_p = 10\text{ ms}$, $V_{RM} = 60\%V_{RRM}$ ³⁾	7.8	kA
I_{FSM2}	Peak non-repetitive surge $t_p = 10\text{ ms}$, $V_{RM} \leq 10\text{ V}$ ³⁾	8.5	kA
I^2t	I^2t capacity for fusing $t_p = 10\text{ ms}$, $V_{RM} = 60\%V_{RRM}$ ³⁾	304	kA^2s
I^2t	I^2t capacity for fusing $t_p = 10\text{ ms}$, $V_{RM} \leq 10\text{ V}$ ³⁾	361	kA^2s
V_{ISOL}	Isolation Voltage ⁴⁾	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:

- 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, 150°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	-	-	1.40	I _{FM} = 785 A, T _{VJ} =25°C	V
V _{T0}	Threshold voltage	-	-	0.85		V
r _T	Slope resistance	-	-	0.45		mΩ
I _{RRM}	Peak reverse current	-	-	30	Rated V _{RRM}	mA
Q _{rr}	Recovered Charge	-	1800	2000	I _{TM} = 320A, t _p =1ms, di/dt =10A/μs, V _R =100 V	μC
Q _{ra}	Recovered Charge, 50% chord	-	1600	-		μC
I _{rm}	Reverse recovery current	-	130	-		A
t _{rr}	Reverse recovery time, 50% chord	-	25	-		μs
R _{thJC}	Thermal resistance, junction to case	-	-	0.11	Single Diode	K/W
		-	-	0.055	Whole Module	K/W
R _{thCH}	Thermal resistance, case to heatsink	-	-	0.04	Single Diode	K/W
		-	-	0.02	Whole Module	K/W
F ₁	Mounting force (to heatsink) ²⁾	5.1	-	6.9		Nm
F ₂	Mounting force (to terminals) ²⁾	7.65	-	10.35		Nm
W _t	Weight	-	800	-		g

Notes:

- 1) Unless otherwise indicated T_{vj}=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
2400	2400	2500	1800
2800	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_{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} = 0.85 V, r_T = 0.45 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	0.1169	0.1136	0.1125	0.1119	0.1111	0.1105	0.1100
Sine wave	0.1110	0.1104	0.1103	0.1102	0.1100		

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 forward 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	0.9038659	A	0.6040343
B	0.03689063	B	0.04159079
C	3.62148×10^{-4}	C	3.99019×10^{-4}
D	-1.194003×10^{-4}	D	4.39622×10^{-4}

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
- τ_p = Time Constant of r_{th} term

The coefficients for this device are shown in the table below:

D.C. Single Diode				
Term	1	2	3	4
r_p	0.07710048	0.02402733	8.295585×10^{-3}	6.2613×10^{-4}
τ_p	2.816585	0.7063744	0.1730958	3.79616×10^{-4}

6.0 Reverse recovery ratings

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

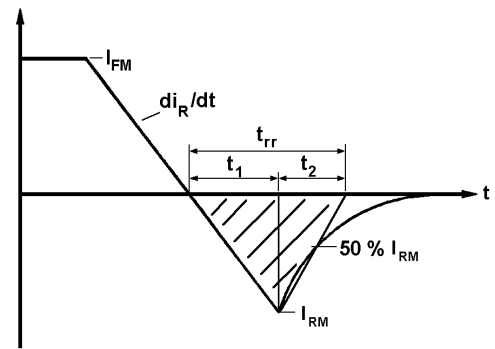


Fig. 1

(ii) Q_{rr} is based on a 150 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

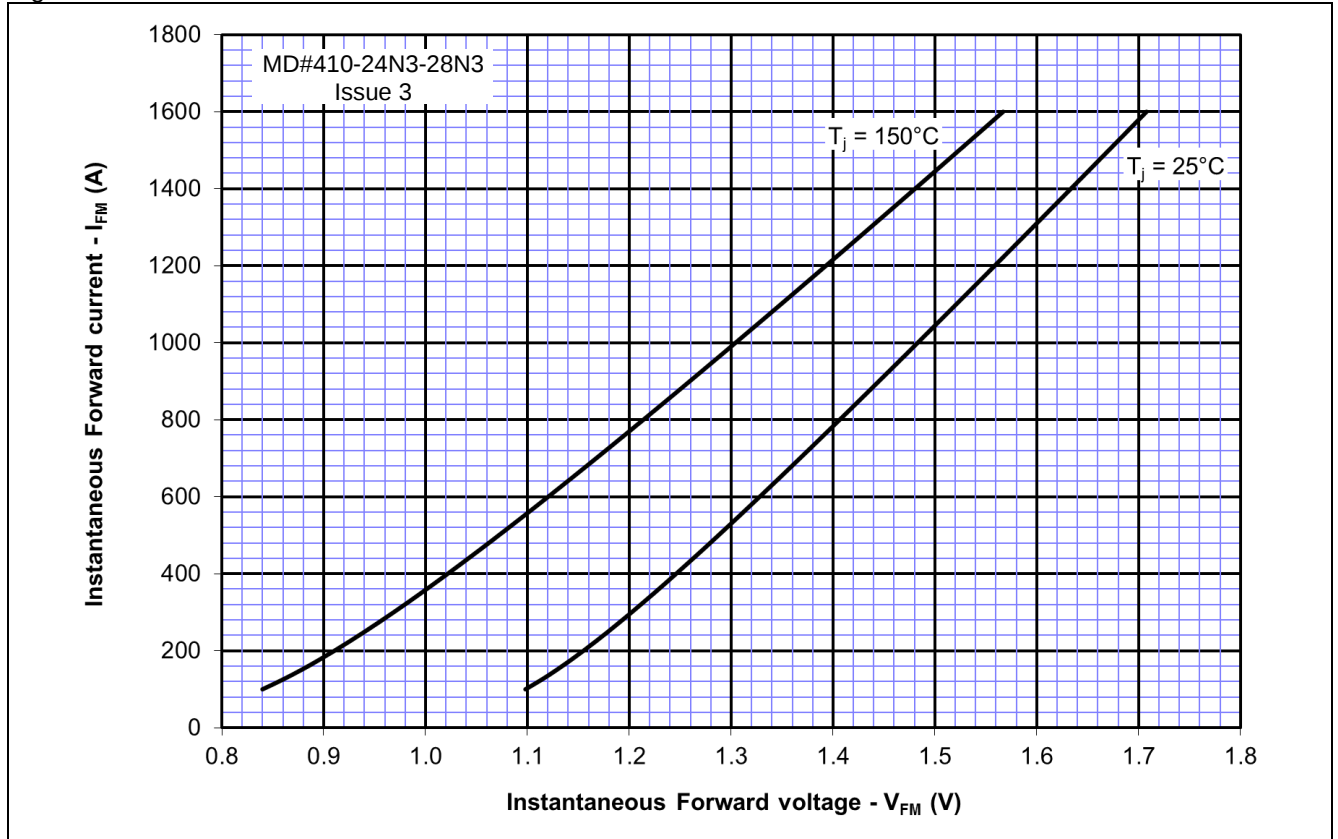


Figure 2 – Maximum surge and I^2t Ratings

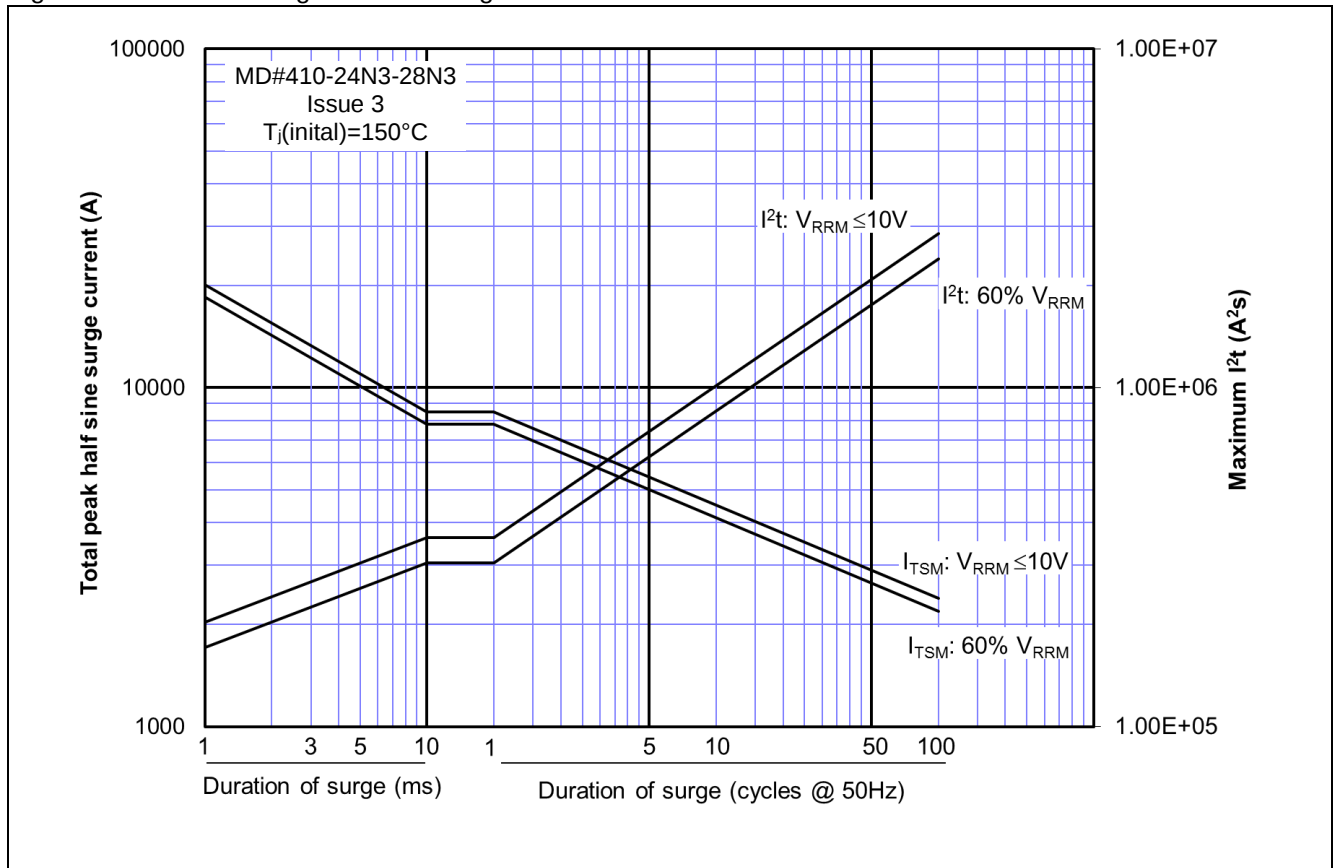


Figure 3 - Total recovered charge, Q_{rr}

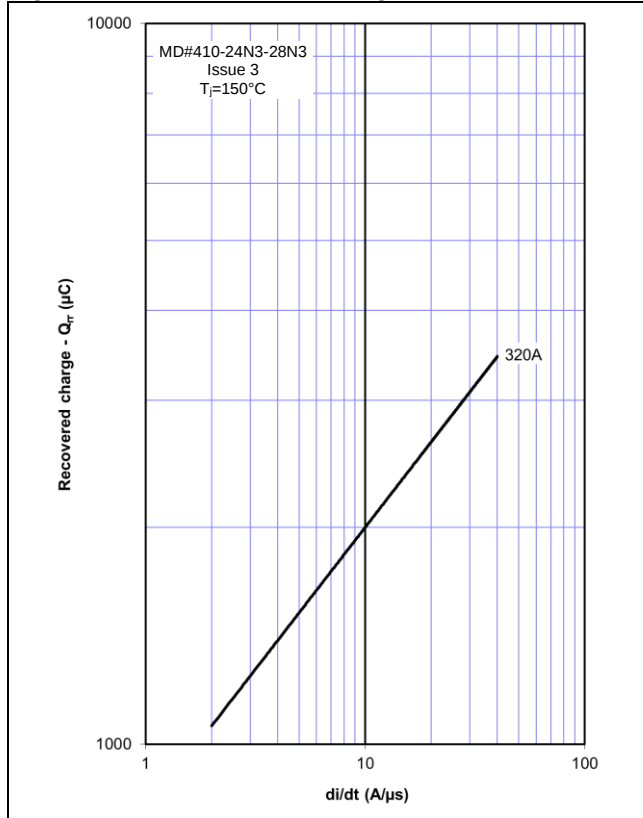


Figure 4 - Recovered charge, Q_{ra} (50% chord)

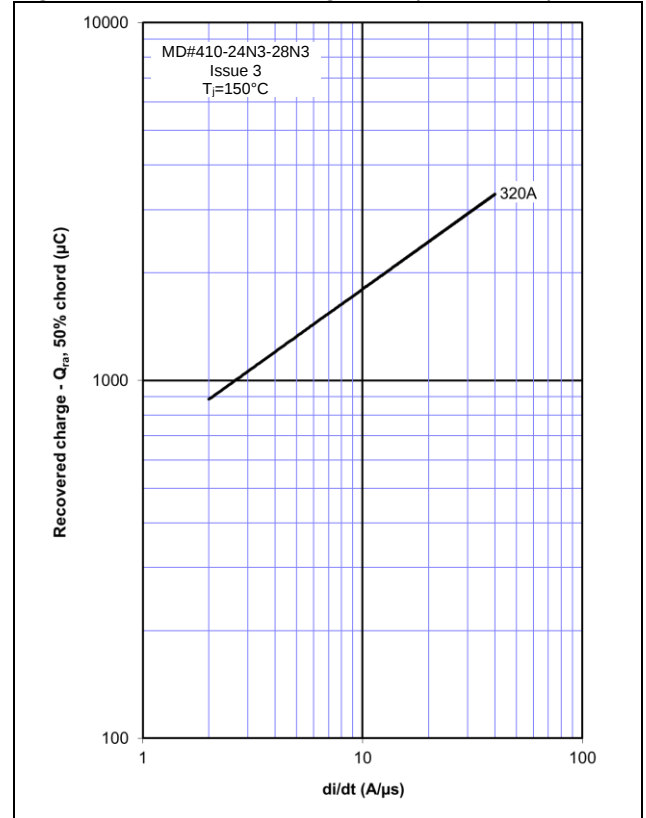


Figure 5 - Peak reverse recovery current, I_{rm}

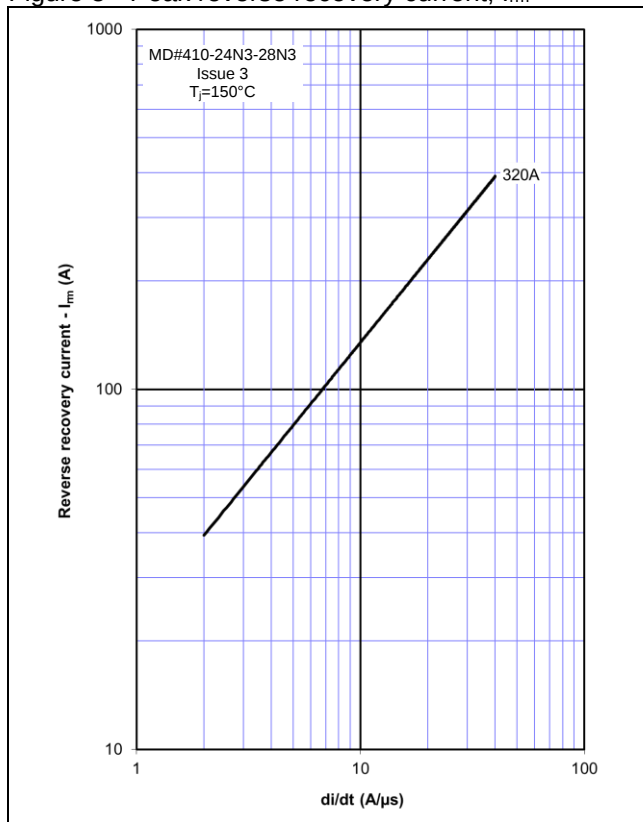


Figure 6 - Maximum recovery time, t_{rr} (50% chord)

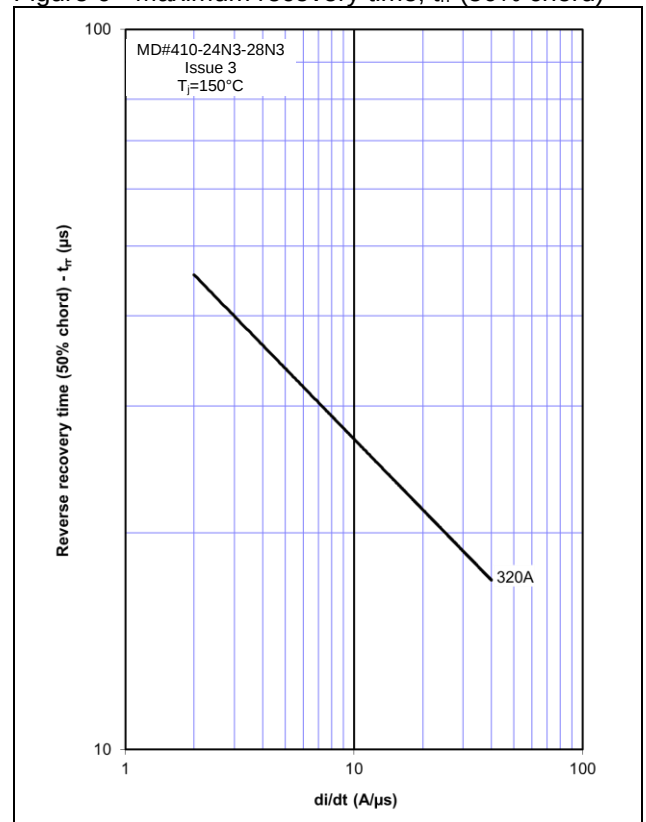


Figure 7 – Forward current vs. Power dissipation

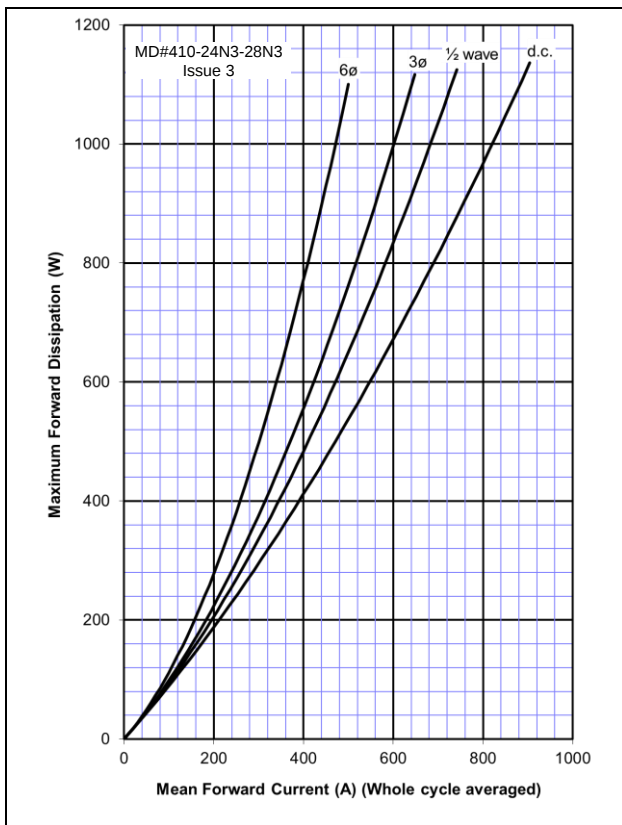


Figure 8 – Forward current vs. Heatsink temperature

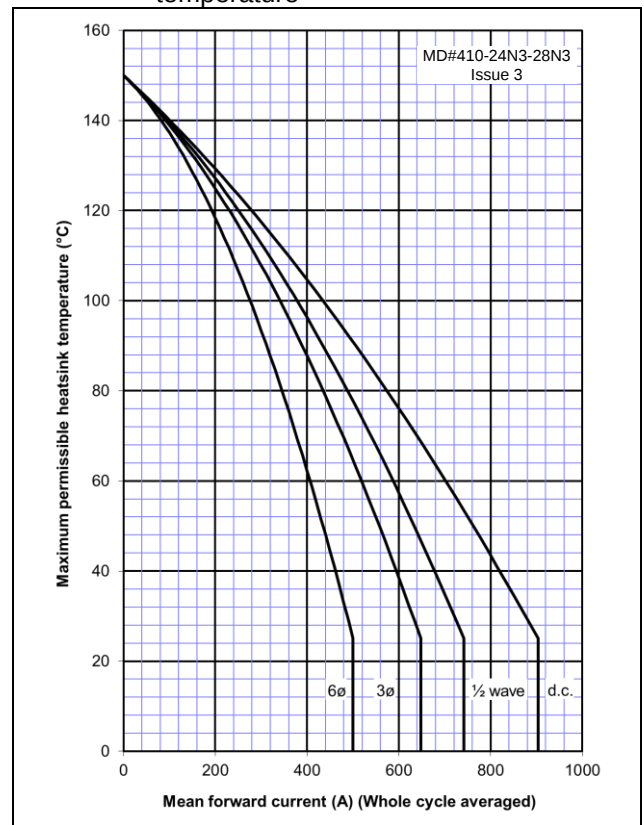
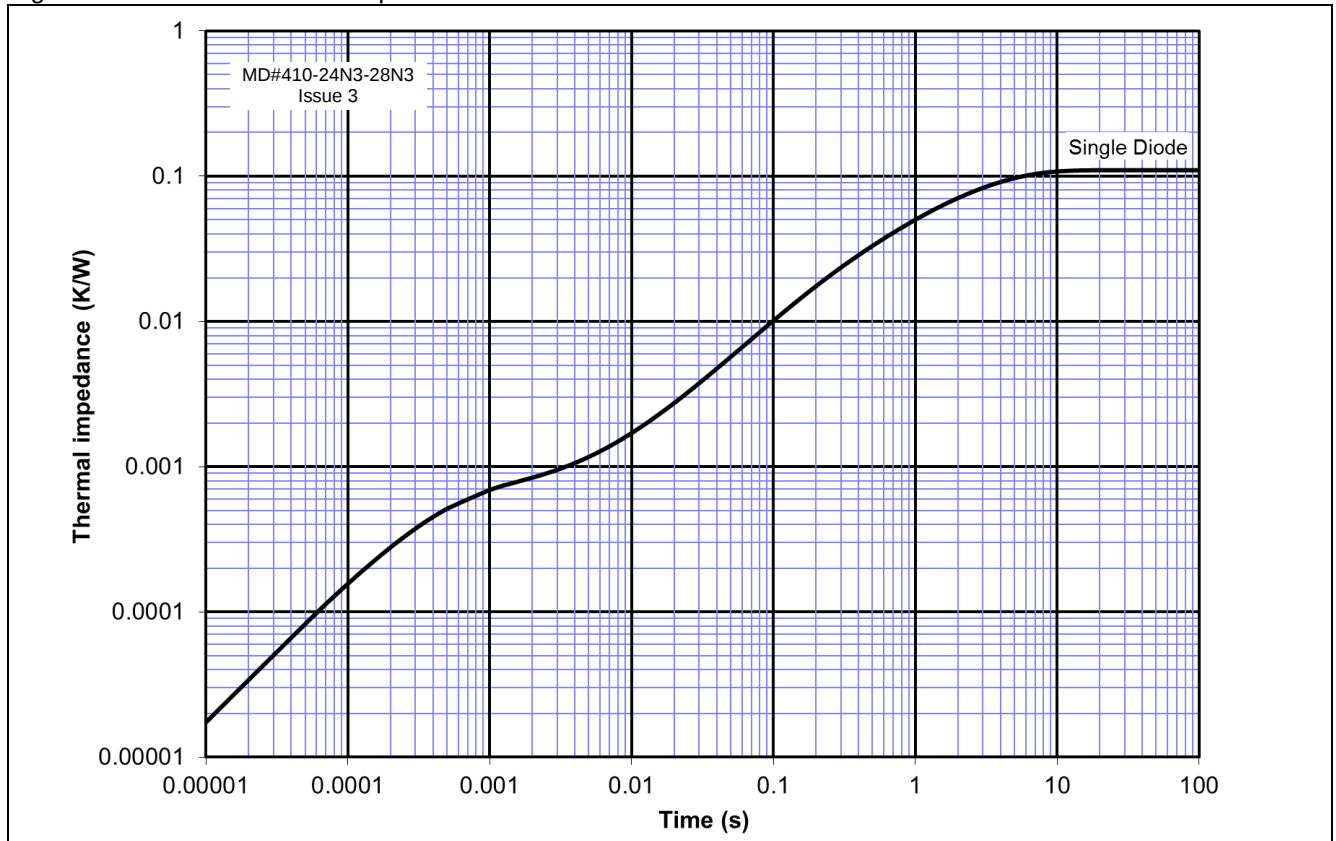
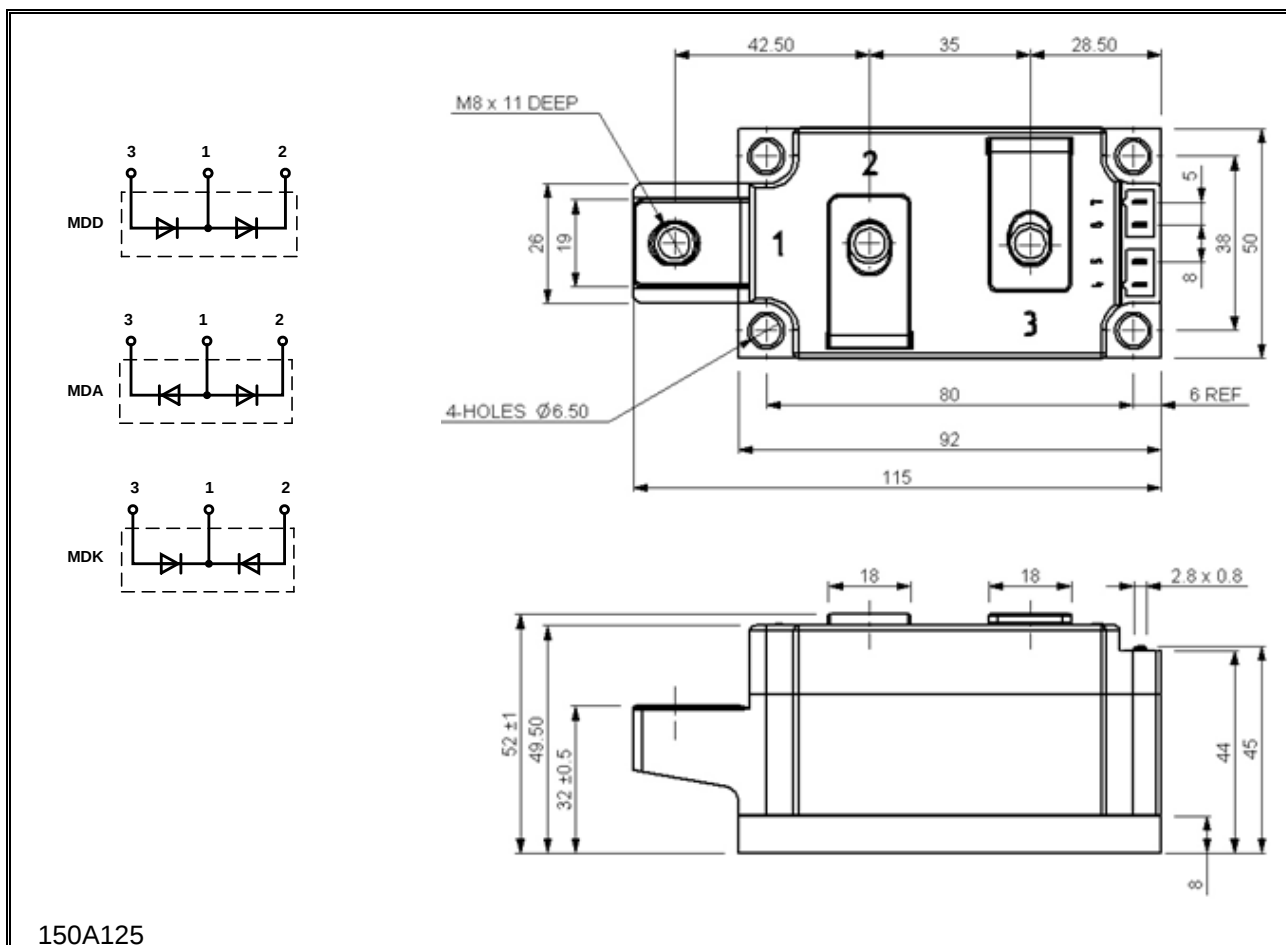


Figure 9 – Transient thermal impedance



Outline Drawing & Ordering Information



150A125

ORDERING INFORMATION

(Please quote 11/14 digit code as below)

M	D#	410	◆◆	N	3
Fixed Type Code	Configuration Code DD, DA, DK	Fixed Type Code	Voltage code $V_{RRM}/100$ 24-28	Standard Diode	Fixed Version Code

 Typical order code: MDA410-28N3—MDA configuration, 2800V V_{RRM}

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