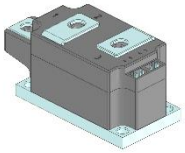
IXYS
A Littelfuse Technology



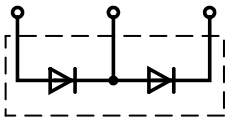
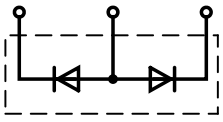
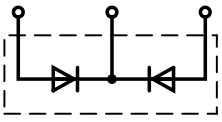
Date: 26th May 2020

Data Sheet Issue: 3

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°C [2]	440	A
$I_{F(AV)M}$	Maximum average on-state current. T_C = 100°C [2]	360	A
$I_{F(RMS)M}$	Nominal RMS on-state current, T_C = 55°C [2]	910	A
$I_{F(d.c.)}$	D.C. on-state current, T_C = 55°C	730	A
I_{FSM}	Peak non-repetitive surge t_p = 10 ms, V_{RM} = 60%V_{RRM} [3]	7.8	kA
I_{FSM2}	Peak non-repetitive surge t_p = 10 ms, $V_{RM} \leq$ 10V [3]	8.5	kA
I^2t	I^2t capacity for fusing t_p = 10 ms, V_{RM} = 60%V_{RRM} [3]	304	kA^2s
I^2t	I^2t capacity for fusing t_p = 10 ms, $V_{RM} \leq$ 10 V [3]	361	kA^2s
V_{ISOL}	Isolation Voltage [4]	3000	V
$T_{vj\ op}$	Operating temperature range	-40 to +150	°C
T_{stg}	Storage temperature range	-40 to +150	°C

Notes:

1) De-rating factor of 0.13% per °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		µC
Q_{ra}	Recovered Charge, 50% chord	-	1600	-	I_{TM} = 320A, t_p =1ms, di/dt =10A/µs, V_R =100 V	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

$$I_{AV} = \frac{-V_{T0} + \sqrt{V_{T0}{}^2 + 4 \cdot ff^2 \cdot r_T \cdot W_{AV}}}{2 \cdot ff^2 \cdot r_T}$$

and:

$$W_{AV} = \frac{\Delta T}{R_{th}}$$

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

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_{ra} is based on 50% I_{RM} chord as shown in Fig. 1

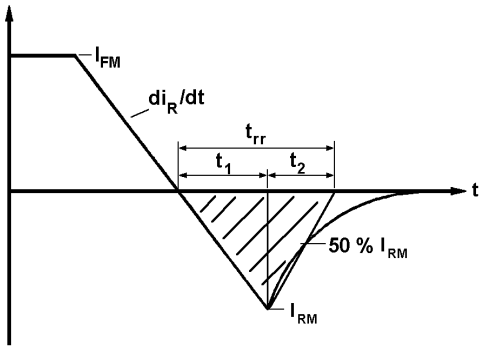


Fig. 1

(ii) Q_{rr} is based on a 150 µs integration time i.e.

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

(iii)

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

Curves

Figure 1 – Forward characteristics of Limit device

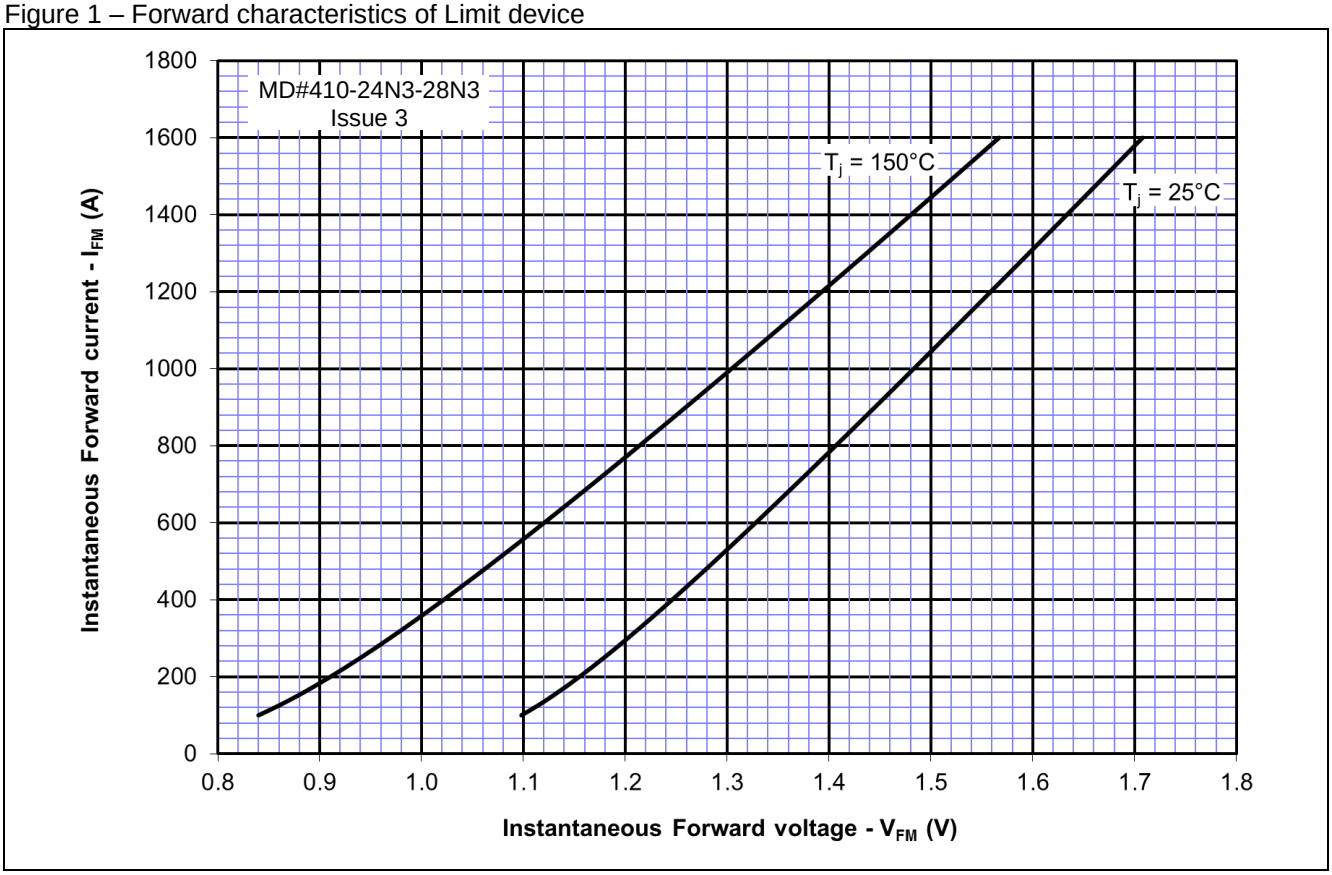


Figure 2 – Maximum surge and I^2t Ratings

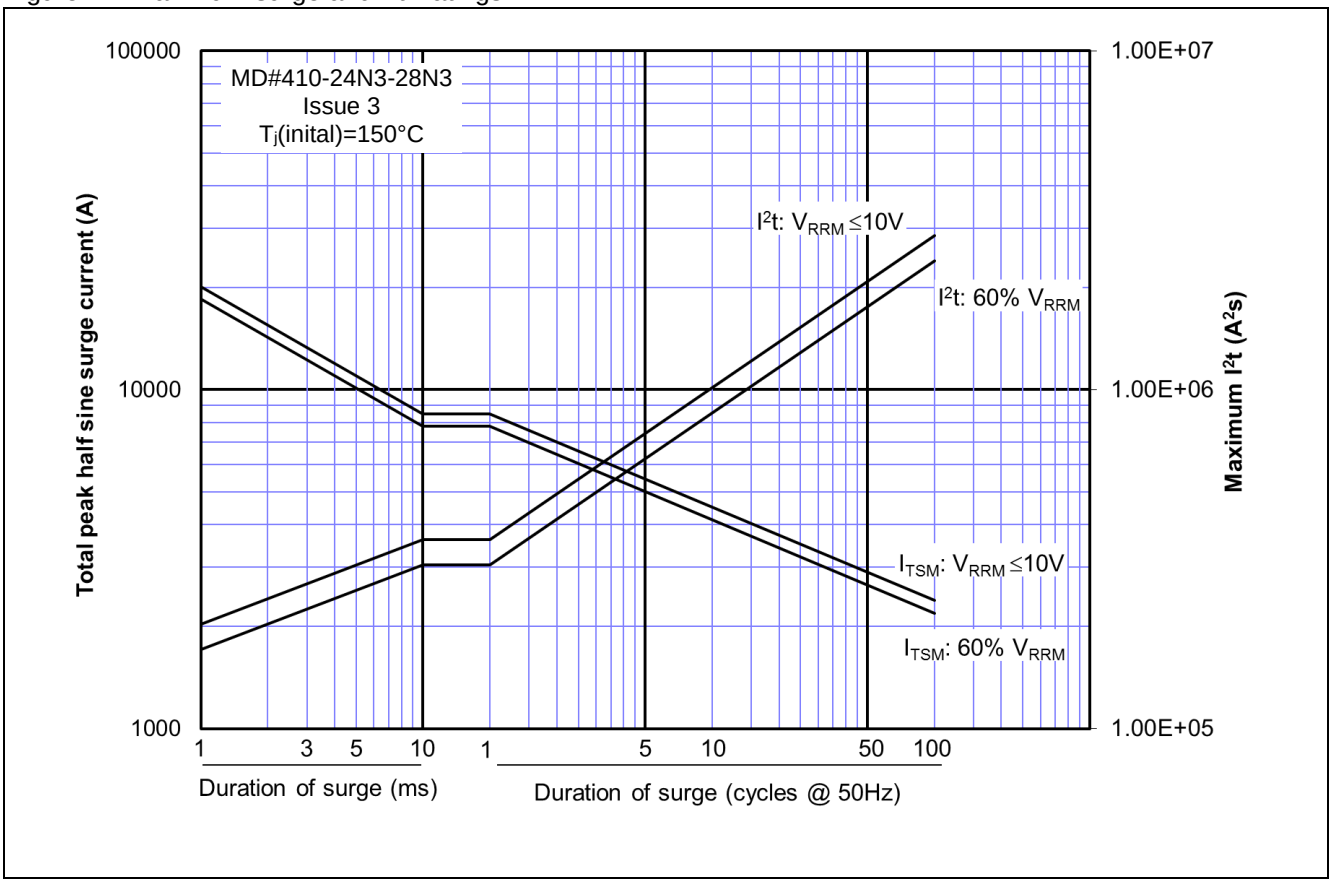


Figure 3 - Total recovered charge, Q_{rr}

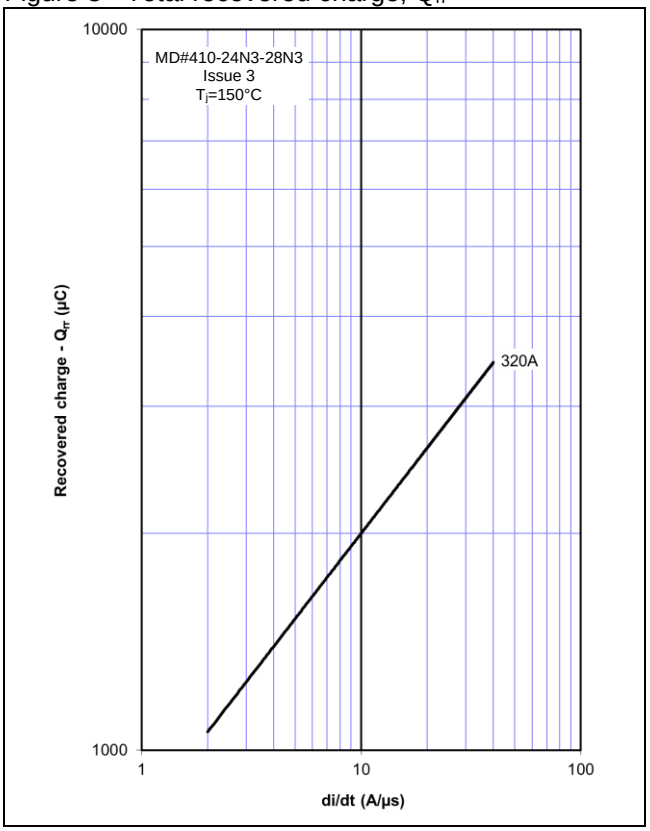


Figure 4 - Recovered charge, Q_{ra} (50% chord)

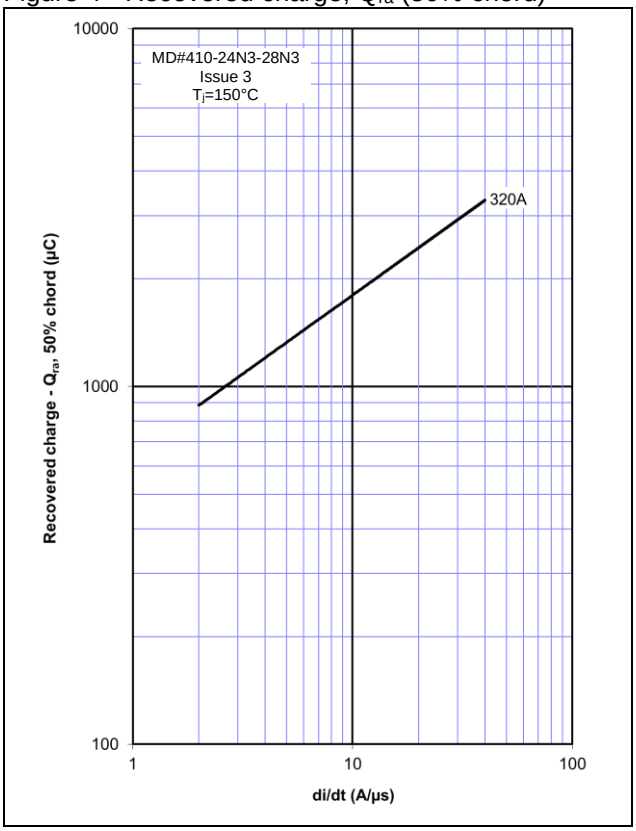


Figure 5 - Peak reverse recovery current, I_{rm}

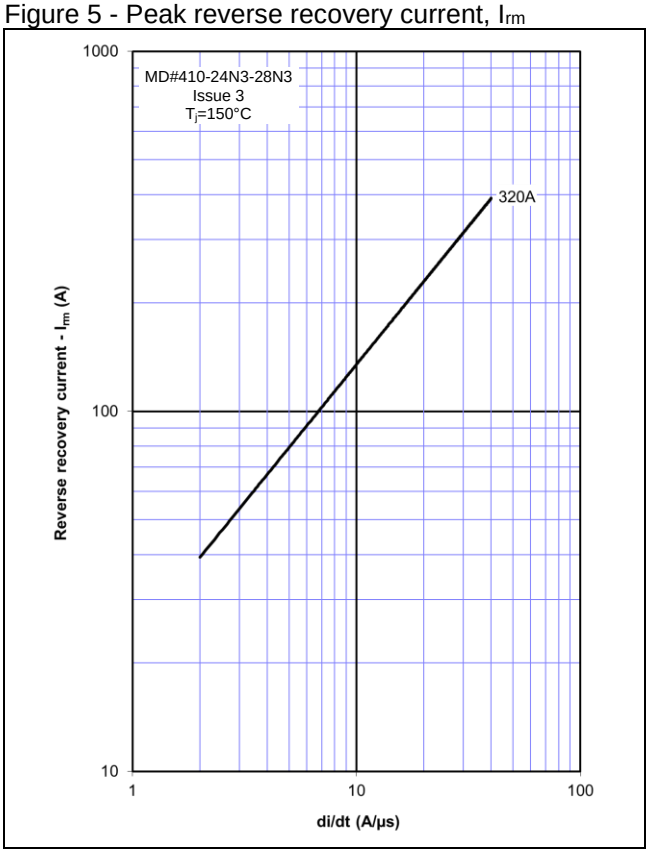


Figure 6 - Maximum recovery time, t_{rr} (50% chord)

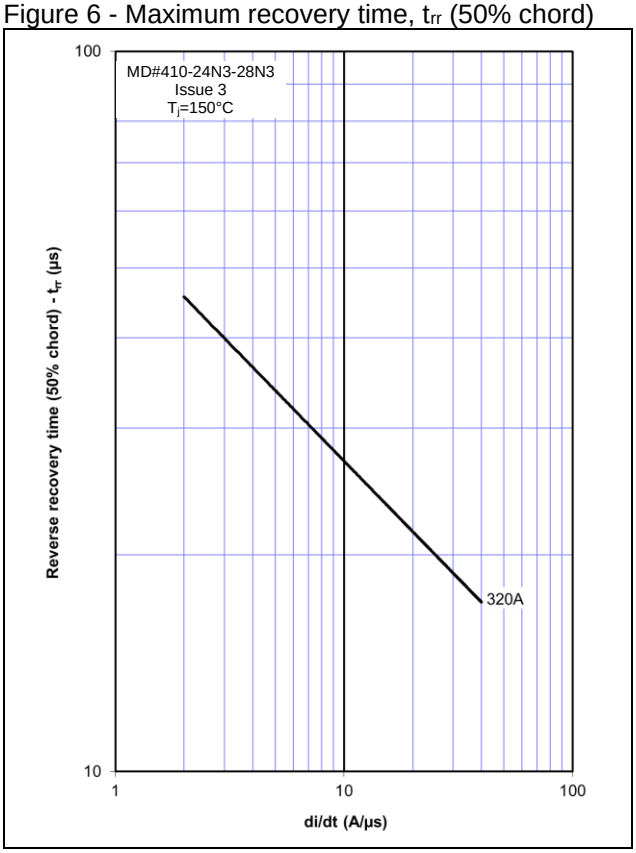


Figure 7 – Forward current vs. Power dissipation

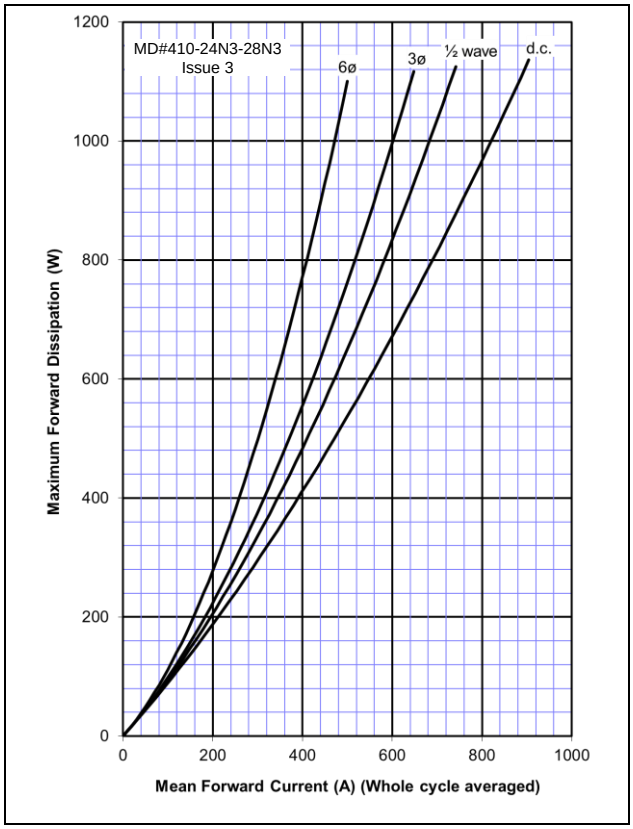


Figure 8 – Forward current vs. Heatsink temperature

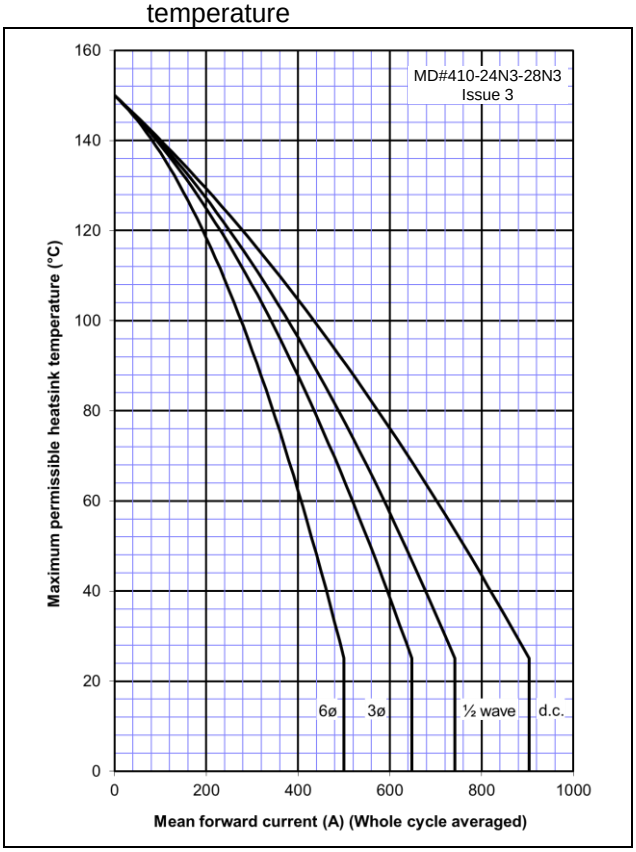
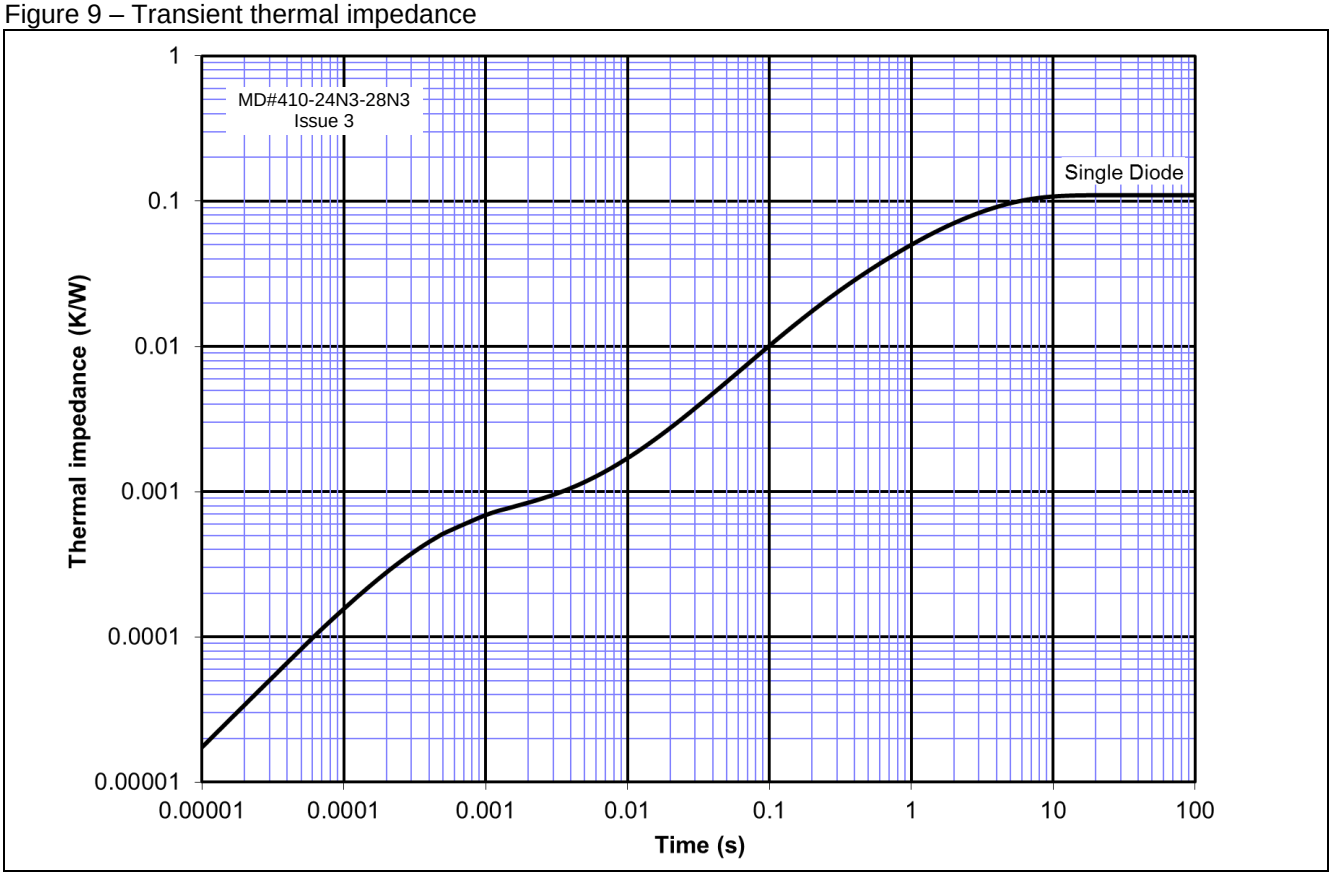
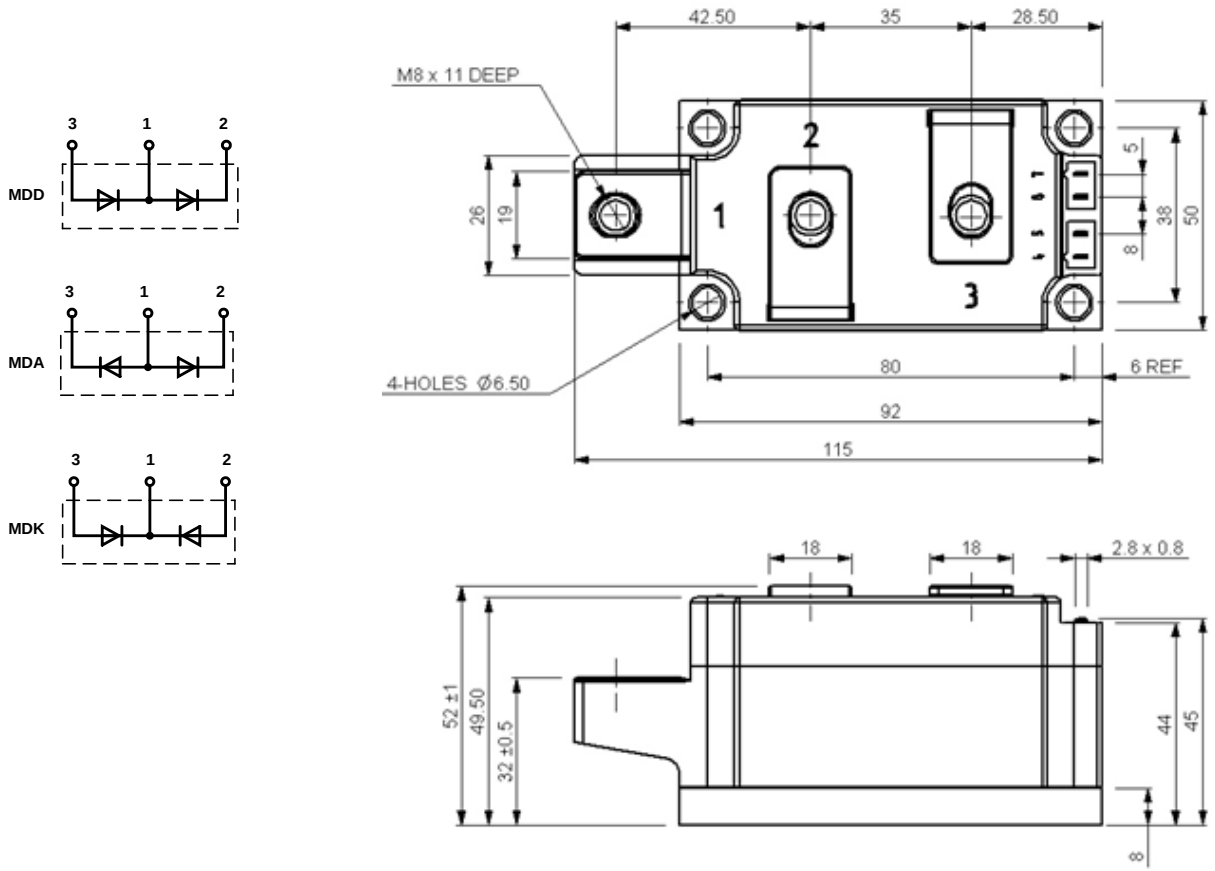


Figure 9 – Transient thermal impedance



Outline Drawing & Ordering Information



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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}

IXYS Semiconductor GmbH
Edisonstraße 15
D-68623 Lampertheim
Tel: +49 6206 503-0
Fax: +49 6206 503-627
E-mail: marcom@ixys.de

IXYS Corporation
1590 Buckeye Drive
Milpitas CA 95035-7418
Tel: +1 (408) 457 9000
Fax: +1 (408) 496 0670
E-mail: sales@ixys.net

IXYS UK Westcode Ltd
Langley Park Way, Langley Park,
Chippenham, Wiltshire, SN15 1GE.
Tel: +44 (0)1249 444524
Fax: +44 (0)1249 659448
E-mail: sales@ixysuk.com

IXYS Long Beach
IXYS Long Beach, Inc
2500 Mira Mar Ave, Long Beach
CA 90815
Tel: +1 (562) 296 6584
Fax: +1 (562) 296 6585
E-mail: service@ixyslongbeach.com

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