Thyristor/Diode Modules M## 325

Absolute Maximum Ratings

V_{RRM} V_{DRM} [V]	MCC	MCD	MDC
1400	325-14io3	325-14io3	325-14io3
1800	325-18io3	325-18io3	325-18io3

	VOLTAGE RATINGS	MAXIMUM LIMITS	UNITS
V_{DRM}	Repetitive peak off-state voltage [1]	1400-1800	V
V_{DSM}	Non-repetitive peak off-state voltage [1]	1500-1900	V
V_{RRM}	Repetitive peak reverse voltage [1]	1400-1800	V
V_{RSM}	Non-repetitive peak reverse voltage [1]	1500-1900	V

	OTHER RATINGS	MAXIMUM LIMITS	UNITS
$I_{T(AV)M}$	Maximum average on-state current, T_C = 85°C [2]	345	A
$I_{T(AV)M}$	Maximum average on-state current. T_C = 100°C [2]	255	A
$I_{T(RMS)M}$	Nominal RMS on-state current, T_C = 55°C [2]	785	A
$I_{T(d.c.)}$	D.C. on-state current, T_C = 55°C	640	A
I_{TSM}	Peak non-repetitive surge t_p = 10 ms, V_{RM} = 60%V_{RRM} [3]	7.65	kA
I_{TSM2}	Peak non-repetitive surge t_p = 10 ms, $V_{RM} \leq$ 10V [3]	8.50	kA
I^2t	I^2t capacity for fusing t_p = 10 ms, V_{RM} = 60%V_{RRM} [3]	293×10³	A²s
I^2t	I^2t capacity for fusing t_p = 10 ms, $V_{RM} \leq$ 10 V [3]	361×10³	A²s
$(di/dt)_{cr}$	Critical rate of rise of on-state current (repetitive) [4]	250	A/µs
	Critical rate of rise of on-state current (non-repetitive) [4]	500	A/µs
V_{RGM}	Peak reverse gate voltage	5	V
$P_{G(AV)}$	Mean forward gate power	3	W
P_{GM}	Peak forward gate power	30	W
V_{ISOL}	Isolation Voltage [5]	3000	V
$T_{vj\,op}$	Operating temperature range	-40 to +130	°C
T_{stg}	Storage temperature range	-40 to +130	°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, 130°C T_{vj} initial.
4) V_D = 67% V_{DRM}, I_{TM} = 700A, I_{FG} = 6 A, di_G/dt = 1A/µs, T_C = 130°C.
5) AC RMS voltage, 50 Hz, 1min test

Characteristics

	PARAMETER	MIN.	TYP.	MAX.	TEST CONDITIONS [1]	UNITS
V_{TM}	Maximum peak on-state voltage	-	-	0.91	I_{TM} = 350 A	V
V_{TM}	Maximum peak on-state voltage	-	-	1.25	I_{TM} = 1000 A	V
V_{T0}	Threshold voltage	-	-	0.75		V
r_T	Slope resistance	-	-	0.50		mΩ
$(dv/dt)_{cr}$	Critical rate of rise of off-state voltage	1000	-	-	V_D = 67% V_{DRM}, linear ramp, Gate o/c	V/µs
I_{DRM}	Peak off-state current	-	-	40	Rated V_{DRM}	mA
I_{RRM}	Peak reverse current	-	-	40	Rated V_{RRM}	mA
V_{GT}	Gate trigger voltage	-	-	2.0	T_{vj} = 25°C, V_D = 12 V, I_T = 3 A	V
I_{GT}	Gate trigger current	-	-	150		mA
V_{GD}	Gate non-trigger voltage	0.25	-	-	67% V_{DRM}	V
I_L	Latching current	-	-	700	V_D = 12 V, T_{vj} = 25°C	mA
I_H	Holding current	-	-	300	V_D = 12 V, T_{vj} = 25°C	mA
t_{gd}	Gate controlled turn-on delay time	-	-	2.0	I_{FG} = 6 A, di_G/dt = 1 A/µs, V_D = 40%V_{DRM}, I_{TM} = 350 A, di/dt = 10 A/µs, T_{vj} = 25°C	µs
Q_{rr}	Recovered Charge	-	-	1450	I_{TM} = 320 A, t_p = 1 ms, di/dt = 10A/µs, V_R = 100 V	µC
Q_{ra}	Recovered Charge, 50% chord	-	-	1200		µC
I_{rm}	Reverse recovery current	-	-	120		A
t_{rr}	Reverse recovery time, 50% chord	-	-	20		µs
t_q	Turn-off time	-	-	160	I_{TM} = 320 A, t_p = 1 ms, di/dt = 10 A/µs, V_R = 100 V, V_{DR} = 67%V_{DRM}, dv_{DR}/dt = 50 V/µs	µs
R_{thJC}	Thermal resistance, junction to case	-	-	0.110	Single Thyristor	K/W
		-	-	0.055	Whole Module	K/W
R_{thCH}	Thermal resistance, case to heatsink	-	-	0.04	Single Thyristor	K/W
		-	-	0.02	Whole Module	K/W
F_1	Mounting force (to heatsink)	5.10	-	6.90		Nm
F_2	Mounting force (to terminals)	7.65	-	10.35	[2]	Nm
W_t	Weight	-	800	-		g

Notes:

1) Unless otherwise indicated T_{vj}=130°C.
2) Screws must be lubricated.

Notes on Ratings and Characteristics

1.0 Voltage Grade Table

Voltage Grade	V_{DRM} V_{RRM} V	V_{DSM} V_{RSM} V	V_D V_R DC V
12	1200	1300	900
14	1400	1500	1050
16	1600	1700	1200
18	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 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 Rate of rise of on-state current

The maximum un-primed rate of rise of on-state current must not exceed 500A/µs at any time during turn-on on a non-repetitive basis. For repetitive performance, the on-state rate of rise of current must not exceed 250A/µs at any time during turn-on. Note that these values of rate of rise of current apply to the total device current including that from any local snubber network.

7.0 Computer Modelling Parameters

7.1 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:

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

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

Where V_{T0} = 0.75 V, r_T = 0.50 mΩ.

R_{th} = Supplementary thermal impedance, see table on next page and

ff = Form factor, see table on next page.

Supplementary Thermal Impedance							
Conduction Angle	30°	60°	90°	120°	180°	270°	d.c.
Square wave	0.1170	0.1163	0.1156	0.1150	0.1137	0.1119	0.1100
Sine wave	0.1165	0.1156	0.1150	0.1142	0.1123		

Form Factors							
Conduction Angle	30°	60°	90°	120°	180°	270°	d.c.
Square wave	3.464	2.449	2.000	1.732	1.414	1.149	1.000
Sine wave	3.980	2.778	2.220	1.879	1.570		

7.2 Calculating thyristor V_T using ABCD Coefficients

The on-state characteristic I_T vs. V_T, on page 6 is represented by a set of constants A, B, C, D, forming the coefficients of the representative equation for V_T in terms of I_T given below:

$$V_T = A + B \cdot \ln(I_T) + C \cdot I_T + D \cdot \sqrt{I_T}$$

The constants, derived by curve fitting software, are given below for both hot and cold characteristics. The resulting values for V_T agree with the true device characteristic over a current range, which is limited to that plotted.

	25°C Coefficients		125°C Coefficients
A	0.9377735	A	0.5178489
B	0.02863417	B	0.0409915
C	3.40709×10^{-4}	C	4.59674×10^{-4}
D	2.08604×10^{-4}	D	-2.65973×10^{-4}

8.3 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.				
Term	1	2	3	4
r_p	0.06311777	0.01445992	0.0202182	0.01254488
τ_p	2.815199	0.6437661	0.09192482	0.02995412

9.0 Reverse recovery ratings

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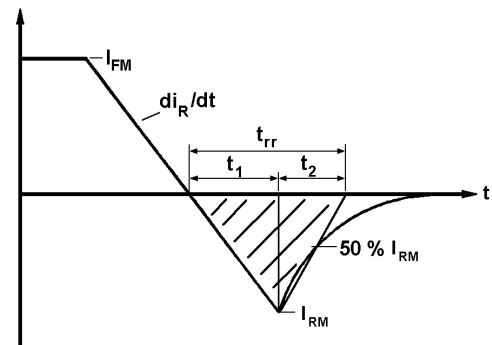
Fig. 1

(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)

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

Curves

Figure 1 – On-state characteristics of Limit device
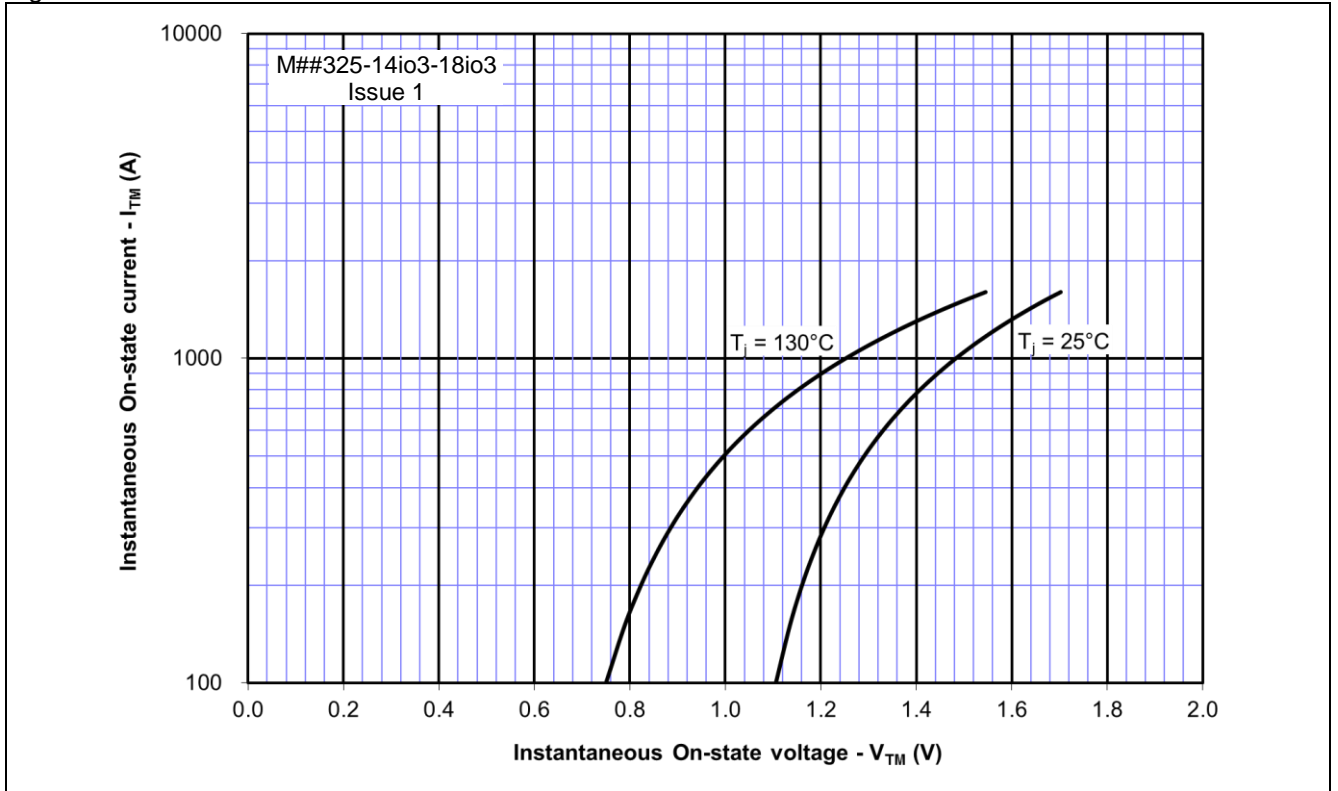
Figure 2 – Gate characteristics – Trigger limits
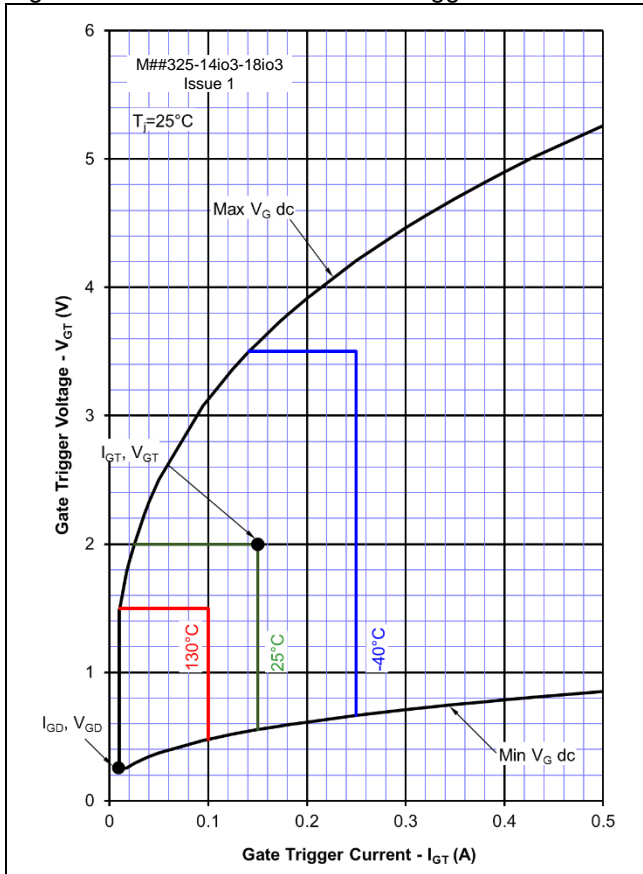
Figure 3 – Gate characteristics – Power curves
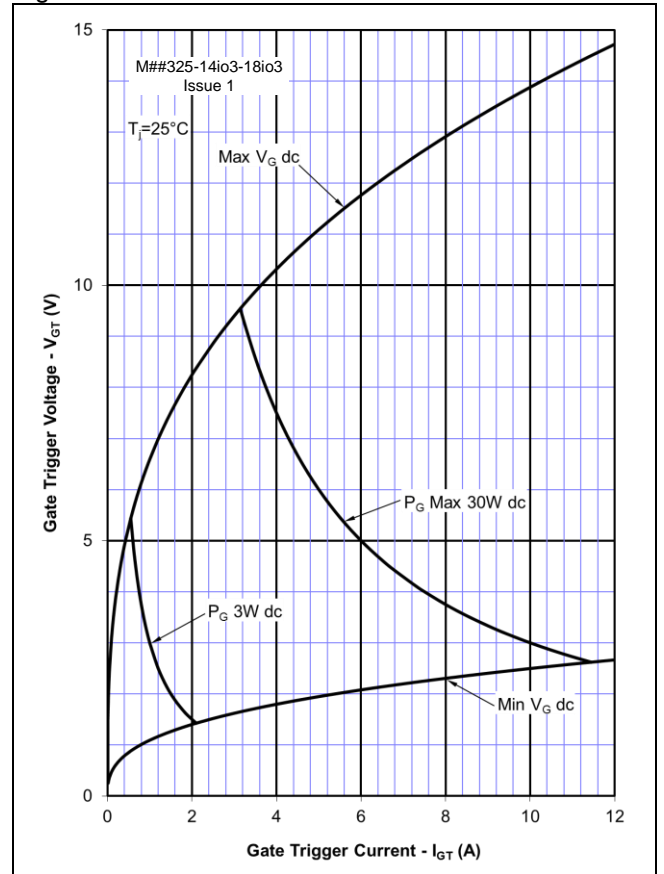
Figure 4 - Total recovered charge, Q$_{rr}$
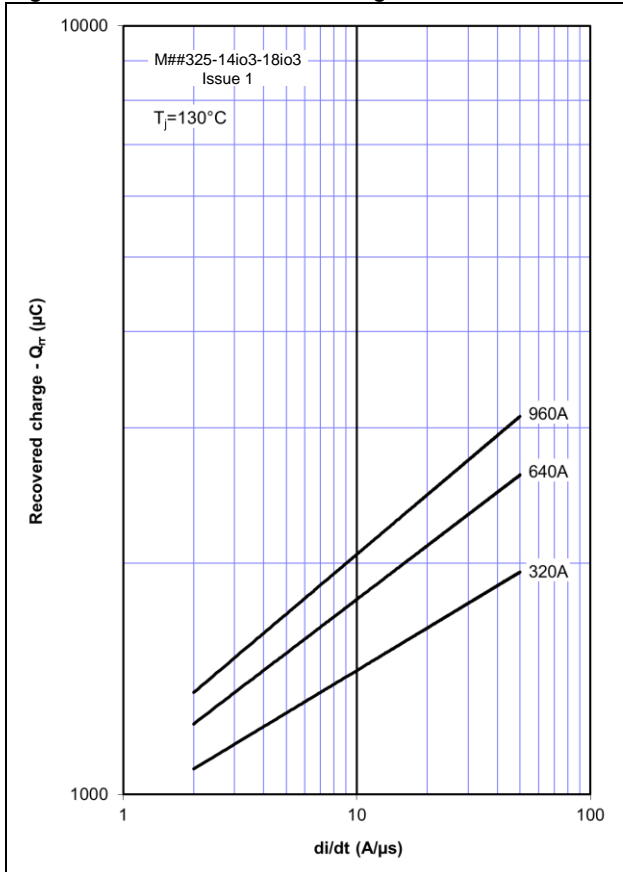
Figure 5 - Recovered charge, Q$_{ra}$ (50% chord)
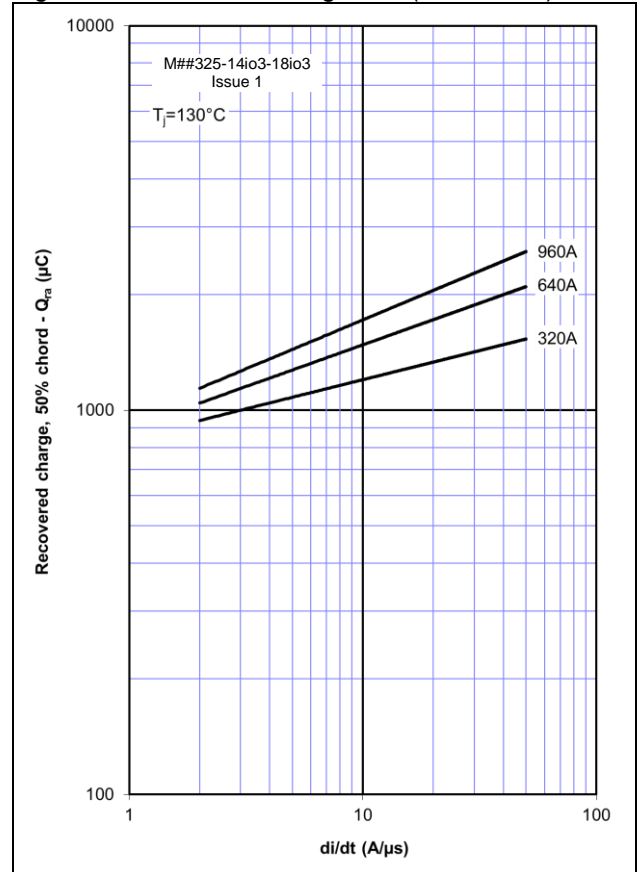
Figure 6 - Peak reverse recovery current, I$_{rm}$
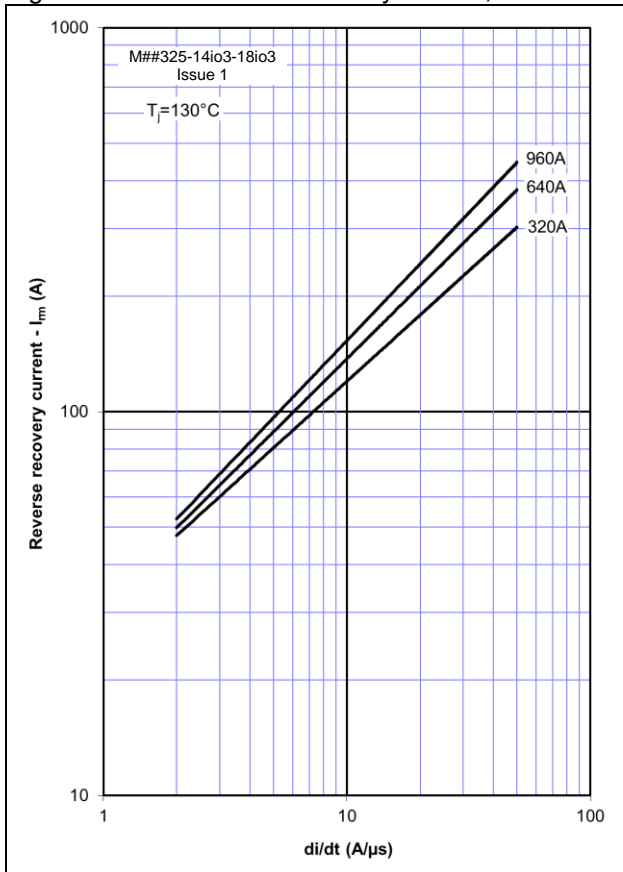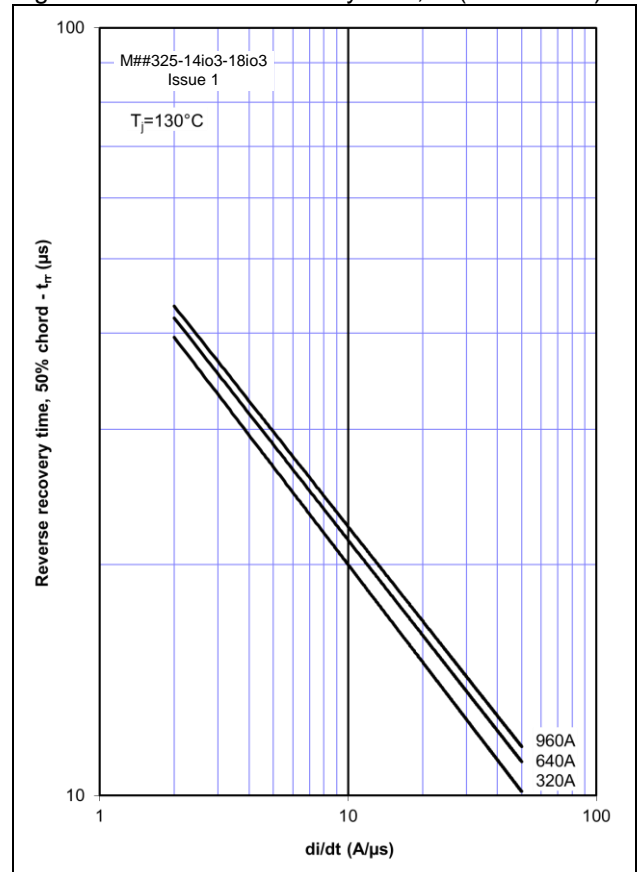

Figure 7 - Maximum recovery time, t$_{rr}$ (50% chord)
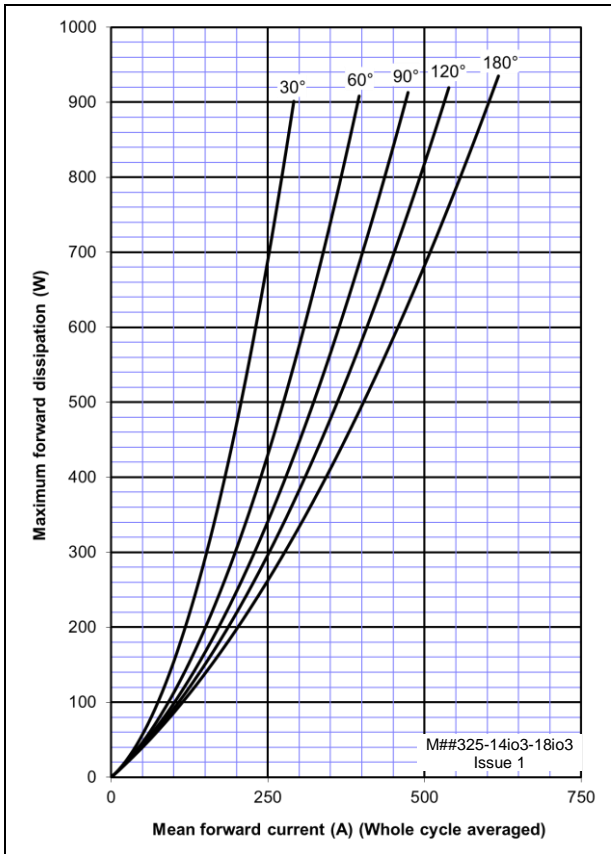
Figure 8 – On-state current vs. Power dissipation – Sine wave

Figure 9 – On-state current vs. Heatsink temperature – Sine wave
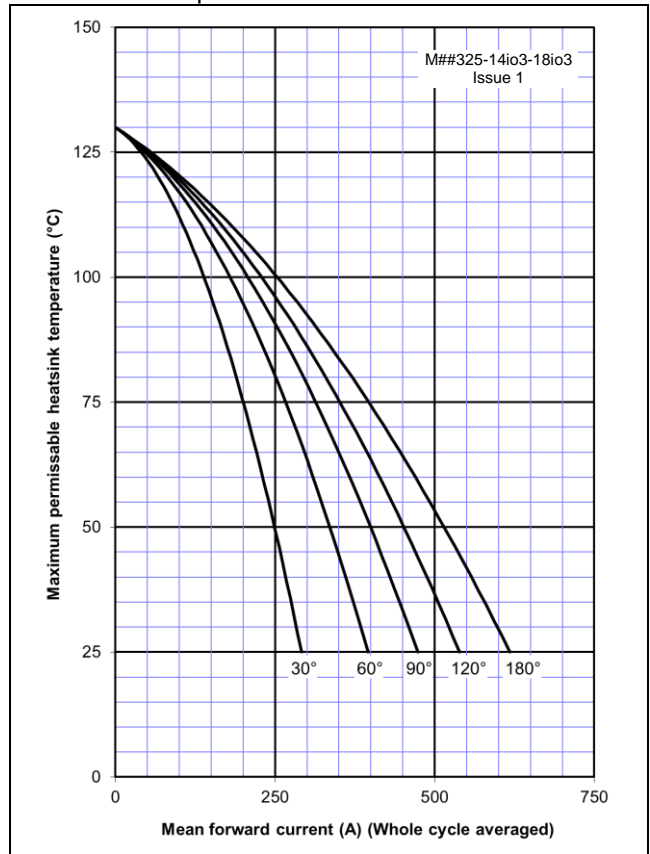
Figure 10 – On-state current vs. Power dissipation – Square wave
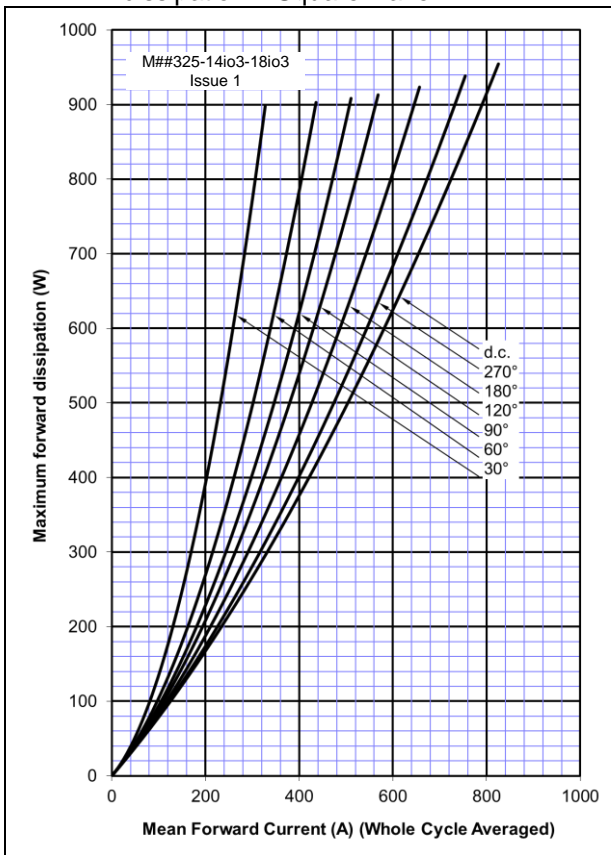
Figure 11 – On-state current vs. Heatsink temperature – Square wave
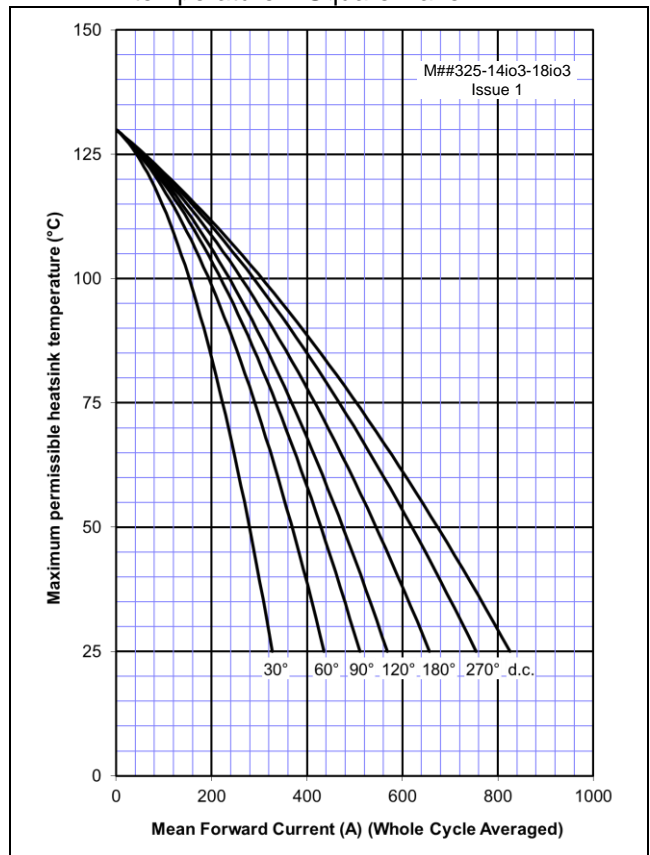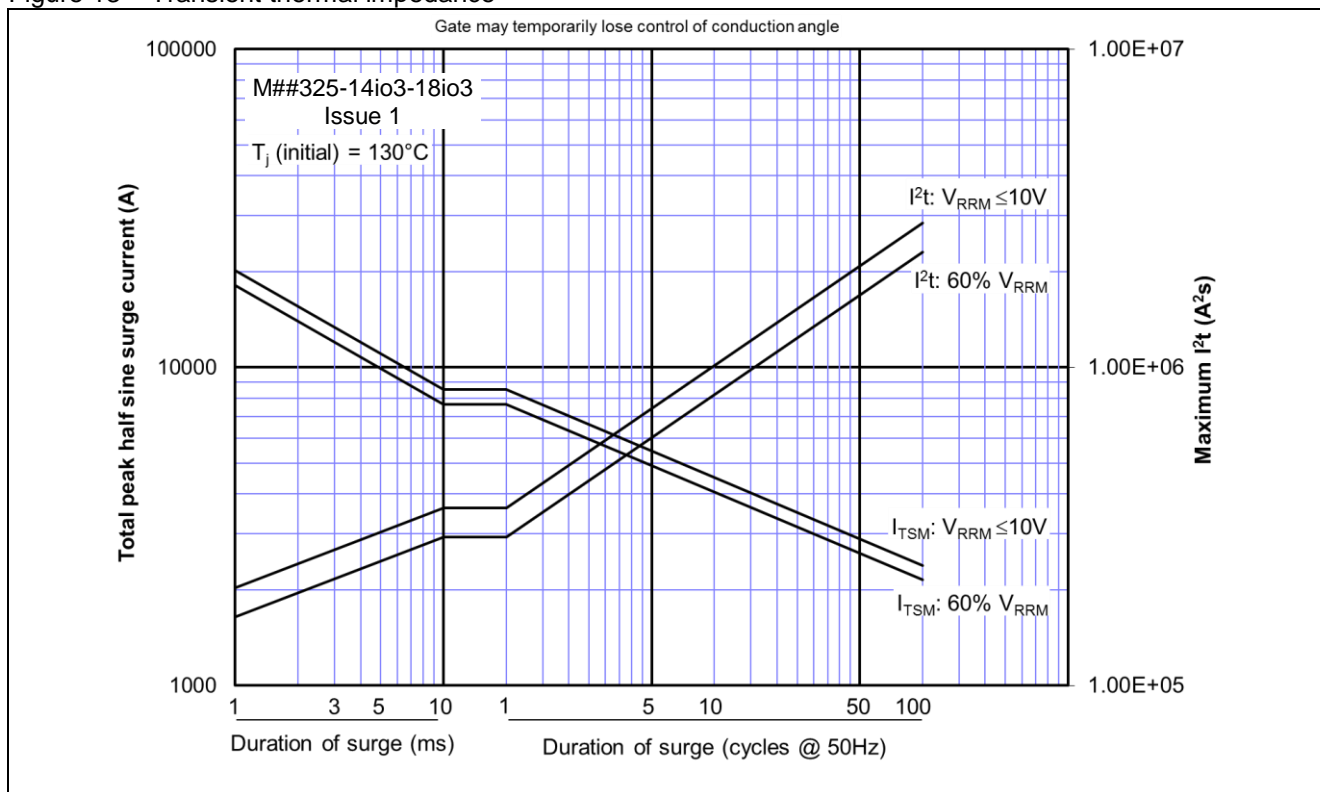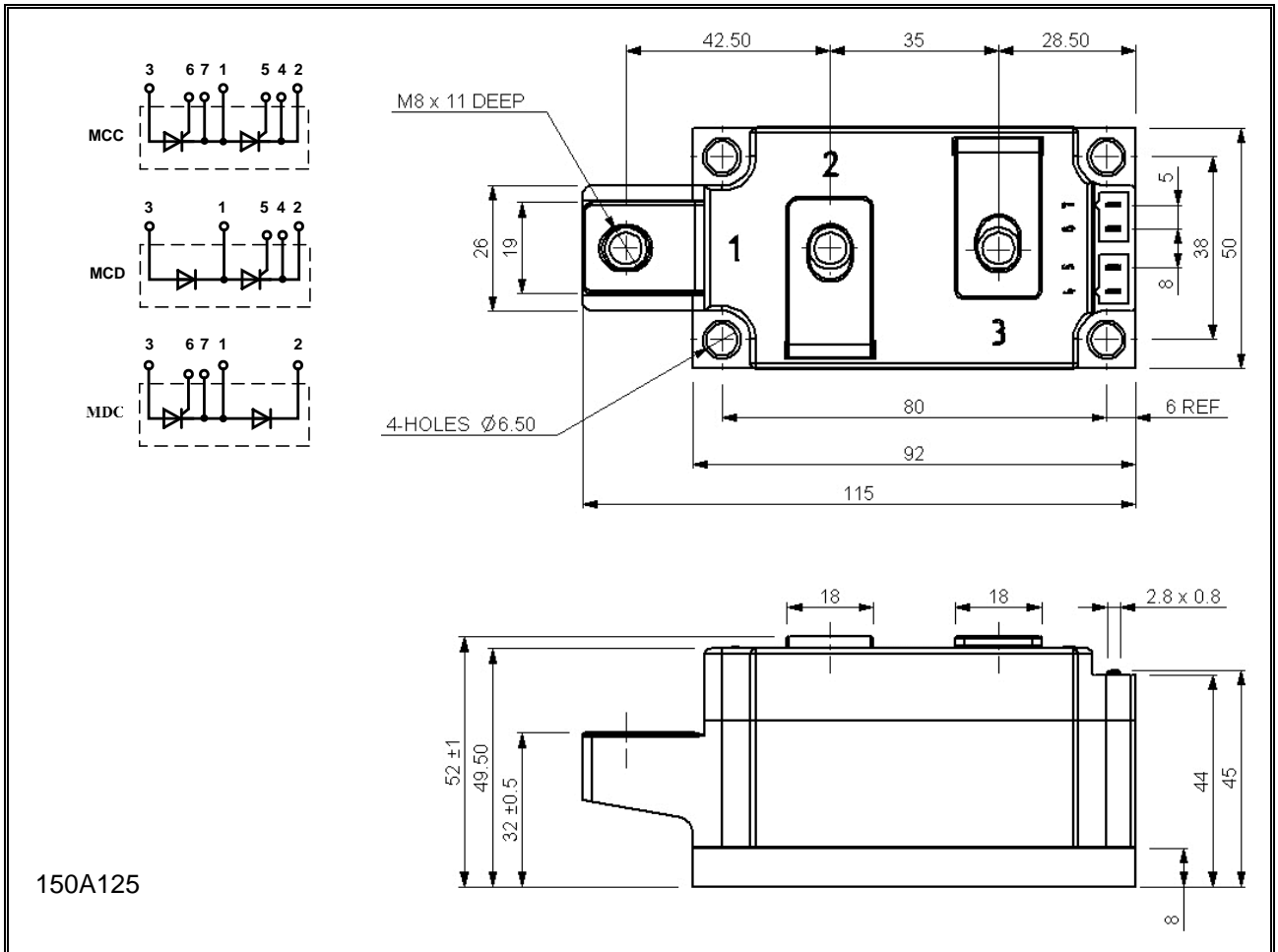
Figure 12 – Maximum surge and I²t Ratings
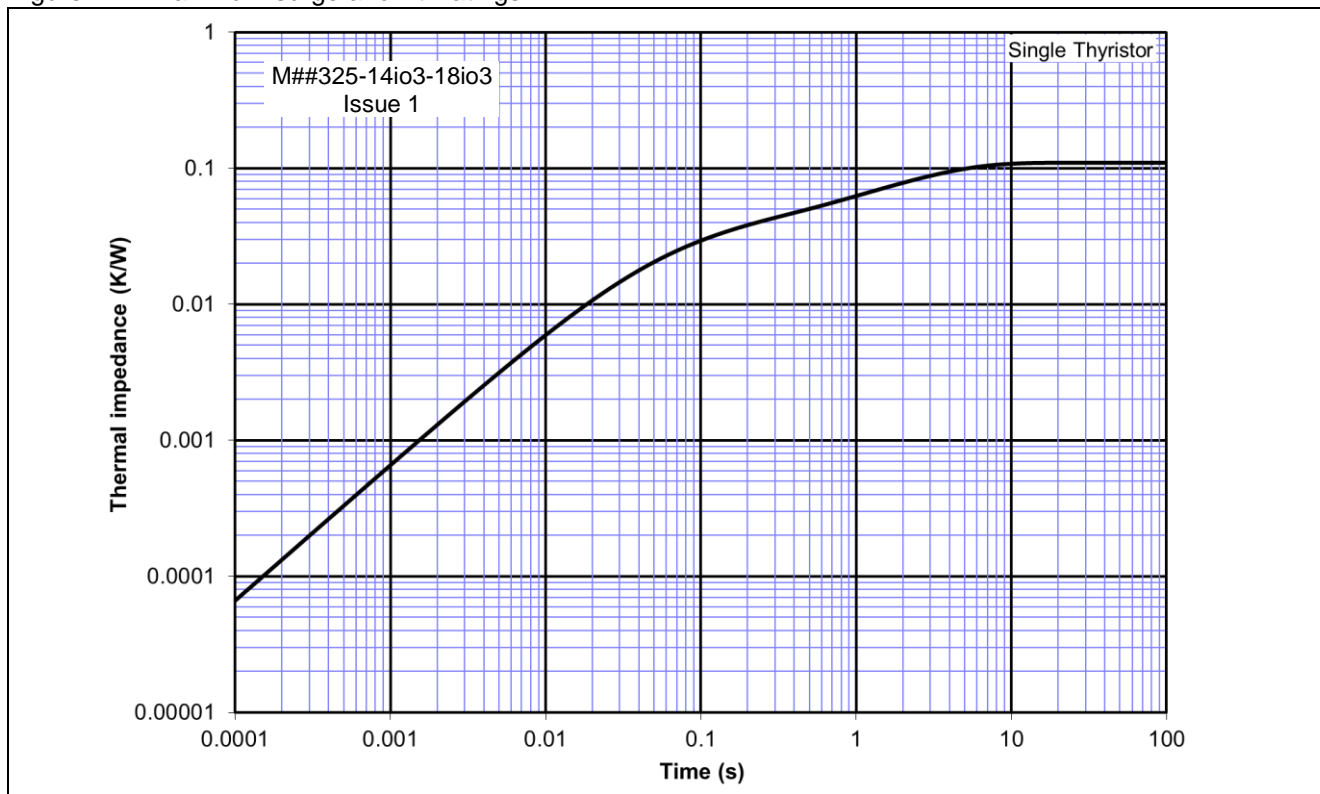
Figure 13 – Transient thermal impedance

Outline Drawing & Ordering Information

150A125

	ORDERING INFORMATION			(Please quote 11 digit code as below)	
M	**##**	**325**	**♦♦**	**io**	**3**
Fixed Type Code	Configuration code CC, CD or DC	Fixed Type Code	Voltage code $V_{RRM}/100$ 14 & 18	i = Critical dv/dt 1000 V/µs o = Typical turn-off time	Fixed Version Code

Typical order code: MCD325-14io3– MCD configuration, 1400V V_{RRM}

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