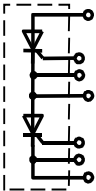
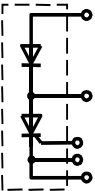


Thyristor/Diode Modules M## 501

Absolute Maximum Ratings

V_{RRM} V_{DRM} [V]	 MCC	 MCD
1400	501-14io2	501-14io2
1600	501-16io2	501-16io2
1800	501-18io2	501-18io2

	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, $T_C = 85^\circ\text{C}$ ²⁾	500	A
$I_{T(AV)M}$	Maximum average on-state current, $T_C = 100^\circ\text{C}$ ²⁾	340	A
$I_{T(RMS)M}$	Nominal RMS on-state current, $T_C = 55^\circ\text{C}$ ²⁾	1215	A
$I_{T(d.c.)}$	D.C. on-state current, $T_C = 55^\circ\text{C}$	925	A
I_{TSM}	Peak non-repetitive surge $t_p = 10$ ms, $V_{RM} = 60\%V_{RRM}$ ³⁾	14.45	kA
I_{TSM2}	Peak non-repetitive surge $t_p = 10$ ms, $V_{RM} \leq 10\text{V}$ ³⁾	17	kA
I^2t	I^2t capacity for fusing $t_p = 10$ ms, $V_{RM} = 60\%V_{RRM}$ ³⁾	1.044×10^6	A ² s
I^2t	I^2t capacity for fusing $t_p = 10$ ms, $V_{RM} \leq 10\text{V}$ ³⁾	1.445×10^6	A ² s
$(di/dt)_{cr}$	Critical rate of rise of on-state current (repetitive) ⁴⁾	200	A/ μ s
V_{RGM}	Peak reverse gate voltage	5	V
$P_{G(AV)}$	Mean forward gate power	4	W
P_{GM}	Peak forward gate power	50	W
V_{ISOL}	Isolation Voltage ⁵⁾	3000	V
$T_{vj\ op}$	Operating temperature range	-40 to +125	$^\circ\text{C}$
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, 125°C T_{vj} initial.
- 4) $T_j = 125^\circ\text{C}$.
- 5) AC RMS voltage, 50 Hz, 1min test

Characteristics

	PARAMETER	MIN.	TYP.	MAX.	TEST CONDITIONS ¹⁾	UNITS
V _{TM}	Maximum peak on-state voltage	-	-	1.45	I _{TM} = 1500 A @25°C	V
V _{TM}	Maximum peak on-state voltage	-	-	1.40	I _{TM} = 1500 A	V
V _{T0}	Threshold voltage	-	-	1.01		V
r _T	Slope resistance	-	-	0.25		mΩ
(dv/dt) _{cr}	Critical rate of rise of off-state voltage	1000	-	-	V _{DR} = 67% V _{DRM}	V/μs
I _{DRM}	Peak off-state current	-	-	80	Rated V _{DRM}	mA
I _{RRM}	Peak reverse current	-	-	80	Rated V _{RRM}	mA
V _{GT}	Gate trigger voltage	-	-	3.0	T _{vj} = 25°C, V _D = 12 V, I _T = 3 A	V
I _{GT}	Gate trigger current	-	-	200		mA
V _{GD}	Gate non-trigger voltage	0.25	-	-	67% V _{DRM}	V
I _L	Latching current	-	-	1500	V _D = 12 V, T _{vj} = 25°C	mA
I _H	Holding current	-	-	300	V _D = 12 V, T _{vj} = 25°C	mA
R _{thJC}	Thermal resistance, junction to case, sin 180°	-	-	0.061	Single Thyristor (per arm)	K/W
		-	-	0.031	Whole Module	K/W
R _{thJC}	Thermal resistance, junction to case, rec 120°	-	-	0.070	Single Thyristor (per arm)	K/W
		-	-	0.035	Whole Module	K/W
R _{thCH}	Thermal resistance, case to heatsink	-	-	0.02	Single Thyristor	K/W
		-	-	0.01	Whole Module	K/W
F ₁	Mounting force (to heatsink)	5.1	-	6.9	²⁾	Nm
F ₂	Mounting force (to terminals)	10.2	-	13.8		Nm
W _t	Weight	-	1.5	-		kg

Notes:

- 1) Unless otherwise indicated T_{vj}=125°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
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

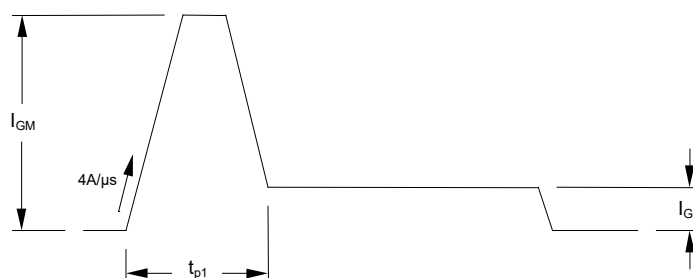
When selecting snubber components, care must be taken not to use excessively large values of snubber capacitor or excessively small values of snubber resistor. Such excessive component values may lead to device damage due to the large resultant values of snubber discharge current. If required, please consult the factory for assistance.

6.0 Rate of rise of on-state current

For repetitive performance, the on-state rate of rise of current must not exceed 200A/μs at any time during turn-on. Note that this value of rate of rise of current applies to the total device current including that from any local snubber network.

7.0 Gate Drive

The nominal requirement for a typical gate drive is illustrated below. An open circuit voltage of at least 30V is assumed. This gate drive must be applied when using the full di/dt capability of the device.



The magnitude of I_{GM} should be between five and ten times I_{GT} , which is shown on page 2. Its duration (t_{p1}) should be 20μs or sufficient to allow the anode current to reach ten times I_L , whichever is greater. Otherwise, an increase in pulse current could be needed to supply the necessary charge to trigger. The 'back-porch' current I_G should remain flowing for the same duration as the anode current and have a magnitude in the order of 1.5 times I_{GT} .

8.0 Computer Modelling Parameters

8.1 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 $V_{T0} = 1.01 \text{ V}$, $r_T = 0.25 \text{ m}\Omega$.

8.2 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.

125°C Coefficients	
A	1.396928676
B	-0.135986141
C	-2.33986×10 ⁻⁵
D	0.026541657

Curves

Figure 1 – On-state characteristics of Limit device

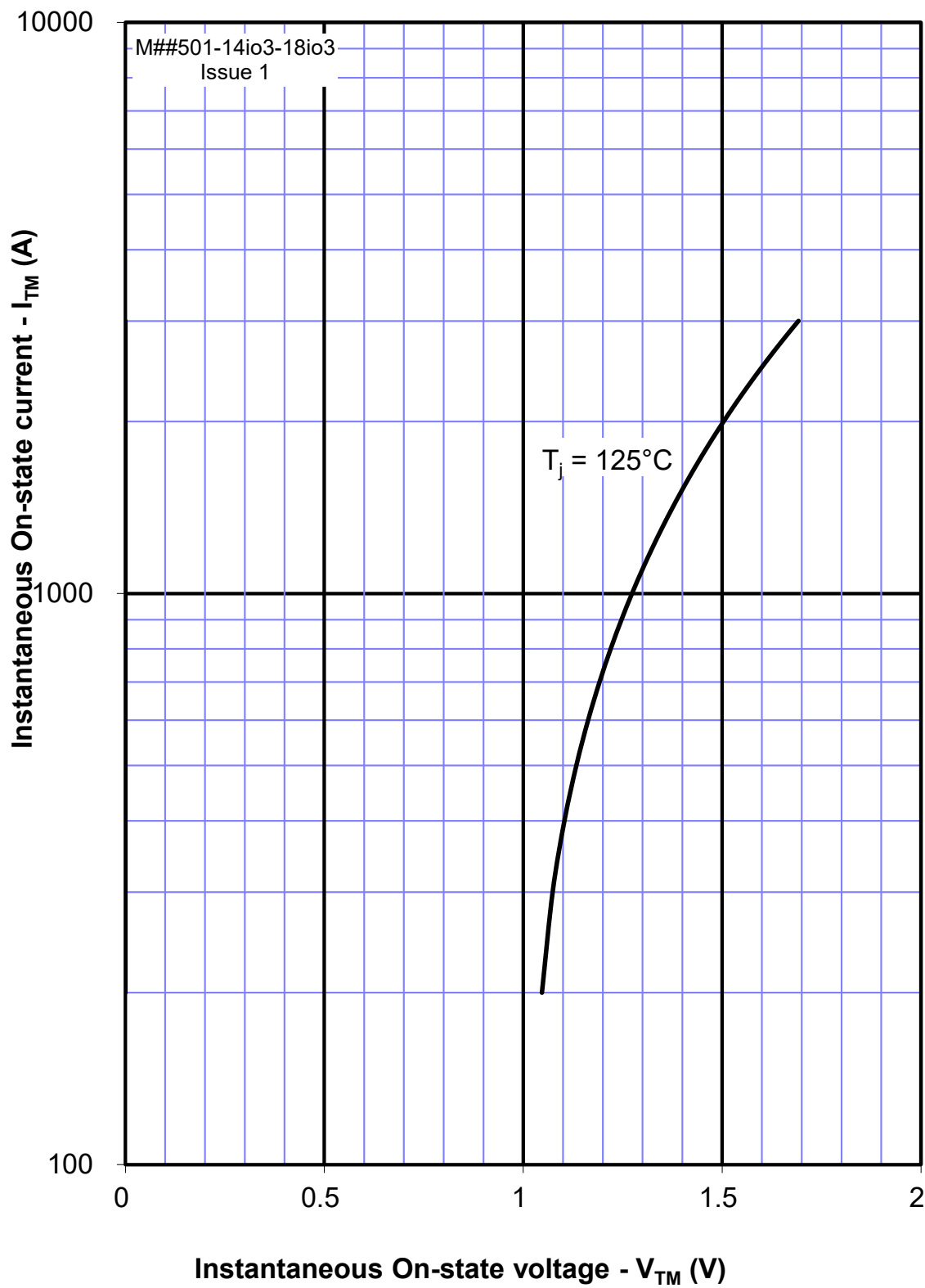


Figure 2 – Gate characteristics – Trigger limits

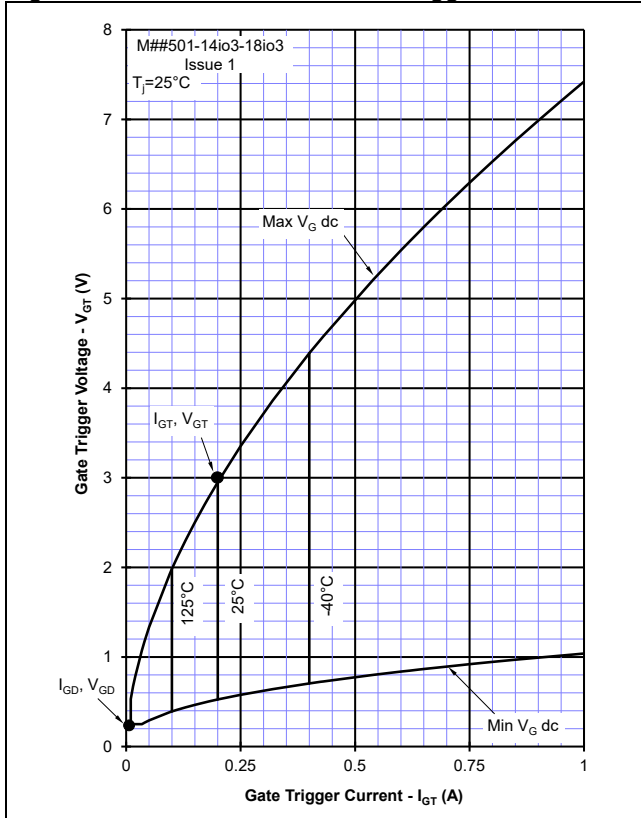


Figure 3 – Gate characteristics – Power curves

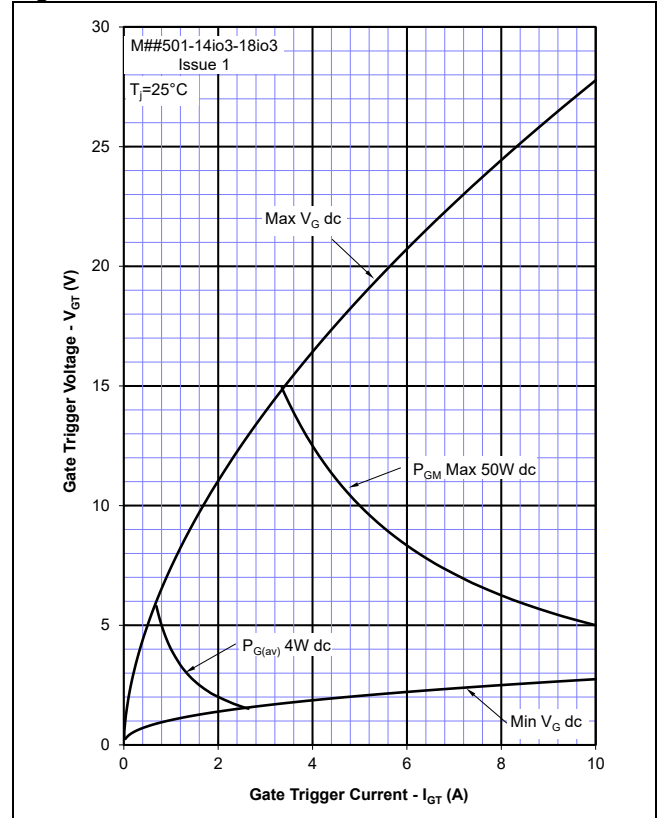


Figure 4 – On-state current vs. Power dissipation – Sine wave

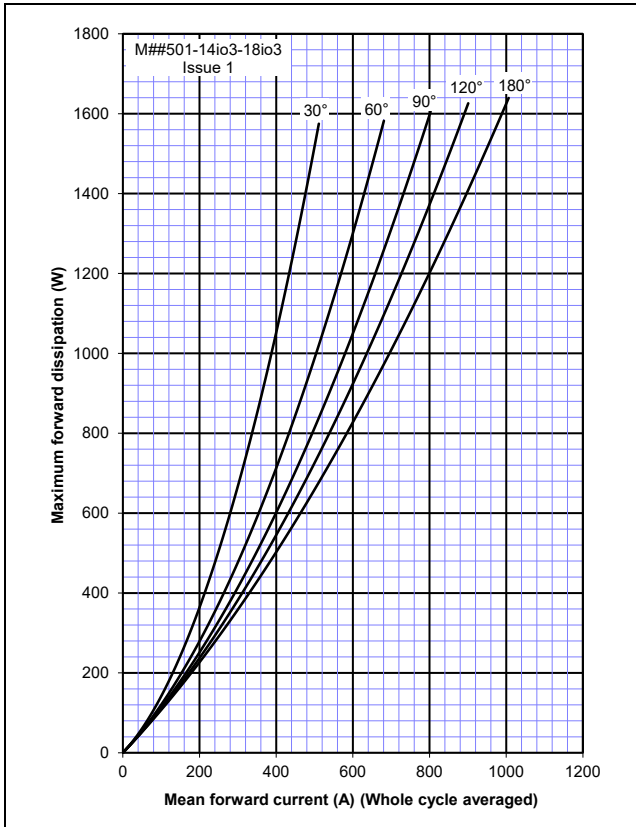


Figure 5 – On-state current vs. Heatsink temperature – Sine wave

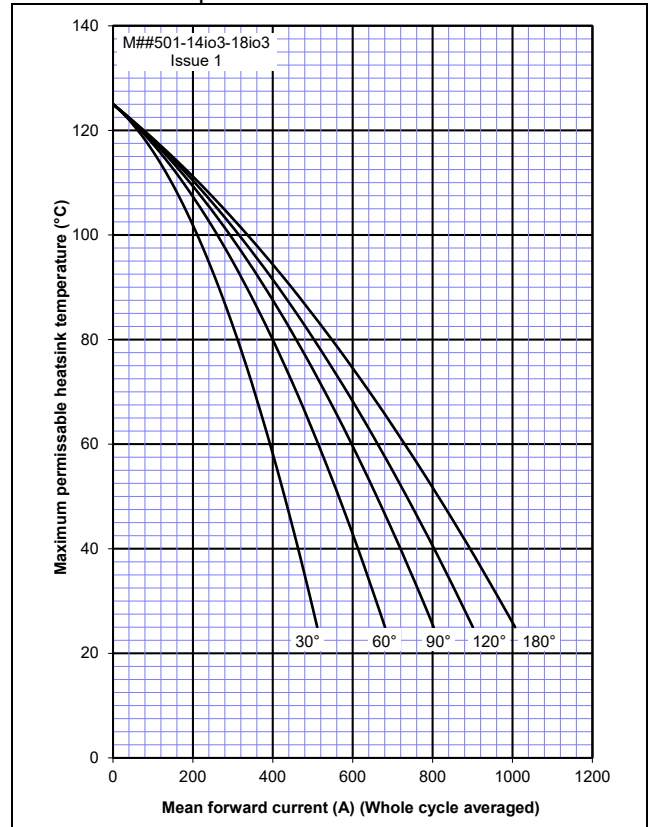


Figure 6 – On-state current vs. Power dissipation – Square wave

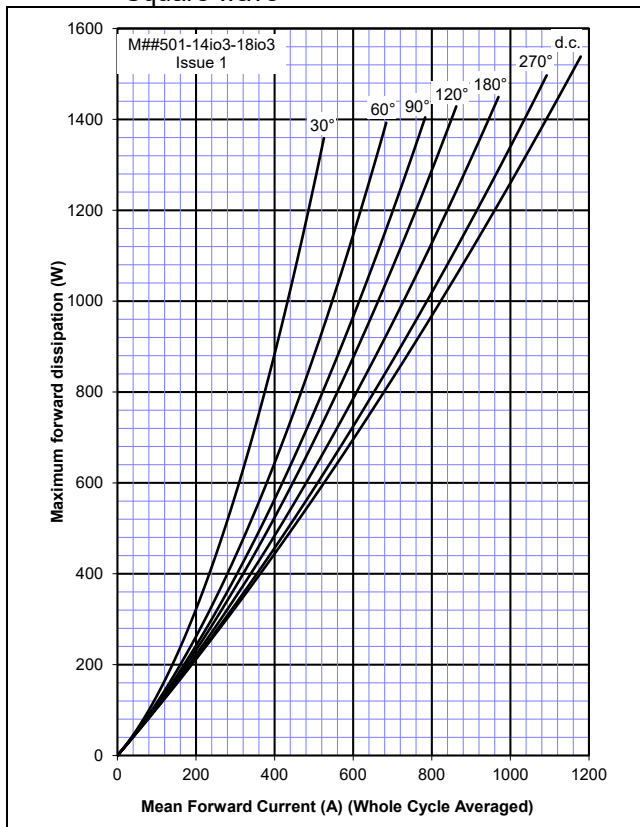


Figure 7 – On-state current vs. Heatsink temperature – Square wave

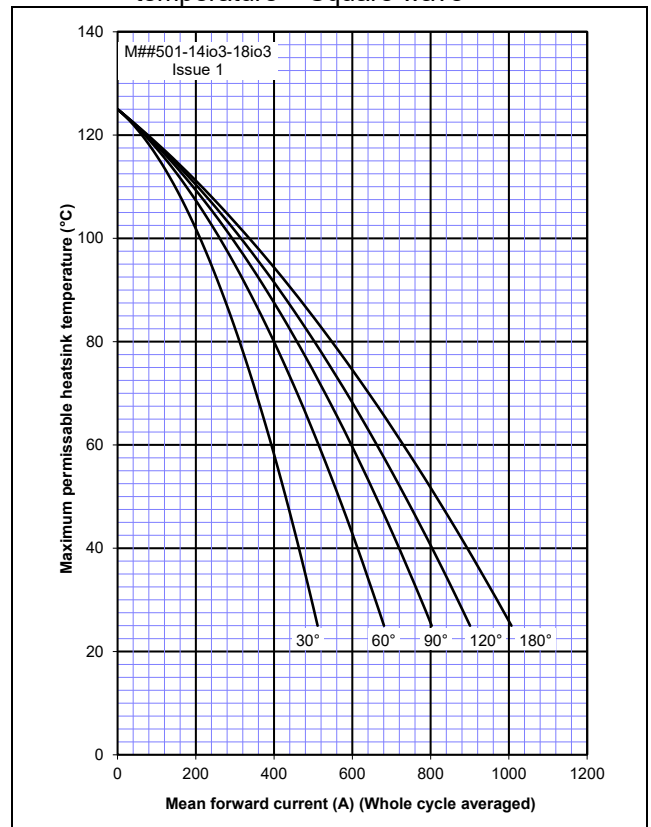


Figure 8 – Maximum surge and I^2t Ratings

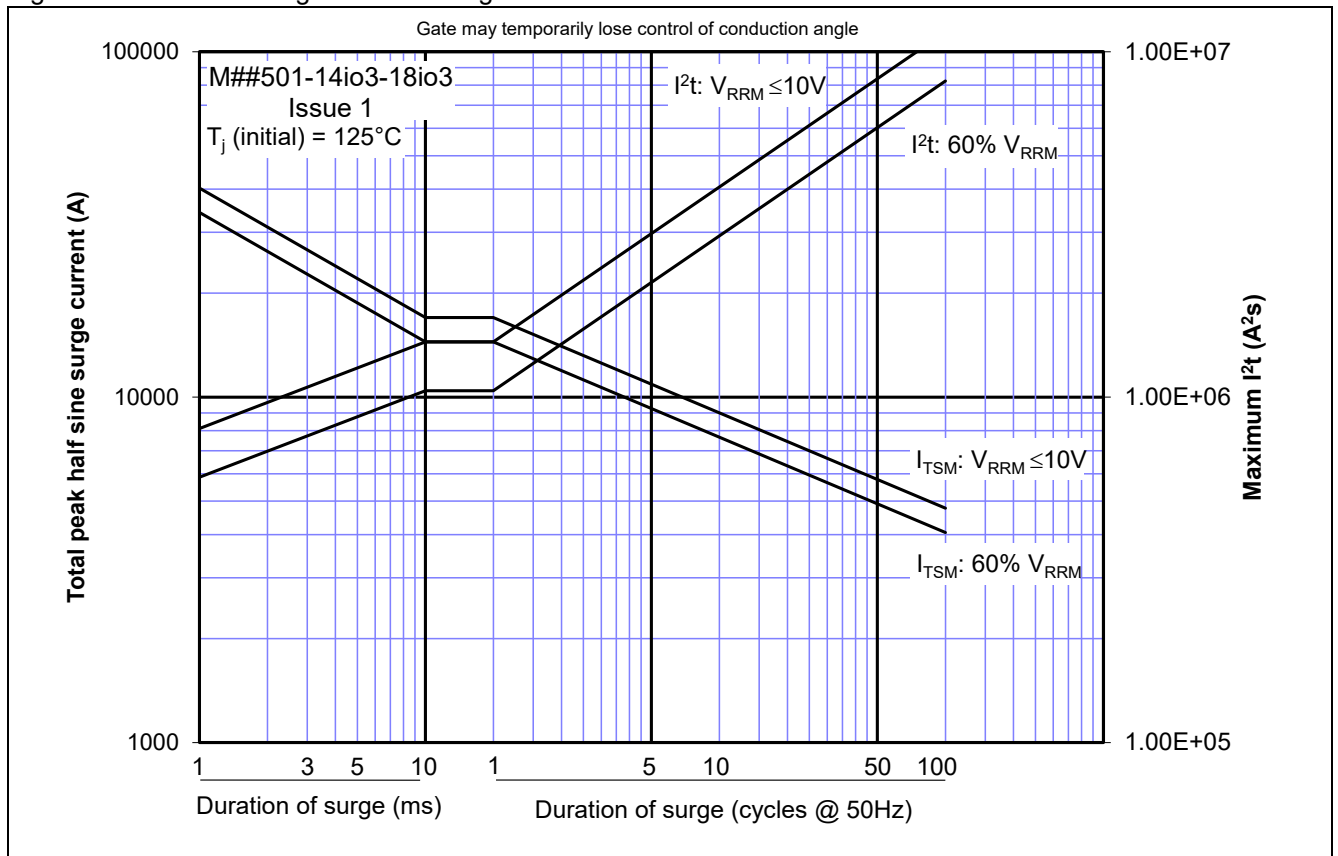
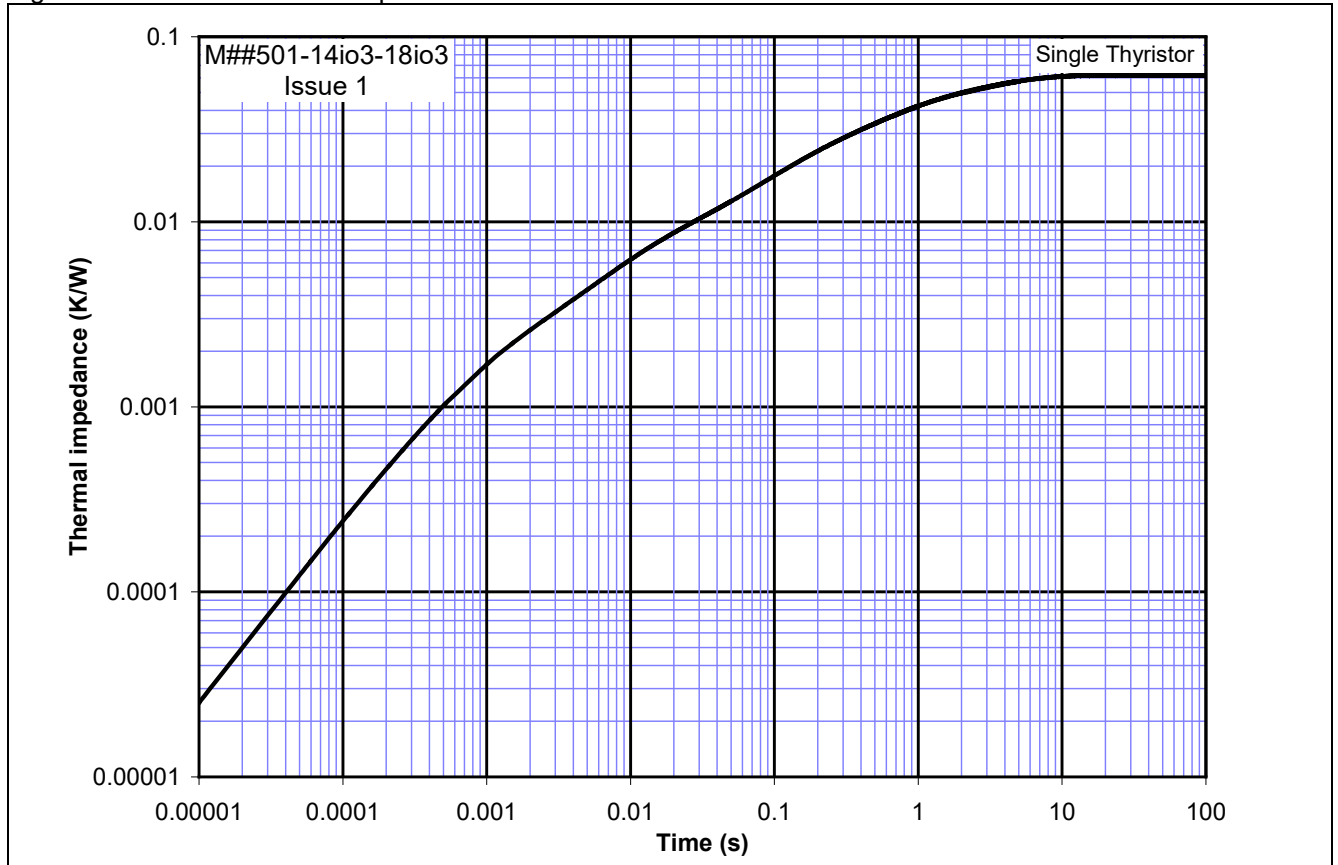
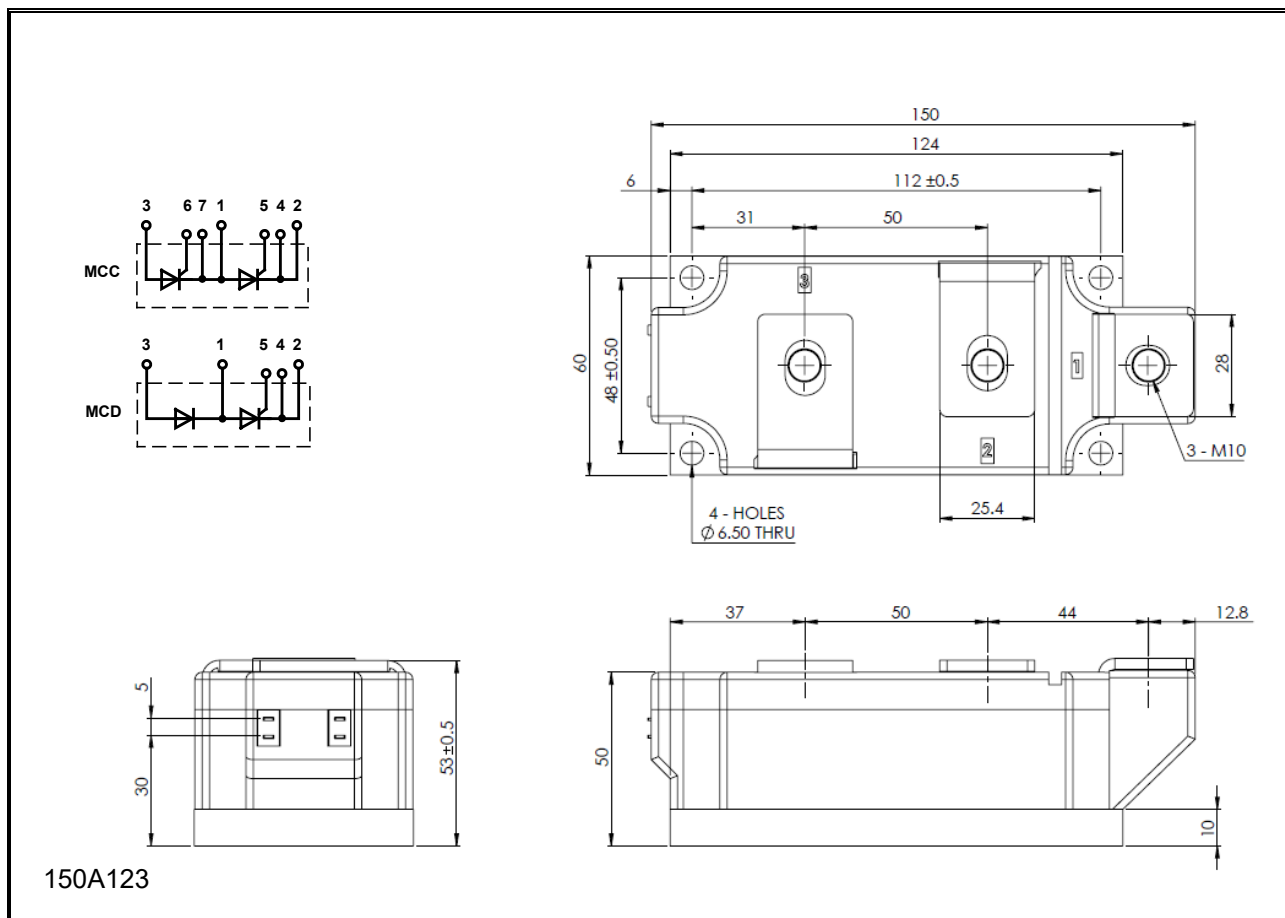


Figure 9 – Transient thermal impedance



Outline Drawing & Ordering Information



ORDERING INFORMATION

(Please quote 11 digit code as below)

M	##	501	◆◆	io	3
Fixed Type Code	Configuration code CC	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: MCC501-18io3, MCC configuration, 1800V V_{RRM}

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