WESTCODE
An IXYS Company

Date:- 8 Jun, 2004

Data Sheet Issue:- 1

Soft Recovery Diode

Types M0225YH300 to M0225YH450

Old Type No.: SM30-45HXC084

Absolute Maximum Ratings

	VOLTAGE RATINGS	MAXIMUM LIMITS	UNITS
V_{RRM}	Repetitive peak reverse voltage, (note 1)	3000-4500	V
V_{RSM}	Non-repetitive peak reverse voltage, (note 1)	3100-4600	V

	OTHER RATINGS	MAXIMUM LIMITS	UNITS
$I_{F(AV)M}$	Maximum average forward current, T_{sink}=55°C, (note 2)	225	A
$I_{F(AV)M}$	Maximum average forward current. T_{sink}=100°C, (note 2)	147	A
$I_{F(AV)M}$	Maximum average forward. T_{sink}=100°C, (note 3)	89	A
$I_{F(RMS)}$	Nominal RMS forward current, T_{sink}=25°C, (note 2)	421	A
$I_{F(d.c.)}$	D.C. forward current, T_{sink}=25°C, (note 4)	365	A
I_{FSM}	Peak non-repetitive surge t_p=10ms, V_{RM}=60%V_{RRM}, (note 5)	2000	A
I_{FSM2}	Peak non-repetitive surge t_p=10ms, $V_{RM}\leq$10V, (note 5)	2200	A
I^2t	I^2t capacity for fusing t_p=10ms, V_{RM}=60%V_{RRM}, (note 5)	20.0×10^3	A^2s
I^2t	I^2t capacity for fusing t_p=10ms, $V_{RM}\leq$10V, (note 5)	24.2×10^3	A^2s
$T_{j\ op}$	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_j below 25°C.
2) Double side cooled, single phase; 50Hz, 180° half-sinewave.
3) Single side cooled, single phase; 50Hz, 180° half-sinewave.
4) Double side cooled.
5) Half-sinewave, 150°C T_j initial.

Characteristics

	PARAMETER	MIN.	TYP.	MAX.	TEST CONDITIONS (Note 1)	UNITS
V_{FM}	Maximum peak forward voltage	- -	- -	4.54 3.80	I_{FM}=635A I_{FM}=450A	V
V_{T0}	Threshold voltage	-	-	1.90		V
r_T	Slope resistance	-	-	4.16		mΩ
V_{FRM}	Maximum forward recovery voltage	- -	- -	200 400	di/dt = 1000A/µs, 25°C di/dt = 1000A/µs	V
I_{RRM}	Peak reverse current	-	-	50	Rated V_{RRM}	mA
Q_{rr}	Recovered charge	-	220	-	I_{FM}=550A, t_p=500µs, di/dt=40A/µs, V_r=50V, 50% Chord.	µC
Q_{ra}	Recovered charge, 50% Chord	-	100	130		µC
I_{rm}	Reverse recovery current	-	70	-		A
t_{rr}	Reverse recovery time, 50% Chord	-	3	-		µs
R_{thJK}	Thermal resistance, junction to heatsink	- -	- -	0.1 0.2	Double side cooled Single side cooled	K/W
F	Mounting force	3.3	-	5.5		kN
W_t	Weight	-	140	-		g

Notes:-

1) Unless otherwise indicated T_j=150°C.

Notes on Ratings and Characteristics

1.0 Voltage Grade Table

Voltage Grade	V_{RRM} (V)	V_{RSM} (V)	V_R dc (V)
30	3000	3100	1700
32	3200	3300	1800
34	3400	3500	1850
36	3600	3700	1900
38	3800	3900	1950
40	4000	4100	2000
42	4200	4300	2050
44	4400	4500	2100
45	4500	4600	2150

2.0 De-rating Factor

A blocking voltage de-rating factor of 0.13% per °C is applicable to this device for T_j below 25°C.

3.0 ABCD Constants

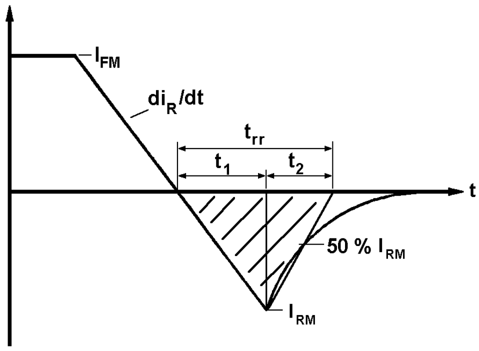
These constants (applicable only over current range of V_F characteristic in Figure 1) are the coefficients of the expression for the forward characteristic given below:

$$V_F = A + B \cdot \ln(I_F) + C \cdot I_F + D \cdot \sqrt{I_F}$$

where I_F = instantaneous forward current.

4.0 Reverse recovery ratings

(i) Q_{ra} is based on 50% I_{rm} chord as shown in Fig.(a) below.



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

I.e.

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

(iii)

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

5.0 Reverse Recovery Loss

The following procedure is recommended for use where it is necessary to include reverse recovery loss.

From waveforms of recovery current obtained from a high frequency shunt (see Note 1) and reverse voltage present during recovery, an instantaneous reverse recovery loss waveform must be constructed. Let the area under this waveform be E joules per pulse. A new sink temperature can then be evaluated from:

$$T_{SINK} = T_{J(MAX)} - E \cdot \left[k + f \cdot R_{thJK}\right]$$

Where k = 0.2314 (°C/W)/s

E = Area under reverse loss waveform per pulse in joules (W.s.)
f = Rated frequency in Hz at the original sink temperature.
R_{thJK} = d.c. thermal resistance (°C/W)

The total dissipation is now given by:

$$W_{(tot)} = W_{(original)} + E \cdot f$$

NOTE 1 - Reverse Recovery Loss by Measurement

This device has a low reverse recovered charge and peak reverse recovery current. When measuring the charge, care must be taken to ensure that:

(a) AC coupled devices such as current transformers are not affected by prior passage of high amplitude forward current.

(b) A suitable, polarised, clipping circuit must be connected to the input of the measuring oscilloscope to avoid overloading the internal amplifiers by the relatively high amplitude forward current signal.

(c) Measurement of reverse recovery waveform should be carried out with an appropriate critically damped snubber, connected across diode anode to cathode. The formula used for the calculation of this snubber is shown below:

$$R^2 = 4 \cdot \frac{V_r}{C_S \cdot {}^{di}\!/_{dt}}$$

Where: V_r = Commutating source voltage
C_S = Snubber capacitance
R = Snubber resistance

6.0 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.

7.0 Computer Modelling Parameters

7.1 Device Dissipation Calculations

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

Where V_{T0} =1.9V, r_T = 4.16mΩ

ff = form factor (normally unity for fast diode applications)

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

$$\Delta T = T_{j(MAX)} - T_K$$

7.2 Calculation of V_F using ABCD Coefficients

The forward characteristic I_F Vs V_F, on page 6 is represented in two ways;

(i) the well established V_{T0} and r_T tangent used for rating purposes and

(ii) a set of constants A, B, C, and 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 in this report 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	-0.98548669	0.604350122
B	0.7956059	0.01967453
C	3.12049×10^{-3}	1.245792×10^{-3}
D	-0.02422947	0.1197498

8.0 Frequency Ratings

The curves illustrated in figures 8 to 16 are for guidance only and are superseded by the maximum ratings shown on page 1.

9.0 Square wave ratings

These ratings are given for load component rate of rise of forward current of 100 and 500 A/µs.

10.0 Duty cycle lines

The 100% duty cycle is represented on all the ratings by a straight line. Other duties can be included as parallel to the first.

Curves

Figure 1 – Forward characteristics of Limit device

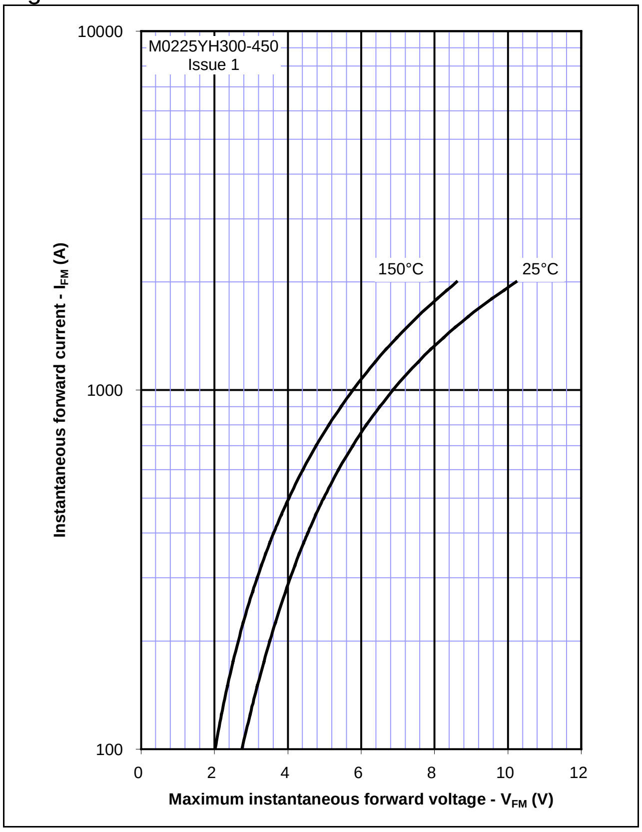


Figure 2 – Maximum forward recovery voltage

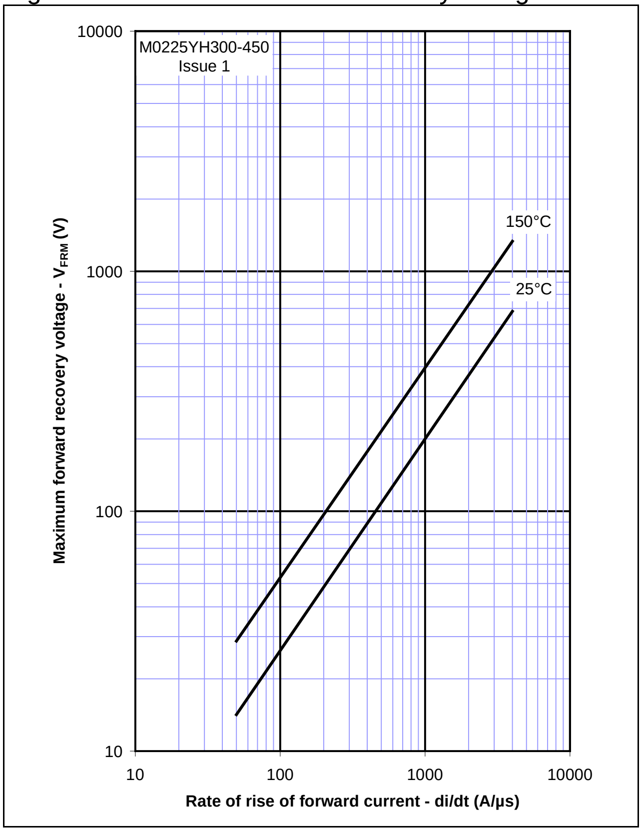


Figure 3 - Recovered charge, Q_{rr}

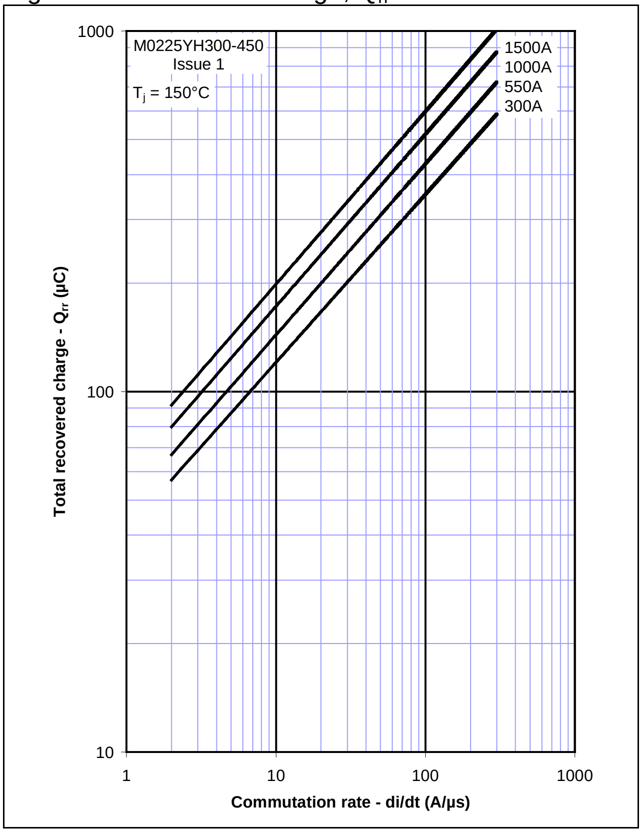


Figure 4 - Recovered charge, Q_{ra} (50% chord)

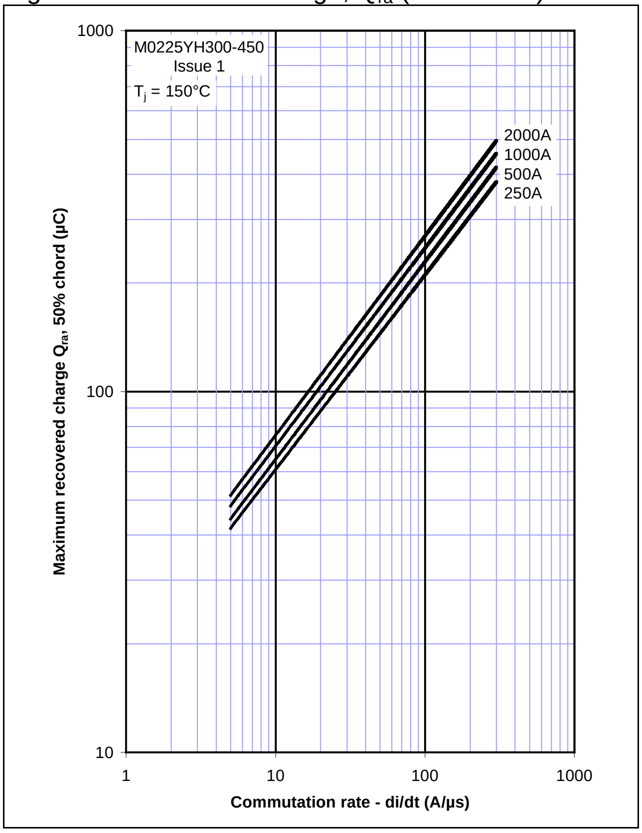


Figure 5 - Maximum reverse current, I_{rm}

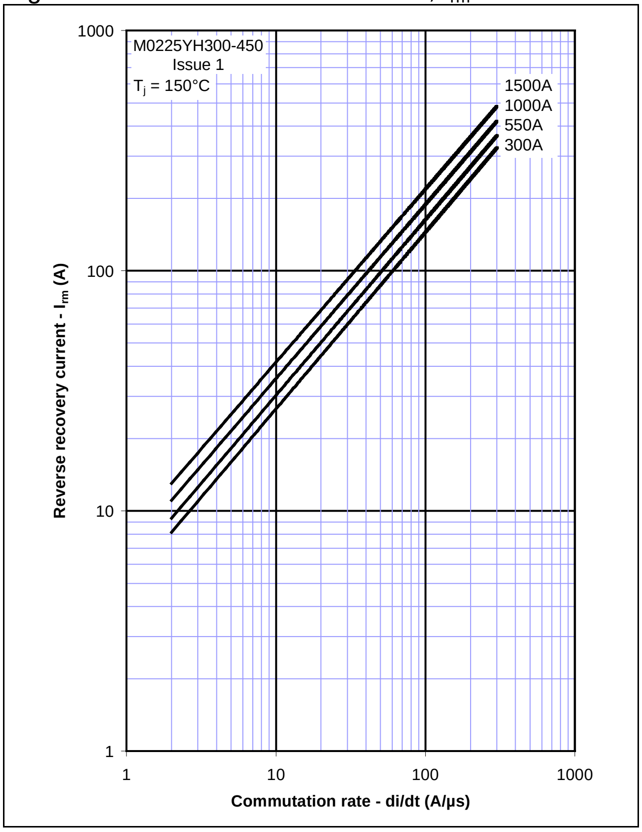


Figure 6 - Maximum recovery time, t_{rr} (50% chord)

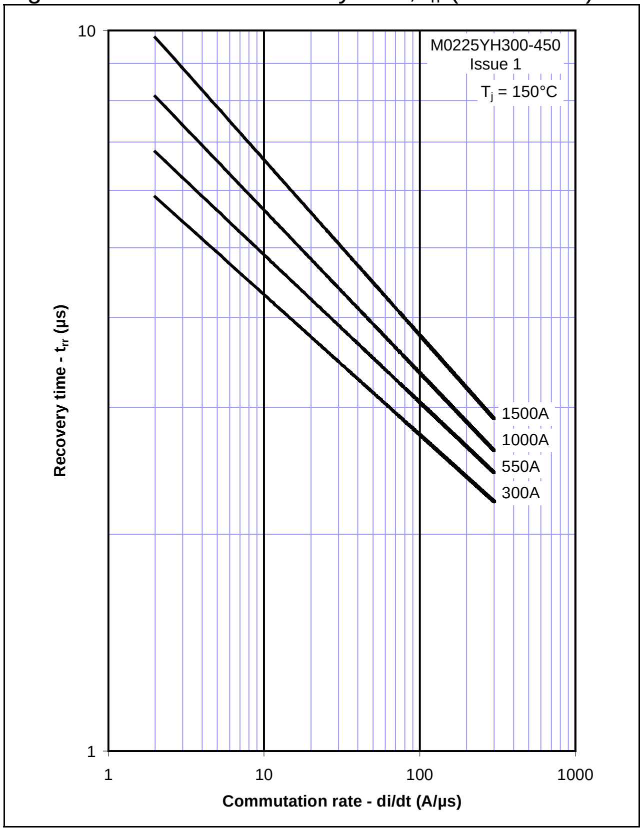


Figure 7 – Reverse recovery energy per pulse

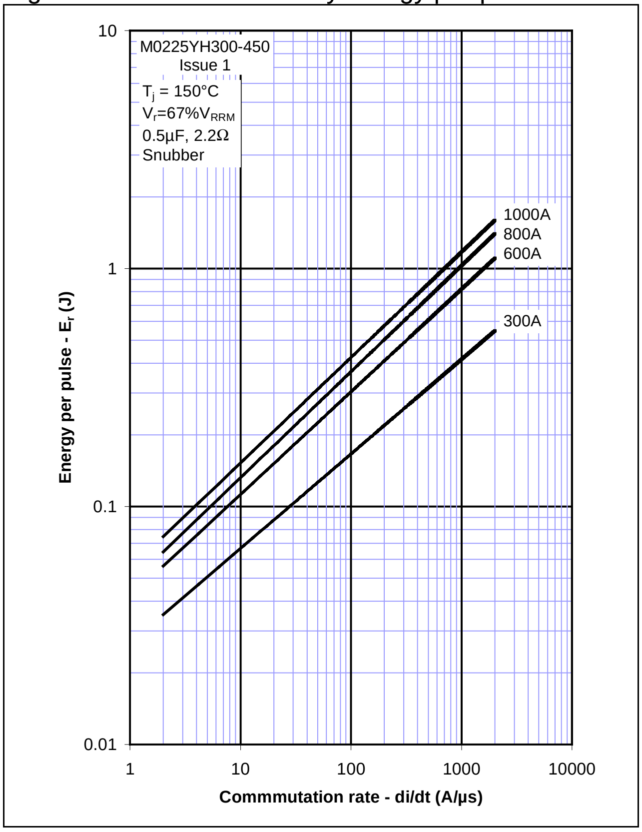


Figure 8 - Sine wave energy per pulse

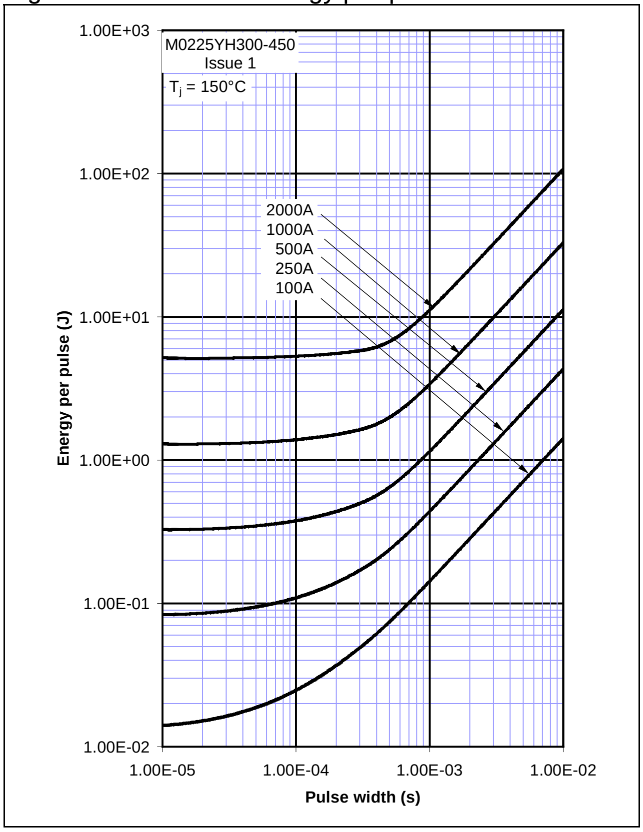


Figure 9 - Sine wave frequency vs. pulse width

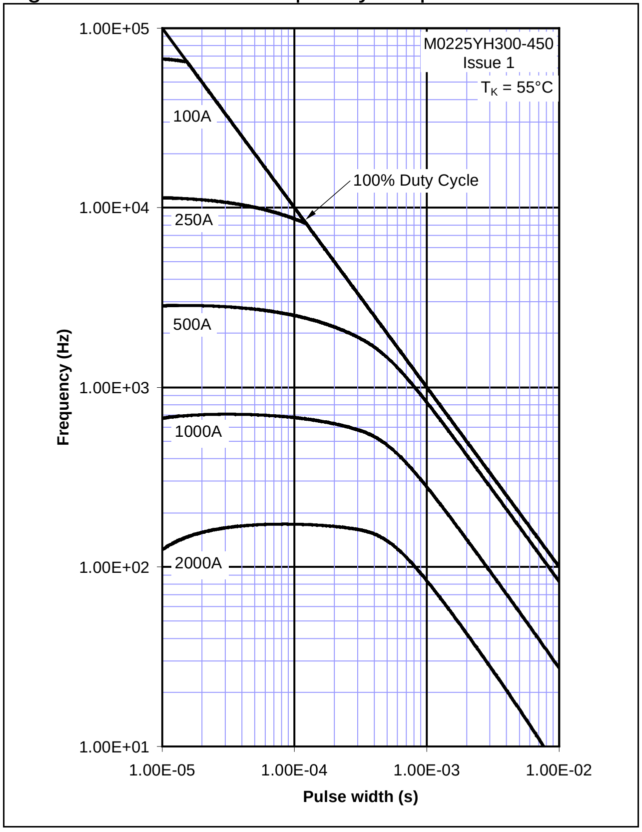


Figure 10 - Sine wave frequency vs. pulse width

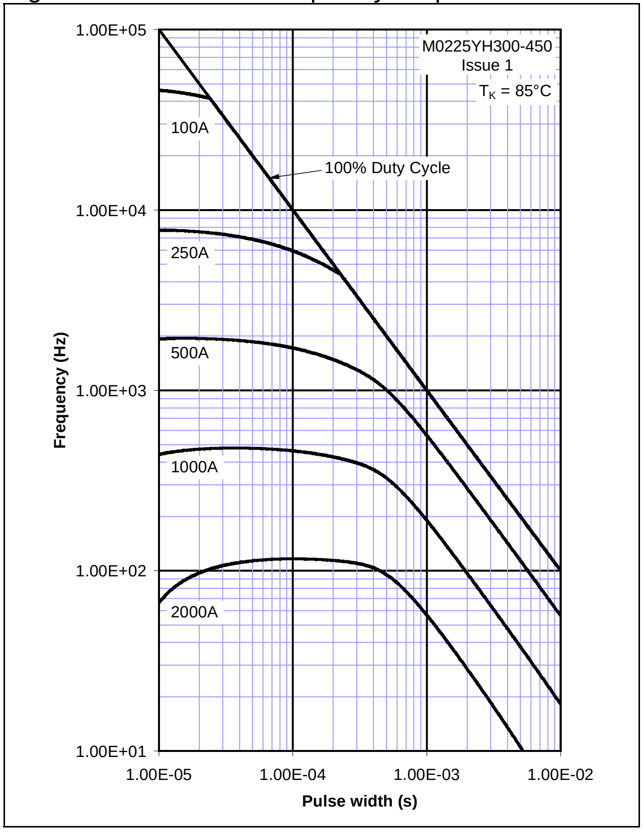


Figure 11 - Square wave energy per pulse

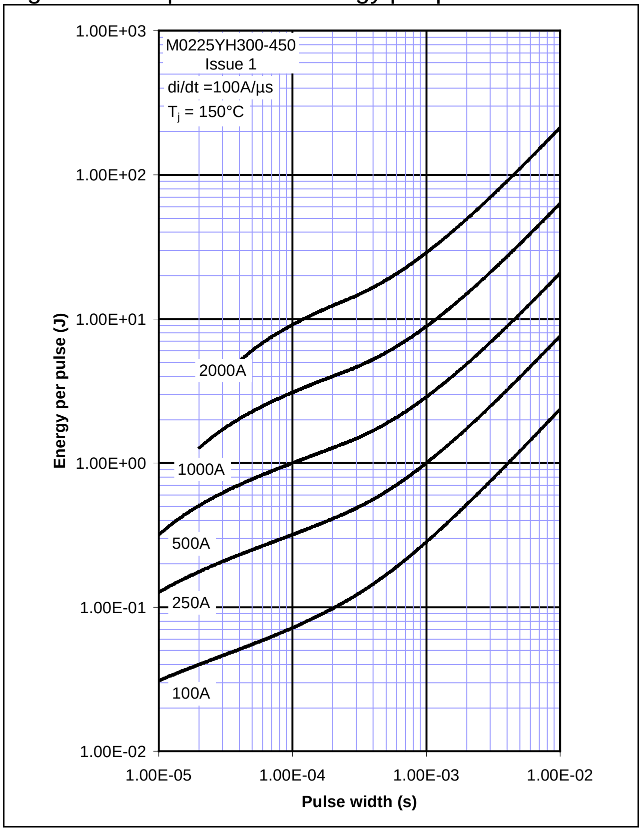


Figure 12 - Square wave energy per pulse

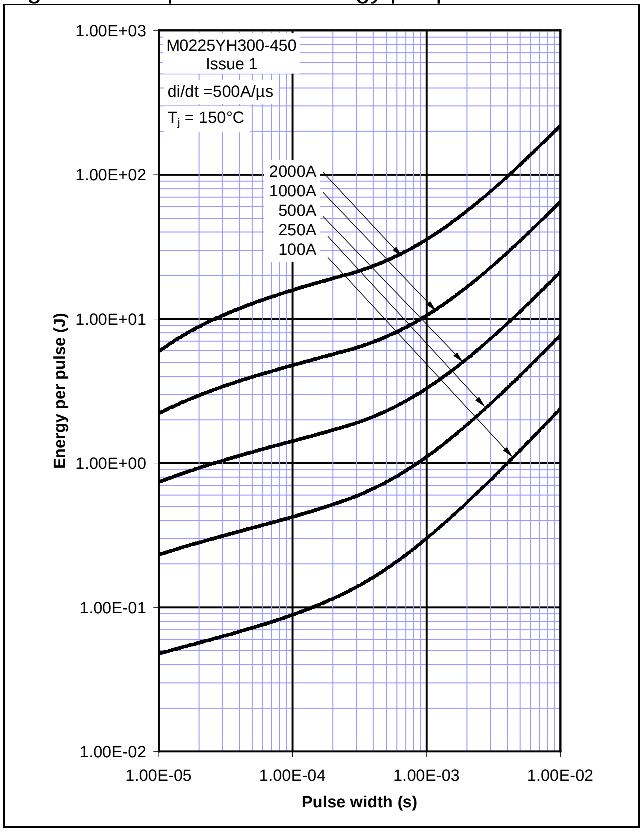


Figure 13 - Square wave frequency vs. pulse width

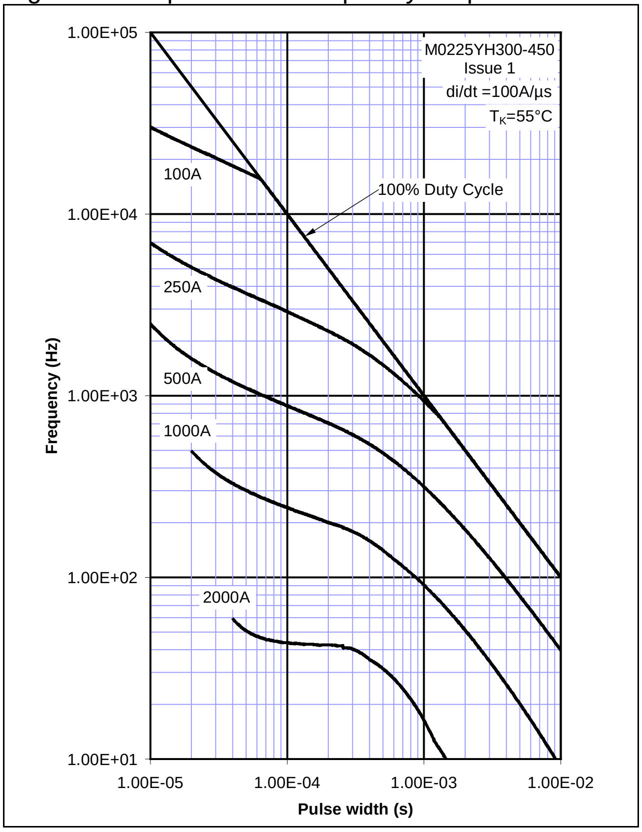


Figure 14 - Square wave frequency vs. pulse width

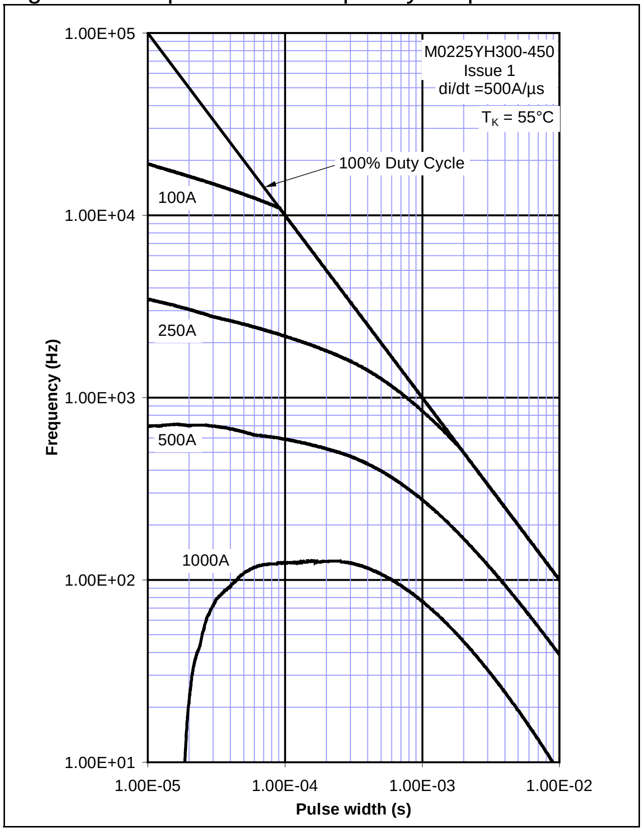


Figure 15 - Square wave frequency vs. pulse width

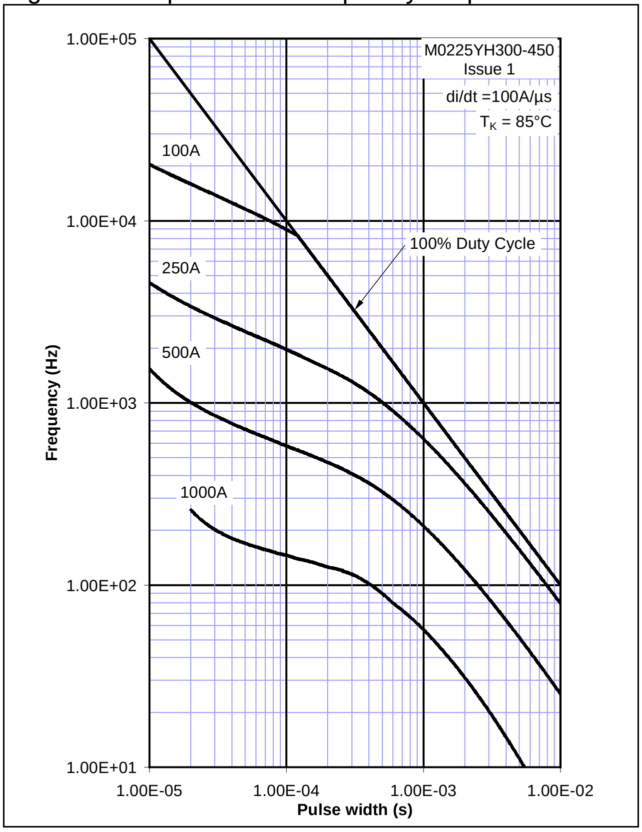


Figure 16 - Square wave frequency vs. pulse width

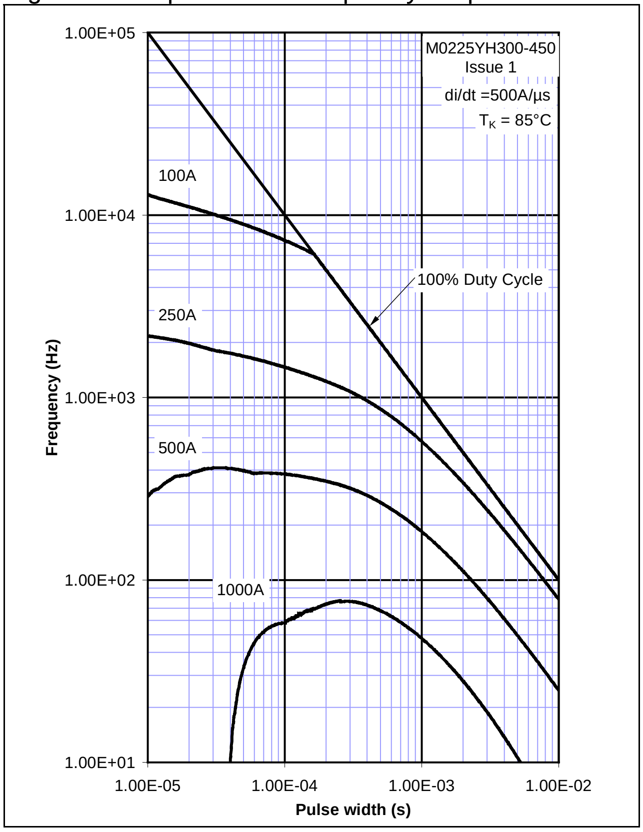


Figure 17 – Maximum surge and I^2t ratings

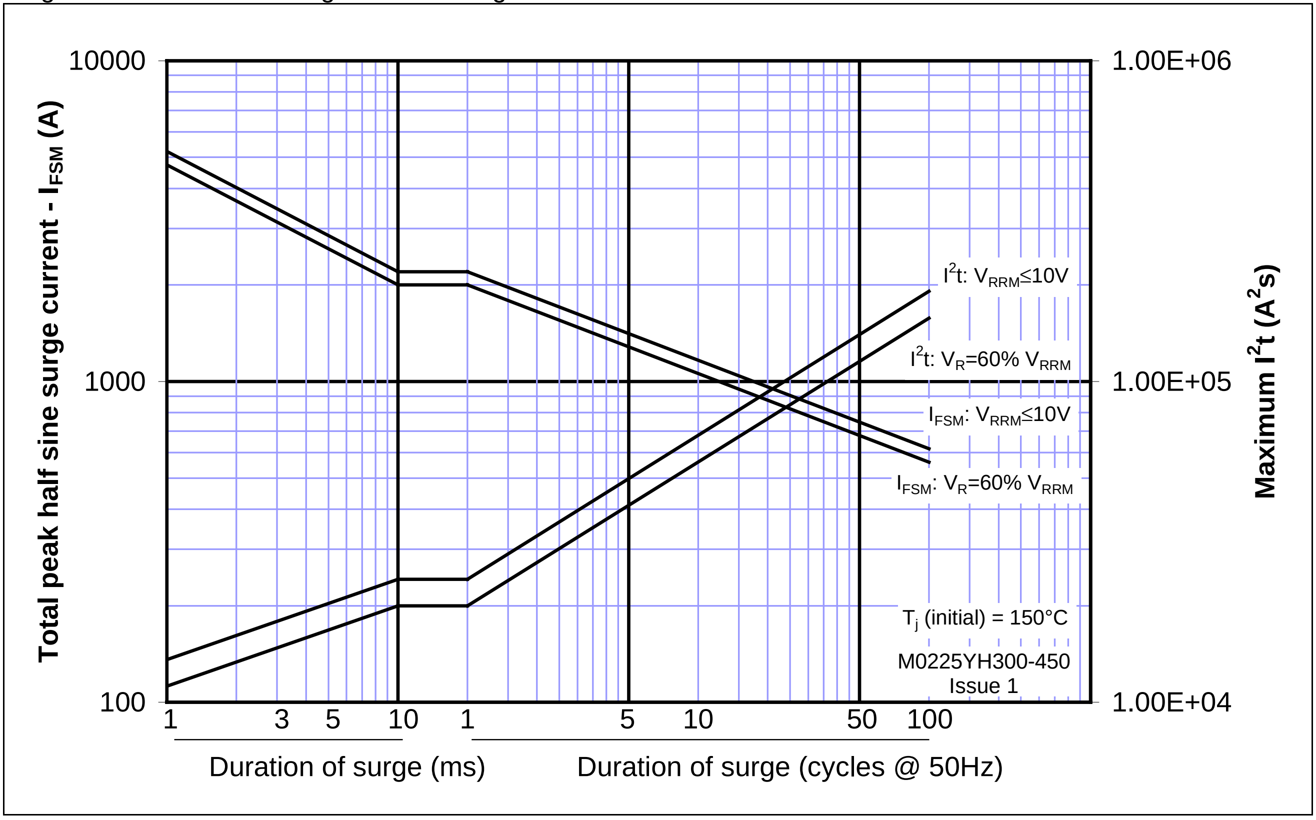
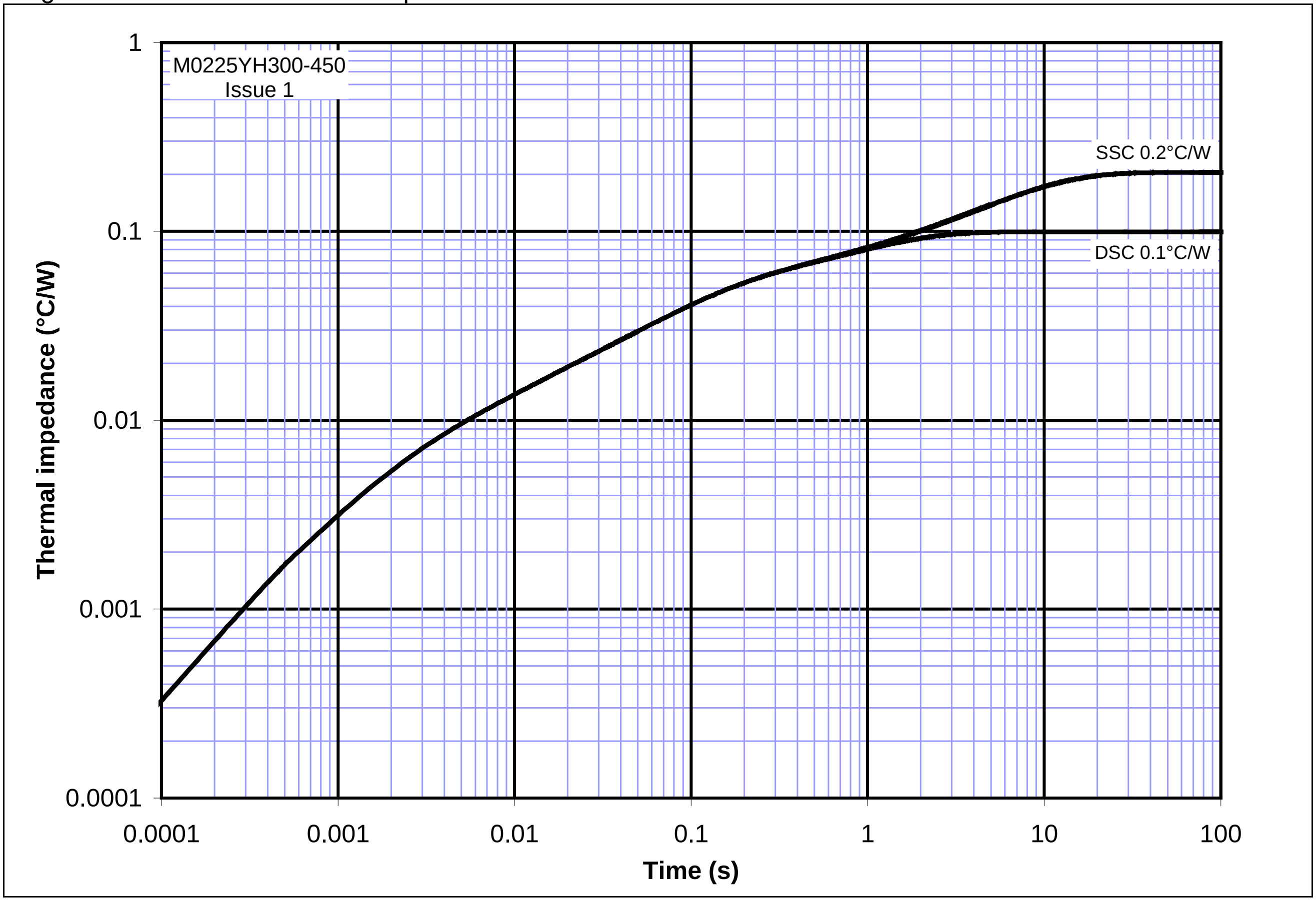
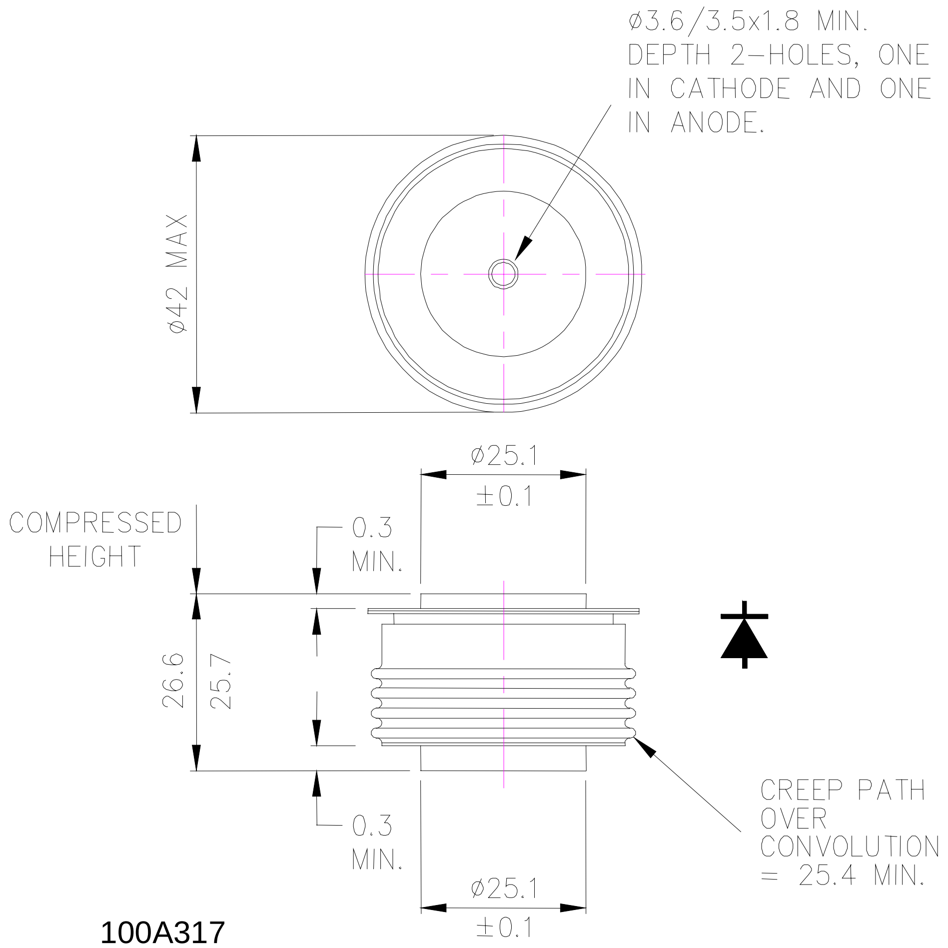


Figure 18 – Transient thermal impedance



Outline Drawing & Ordering Information



ORDERING INFORMATION (Please quote 10 digit code as below)

M0225	YH	♦♦	0
Fixed Type Code	Fixed outline code	Voltage code V_{RRM}÷100 30-45	Fixed code

Typical order code: M0225YH320 – 3200V V_{RRM}, 26.6mm clamp height capsule.

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