

Soft Recovery Diode

Types M0371YH350 to M0371YH450

The data sheet on the subsequent pages of this document is a scanned copy of existing data for this product.

(Rating Report 93NR4 Issue 1)

This data reflects the old part number for this product which is: SM30-45HXC164. This part number must **NOT** be used for ordering purposes – please use the ordering particulars detailed below.

The limitations of this data are as follows:

Device no longer available for grades 30 to 34 (3000V to 3400V V_{RRM})

Please use the following link to view an up to date outline drawing for this device

[Outline W3](#)

Where any information on the product matrix page differs from that in the following data, the product matrix must be considered correct

An electronic data sheet for this product is presently in preparation.

For further information on this product, please contact your local ASM or distributor.

Alternatively, please contact Westcode as detailed below.

Ordering Particulars			
M0371	YH	◆◆	0
Fixed Type Code	Fixed Outline Code	Voltage code $V_{RRM}/100$ 35-45	Fixed Code
Typical Order Code: M0371YH400, 26mm clamp height, 4000V 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

WESTCODE
An  IXYS Company

IXYS Corporation
3540 Bassett Street
Santa Clara CA 95054 USA
Tel: +1 (408) 982 0700
Fax: +1 (408) 496 0670
E-mail: sales@ixys.net

www.westcode.com

www.ixys.com

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

Westcode Semiconductors Inc
3270 Cherry Avenue
Long Beach CA 90807 USA
Tel: +1 (562) 595 6971
Fax: +1 (562) 595 8182
E-mail: WSI.sales@westcode.com

The information contained herein is confidential and is protected by Copyright. The information may not be used or disclosed except with the written permission of and in the manner permitted by the proprietors Westcode Semiconductors Ltd.

© Westcode Semiconductors Ltd.

In the interest of product improvement, Westcode reserves the right to change specifications at any time without prior notice.

Devices with a suffix code (2-letter, 3-letter or letter/digit/letter combination) added to their generic code are not necessarily subject to the conditions and limits contained in this report.

QUALITY AND EVALUATION LABORATORY

Rating Report No: 93NR4

Date: 16th June, 1993

Origin: Q.E.L.

Pages: 25

Diode Capsule Type: SM30-45HXC164

Written by: M.J. Perry *M.J. Perry* Checked: M Baker *M Baker* Approved: *BLOH*

30 mm Silicon with low recovered charge for snubber duties in high voltage gate turn-off thyristor applications; housed in a high voltage capsule.

Ratings

Voltage Grades

: 30-45

 V_{RSM}

: 3100-4600V

 V_{RRM}

: 3000-4500V

 $I_{F(AV)}$: Single phase: 50 Hz, 180° half sinewave; (Converter Ratings)Double Side Cooled $T_{HS} = 55^{\circ}C, 100^{\circ}C$

: 364A; 239A

Single Side Cooled $T_{HS} = 100^{\circ}C$

: 147A

 $I_{F(rms)} T_{HS} = 25^{\circ}C$

)

: 678A

 $I_F T_{HS} = 25^{\circ}C$

)

Double side cooled

: 597A

 I_{FSM} : $t = 10ms$ half sinewave; T_j (initial) = $150^{\circ}C$ $V_{RM} = 0.6V_{RRM(MAX)}$

: 4900A

 I_{FSM} : $t = 10ms$ half sinewave; T_j (initial) = $150^{\circ}C$ $V_{RM} \leq 10V$

: 5400A

 I^2t : $t = 10ms$; T_j (initial) = $150^{\circ}C$; $V_{RM} = 0.6V_{RRM(MAX)}$: $120 \times 10^3 A^2s$ I^2t : $t = 10ms$; T_j (initial) = $150^{\circ}C$; $V_{RM} \leq 10V$: $146 \times 10^3 A^2s$ I^2t : $t = 3ms$; T_j (initial) = $150^{\circ}C$; $V_{RM} \leq 10V$: $110 \times 10^3 A^2s$ T_{HS} Operating Range: -40 to $+150^{\circ}C$ T_{stg} : Non-operating: -40 to $+150^{\circ}C$

R.R. No.	93NR4
R.R. Issue	1
Page Issue	1

Characteristics

(Maximum values unless otherwise stated)

V_o	: 1.05V
r_s	: 1.65mohms
A : $T_J = 25^\circ\text{C}$	: 0.171044306
B : $T_J = 25^\circ\text{C}$	: 0.203488535
C : $T_J = 25^\circ\text{C}$	: 7.4078071E-4
D : $T_J = 25^\circ\text{C}$	: 1.50068853E-2
A	: 0.125659408
B	: 0.109853554
C	: 7.39508871E-4
D	: 3.11942547E-2
V_{FM} at $I_{FM} = 635A$	: 2.10V
$R_{th(J-HS)}$ Double side cooled	: 0.10 K/W
Single side cooled	: 0.20 K/W
I_{RRM} : at $V_{RRM(MAX)}$	: 50mA
V_{fr} : at $dI/dt = 1000A/\mu s$	: 370V
Reverse recovery at $I_{FM} = 1000A$; $t_p = 500\mu s$:	
$di_R/dt = 200A/\mu s$; $V_{RM} = 50V$	
Q_{RR} (total area)	: 1560 μC
Q_{RA} (50% chord)	: 640 μC
t_{rr} (50% chord)	: 3.3 μs
I_{RM}	: 400A
Mounting Force	: 330-550 Kgf
Outline Drawing	: 100A317
JEDEC Outline No.	:

NOTE: All characteristics are at $T_{VJ} = T_{Jmax}$ operating unless stated otherwise.

R.R. No.	93NR4
R.R. Issue	1
Page Issue	1

CONTENTS

Ratings and characteristics	<u>Page</u> 1, 2
Voltage grade table	4
2. <u>Introduction</u>	5
3. <u>Notes on the Ratings</u>	
(a) Square wave ratings	5
(b) Energy per pulse characteristics	5
(c) ABCD constants	5
(d) Reverse Recovery Ratings	5
4. <u>Reverse Recovery Loss</u>	
(a) Determination by Measurement	6
(b) Determination without Measurement	6
Limit forward characteristic	8
Transient thermal impedance	9
Surge rating	10
Forward recovery voltage	11
Recovered charge	12, 13
Reverse recovery current	14
Reverse recovery energy per pulse	15
Square wave frequency rating 55°C Sink 100A/μS	16
Square wave frequency rating 55°C Sink 500A/μS	17
Square wave frequency rating 85°C Sink 100A/μS	18
Square wave frequency rating 85°C Sink 500A/μS	19
Energy per pulse 100A/μS	20
Energy per pulse 500A/μS	21
Sine wave frequency rating 55°C Sink	22
Sine wave frequency rating 85°C Sink	23
Sine wave energy per pulse	24
Outline drawing	25

R.R. No.	93NR4
R.R. Issue	1
Page Issue	1

Voltage Ratings

Voltage Class	V_{RRM} V	V_{RSM} V
30	3000	3100
32	3200	3300
34	3400	3500
36	3600	3700
38	3800	3900
40	4000	4100
42	4200	4300
44	4400	4500
45	4500	4600

1. This Report is applicable to higher or lower voltage grades when supply has been agreed by Sales/Production.
2. A blocking voltage derating factor of 0.13% per deg. Celsius is applicable to this device for T_j below 25°C.

R.R. No.	93NR4
R.R. Issue	1
Page Issue	1

2.0 INTRODUCTION

The diode series comprises fast recovery capsule devices with all diffused silicon slices. All these diodes have controlled reverse recovery characteristics. These diodes are particularly suitable for use in G.T.O. and SCR snubber networks.

3.0 NOTES ON THE RATINGS

(a) Square wave ratings

These ratings are given for leading edge linear rates of rise of forward current of $100\text{A}/\mu\text{S}$ and $500\text{A}/\mu\text{S}$.

(b) Energy per pulse characteristics

These curves enable rapid estimation of device dissipation to be obtained for conditions not covered by the frequency ratings.

Let: E_p be the Energy per pulse for a given current and pulse width in joules, and f be the repetition rate.

Then $W_{AV} = E_p \times f$

$T_{SINK} = T_{J(MAX)} - (E_p \times f \times R_{thJ-HS})$

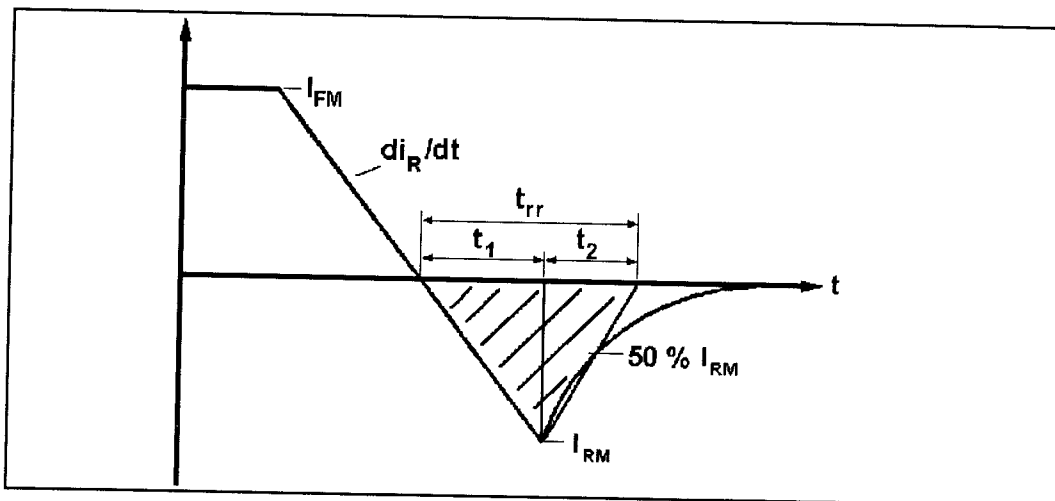
(c) ABCD Constants

These constants (applicable only over current range of V_F characteristic on page 8) are the co-efficients of the expression for the forward characteristic given below:

$V_F = A + B \ln(i_F) + C i_F + D/i_F$: where i_F = instantaneous forward current.

(d) Reverse recovery ratings

(i) Q_{RA} is based on 50% I_{RM} chord as shown below.



R.R. No.	93NR4
R.R. Issue	1
Page Issue	1

(ii) Q_{RR} is based on a 150uS integration time

$$\text{i.e. } Q_{RR} = \int_{t=0}^{150\mu\text{S}} i_{RR} \cdot dt$$

(iii) K factor = t_1/t_2

4.0 Reverse Recovery Loss

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

(a) Determination by measurement

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 A joules per pulse. A new sink temperature can then be evaluated from:

$$T_{\text{SINK}} (\text{new}) = T_{\text{SINK}} (\text{original}) - A \left(\frac{r_t \times 10^6}{t} + R_{\text{thJ-HS}} \times f \right)$$

where $r_t = 3.30\text{E-}6 \times t$ (K/W)

t = duration of reverse recovery loss per pulse in microseconds.

A = Area under reverse loss waveform per pulse in joules (W.S.)

f = Rated frequency at the original sink temperature.

The total dissipation is now given by

$$W_{(\text{TOT})} = W_{(\text{original})} + A \times f$$

(b) Determination without Measurement

In circumstances where it is not possible to measure voltage and current conditions, or for design purposes, the additional losses A in joules may be estimated from curves on page 15.

Let E be the value of energy per reverse cycle in joules (curves on p15).

Let f be the operating frequency in Hz

$$\text{then } T_{\text{SINK new}} = T_{\text{SINK original}} - (E \times R_{\text{th}} \times f)$$

where $T_{\text{SINK new}}$ is the required maximum heat sink temperature and $T_{\text{SINK original}}$ is the heat sink temperature given with the frequency ratings.

A suitable R-C snubber network is connected across the diode to restrict the transient reverse voltage waveform to a peak value (V_{RM}) of 0.67 of the maximum grade.

If a different grade is being used or V_{RM} is lower than 0.67 of Grade, the reverse loss may be approximated by a pro rata adjustment of the maximum value obtained from the curves provided.

R.R. No.	93NR4
R.R. Issue	1
Page Issue	1

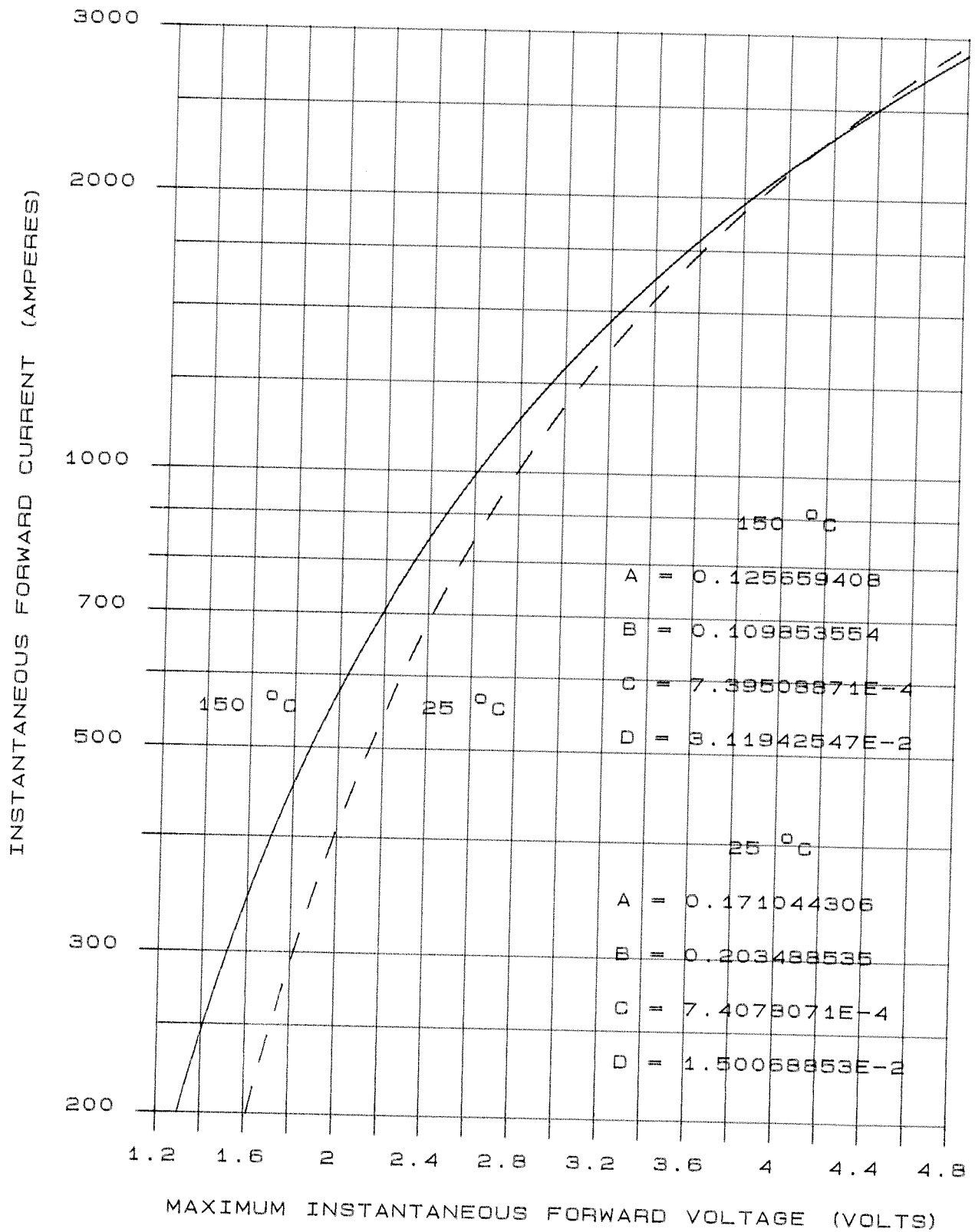
NOTE 1

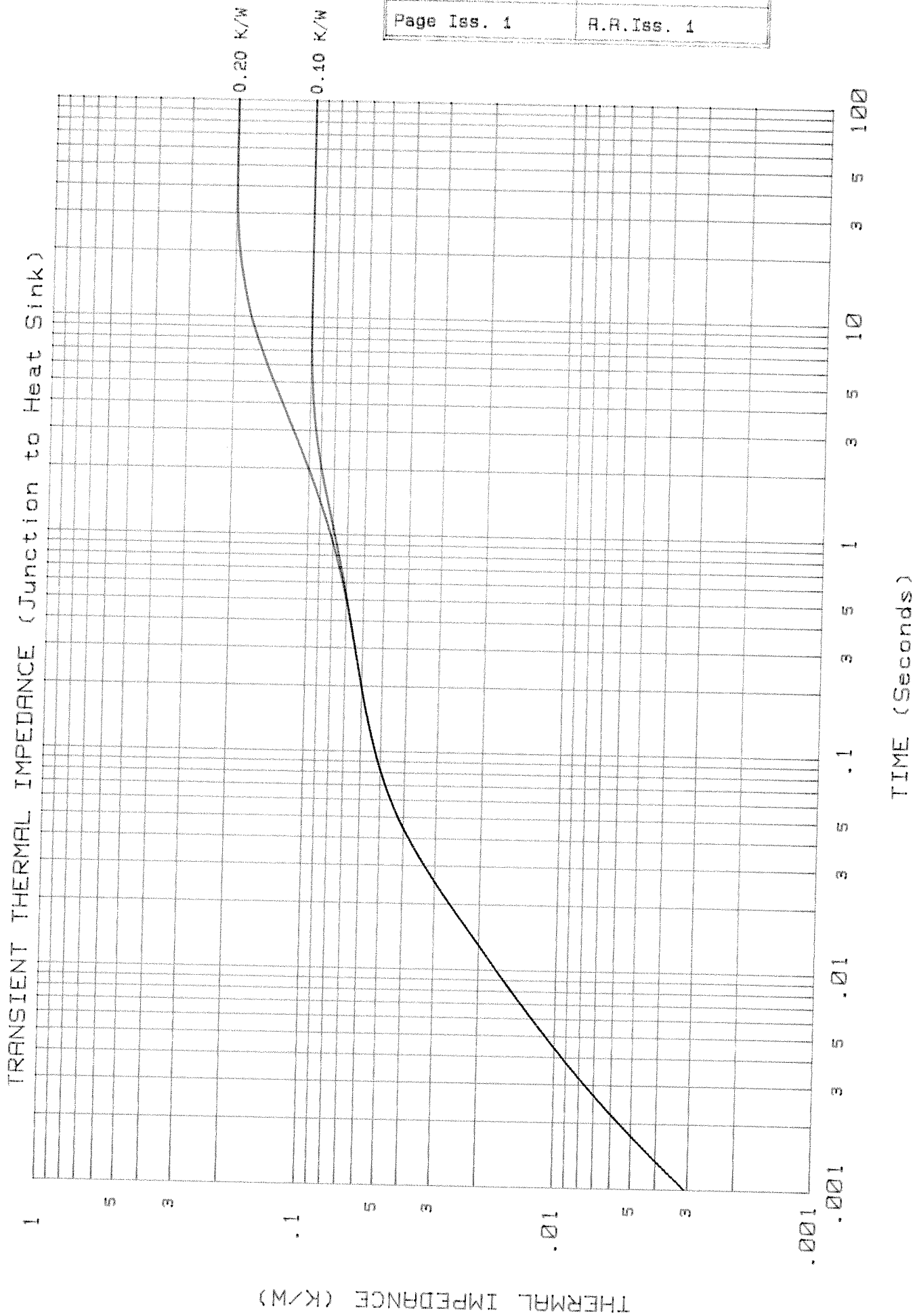
Reverse Recovery Loss by Measurement

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

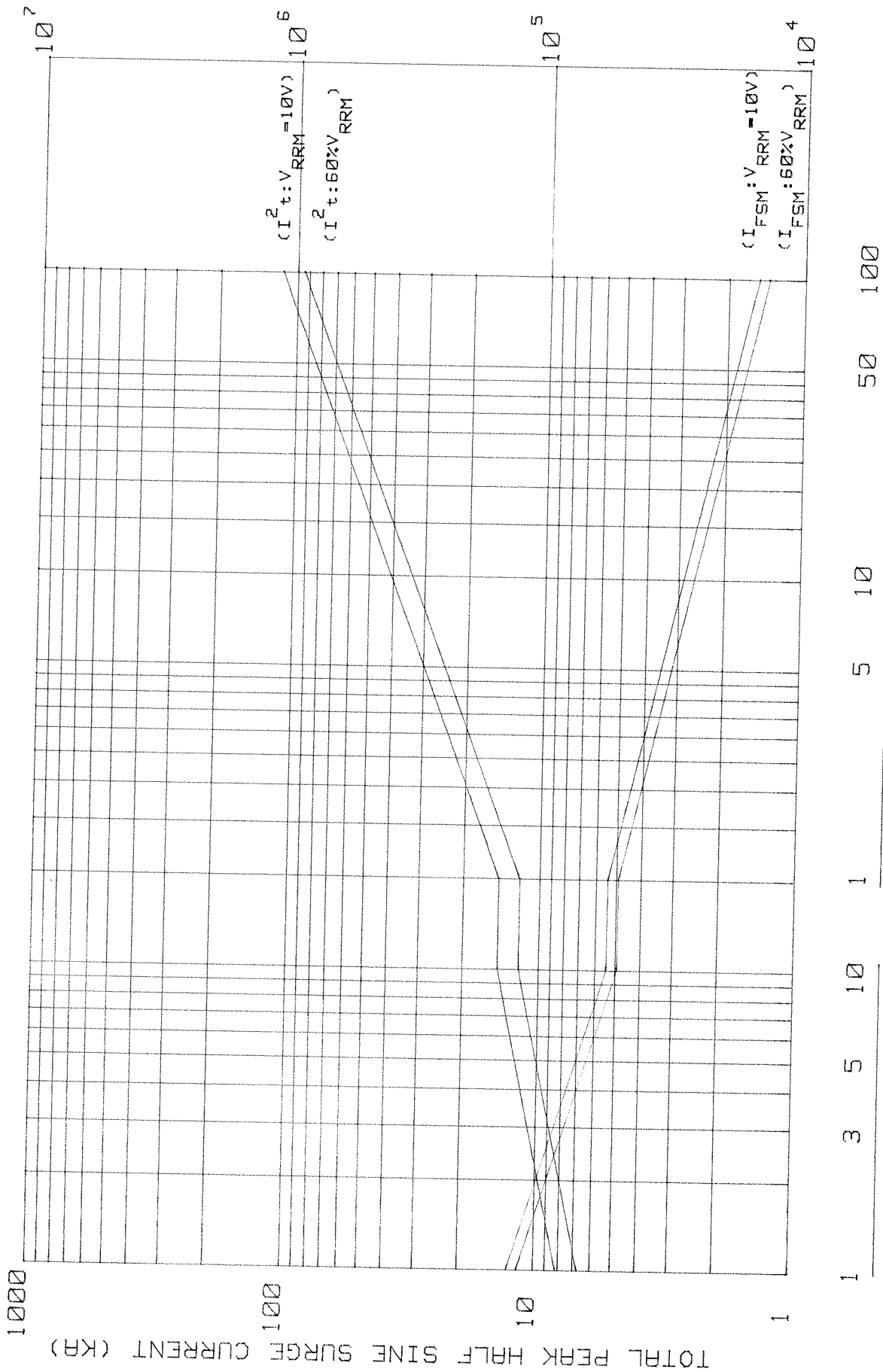
- (a) a.c. coupled devices such as current transformers are not affected by prior passage of high amplitude forward current.
- (b) A suitable, polarised, clipping circuit must be connected to the input of the measuring oscilloscope to avoid overloading the internal amplifiers by the relatively high amplitude forward current signal.
- (c) Measurement of reverse recovery waveform should be carried out with an appropriate snubber of $0.5\mu\text{F}$, 2.2ohms connected across diode anode to cathode.

FORWARD CHARACTERISTIC OF LIMIT DEVICE



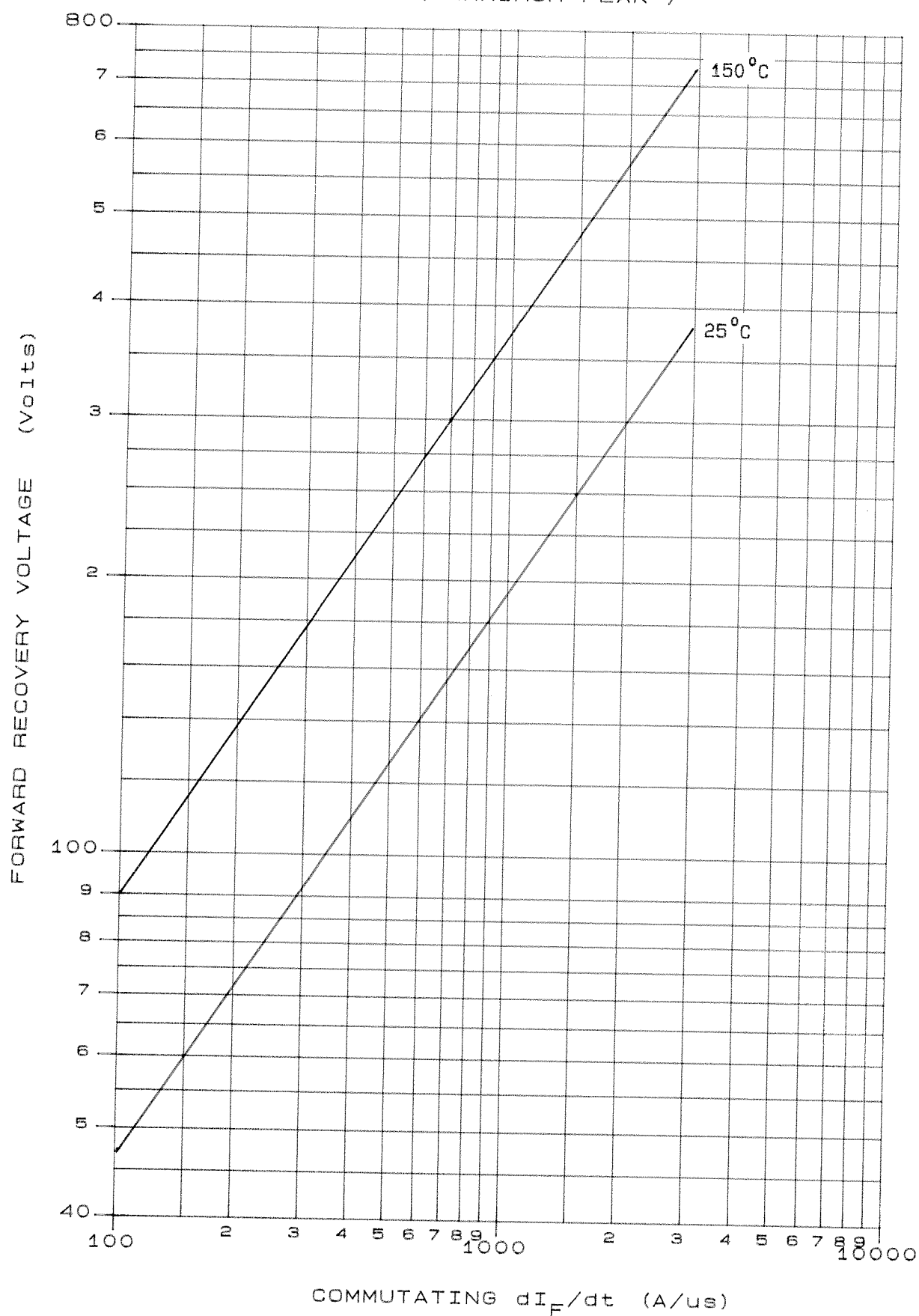


MAXIMUM NON REPETITIVE SURGE CURRENT AT INITIAL JUNCTION TEMPERATURE 150°C

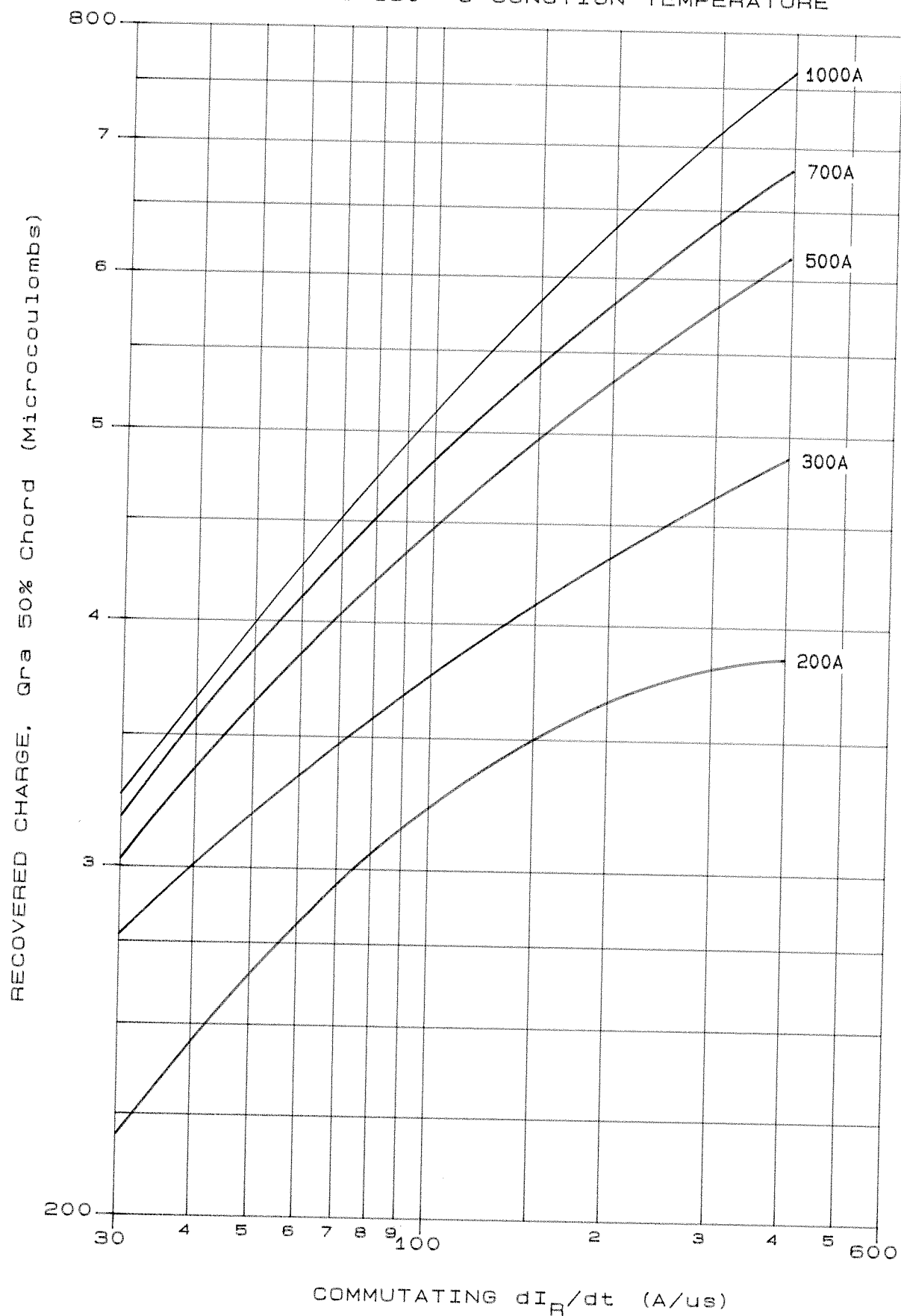


MAXIMUM $I^2 t$ (AMPS² SECS)

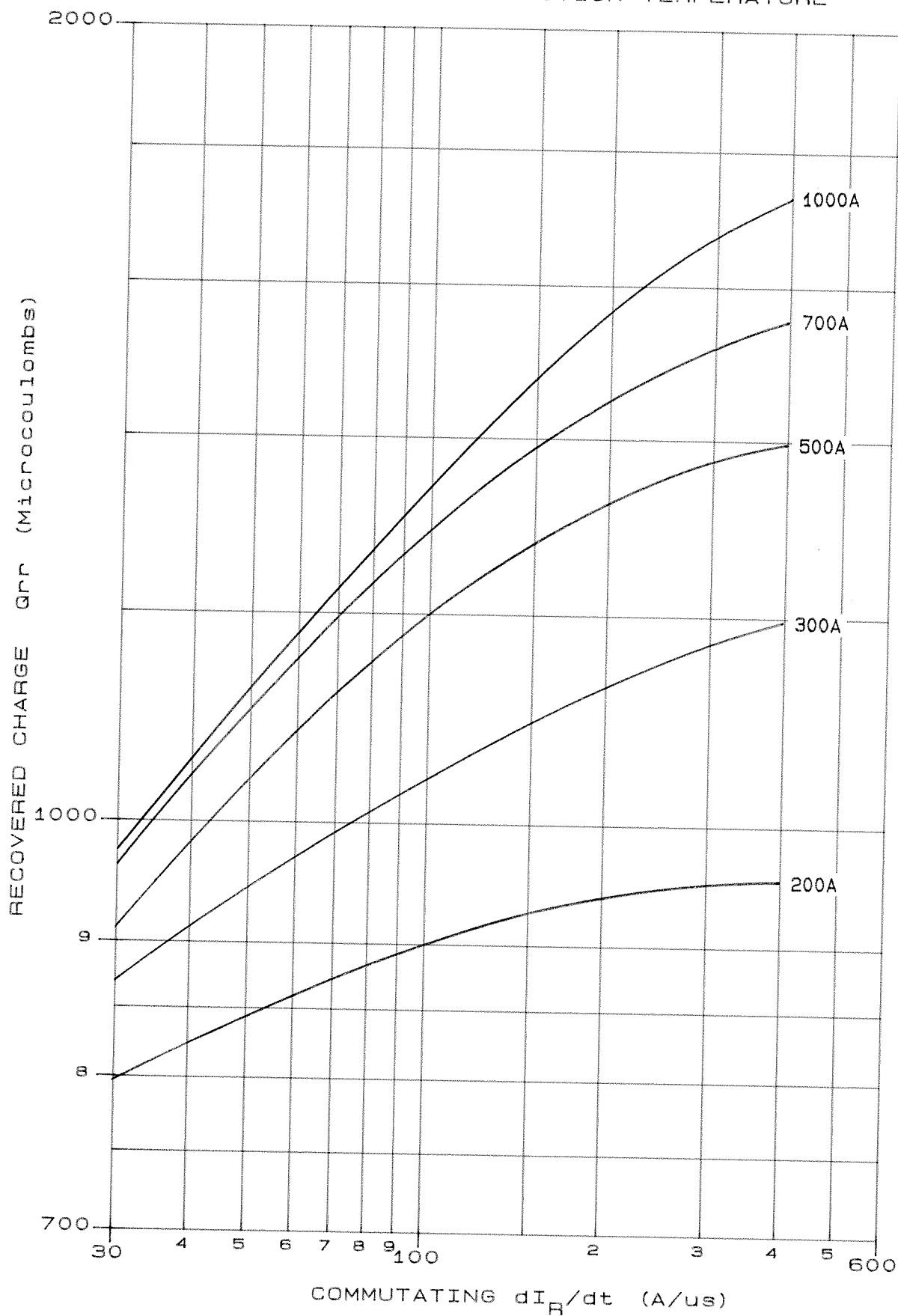
FORWARD RECOVERY VOLTAGE
(MAXIMUM PEAK)



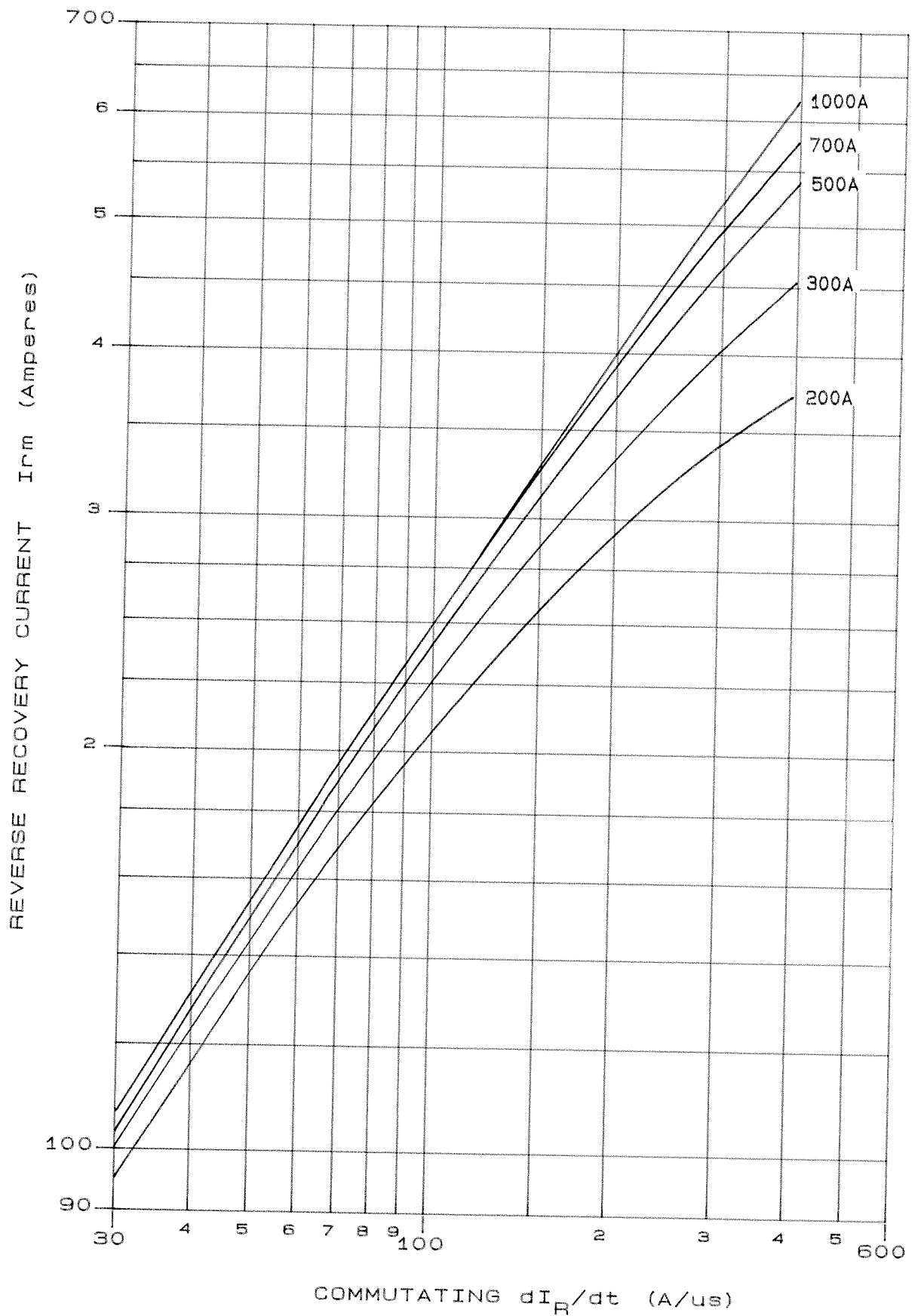
MAXIMUM RECOVERED CHARGE
 Q_{ra} @ 150 °C JUNCTION TEMPERATURE



MAXIMUM TOTAL RECOVERED CHARGE
 Q_{rr} @ 150 °C JUNCTION TEMPERATURE

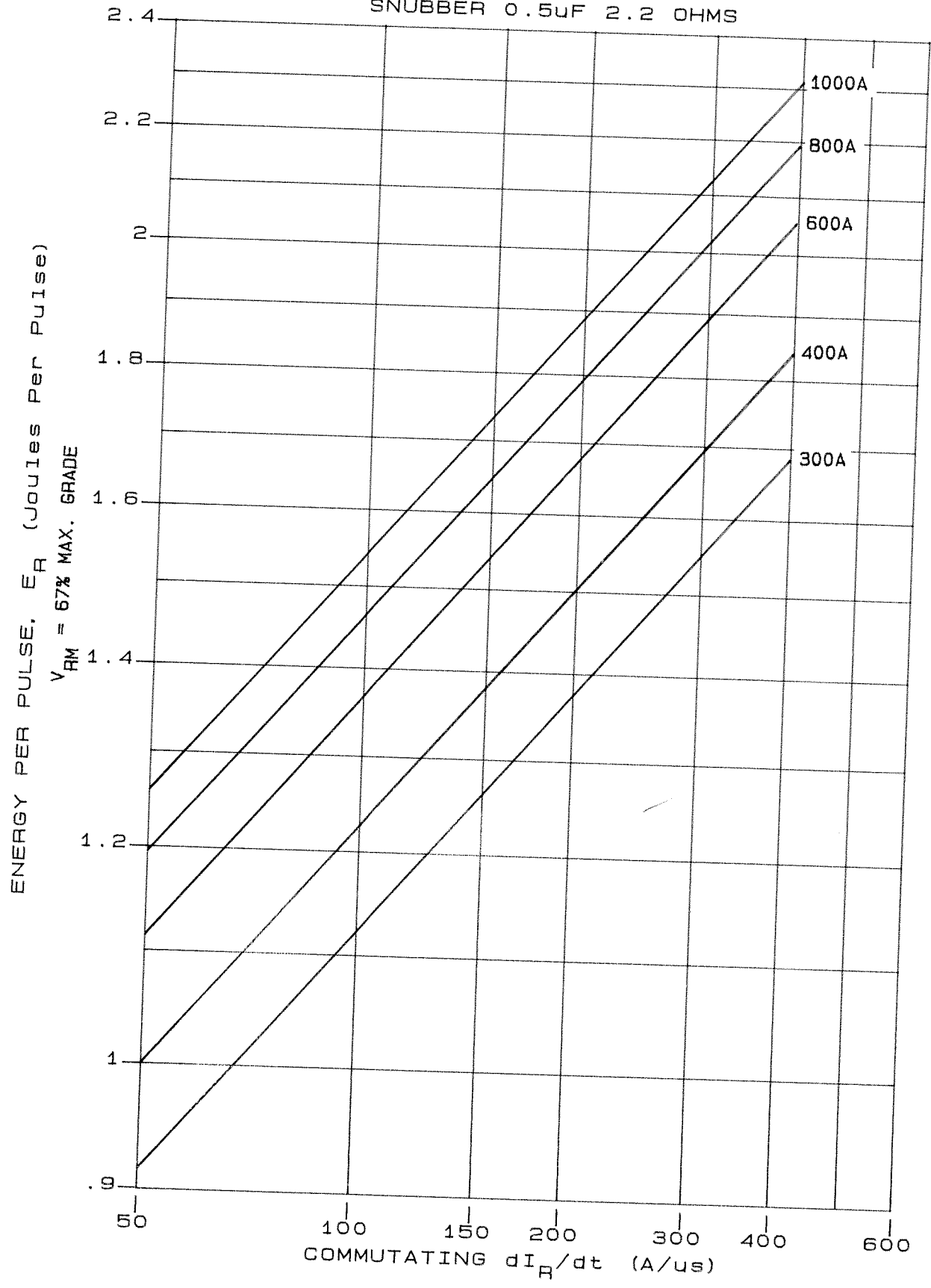


MAXIMUM PEAK REVERSE RECOVERY CURRENT
 I_{rm} @ 150 °C JUNCTION TEMPERATURE



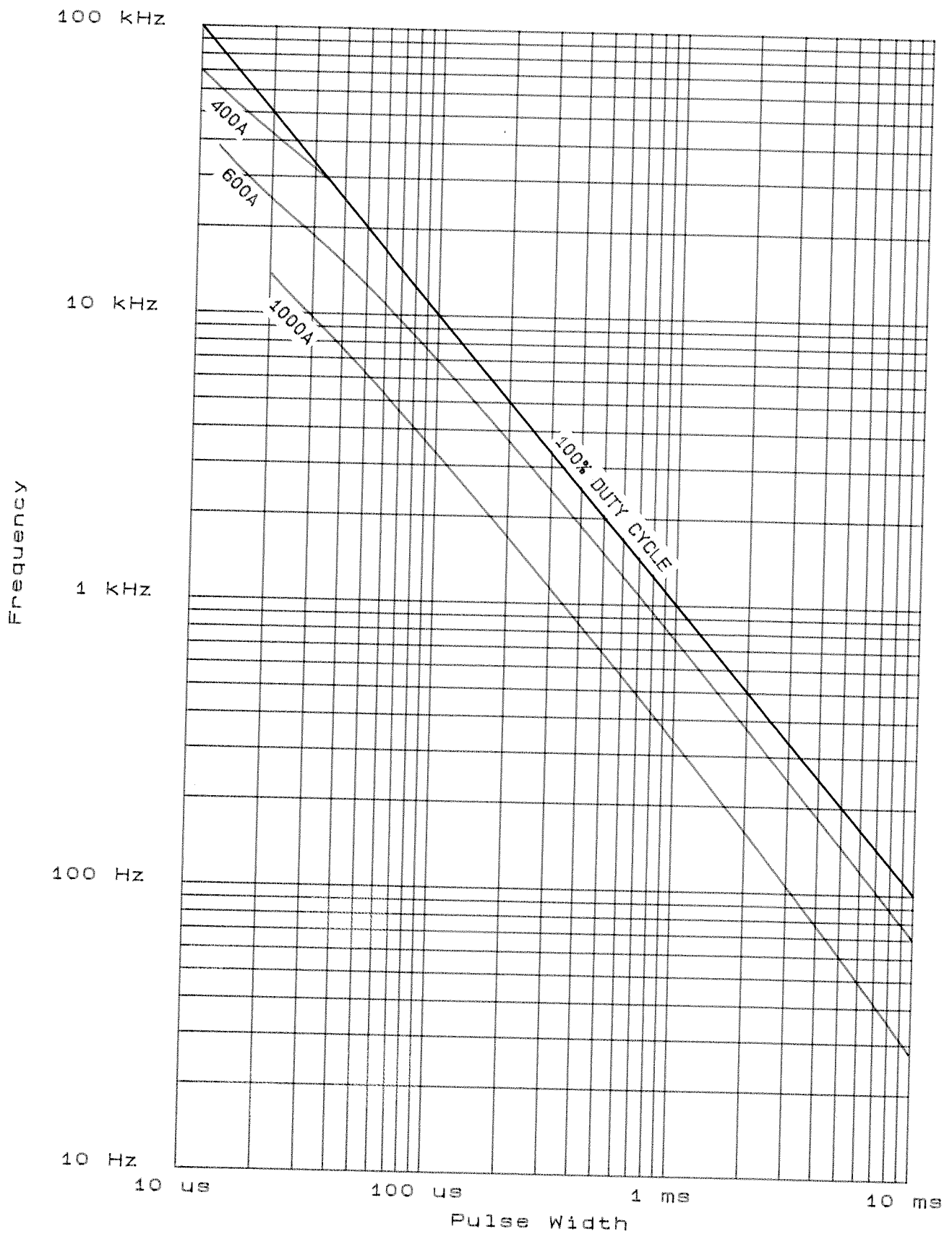
MAXIMUM REVERSE RECOVERED ENERGY LOSS PER PULSE
 E_R @ 150 °C JUNCTION TEMPERATURE

SNUBBER 0.5uF 2.2 OHMS



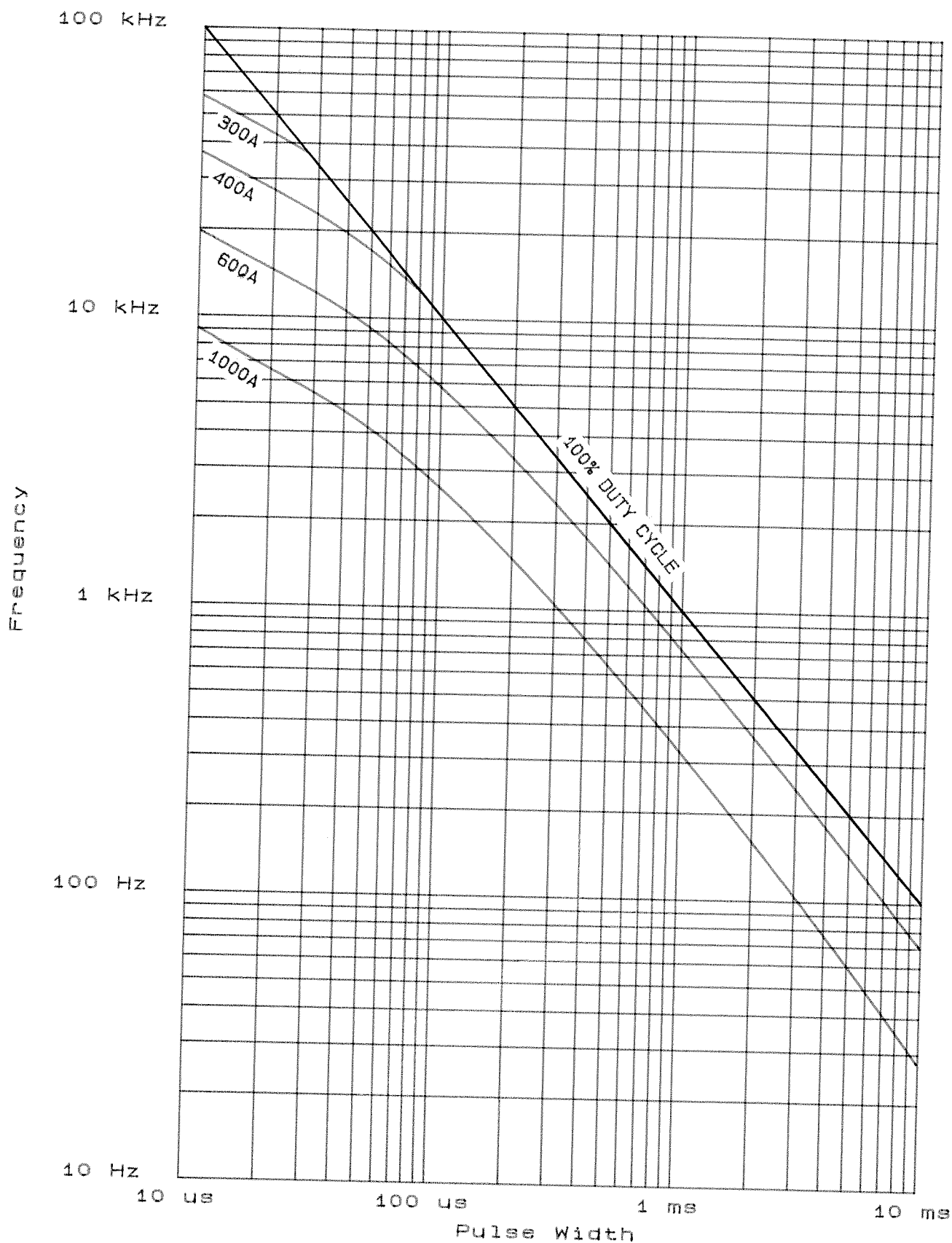
Page No. 16	R.R. No. 93NR04
Page Iss. 1	R.R.Iss. 1

Frequency Vs Pulse Width
 $T_{\text{Sink}} = 55.^{\circ}\text{C. } 100. \text{ A/us}$

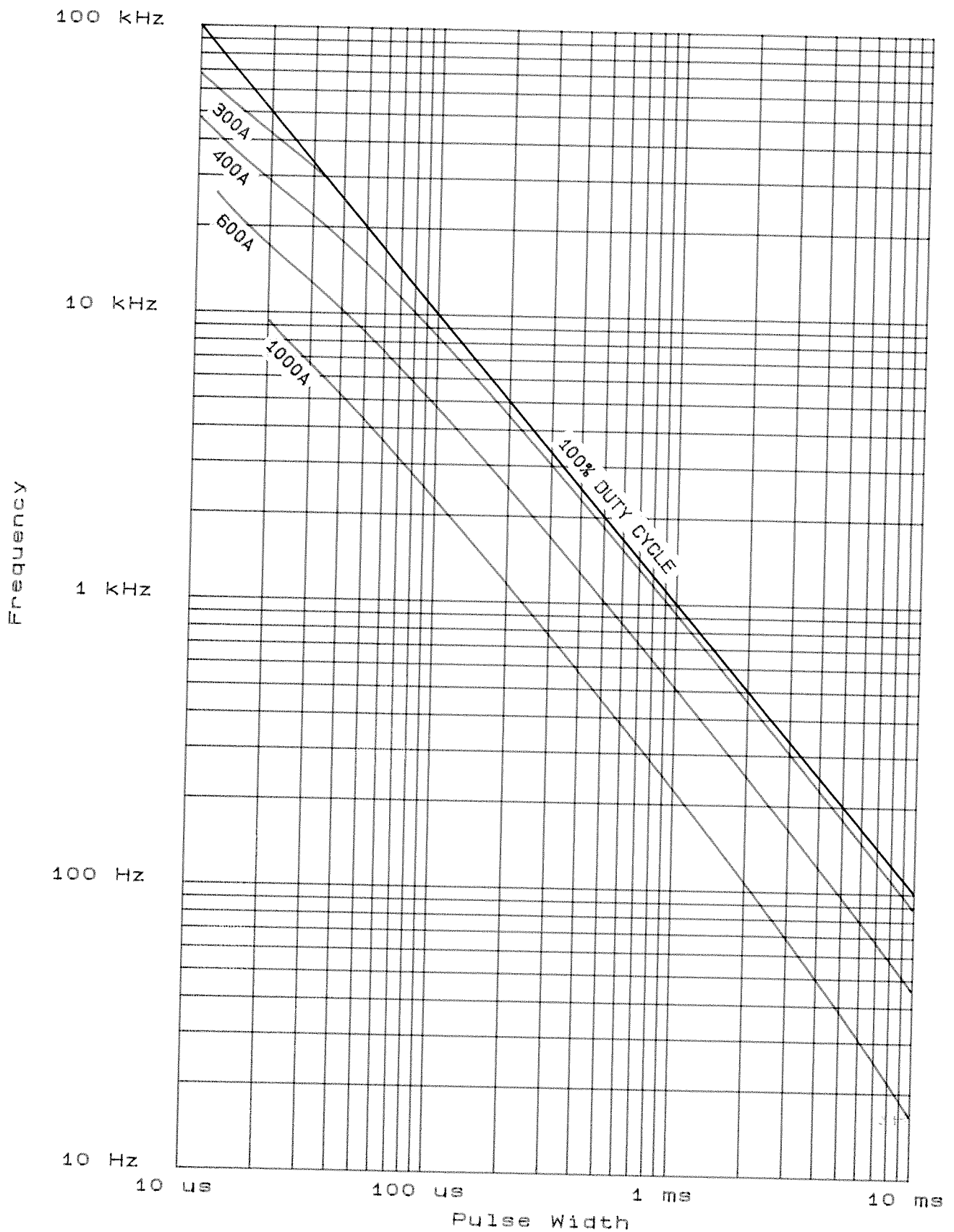


Frequency Vs Pulse Width

T Sink = 55.^oC. 500. A/us

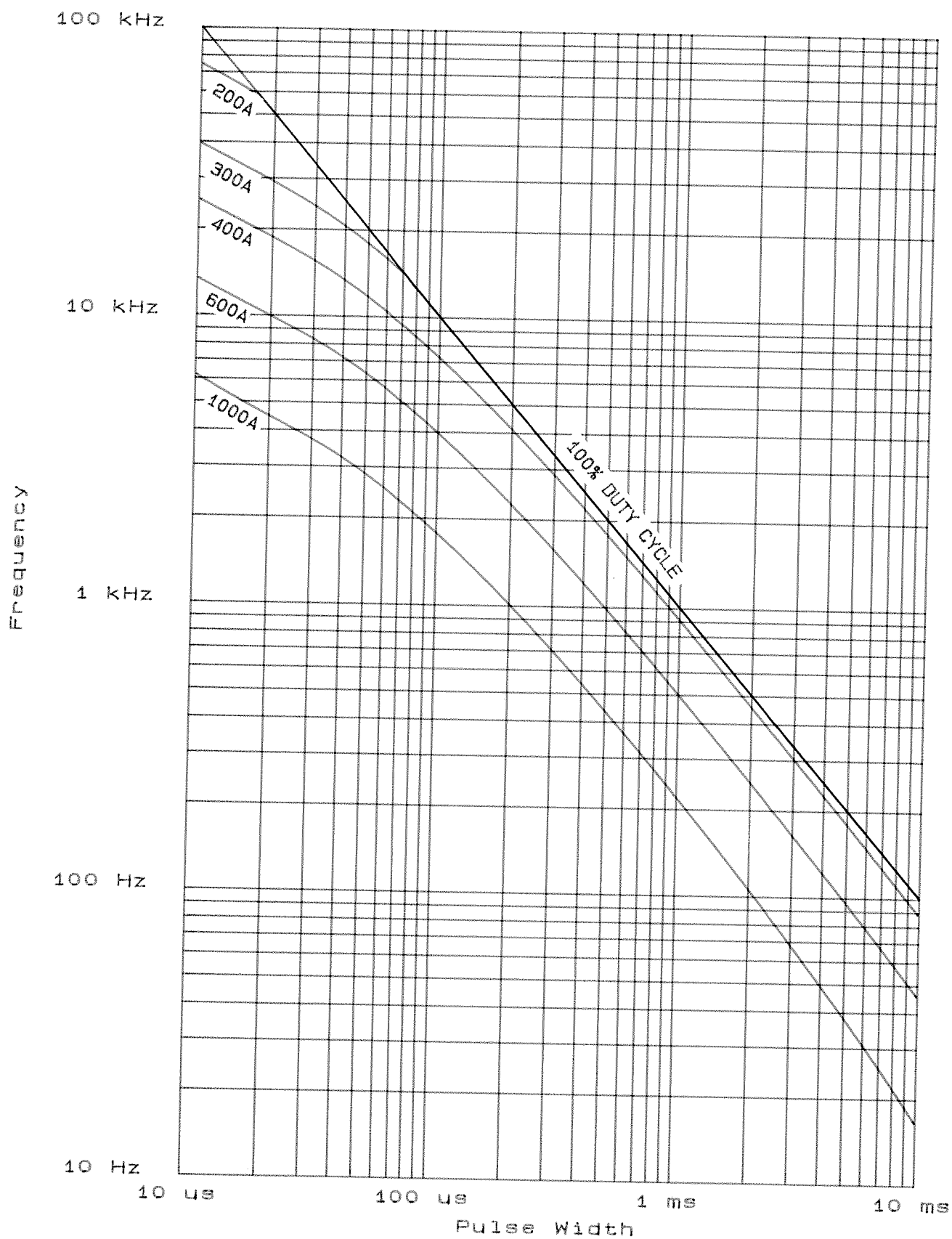


Frequency Vs Pulse Width

 $T_{\text{Sink}} = 85.^{\circ}\text{C. } 100. \text{ A/us}$ 

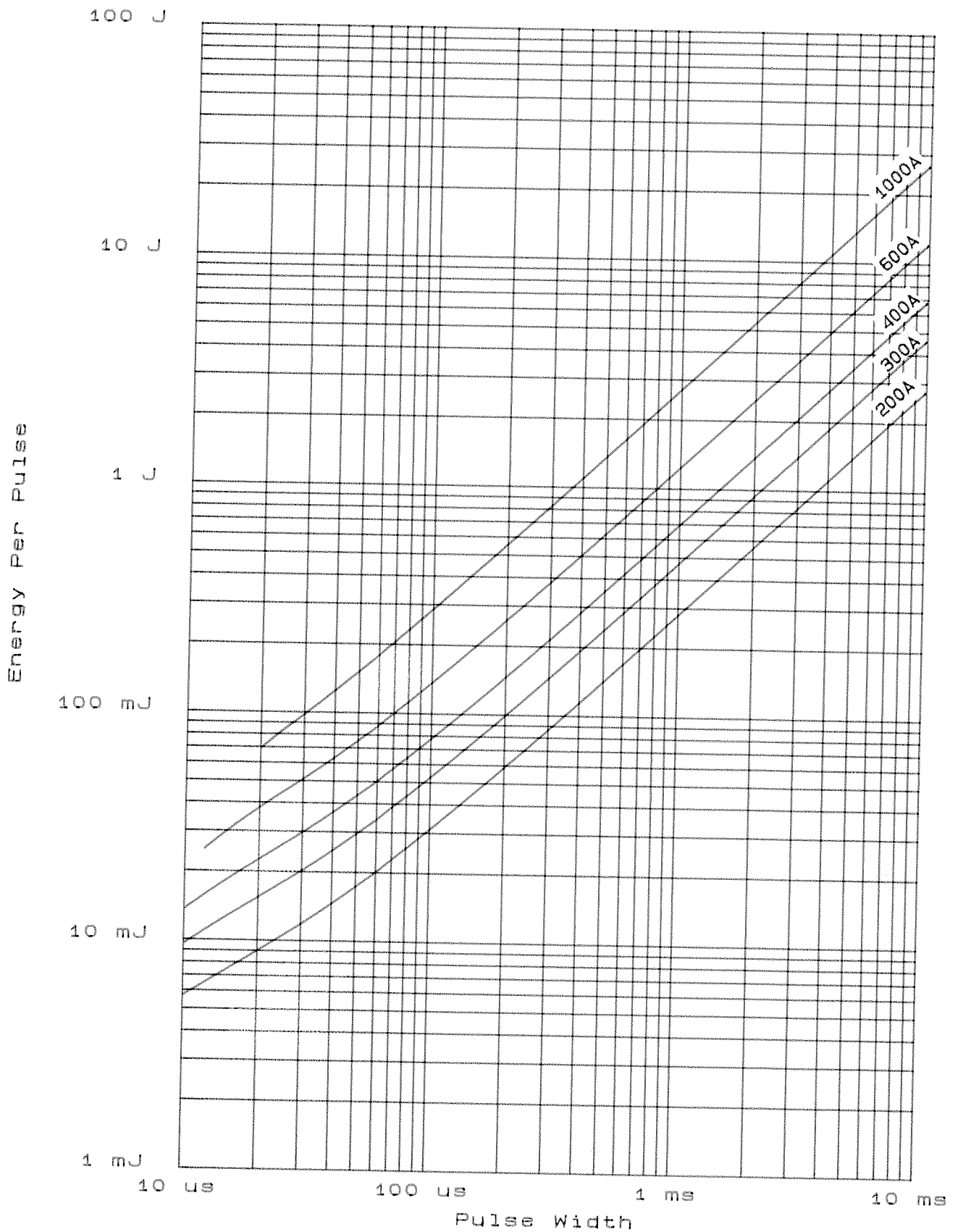
Frequency Vs Pulse Width

T Sink = 85.^oC. 500. A/us



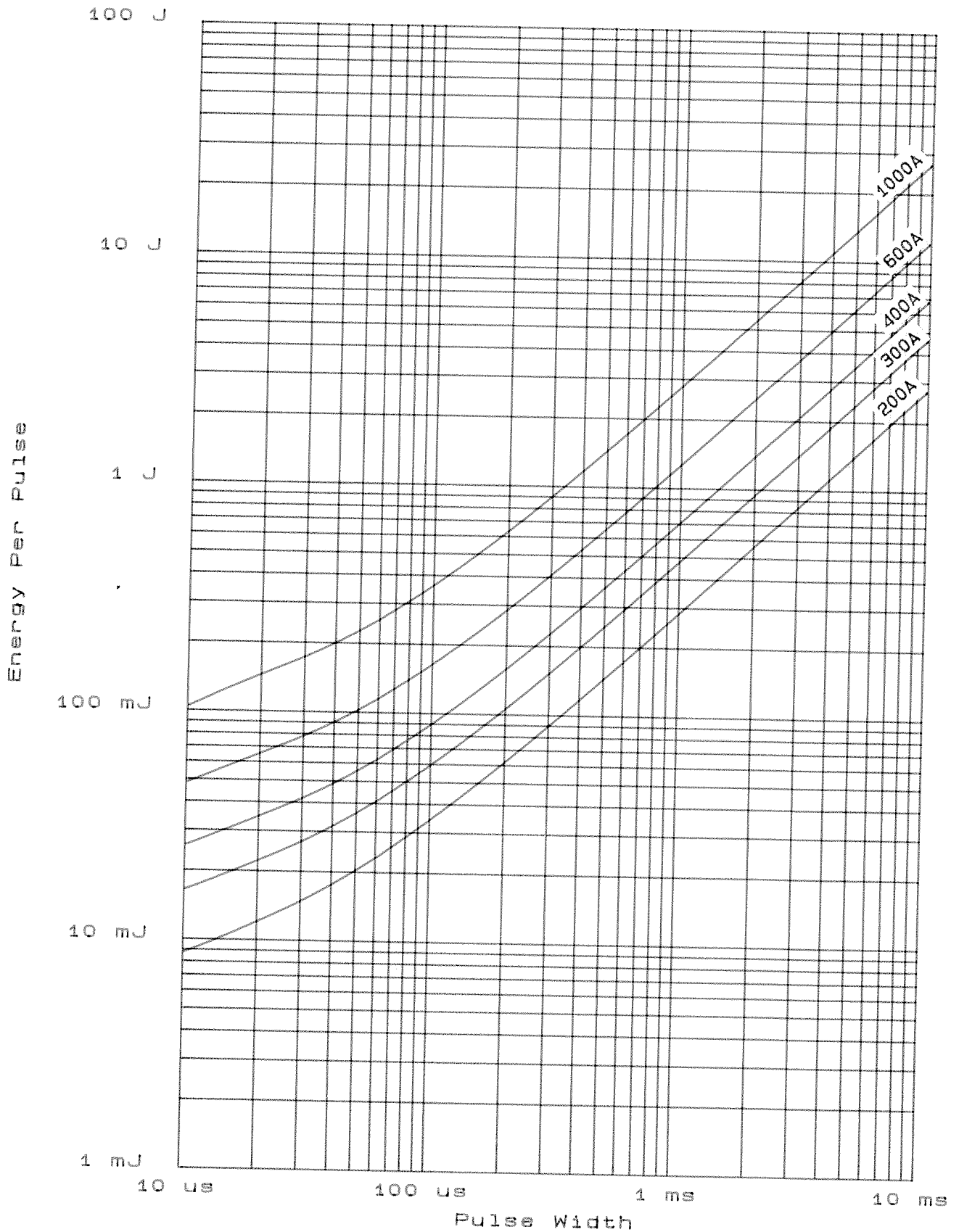
Forward Energy Vs Pulse Width

$T_j = 150.^{\circ}\text{C.}$ 100. A/us

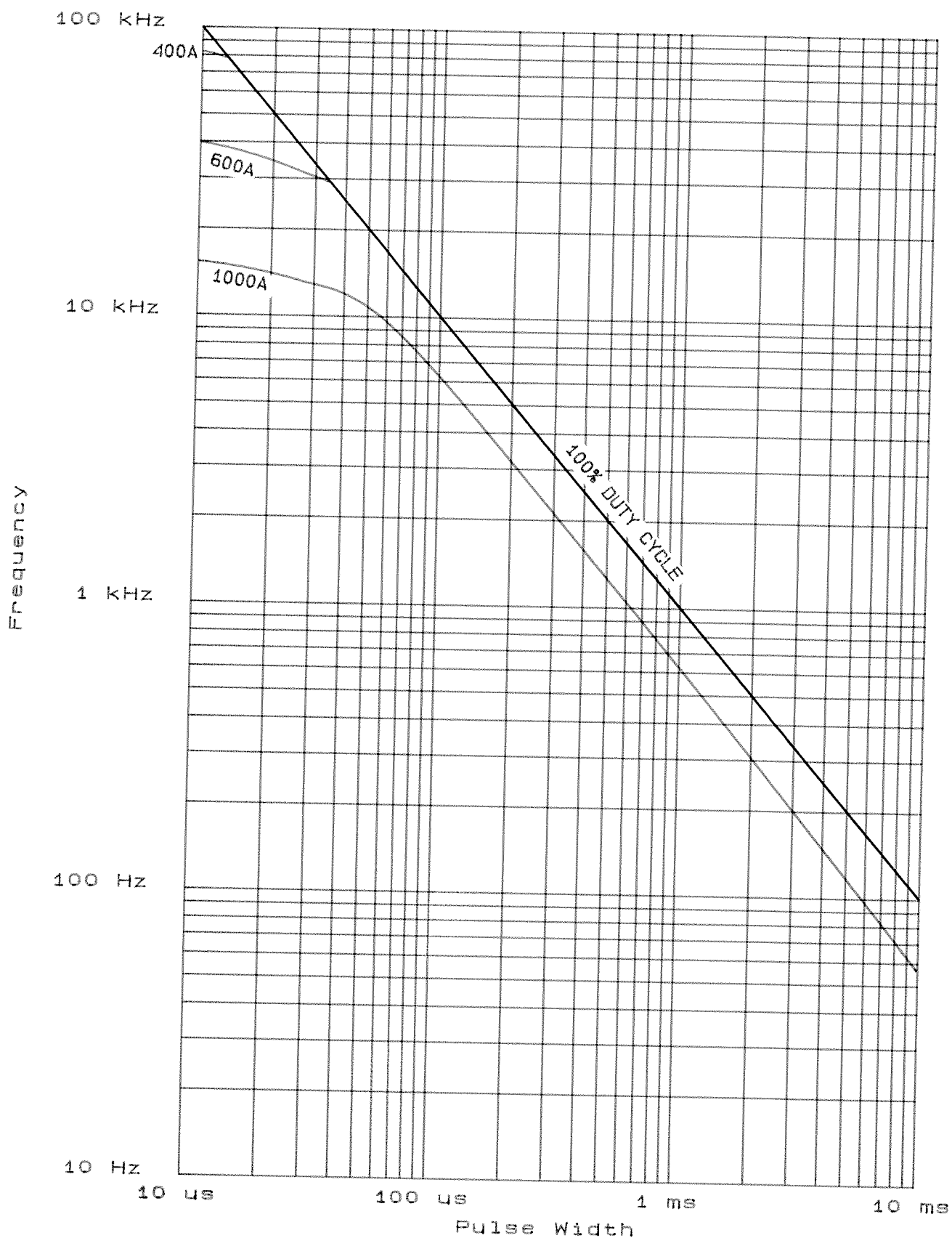


Forward Energy Vs Pulse Width

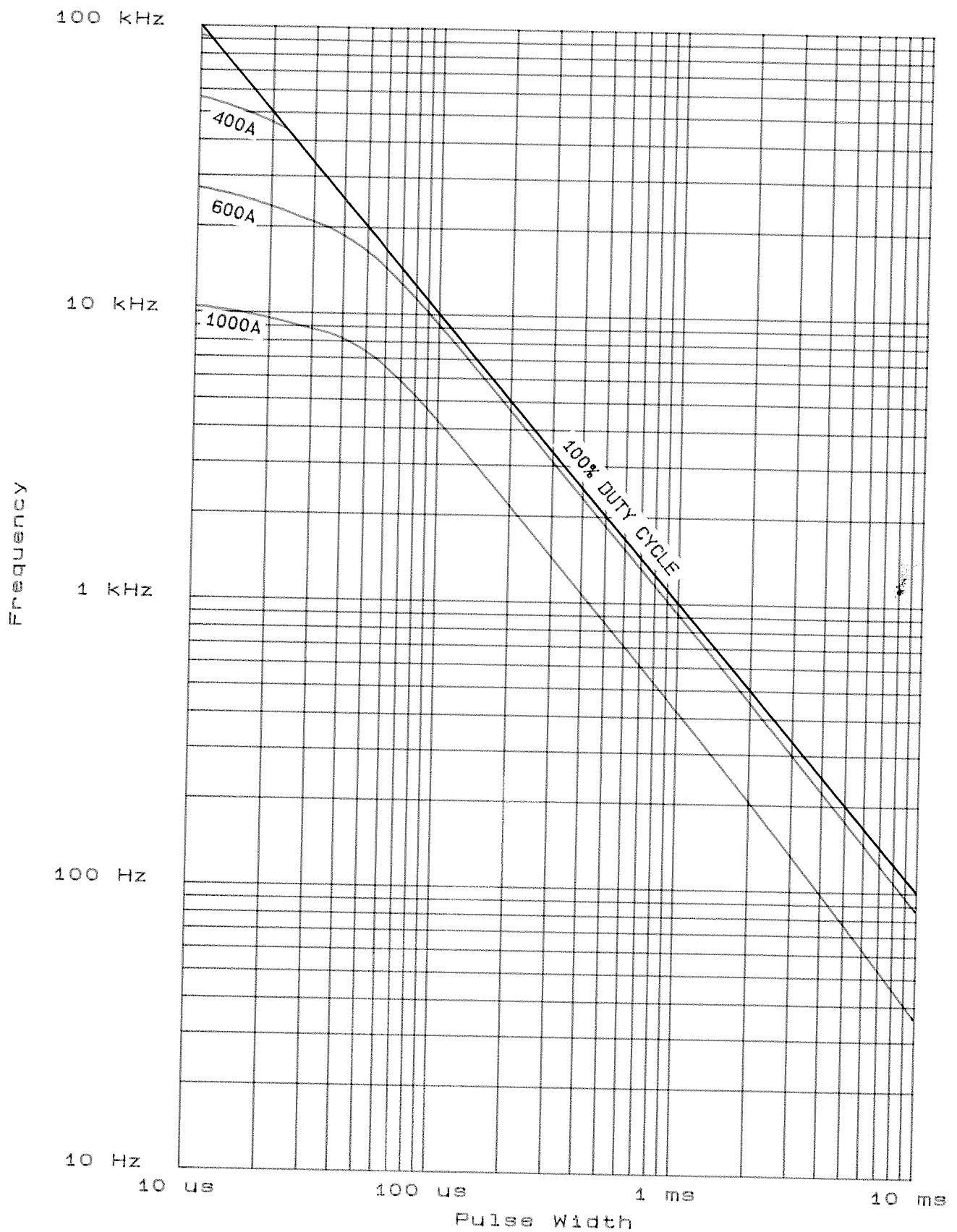
$T_j = 150.^{\circ}\text{C}.$ 500. A/us



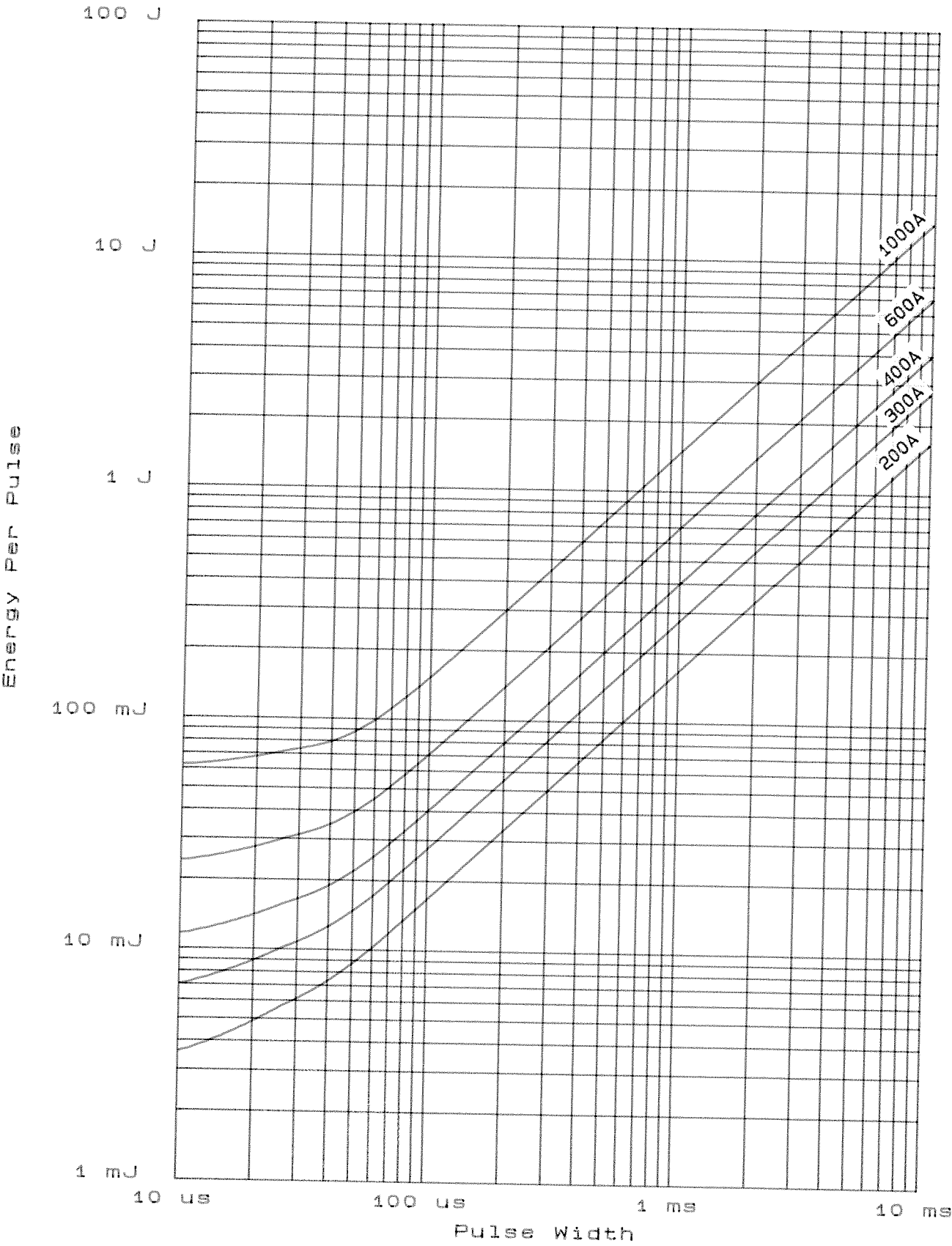
Frequency Vs Pulse Width
T Sink = 55.^oC. Sine Wave



Frequency Vs Pulse Width
 $T_{\text{Sink}} = 85.^{\circ}\text{C}$. Sine Wave



Forward Energy Vs Pulse Width
 $T_j = 150.^{\circ}\text{C}$. Sine Wave



INTERNATIONAL OUTLINE No.

G.A. DWG No. 159B100H126

WEIGHT. 141 GRAMS

FINISH. NICKEL PLATE

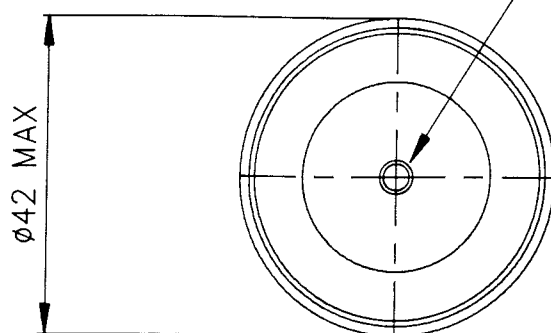
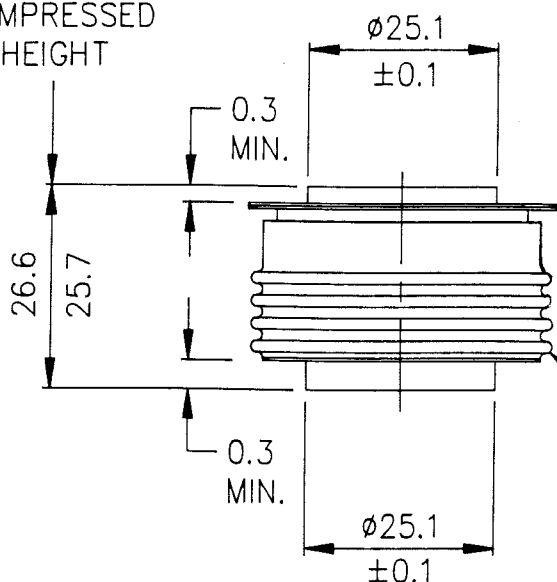
DEVICE MOUNTING: CLAMPING FORCE TO BE APPLIED ON
CENTRE LINE OF LOCATION HOLES AND BE EVENLY
DISTRIBUTED OVER AREA OF CONTACT. FLAT TOL. ON
SURFACES TO WHICH DEVICE IS CLAMPED TO BE 0.04 WIDE.
CLAMPING FORCE = 330-550kgf.

TYPE NUMBER

HXC084

HXC164

$\phi 3.6/3.5 \times 1.8$ MIN.
DEPTH 2-HOLES, ONE
IN CATHODE AND ONE
IN ANODE.

COMPRESSED
HEIGHT

CREEP PATH OVER
CONVOLUTION = 25.4 MIN.



THIRD ANGLE PROJECTION.

DWG. COMPLIES WITH BS 308.

DIMNS. IN MILLIMETRES.

DWG No.

100A317

UNCONTROLLED COPY



WESTCODE SEMICONDUCTORS LTD.,
P.O. BOX 57, CHIPPENHAM, WILTSHIRE, SN15 1JL, ENGLAND.
TEL 0249 441000. TELEX 44751 WESCDE G. TELEFAX 0249 659448.

THE INFORMATION CONTAINED IN THIS DWG IS PROTECTED BY COPYRIGHT. THE INFORMATION MAY NOT BE DISCLOSED EXCEPT WITH THE WRITTEN PERMISSION OF WESTCODE SEMICONDUCTORS LIMITED.

SCALE 1/1 ISS REVISIONS

DRAWN HDN 1 11.10.91

2E 18.6.93 M2256
DO-200AA DELETED

Ref AWF