

# Fast Recovery Diode Stud

## Types M0139S/RX120 to M0139S/RX180

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

(Rating Report 83NR3 Issue 2)

This data reflects the old part number for this product which is: SM12-18PHN/R100. 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:  
Only S/RM outline drawing (W21) in datasheet

The following links will direct you to the appropriate outline drawings

[Outline W20](#) – M12 Ceramic stud + lug

[Outline W21](#) – 3/8" Ceramic stud

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			
M0139	S/RX	◆◆	0
Fixed Type Code	S/RL - M12 Ceramic stud + lug S/RM – 3/8" Ceramic stud	Voltage code $V_{RRM}/100$ 12-18	Fixed Code
Typical Order Code: M0139SM120, Forward polarity, 3/8" Ceramic stud, 1200V $V_{RRM}$			

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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: 83NR3 Issue 2

Date: 18th January, 1994

Origin: Q.E.L.

Pages: 23

Stud Based Diode Type SM12-18PHN/R100

Written by: B. Holloway

Checked: *M. Shorb.*Approved: *[Signature]*

The series is based on a 19 mm diameter slice mounted under spring pressure in a stud base housing with flexible lead.

This Report supersedes 83NR3 Issue 1.

Ratings

Voltage Grades	: 12 - 18
$V_{RSM}$	: 1300-1900V
$V_{RRM}$	: 1200-1800V
$I_{F(AV)}$ Single phase: 50 Hz 180° half sinewave; (Converter Ratings)	
$T_{CASE} = 100^{\circ}C$	: 58A
$I_{F(rms)}$ max. ( $T_{CASE} 72^{\circ}C$ ) Housing limited	: 175A
$I_F$ max. ( $T_{CASE} 48^{\circ}C$ )	: 175A
$I_{FSM}$ : t = 10ms half sinewave; $T_J$ (initial) = 125°C	
$V_{RM} = 0.6V_{RRM(MAX)}$	: 2450A
$I_{FSM}$ : t = 10ms half sinewave; $T_J$ (initial) = 125°C	
$V_{RM} \leq 10V$	: 2700A
$I^2t$ : t = 10ms; $T_J$ (initial) = 125°C; $V_{RM} = 0.6V_{RRM(MAX)}$	: $3.0 \times 10^4 A^2 SEC$
$I^2t$ : t = 10ms; $T_J$ (initial) = 125°C; $V_{RM} \leq 10V$	: $3.65 \times 10^4 A^2 SEC$
$I^2t$ : t = 3ms; $T_J$ (initial) = 125°C; $V_{RM} \leq 10V$	: $2.7 \times 10^4 A^2 SEC$
$T_{CASE}$ Operating Range	: -40 to +125°C
$T_{stg}$ : Non-operating	: -40 to +150°C

-2-

### Characteristics

(Maximum values unless otherwise stated)

$V_o$ ) IFM < 500 A : IFM > 500 A	: 1.24 V : 1.46 V
$r_s$ )	: 1.28 mΩ : 0.8 mΩ
A : $T_J = 25^\circ\text{C}$ )	:
B : $T_J = 25^\circ\text{C}$ )	:
C : $T_J = 25^\circ\text{C}$ )	:
D : $T_J = 25^\circ\text{C}$ )	:
A : Constant )	:
B : $\ln(i_F)$ )	:
C : $i_F$ )	:
D : $\sqrt{i_F}$ )	:
$V_{FM}$ at $I_{FM} = 280$ A	: 1.6 V
$R_{th(J-C)}$	: 0.3 K/W
$R_{th(C-HS)}$	: 0.08 K/W
$I_{RRM}$ : at $V_{RRM(MAX)}$	: 20 mA
$V_{fr}$ : at $dI/dt =$ A/μs	:
Reverse recovery at $I_{FM} = 1000$ A; $t_p = 500$ μs $di_R/dt = 100$ A/μs; $V_{RM} = 50$ V	
$Q_{RR}$ (total area)	:
$Q_{RA}$ (50% chord)	: 90 μC
$t_{rr}$ (50% chord)	:
$I_{RM}$	:
Mounting Torque	: 11 Nm
Outline Drawing	: 100A294
JEDEC Outline No.	: DO - 8

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

R.R. No.	83NR3
R.R. Issue	2
Page Issue	1

## CONTENTS

	<u>Page</u>
Ratings and characteristics	1, 2
Voltage grade table	4
2. <u>Introduction</u>	5
3. <u>Notes on Ratings</u>	
(a) Square wave ratings	5
(b) Energy per pulse characteristics	5
(c) Housing Loss	5
(d) ABCD constants	5
(e) Reverse Recovery Ratings	5
4. <u>Reverse Recovery Ratings</u>	
(a) Determination by Measurement	6
(b) Design Method	7
Limit forward characteristic	8
Transient thermal impedance	9
Surge rating	10
Recovered charge	11
S factor	12
Reverse recovery energy per pulse	13
Square wave frequency rating	14
Square wave frequency rating	15
Square wave frequency rating	16
Square wave frequency rating	17
Energy per pulse	18
Energy per pulse	19
Sine wave frequency rating	20
Sine wave frequency rating	21
Sine wave energy per pulse	22
Outline drawing	23

R.R. No.	83NR3
R.R. Issue	2
Page Issue	1

Voltage Ratings

Voltage Class	$V_{RRM}$ V	$V_{RSM}$ V
12	1200	1300
14	1400	1500
16	1600	1700
18	1800	1900

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.	83NR3
R.R. Issue	2
Page Issue	1

## 2.0 INTRODUCTION

The diode series comprises fast recovery stud base devices with all diffused silicon slices. All these diodes have controlled reverse recovery characteristics with good "K" factors, and 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 50 A/ $\mu$ S and 100 A/ $\mu$ 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.

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

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

### (c) Housing Loss

The loss caused by coupling between housing and anode current (which gives rise to additional heating at high frequency) has been incorporated into the curves of forward energy loss per pulse.

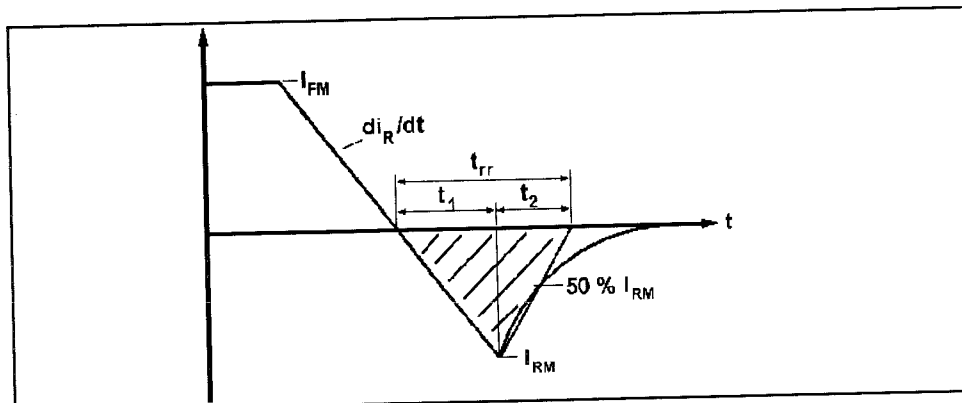
### (d) ABCD Constants

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

$$V_F = A + B \ln(i_F) + C i_F + D \sqrt{i_F} : \text{ where } i_F = \text{instantaneous forward current.}$$

### (e) Reverse recovery ratings

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



R.R. No.	83NR3
R.R. Issue	2
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 case temperature can then be evaluated from:

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

$$\text{where } r_t = 4.42 \times \sqrt{t} \cdot 10^{-4} \quad (\text{K/W})$$

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 case 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 13.

Let E be the value of energy per reverse cycle in joules (curves on p 13).

Let f be the operating frequency in Hz

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

where  $T_{\text{CASE new}}$  is the required maximum heat sink temperature and  $T_{\text{CASE original}}$  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.

- 7 -

R.R. No.	83NR3
R.R. Issue	2
Page Issue	1

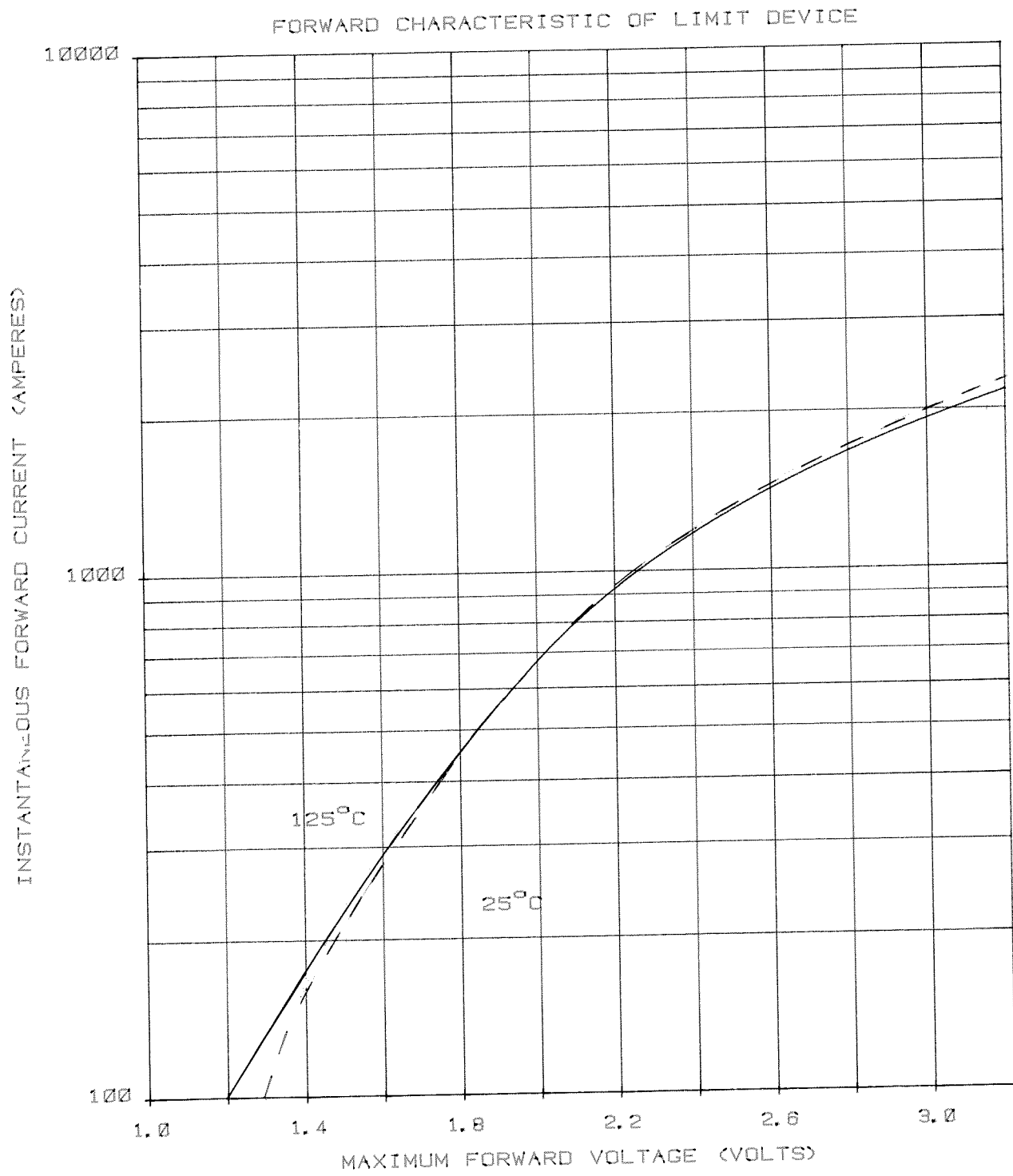
NOTE 1

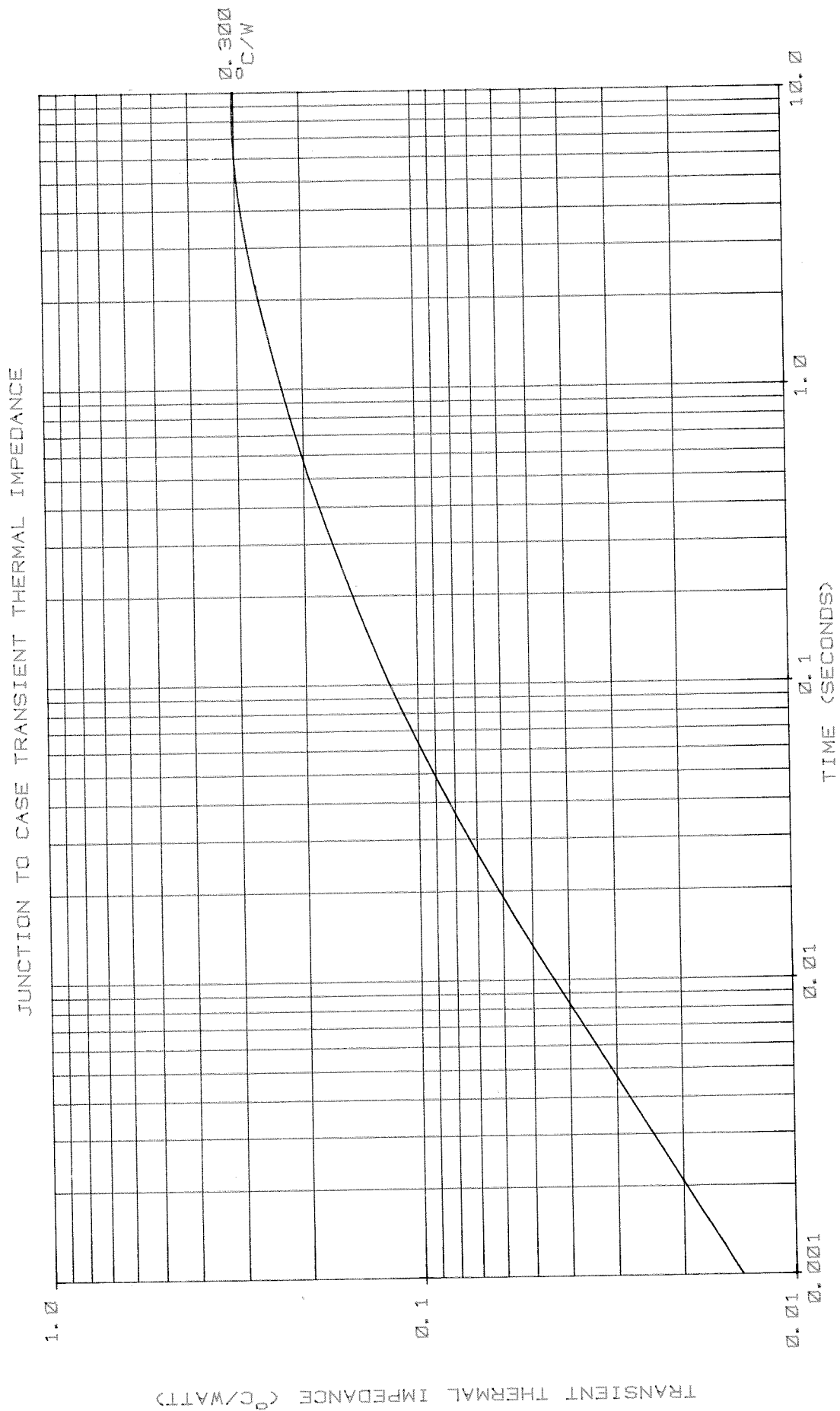
Reverse Recovery Loss by Measurement

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

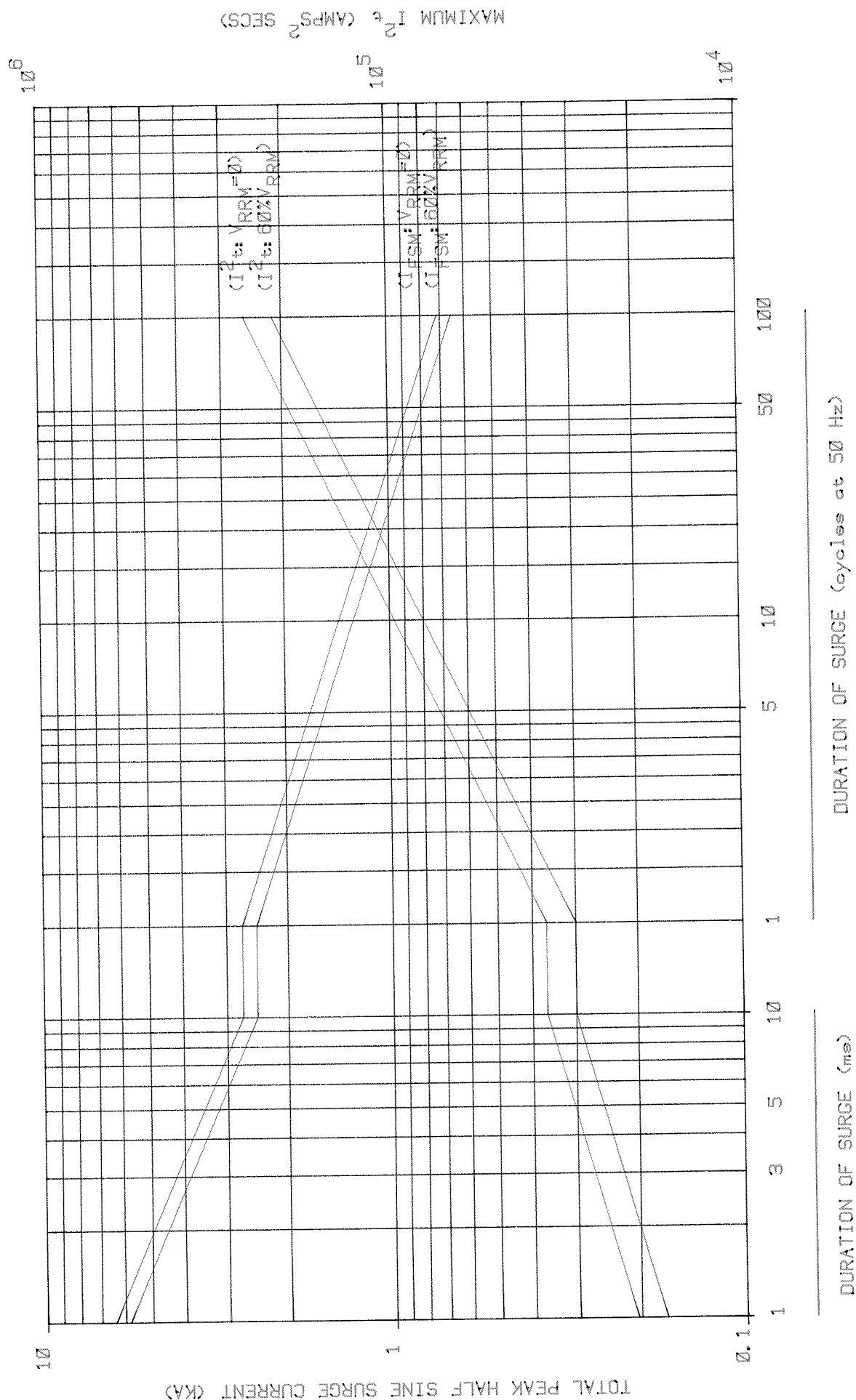
- (a) a.c. coupled devices such as current transformers are not affected by prior passage of high amplitude forward current.
- (b) A suitable, polarised, clipping circuit must be connected to the input of the measuring oscilloscope to avoid overloading the internal amplifiers by the relatively high amplitude forward current signal.
- (c) Measurement of reverse recovery waveform should be carried out with an appropriate snubber of 0.1  $\mu$ F, 5 ohms connected across diode anode to cathode.



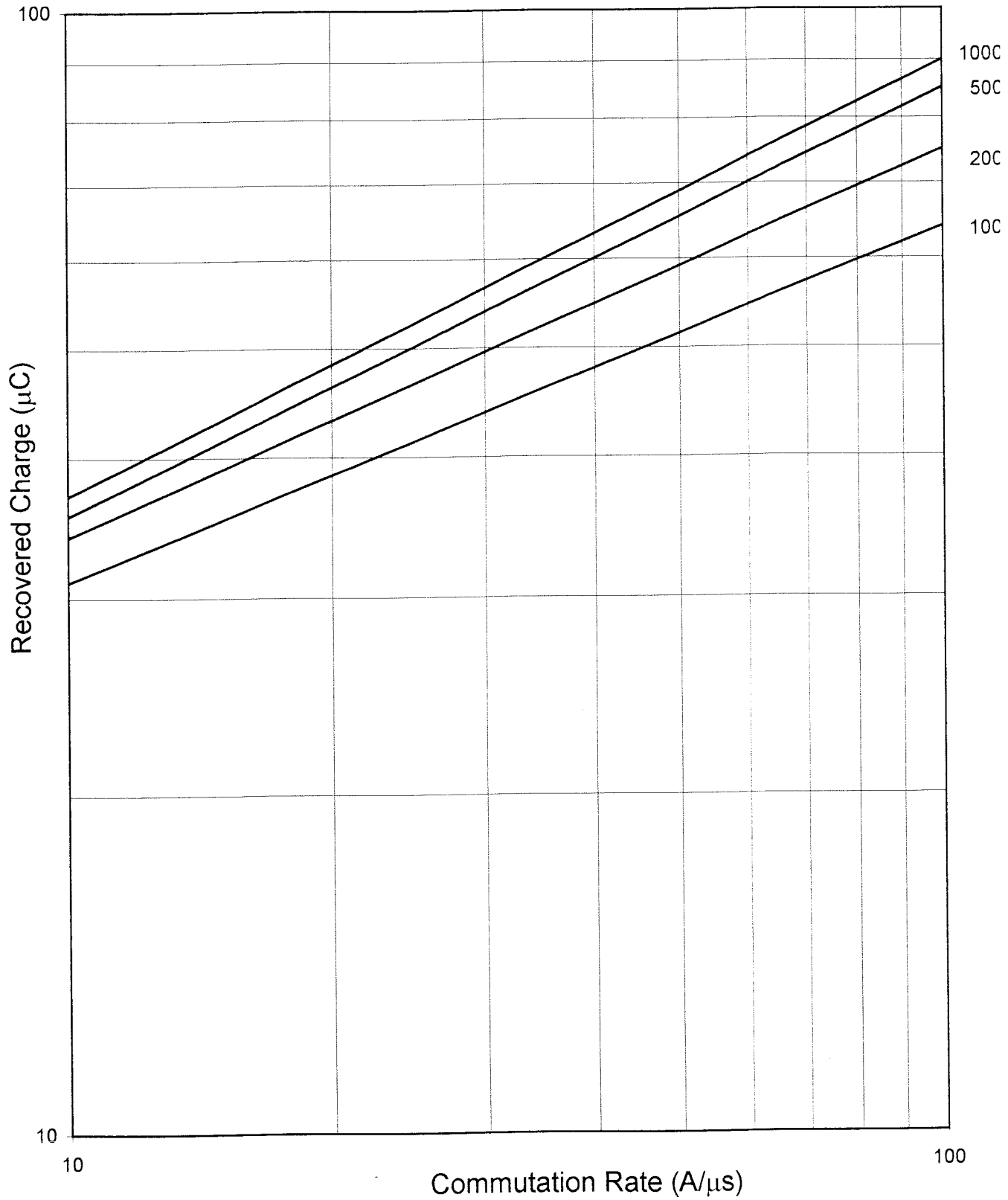




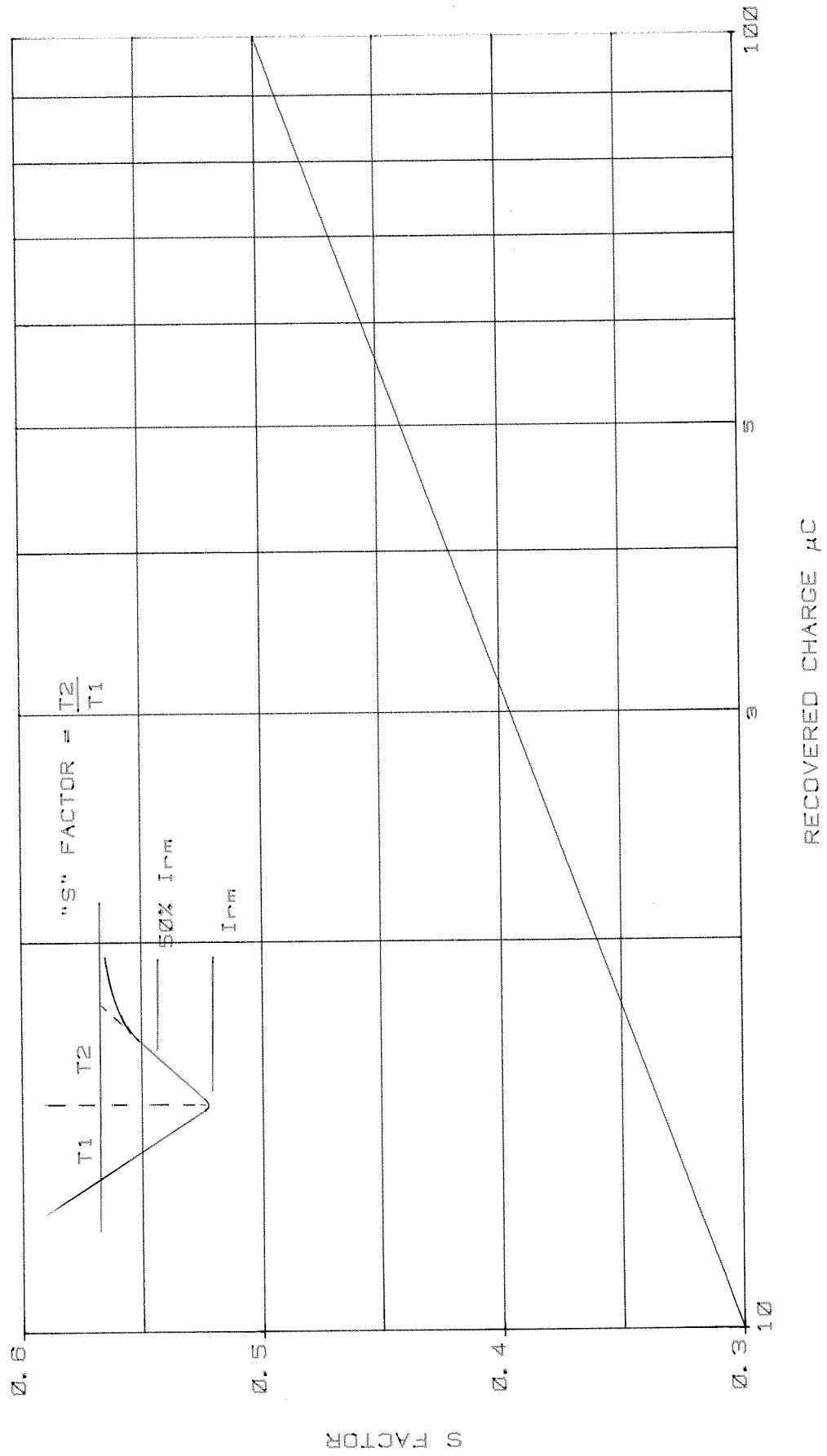
# MAXIMUM NON REPETITIVE SURGE CURRENT AT INITIAL JUNCTION TEMPERATURE 125°C



Maximum Recovered Charge  $Q_{ra}$  50 % Chord  
@125 °C Junction Temperature



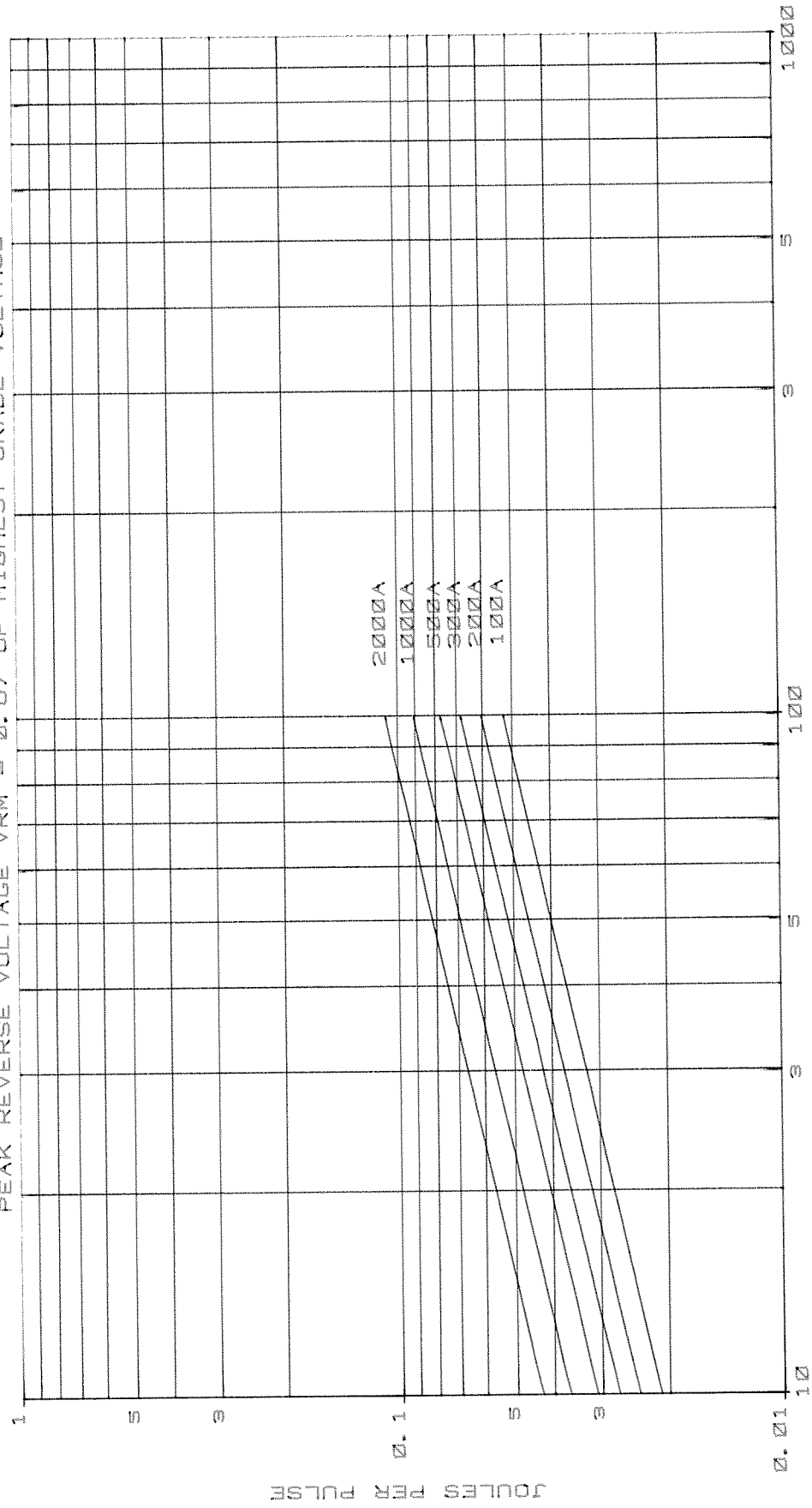
MINIMUM S FACTOR AT 125°C JUNCTION TEMPERATURE



MAXIMUM REVERSE RECOVERY ENERGY LOSS PER PULSE, 125°C JUNCTION TEMPERATURE

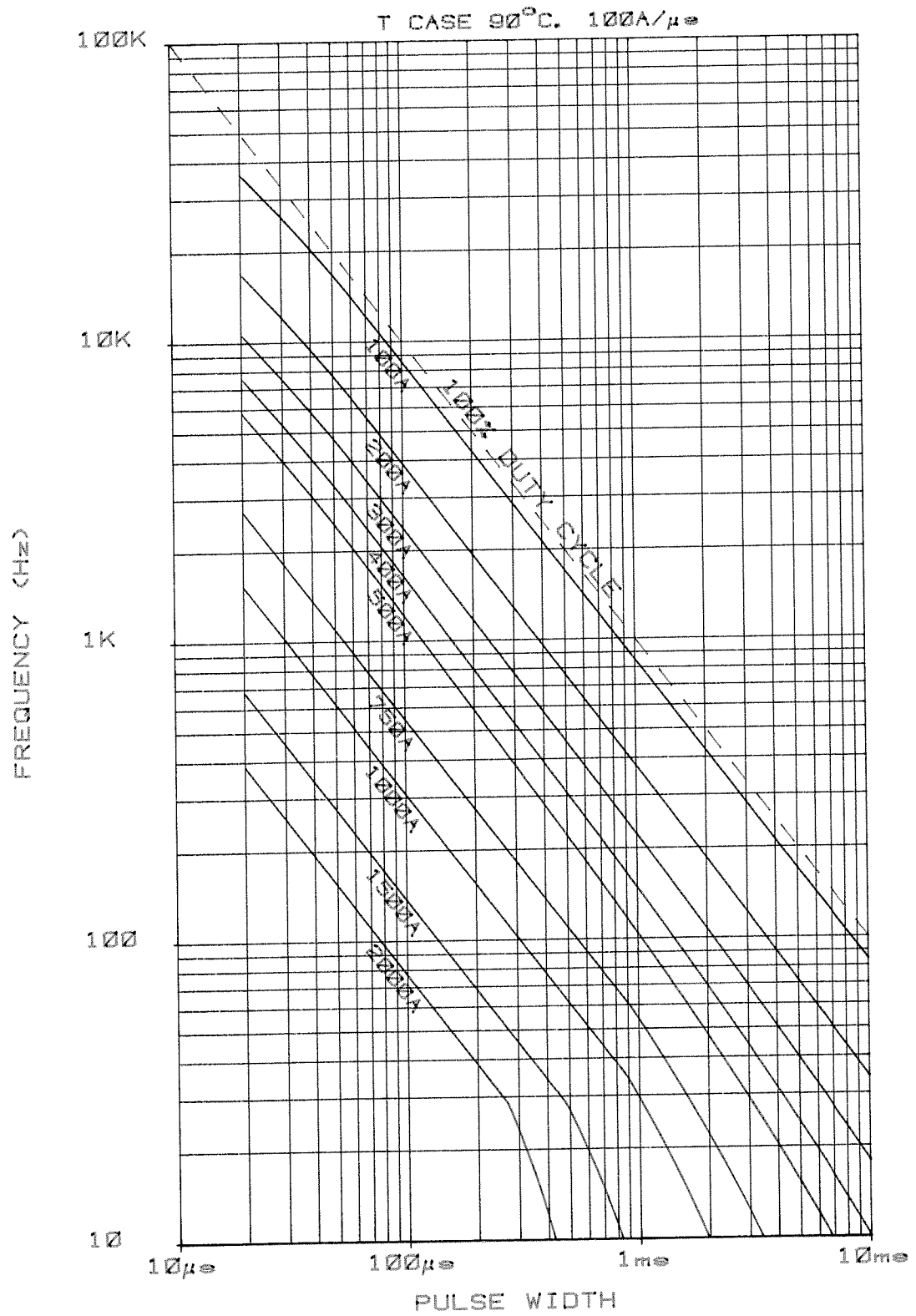
SNUBBER CONNECTED 0.1μF, 5 OHM. \*

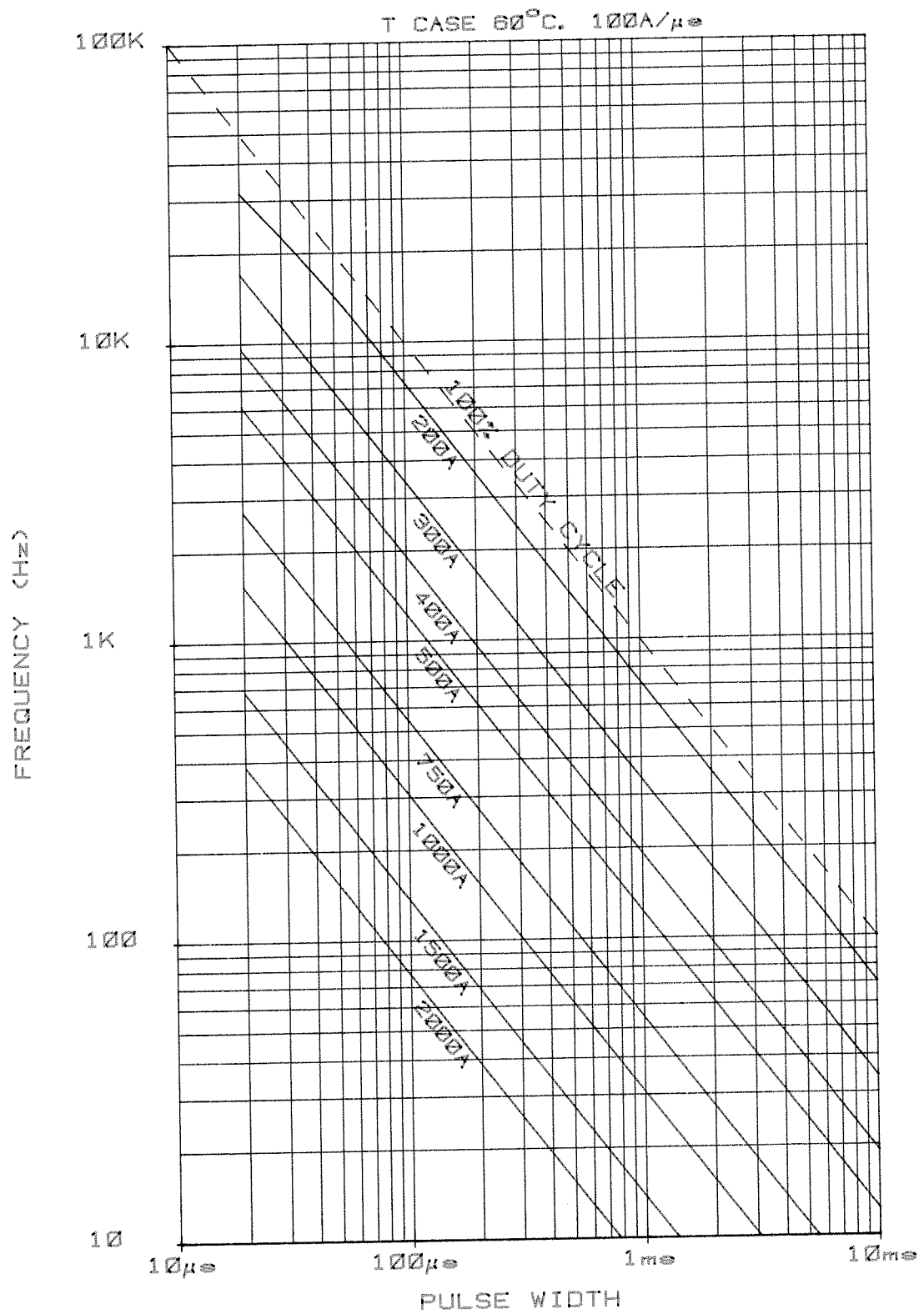
PEAK REVERSE VOLTAGE VRM = 0.67 OF HIGHEST GRADE VOLTAGE



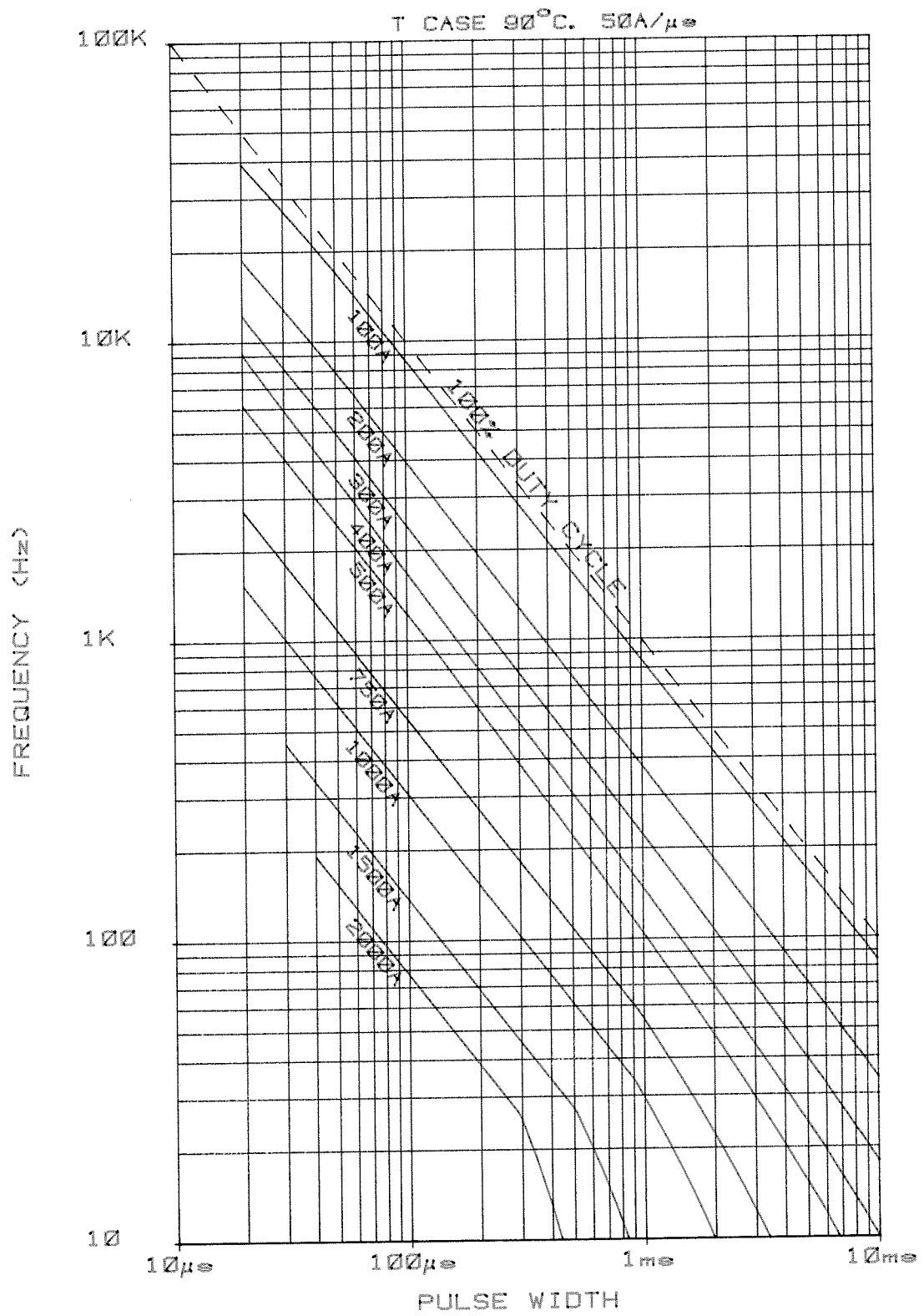
COMMUTATING  $di/dt$  AMPS/μs

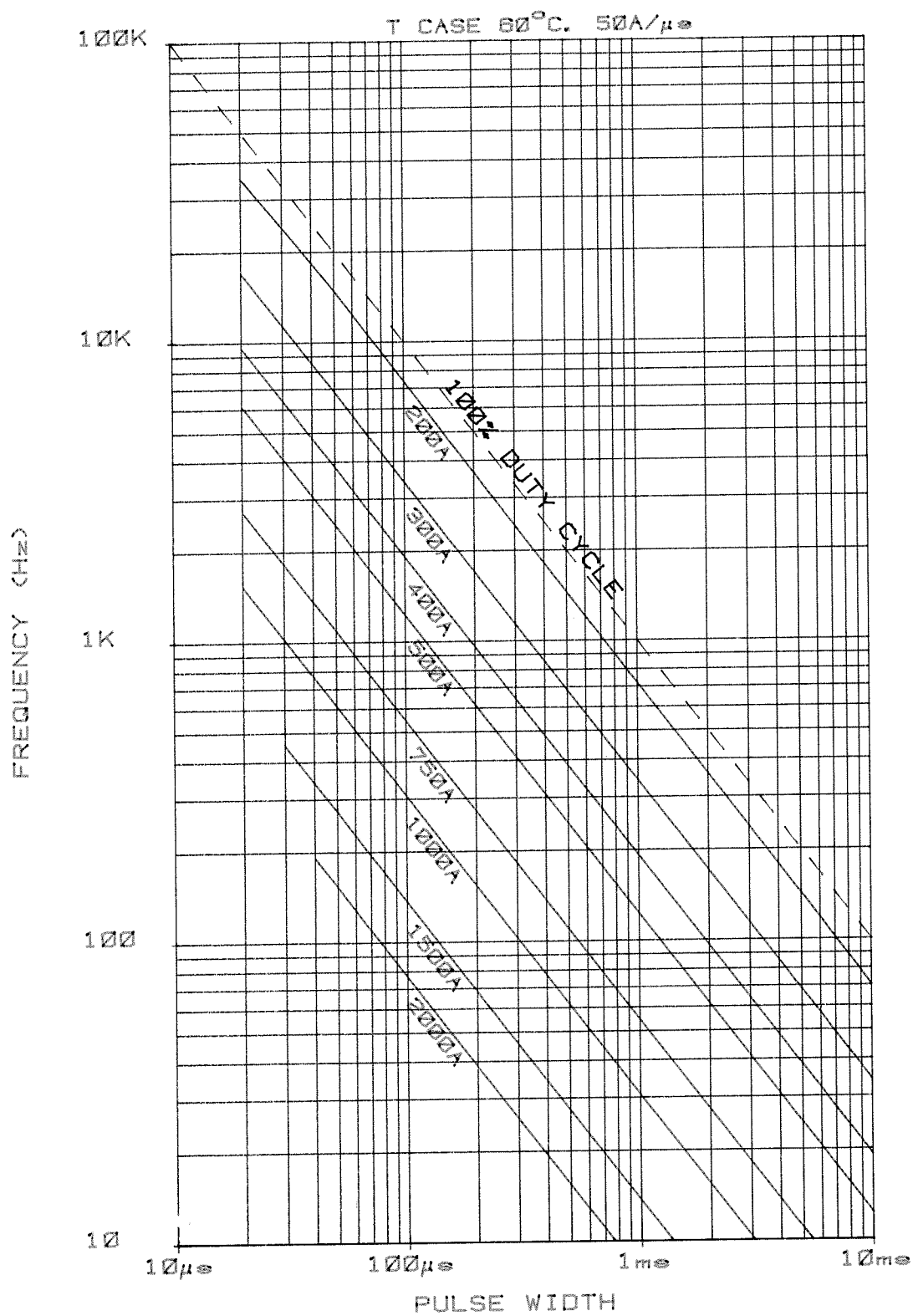
\* NOTE: ENERGY PER PULSE SHOULD BE ADJUSTED PRO RATA TO APPLIED PEAK RECOVERY VOLTAGE

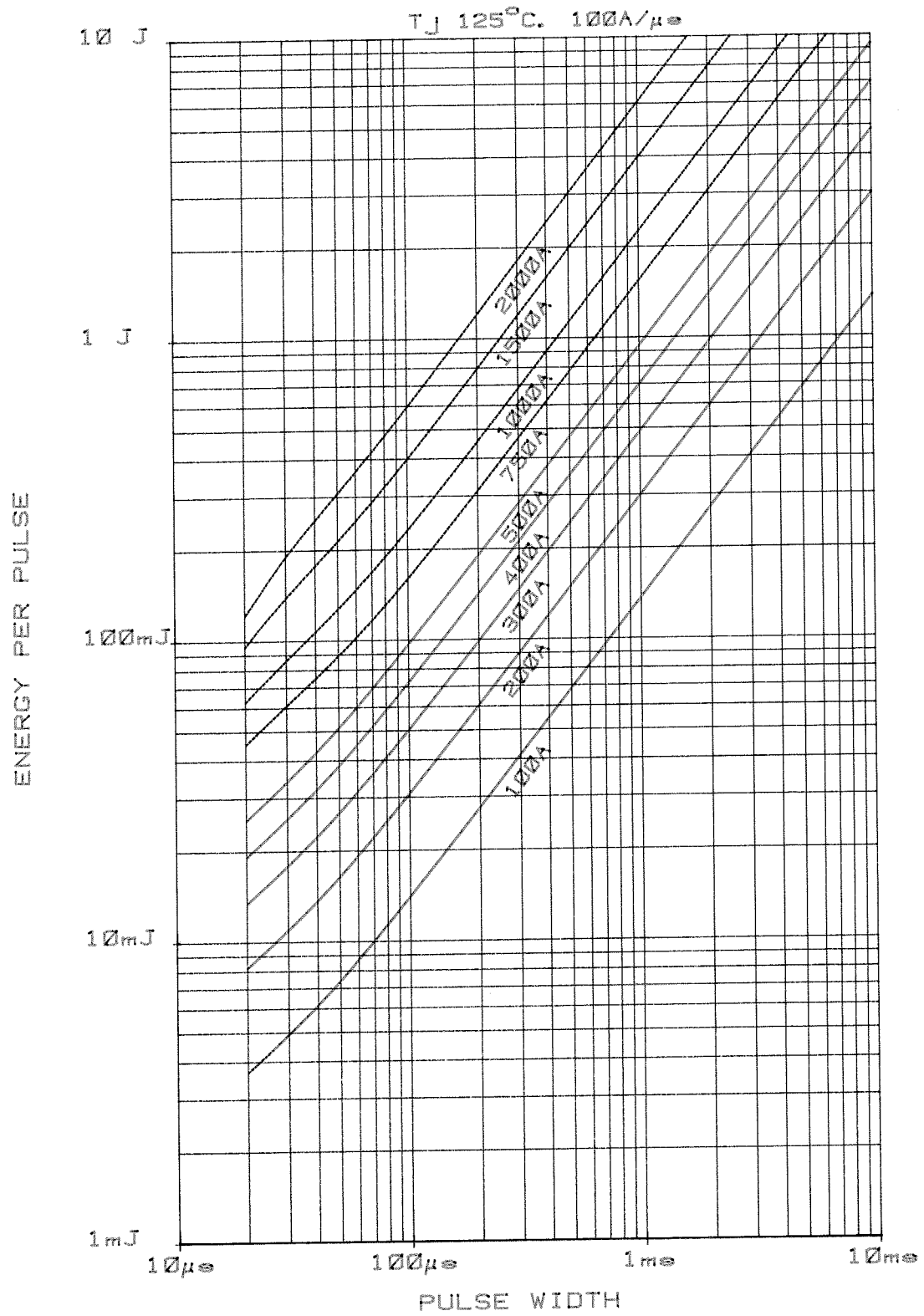


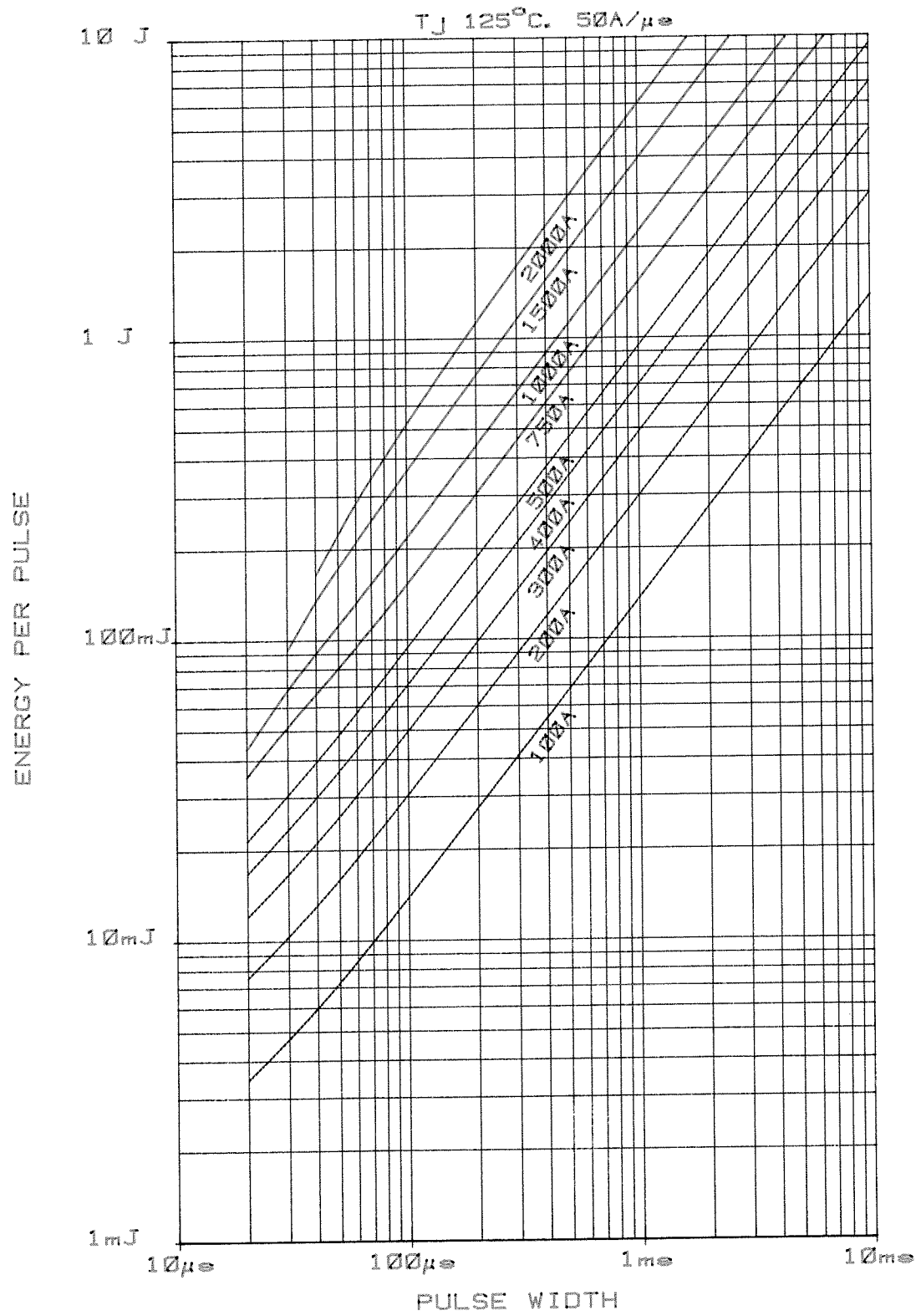


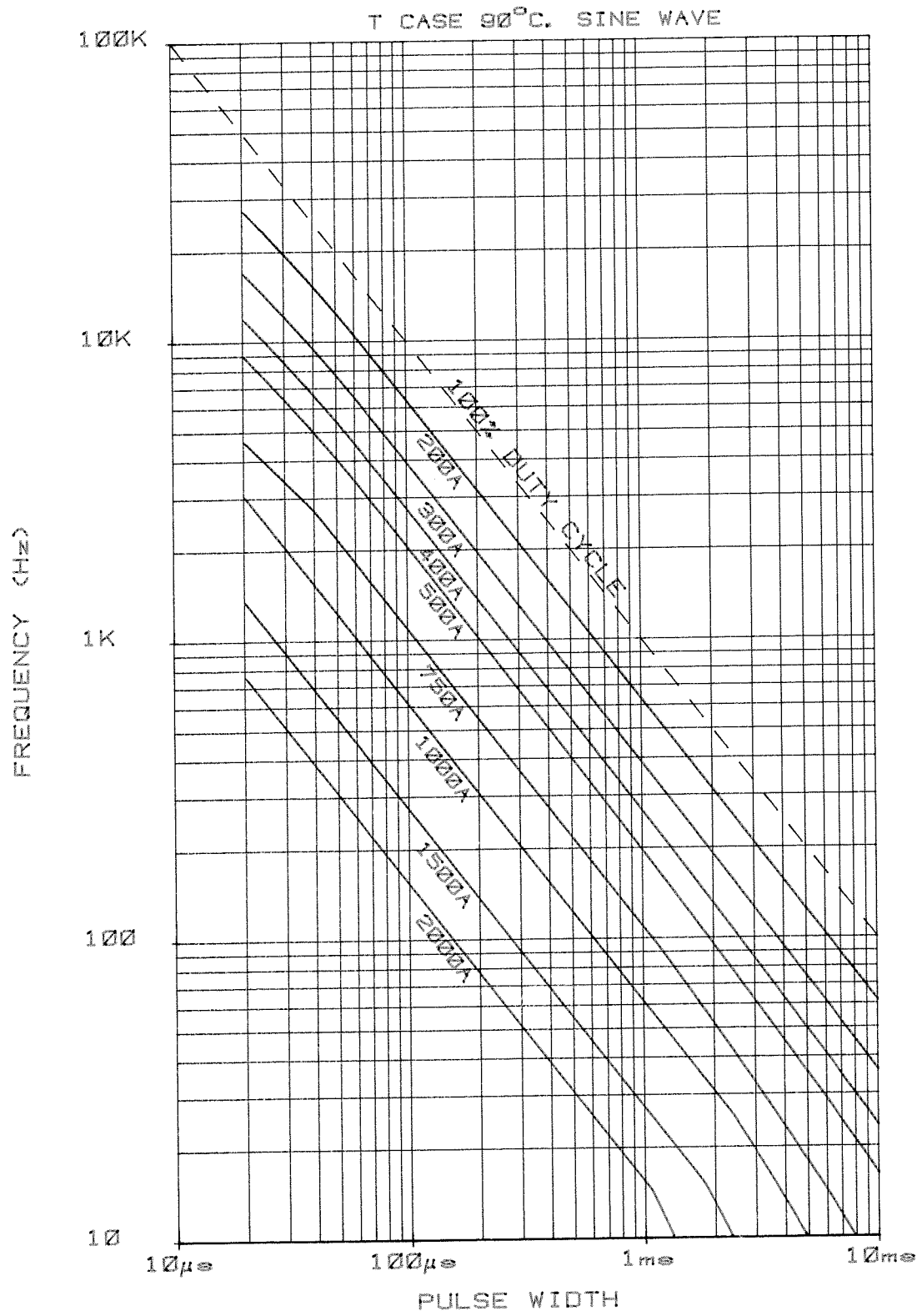


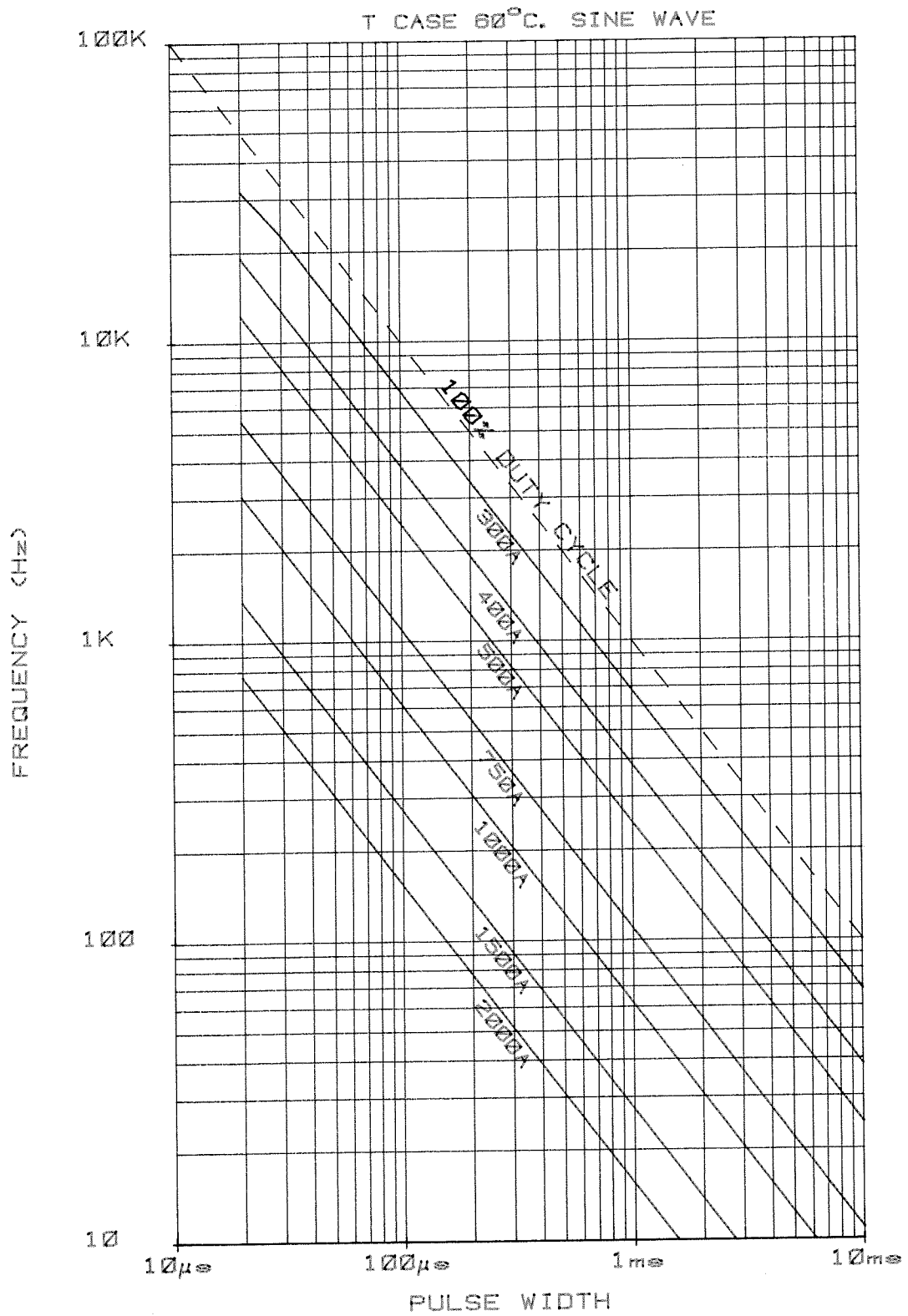


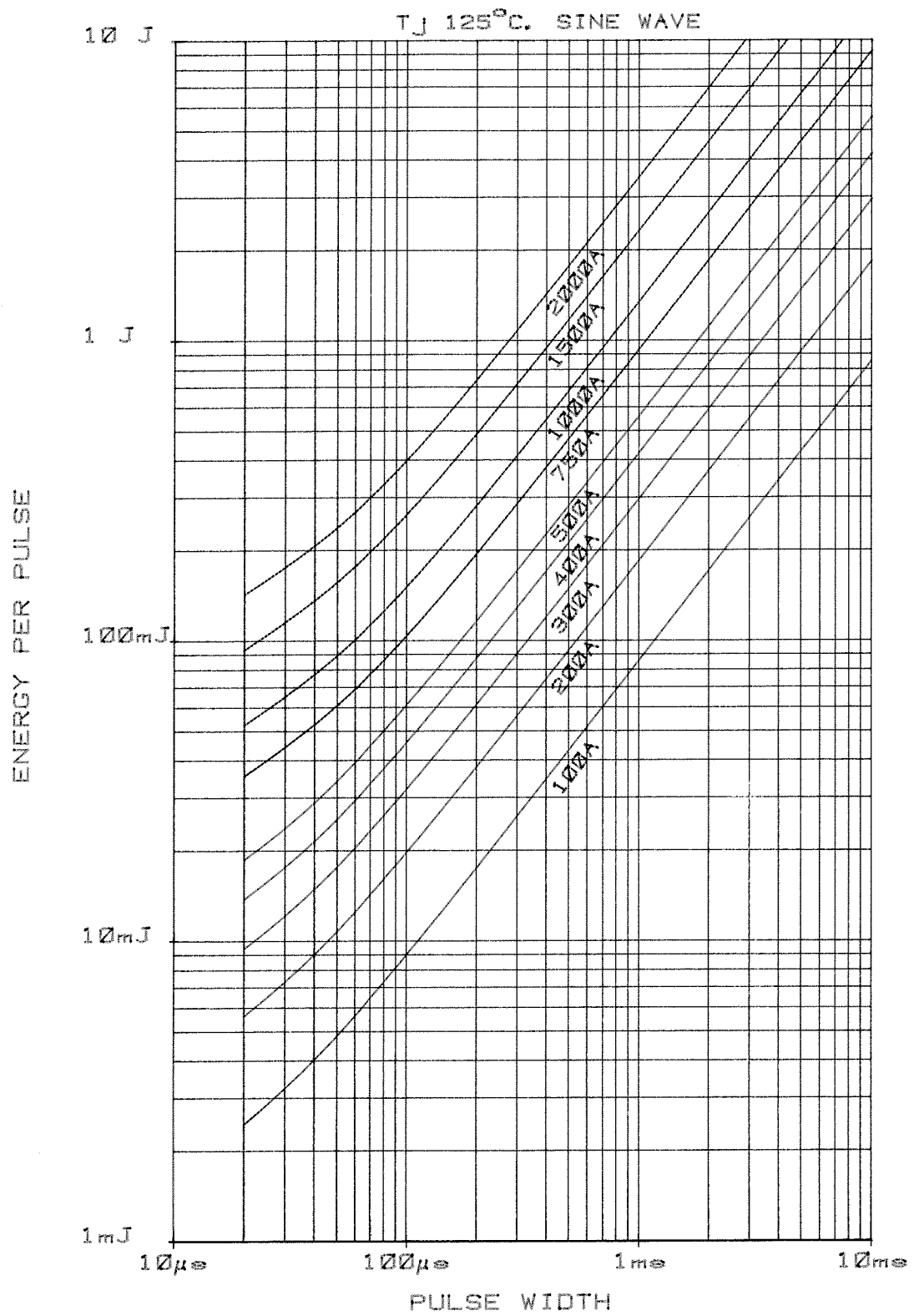












INTERNATIONAL OUTLINE No. DO-8

G.A. DWG No. 102A232

WEIGHT.

FINISH. BRIGHT NICKEL PLATE

DEVICE MOUNTING TORQUE:

3/8"UNF THREAD 14 Nm (1.4 kgf m)

DO NOT LUBRICATE THREADS.

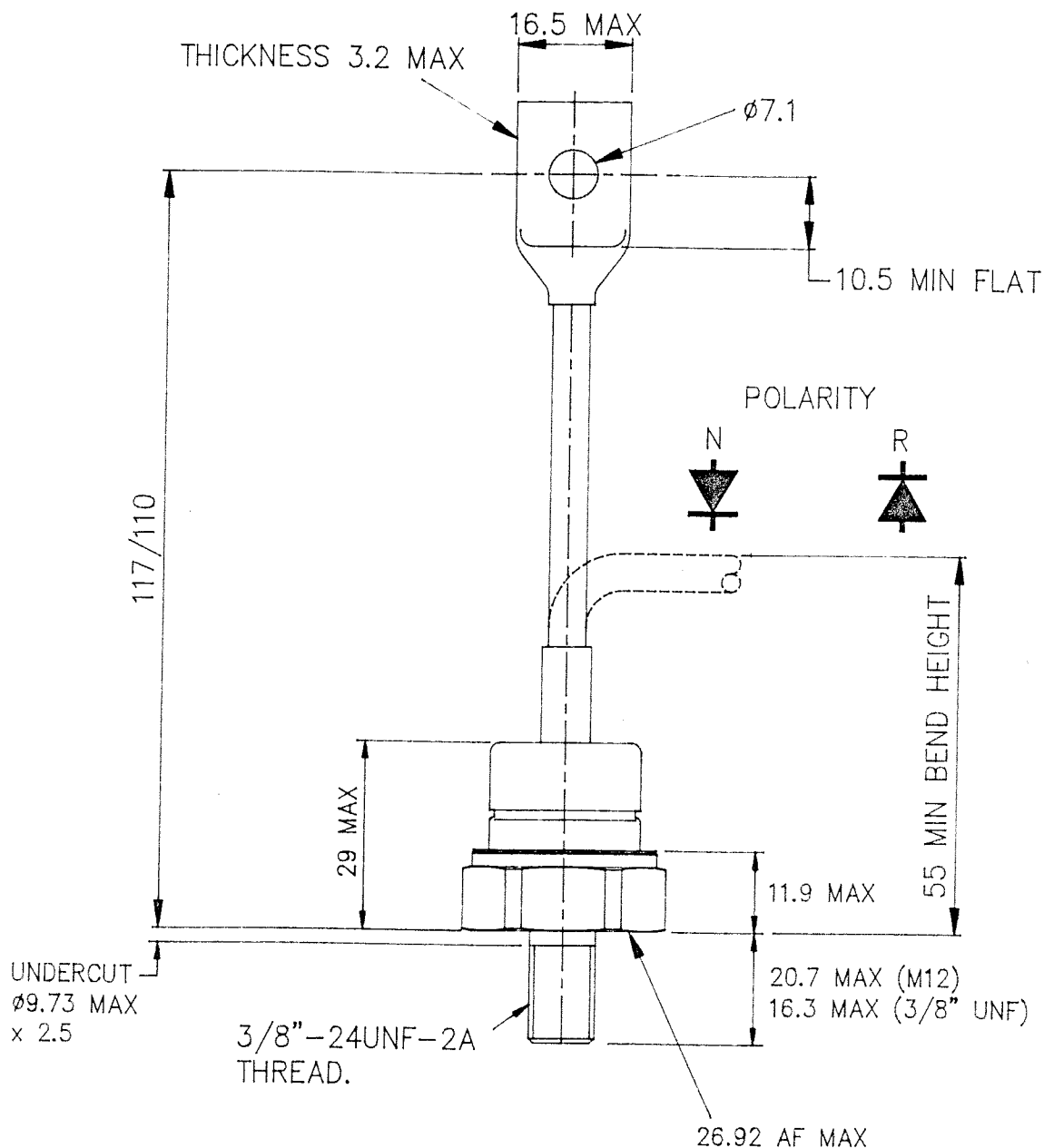
TYPE NUMBER

PHN094

PHR094

PHN100

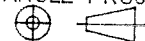
PHR100



SCALE 1/1	ISS	REVISIONS
DRAWN REF	1	13.6.83 P382
	3D	19.5.90 M1525 REDRAWN ON
		CAD. PHN/R100 ADDED. 11.9 WAS 11.7. U' CUT WAS ø9.47x2.66 AWF

P.O.

THIRD ANGLE PROJECTION.



DWG. COMPLIES WITH BS 308.

DIMNS. IN MILLIMETRES.

DWG No.

100A294

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