Fast Recovery Diode Stud
Types M0280S/RX200 to M0280S/RX250

The data sheet on the subsequent pages of this document is a scanned copy of existing data for this product.
(Rating Report 90NR2 Issue 2)

This data reflects the old part number for this product which is: SM16-25PCN/R144.
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 16 & 18 (1600V & 1800V V_{RRM})

The following links will direct you to the appropriate outline drawings
Outline W22 – ½" Ceramic stud and lug
Outline W24 – ¾" 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			
M0280	S/RX	♦♦	**0**
Fixed Type Code	S/RC – ¾" Ceramic stud S/RJ – ½" Ceramic stud and lug	Voltage code V_{RRM}/100 20-25	Fixed Code
Typical Order Code: M0280SC200, Normal polarity ¾" Ceramic stud, 2000V 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.

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QUALITY EVALUATION LABORATORY

Rating Report No: 90NR2 (Issue 2) Date: 8th March, 1993

Origin: Q.E.L. Pages: 27

Stud Based Diode Type: SM16-25PC/H N/R144

Written by: B. Holloway Checked: M Baker Approved:

The PCN/R144 series of fast recovery diodes are based on a 24 mm diameter silicon slice mounted under spring pressure in a study base housing. These diodes are particularly suitable for use in G.T.O. snubber networks.

This supersides 90NR2 Issue 1 dated 14.2.90 and 90NR4 Issue 1 dated 2.8.90.

Ratings

Voltage Grades	: 16 - 25
V_{RSM}	: 1700-2600V
V_{RRM}	: 1600V-2500V
$I_{F(AV)}$ Single phase: 50 Hz 180° half sinewave; T_{CASE} = 100°C	: 123A
$I_{F(rms)}$ max.	: 400A
I_F max.	: 400A
I_{FSM} : t = 10ms half sinewave; T_J (initial) = 125°C $V_{RM} = 0.6V_{RRM(MAX)}$	: 4500A
I_{FSM} : t = 10ms half sinewave; T_J (initial) = 125°C VRM $\leq$ 10V	: 4950A
I^2t : t = 10ms T_J (initial) = 125°C; $V_{RM} = 0.6V_{RRM(MAX)}$	: $1.0 \times 10^5 A^2S$
I^2t : t = 10ms; T_J (initial) = 125°C; $V_{RM} \leq$ 10V	: $1.23 \times 10^5 A^2S$
I^2t : t = 3ms; T_J (initial) = 125°C; $V_{RM} \leq$ 10V	: $1.91 \times 10^5 A^2S$
T_{CASE} Operating Range	: -40 to 125°C
T_{stg} : Non-operating	: -40 to 150°C

R.R. No.	90NR2
R.R. Issue	2
Page Issue	1

Characteristics
(Maximum values unless otherwise stated)

V_o :	: 1.28V
r_s :	: 0.92mohms
A : T_J = 25°C	: -
B : T_J = 25°C	: -
C : T_J = 25°C	: -
D : T_J = 25°C	: -
A	: 0.1805148
B	: 0.2223172
C	: 9.24871×10^{-4}
D	: -1.399568×10^{-2}
V_{FM} at I_{FM} = 470A	: 1.71V
$R_{th(J-C)}$	: 0.13 K/W
$R_{th(C-HS)}$	: 0.04 K/W
I_{RRM} : at $V_{RRM(MAX)}$	: 20mA
V_{fr} : at dI/dt = 400A/μS	: 51V typical

Reverse recovery at I_{FM} = 1000A; t_p = 200μs

di_R/dt = 150A/uS; V_{RM} = 50V

Q_{RR} (total area)	: 730μC
Q_{RA} (50% chord)	: 342μC
t_{rr} (50% chord)	: 2.8μS Typical
I_{RM}	: 265A

Mounting Torque	Type PCN/R	: 14 Nm
	Type PHN/R	: 24.5-27Nm
Outline Drawing	Type PCN/R	: 100A297
	Type PHN/R	: 100A280
JEDEC Outline No.		: -

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

R.R. No.	90NR2
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Voltage Ratings

Voltage Class	V_{RRM} V	V_{RSM} V
16	1600	1700
18	1800	1900
20	2000	2100
22	2200	2300
24	2400	2500
25	2500	2600

This Report is applicable to higher or lower voltage grades when supply has been agreed by Sales/Production.

2.0 Introduction

The diode series comprises fast recovery stud based devices with all diffused silicon slices. All these diodes have controlled reverse recovery characteristics with good "K" factors. 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 400 and 800A/uS.

(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: Ep be the Energy per pulse for a given current and pulse width in joules, and f be the repetition rate

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

$T_{CASE} = T_{J(MAX)} - Ep \times f \times R_{th}$

(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.

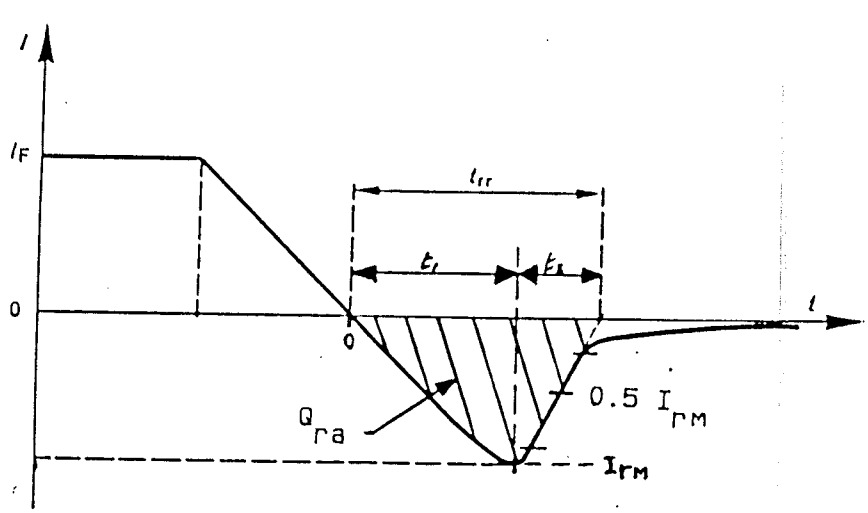
(d) ABCD Constants

These constants are the co-efficients of the semi-empirical expression for the forward characteristic given below:

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

(e) Reverse recovery ratings

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



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

$$\text{i.e. } Q_{rr} = \int_{t=0}^{150uS} I_r \cdot dt$$

(iii) K factor = t_1/t_2

4.0 Reverse recovery loss

On account of the number of circuit variables affecting reverse recovery voltage, no allowance for reverse recovery loss has been made in these ratings. 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 by A joules per pulse. A new case temperature can then be evaluated from:

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

where $r_t = 1.77 \times 10^{-4} \cdot \sqrt{t}$

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

$$W_{(TOT)} = W_{(original)} + Axf$$

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) The measuring oscilloscope has adequate dynamic range - typically 100 screen heights - to cope with the initial forward current without overload.

(c) Measurement of reverse recovery waveform should be carried out with an appropriate snubber of 0.1uF, 5 ohms connected across diode anode to cathode.

(b) Design Method

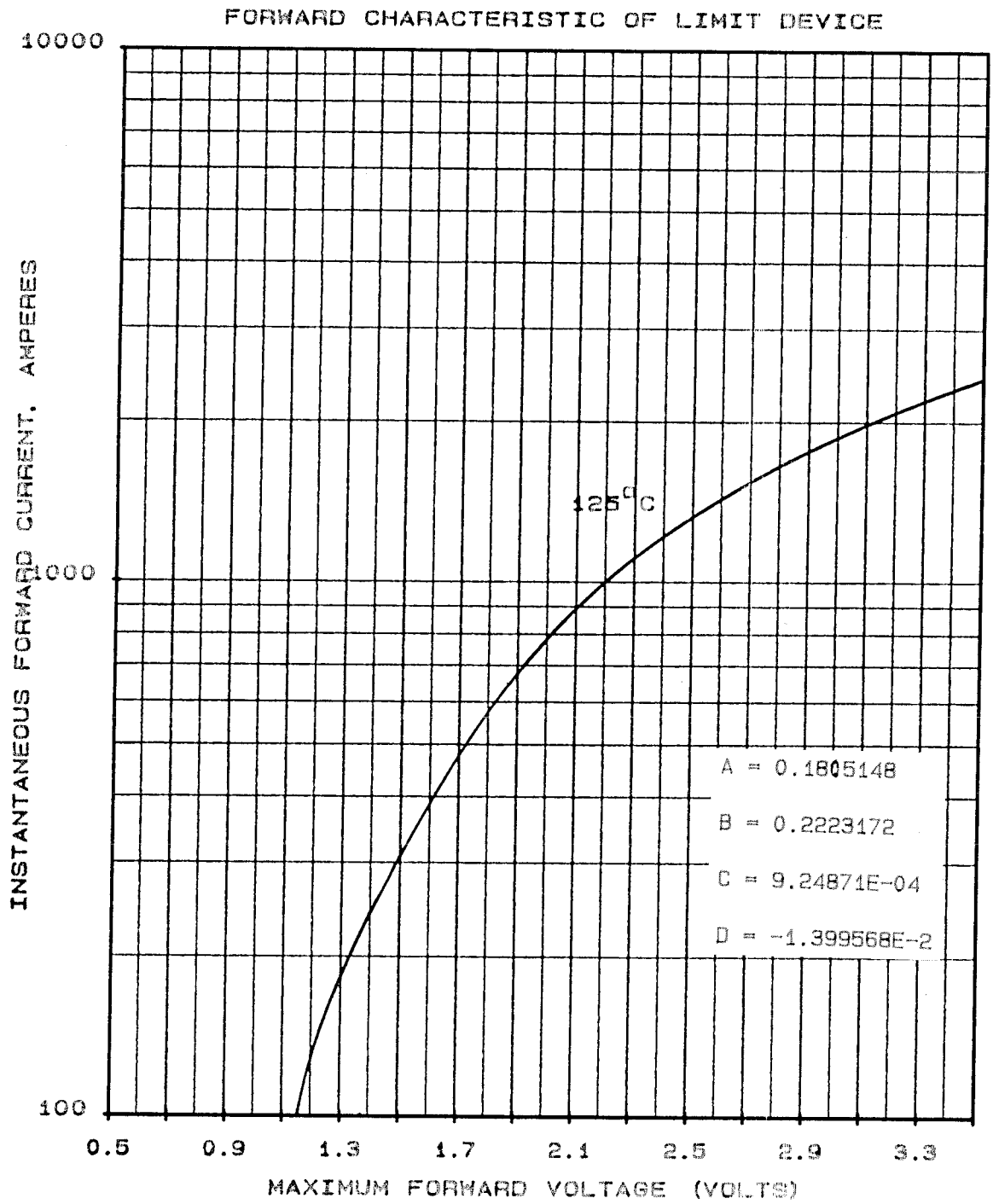
In circumstances where it is not possible to measure voltage and current conditions, or for design purposes, the additional losses may be estimated from curves on pages 16.

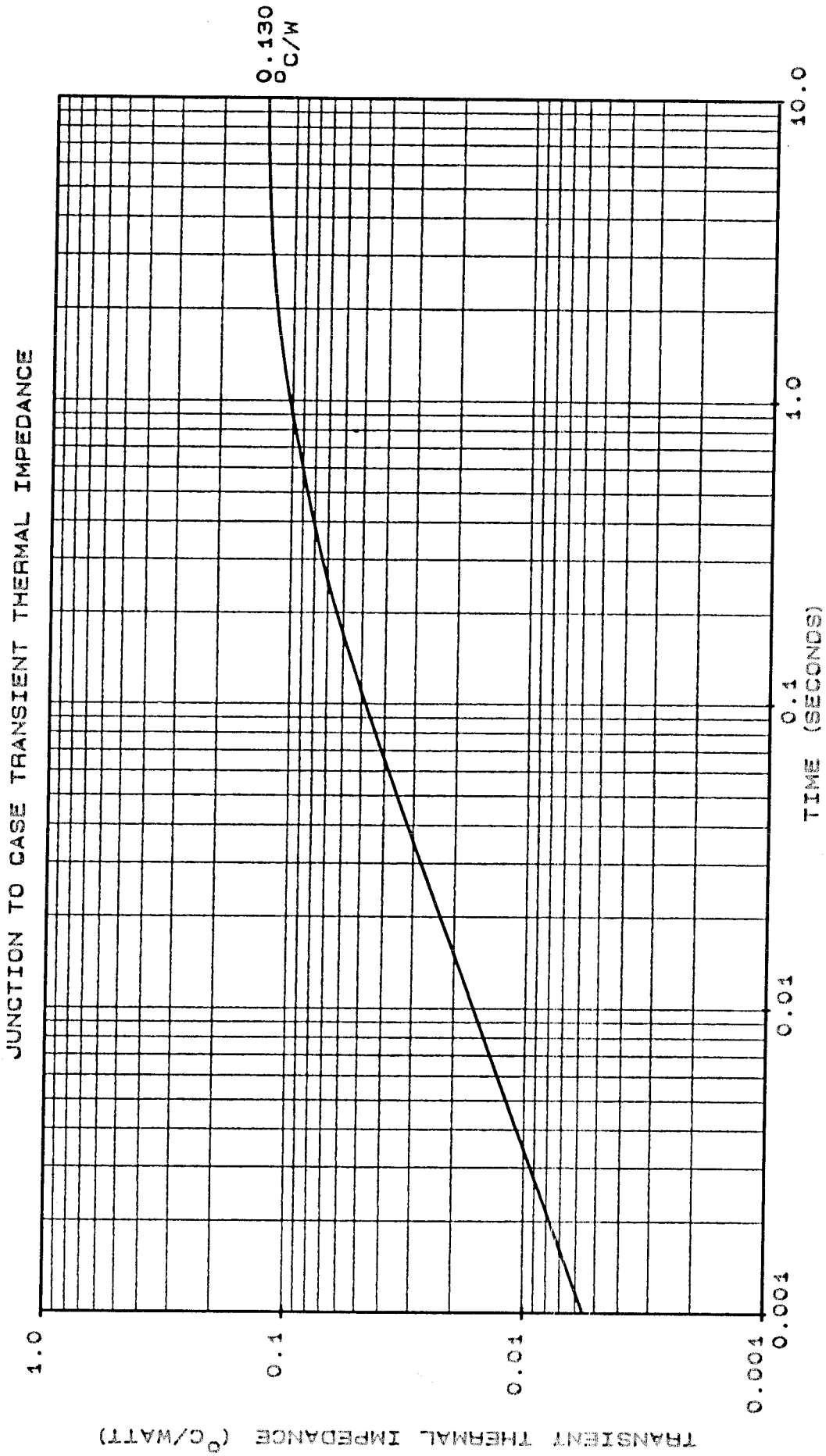
Let E be the value of energy per reverse cycle in joules (curves on page 16.

Let f be the operating frequency in Hz

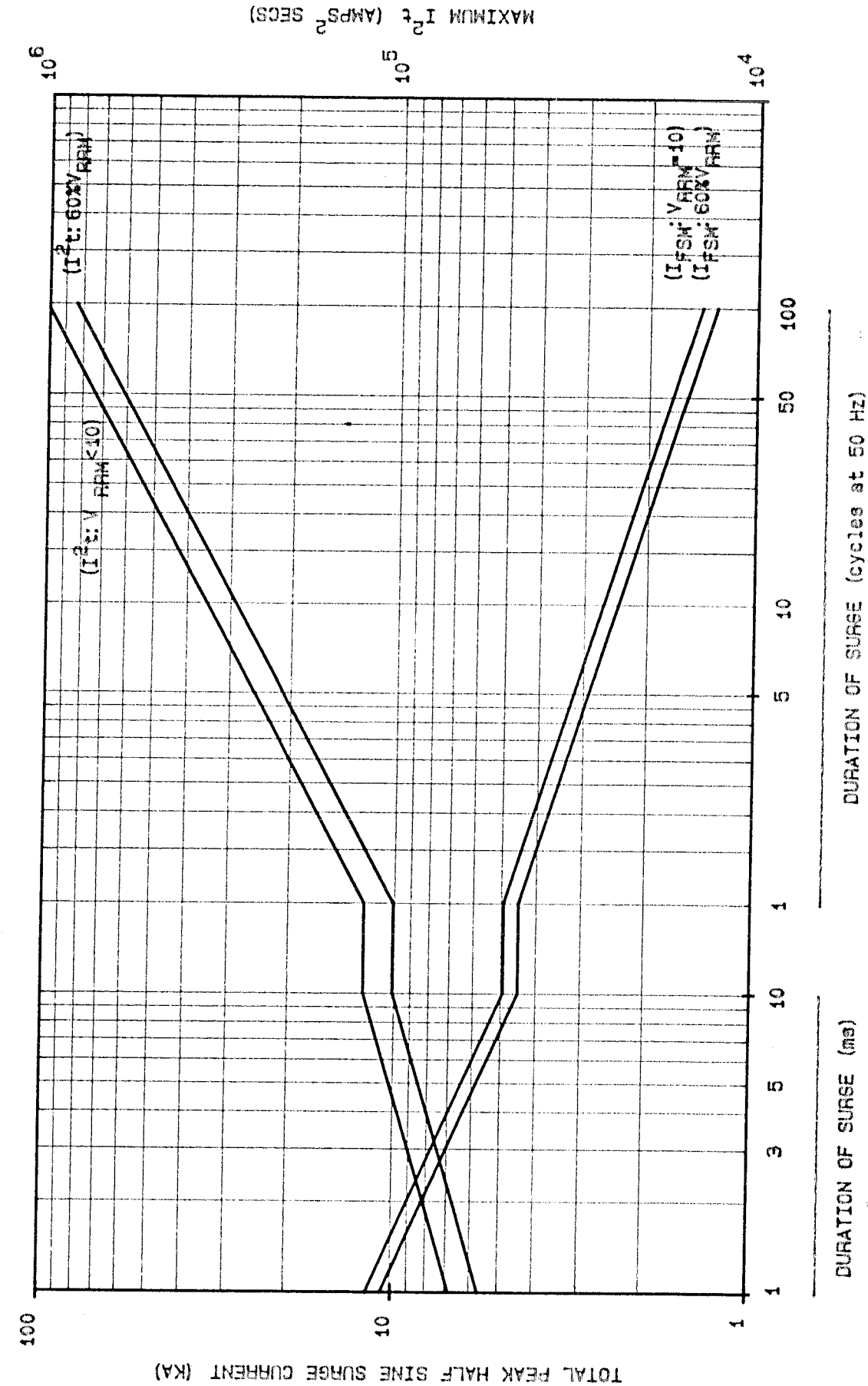
Then T_{CASE} new = T_{CASE} original - ER_{th} x f

Where T_{CASE} new is the required maximum case temperature and T_{CASE} original is the case temperature given with the frequency ratings.

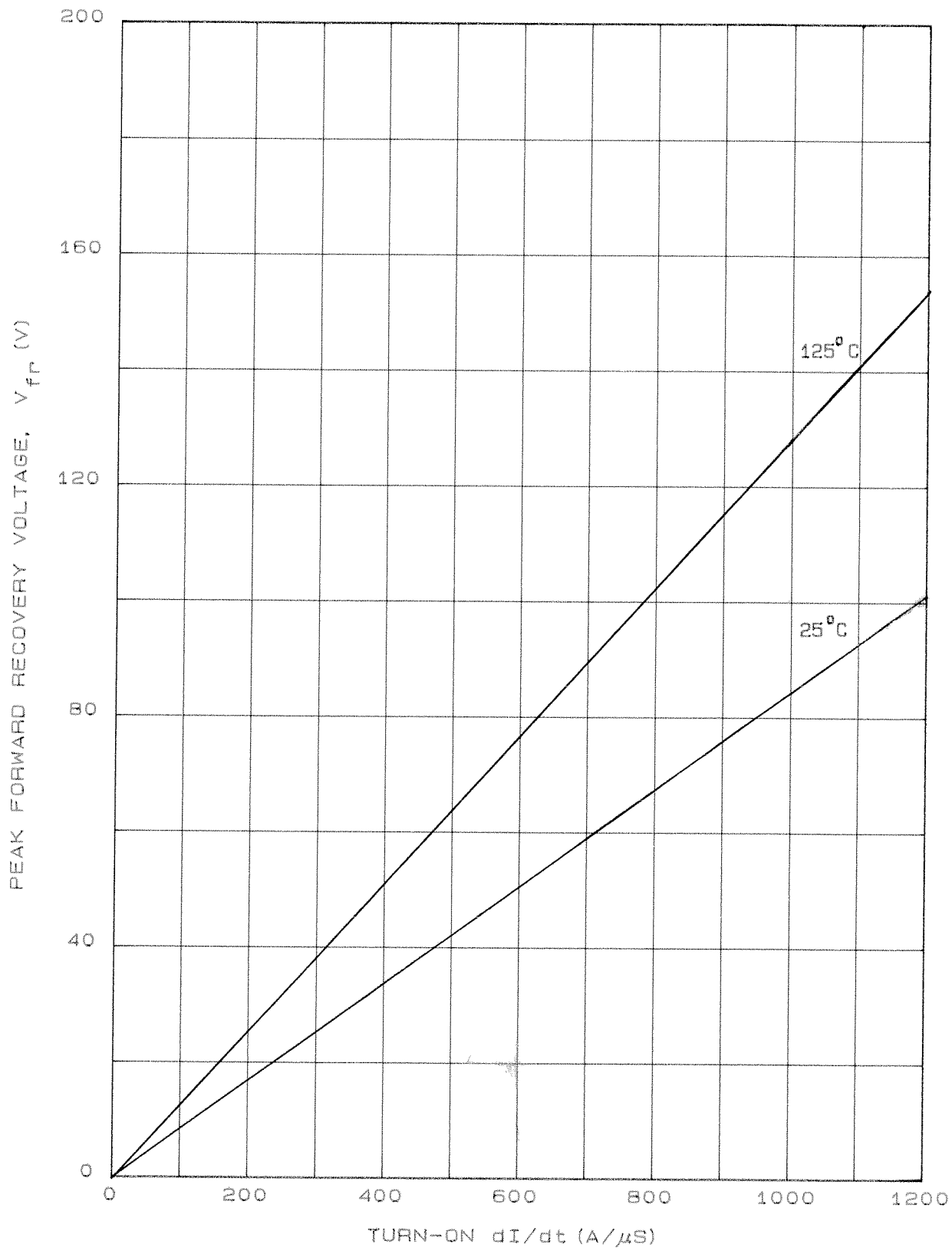

FORWARD CHARACTERISTIC OF LIMIT DEVICE
10000
1000
100
INSTANTANEOUS FORWARD CURRENT, AMPERES
125°C
A = 0.1805148
B = 0.2223172
C = 9.24871E-04
D = -1.399568E-2
0.5
0.9
1.3
1.7
2.1
2.5
2.9
3.3
MAXIMUM FORWARD VOLTAGE (VOLTS)


JUNCTION TO CASE TRANSIENT THERMAL IMPEDANCE
0.130 °C/W
TRANSIENT THERMAL IMPEDANCE (°C/WATT)
1.0
0.1
0.01
0.001
0.004
0.01
0.1
1.0
10.0
TIME (SECONDS)

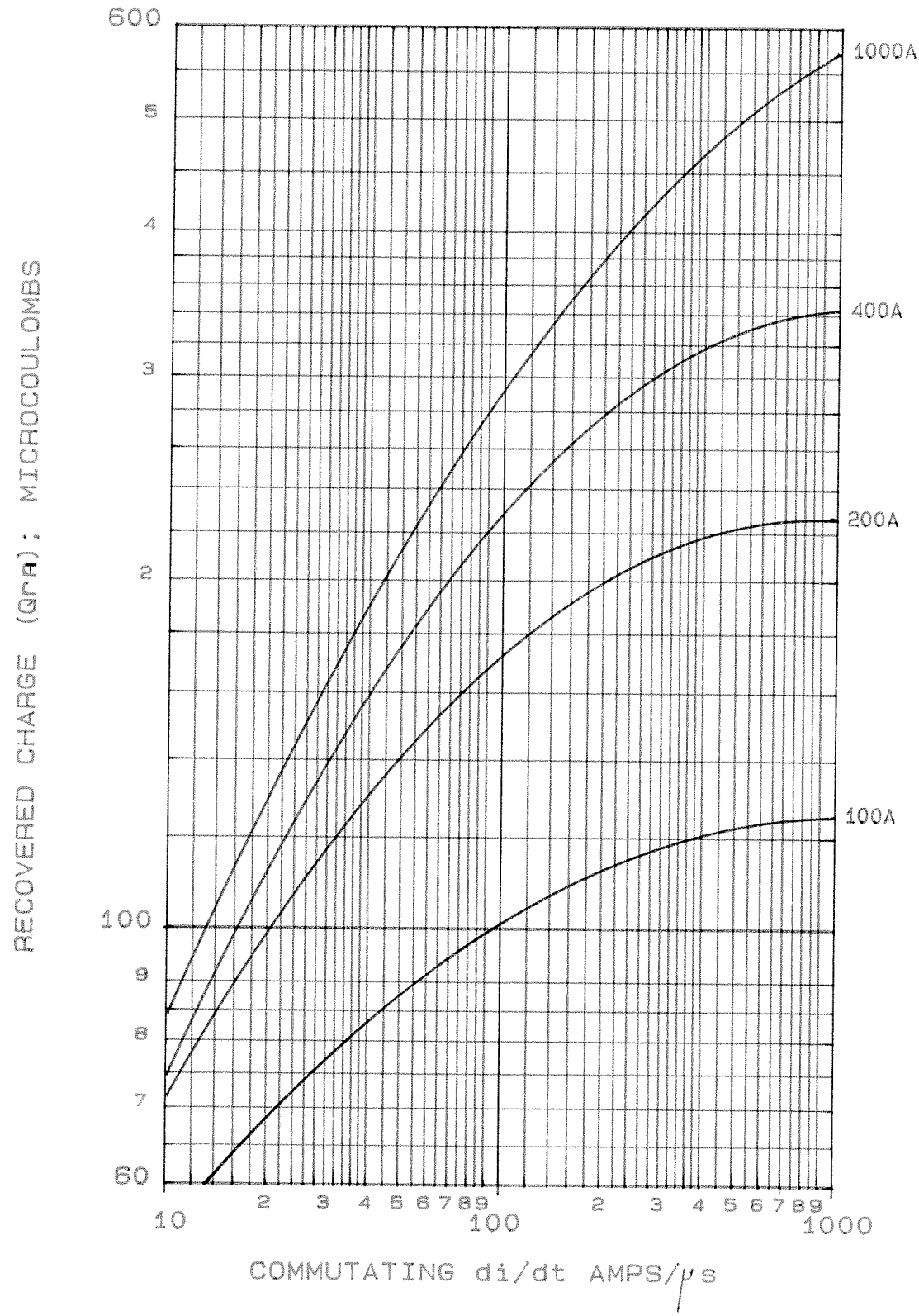
MAXIMUM NON REPETITIVE SURGE CURRENT AT INITIAL JUNCTION TEMPERATURE 125°C



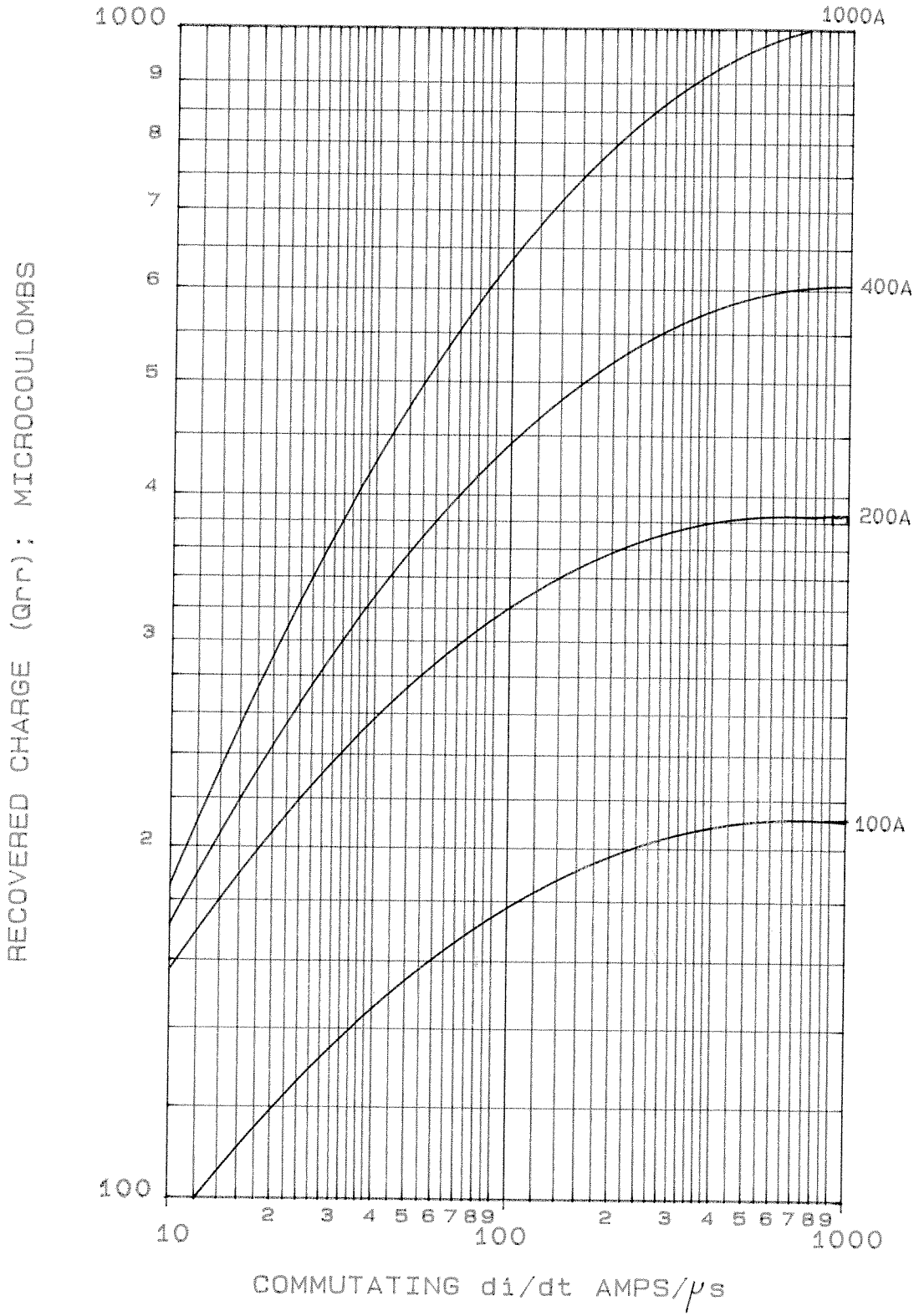
TYPICAL FORWARD RECOVERY VOLTAGE



MAXIMUM RECOVERED CHARGE AT 125°C JUNCTION TEMPERATURE

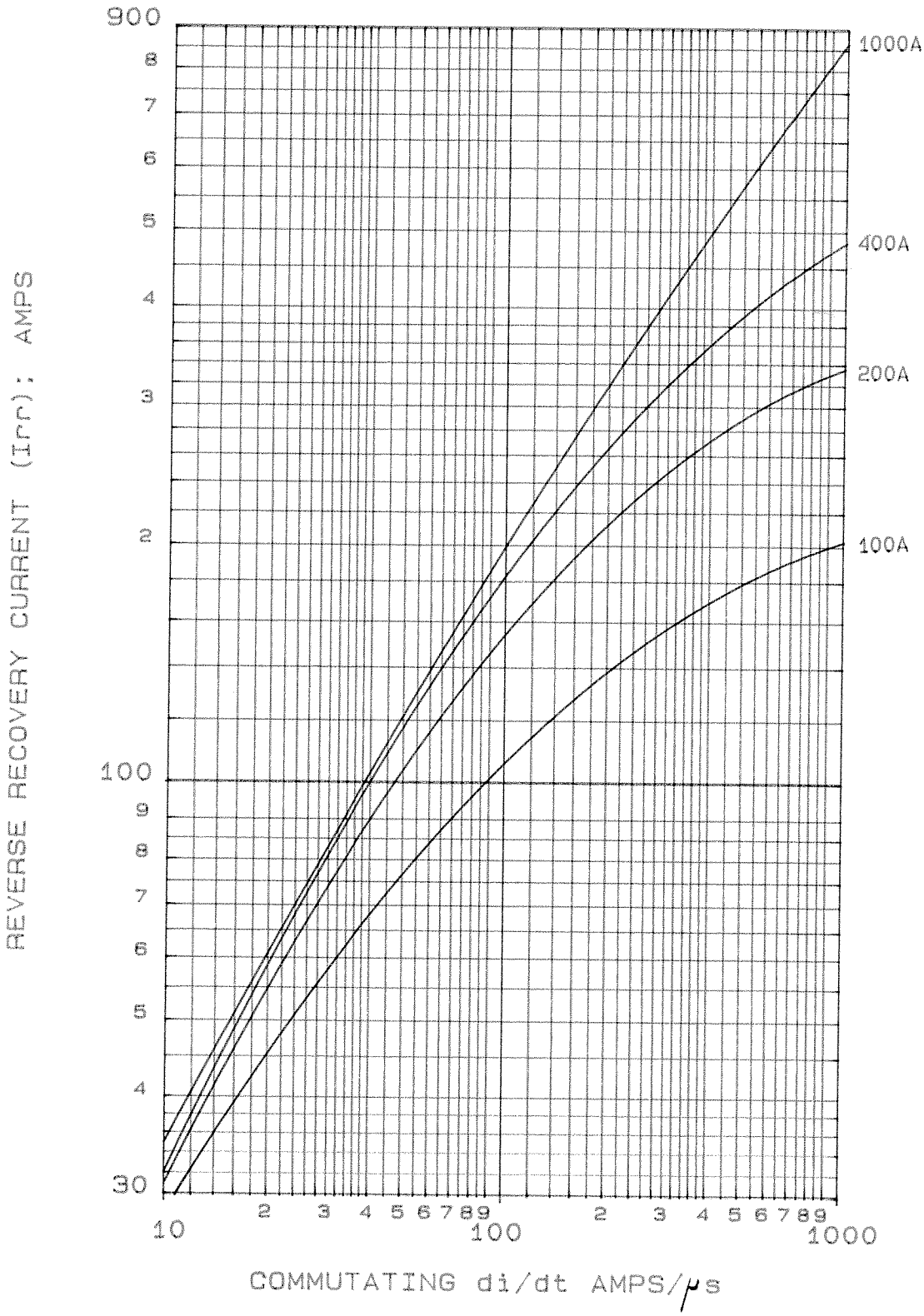


MAXIMUM RECOVERED CHARGE AT 125°C JUNCTION TEMPERATURE



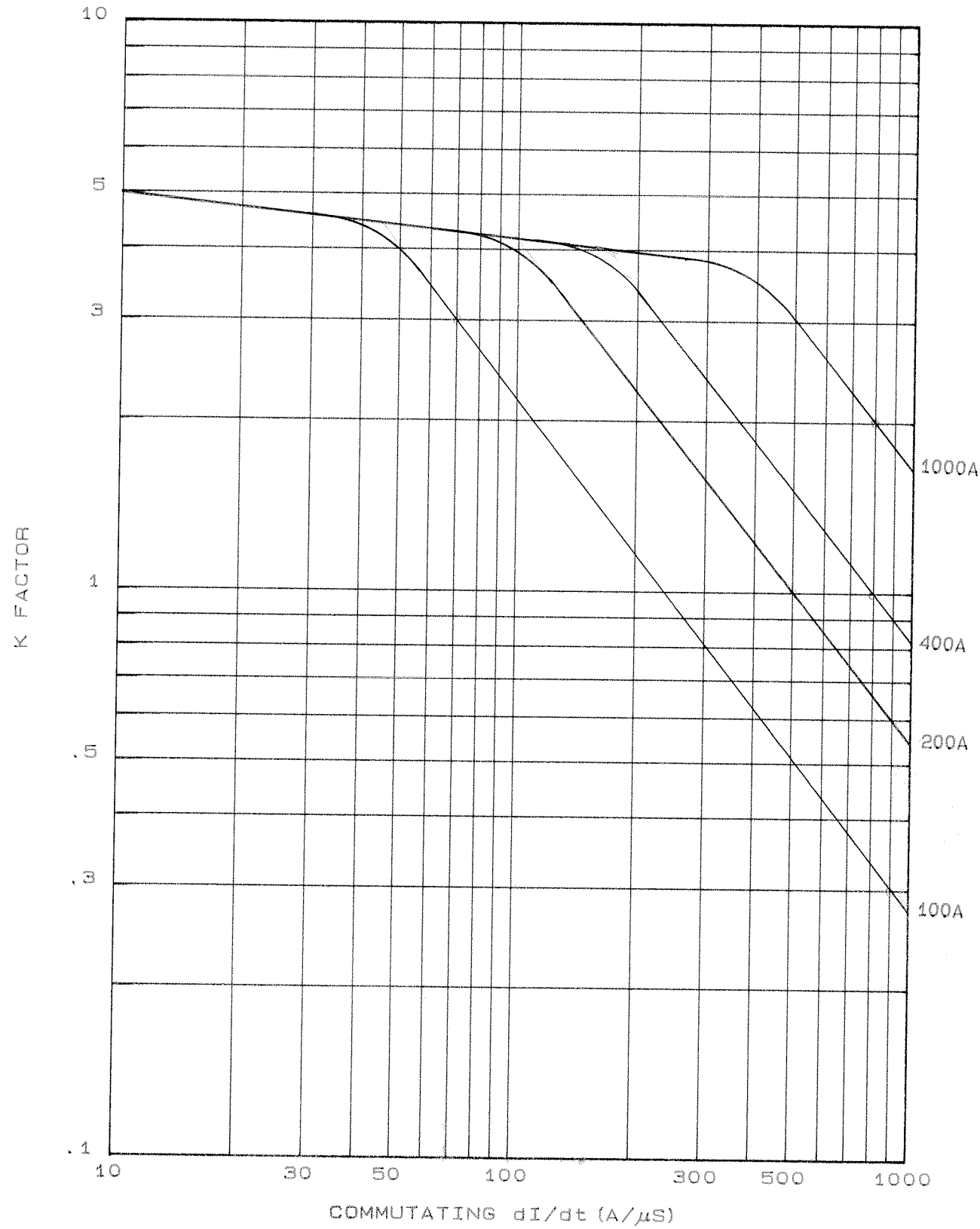
MAXIMUM REVERSE RECOVERY CURRENT

AT 125°C JUNCTION TEMPERATURE

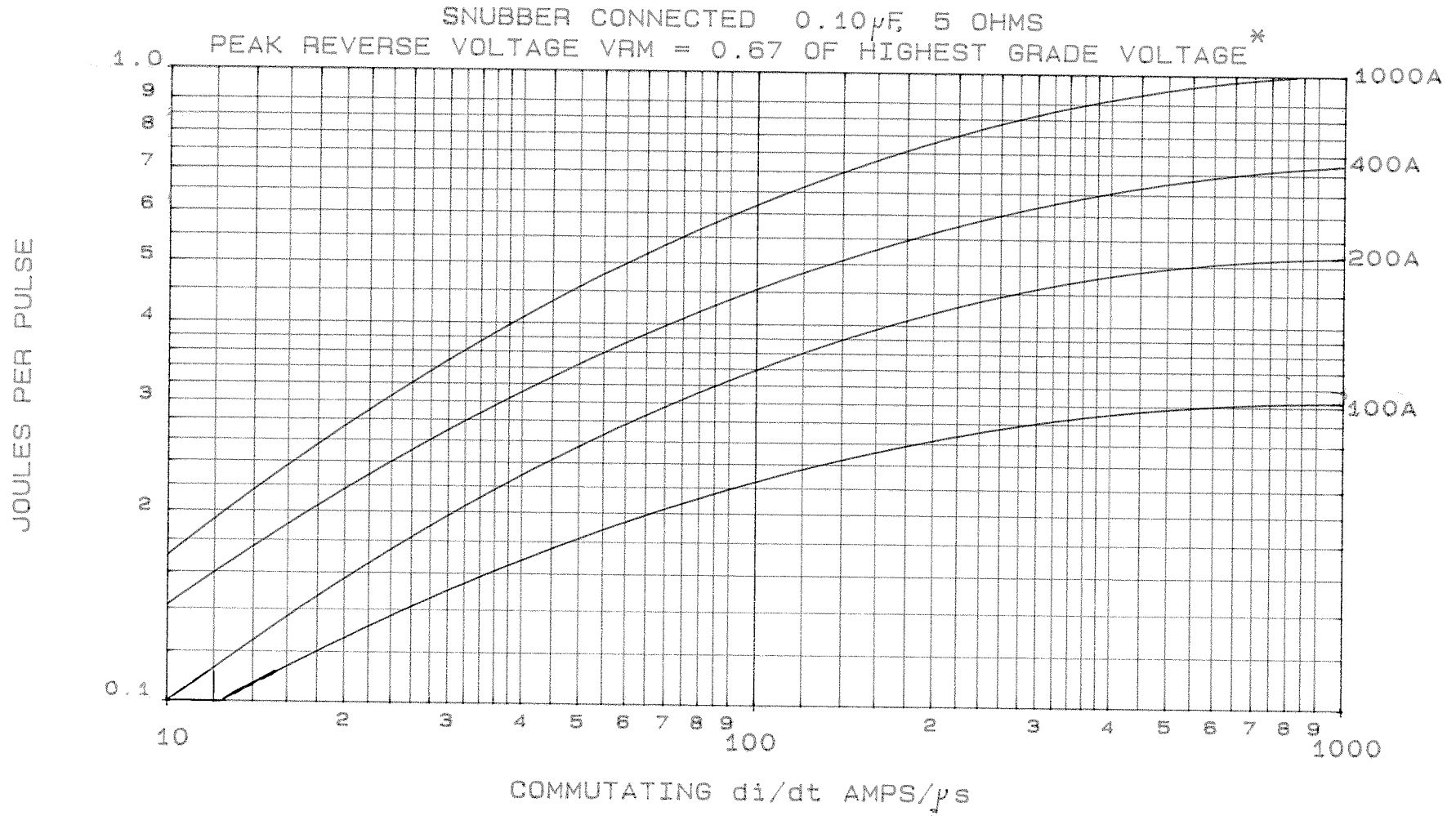


MAXIMUM K FACTOR

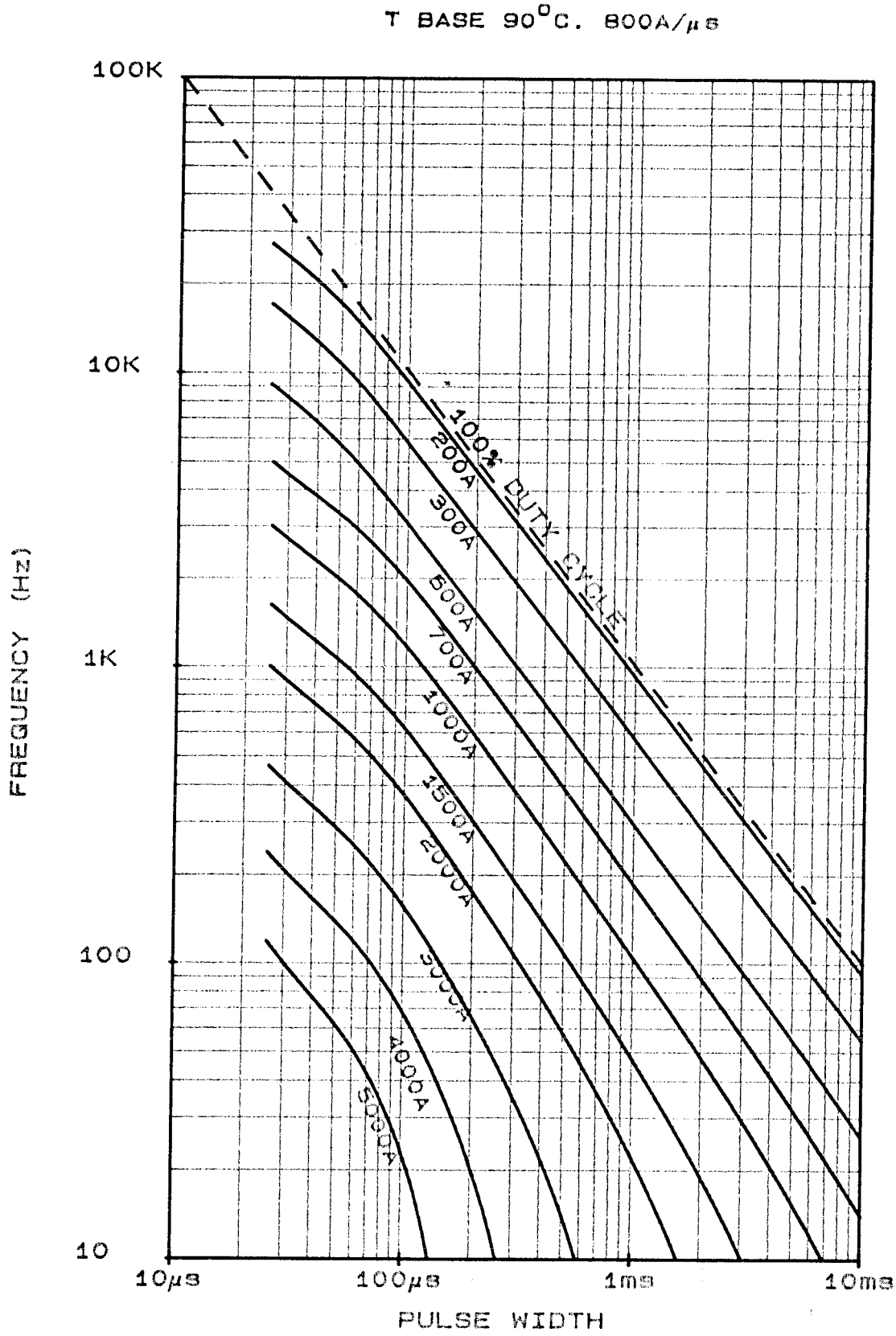
T_j = 125°C

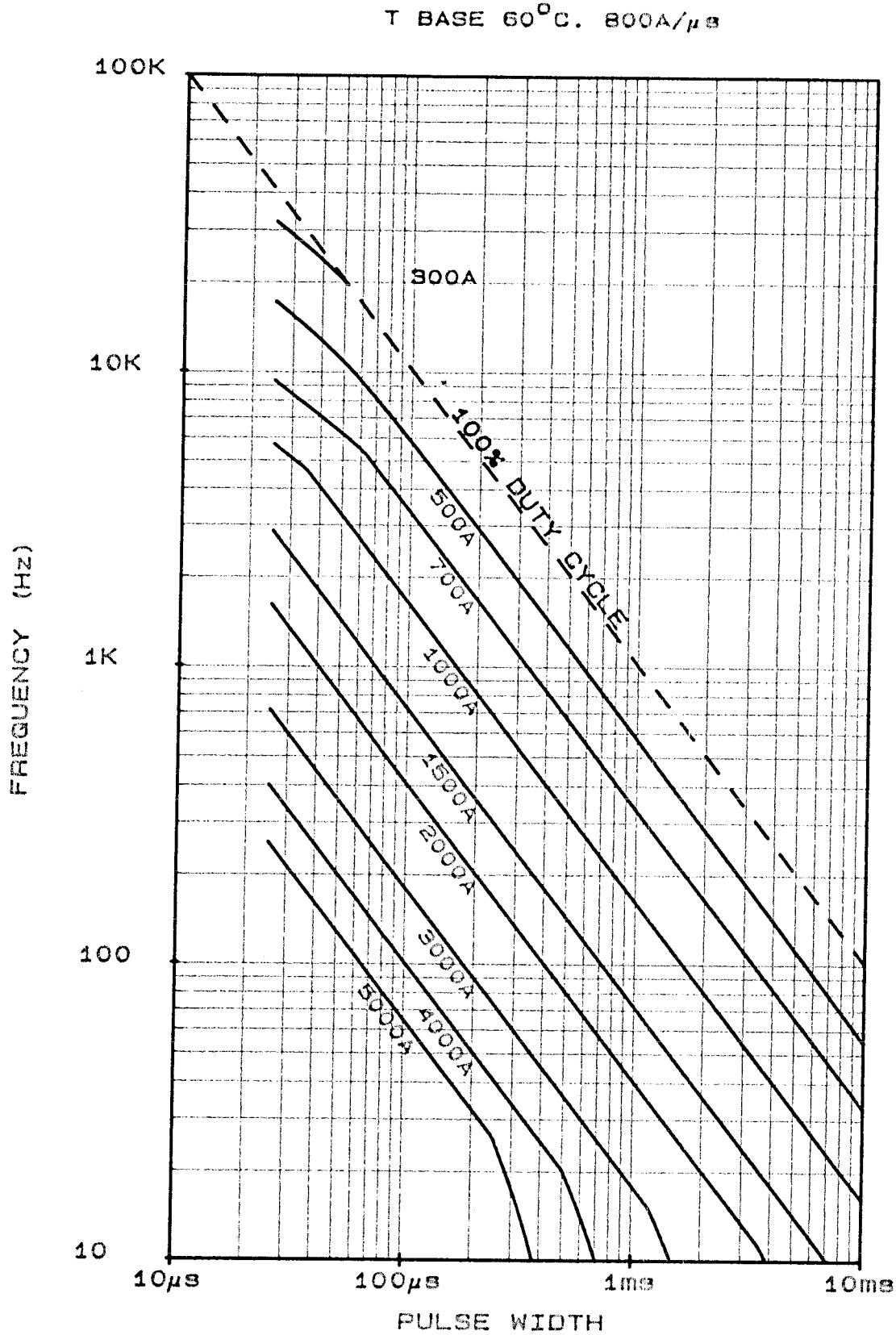


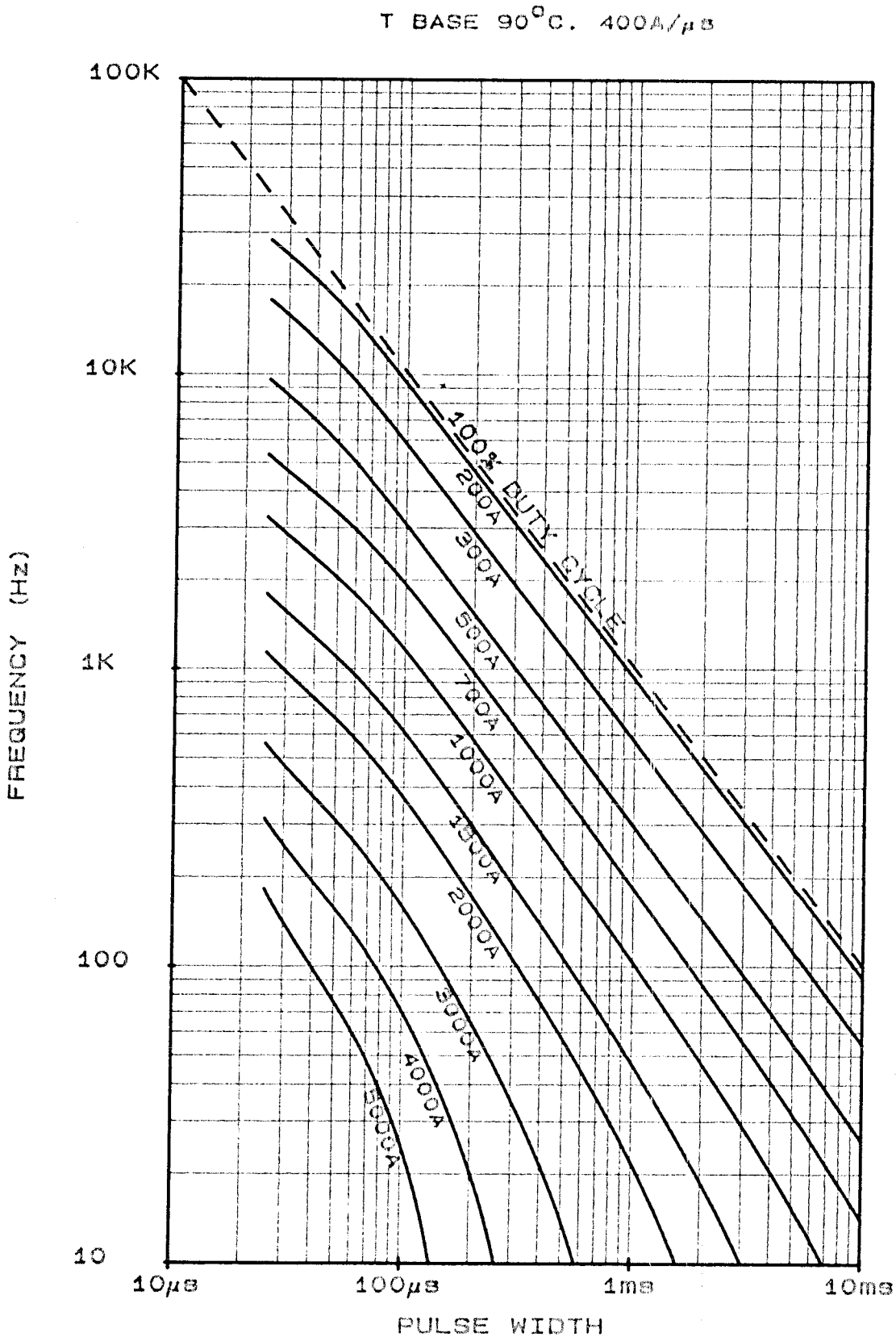
MAXIMUM REVERSE RECOVERY ENERGY LOSS PER PULSE, 125°C JUNCTION TEMPERATURE

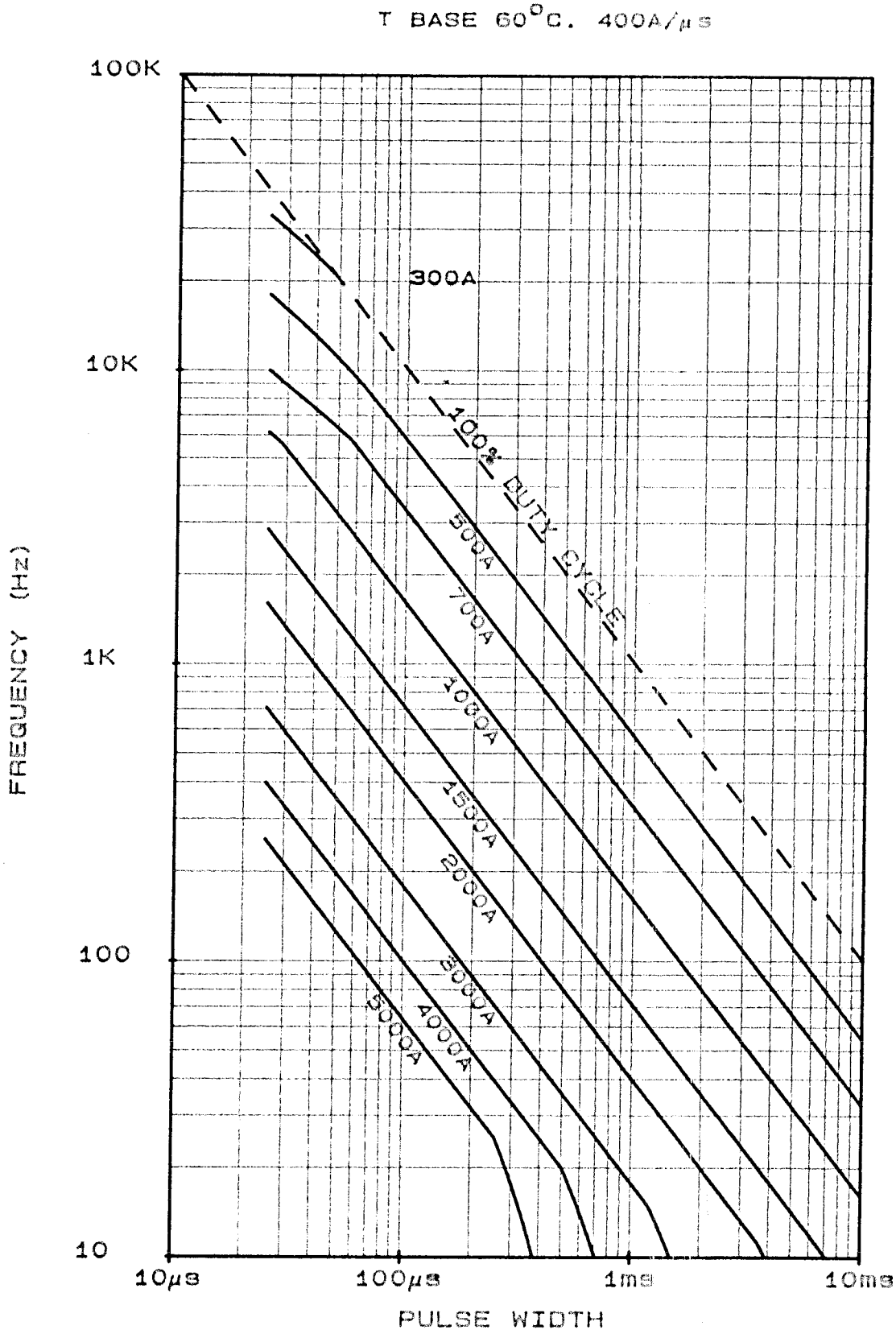


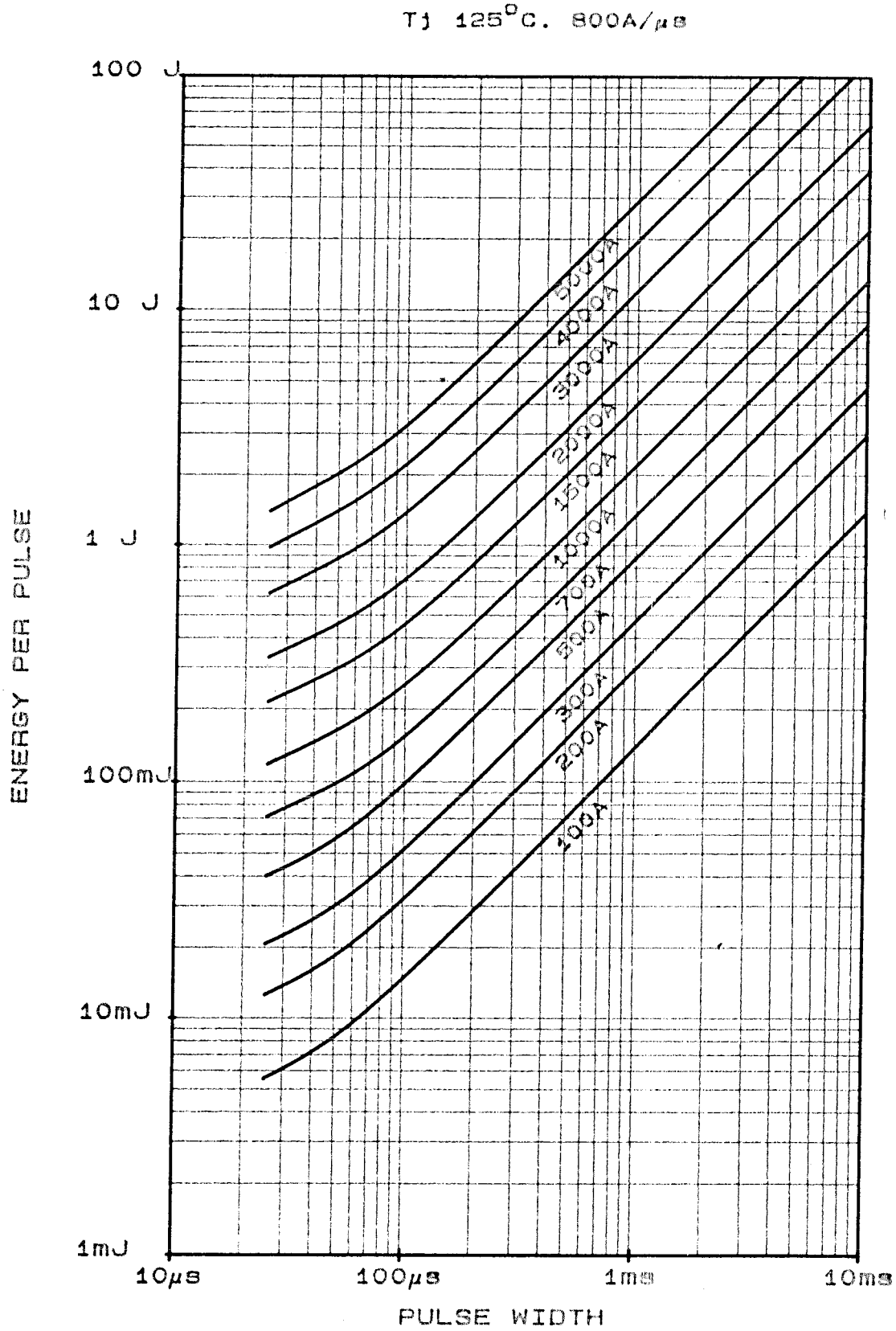
*NOTE: ENERGY PER PULSE SHOULD BE ADJUSTED PRO RATA WITH APPLIED PEAK RECOVERY VOLTAGE

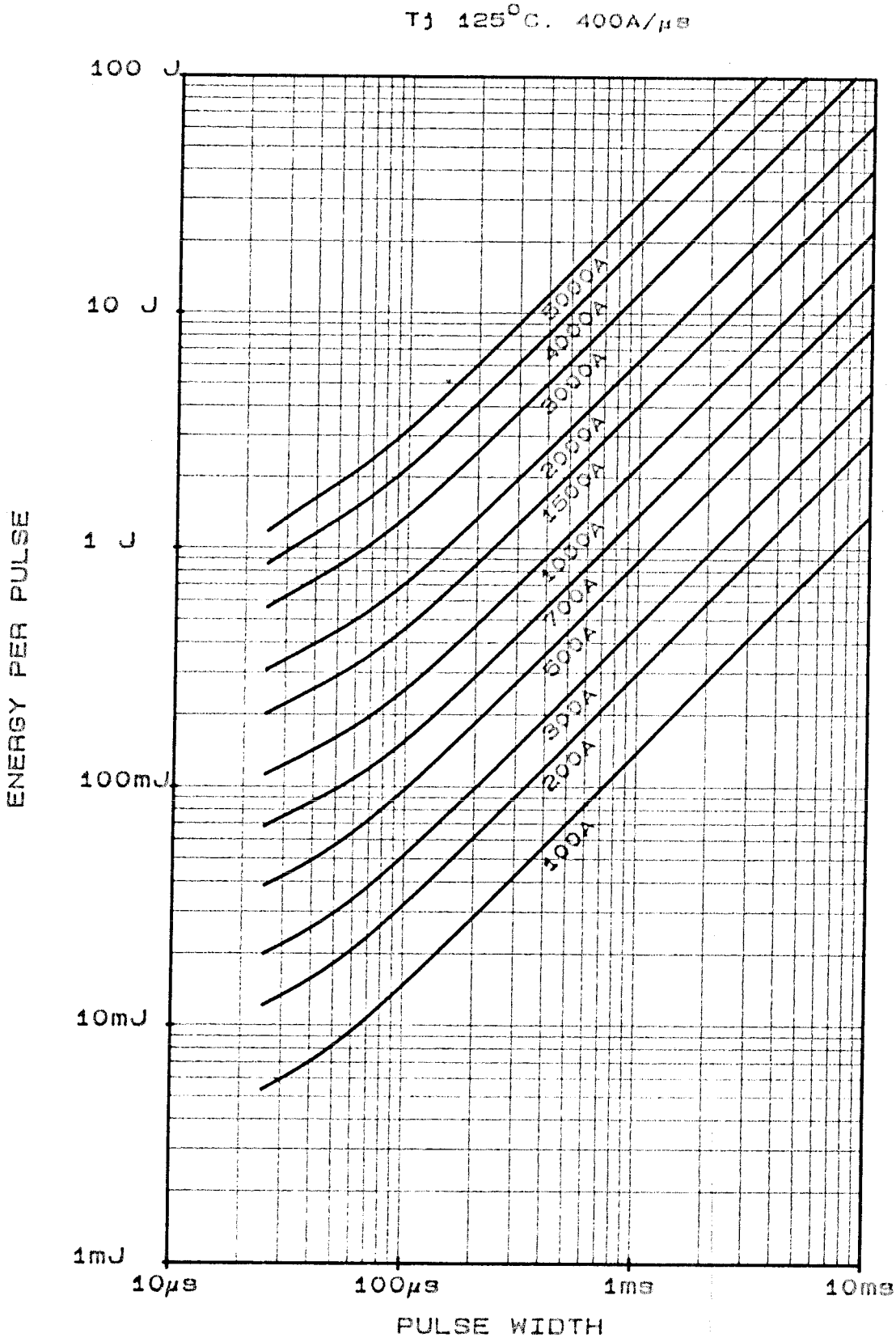

T BASE 90°C. 800A/μs
100K
10K
1K
100
10
FREQUENCY (Hz)
100% DUTY CYCLE
200A
300A
500A
700A
1000A
1500A
2000A
3000A
4000A
5000A
10μs
100μs
1ms
10ms
PULSE WIDTH

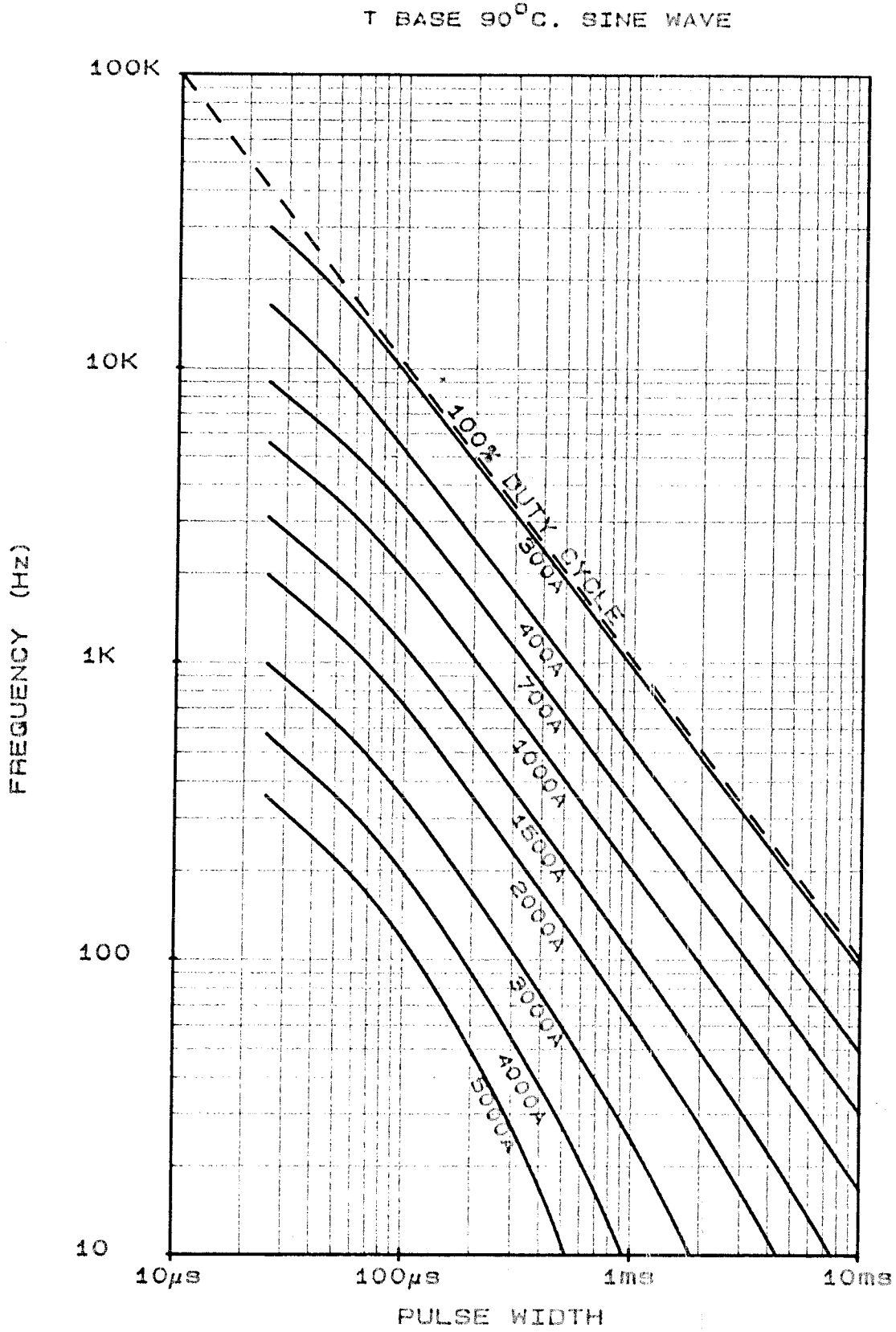

T BASE 60°C. 800A/μs
100K
10K
1K
100
10
FREQUENCY (Hz)
300A
100% DUTY CYCLE
500A
700A
1000A
1500A
2000A
3000A
4000A
5000A
10μs
100μs
1ms
10ms
PULSE WIDTH

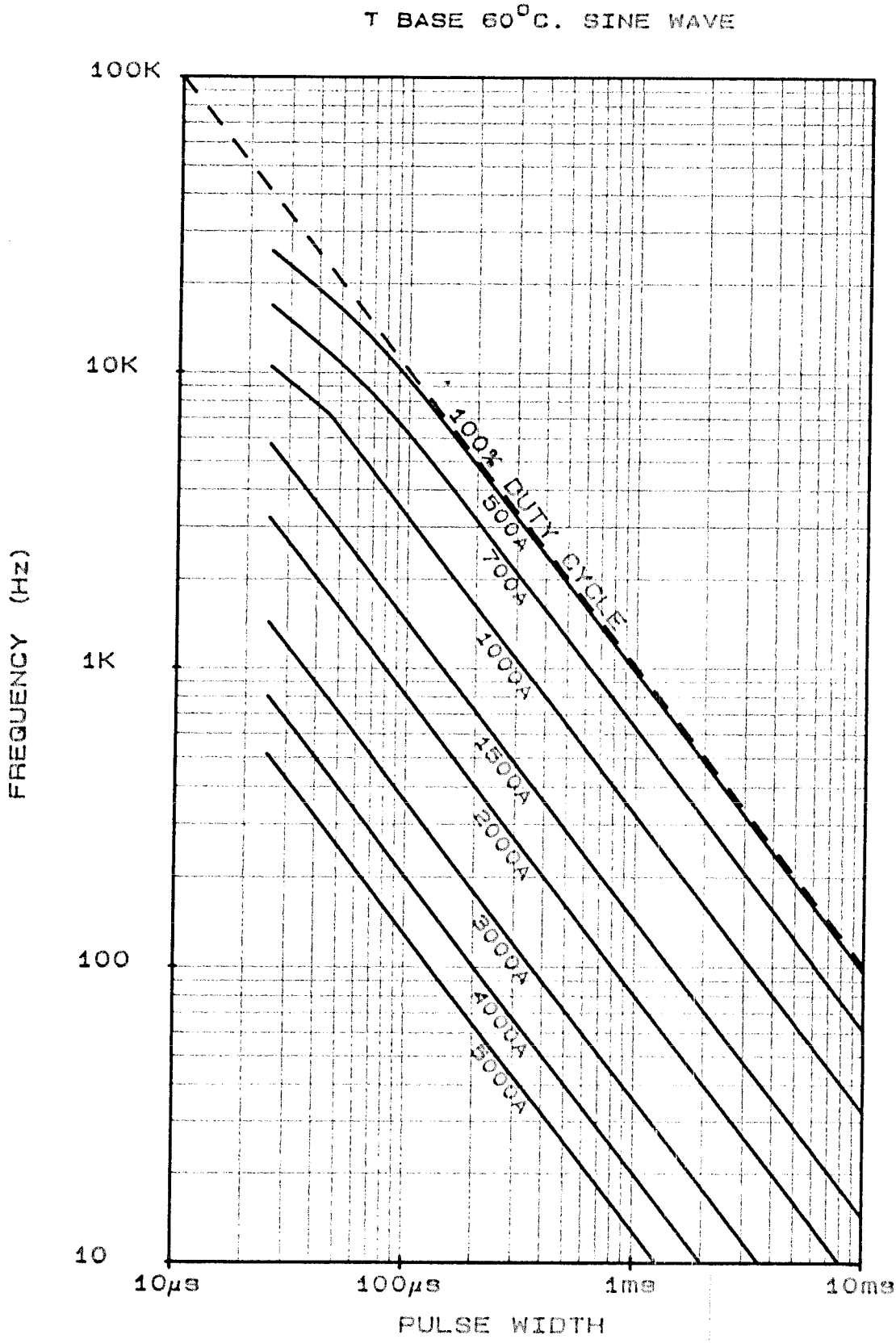

T BASE 90°C. 400A/µs
100K
10K
1K
100
10
FREQUENCY (Hz)
100% DUTY CYCLE
200A
300A
500A
700A
1000A
1500A
2000A
3000A
4000A
5000A
10µs
100µs
1ms
10ms
PULSE WIDTH

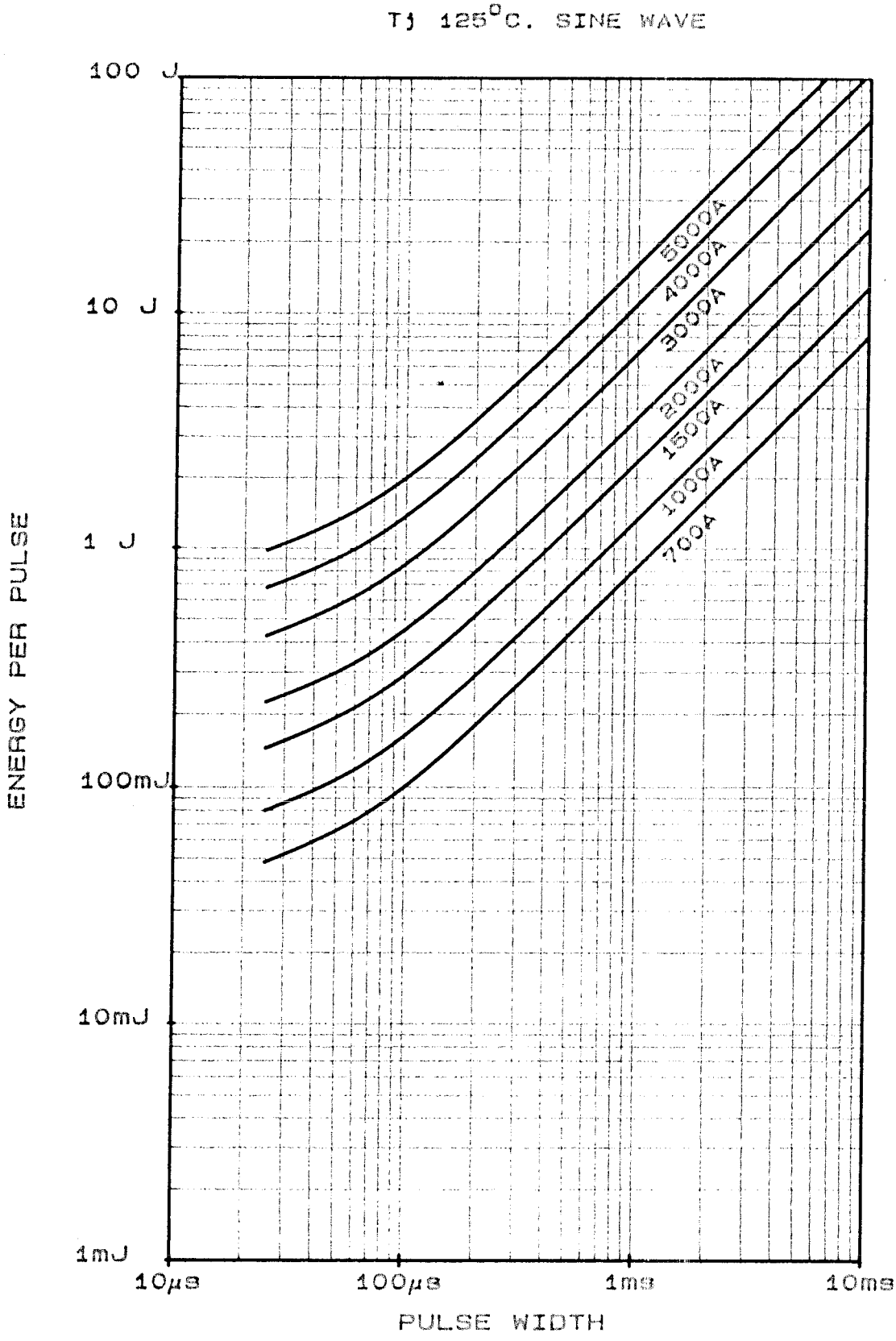

T BASE 60°C. 400A/µs
100K
10K
1K
100
10
FREQUENCY (Hz)
300A
100% DUTY CYCLE
500A
700A
1000A
1500A
2000A
3000A
4000A
5000A
10µs
100µs
1ms
10ms
PULSE WIDTH


Tj 125°C. 800A/µs
100 J
10 J
1 J
100mJ
10mJ
1mJ
ENERGY PER PULSE
5000A
4000A
3000A
2000A
1500A
1000A
700A
500A
300A
200A
100A
10µs
100µs
1ms
10ms
PULSE WIDTH


Tj 125°C. 400A/µs
100 J
10 J
1 J
100mJ
10mJ
1mJ
ENERGY PER PULSE
5000A
4000A
3000A
2000A
1500A
1000A
700A
500A
300A
200A
100A
10µs
100µs
1ms
10ms
PULSE WIDTH


T BASE 90°C. SINE WAVE
100K
10K
1K
100
10
FREQUENCY (Hz)
100% DUTY CYCLE
300A
400A
700A
1000A
1500A
2000A
3000A
4000A
5000A
10µs
100µs
1ms
10ms
PULSE WIDTH


T BASE 60°C. SINE WAVE
100K
10K
1K
100
10
FREQUENCY (Hz)
100% DUTY CYCLE
500A
700A
1000A
1500A
2000A
3000A
4000A
5000A
10µs
100µs
1ms
10ms
PULSE WIDTH


Tj 125°C. SINE WAVE
100 J
10 J
1 J
100mJ
10mJ
1mJ
ENERGY PER PULSE
5000A
4000A
3000A
2000A
1500A
1000A
700A
10µs
100µs
1ms
10ms
PULSE WIDTH

SCALE	1/1
DRN	AWF
CHKD	
APPD	
	A
S	NI

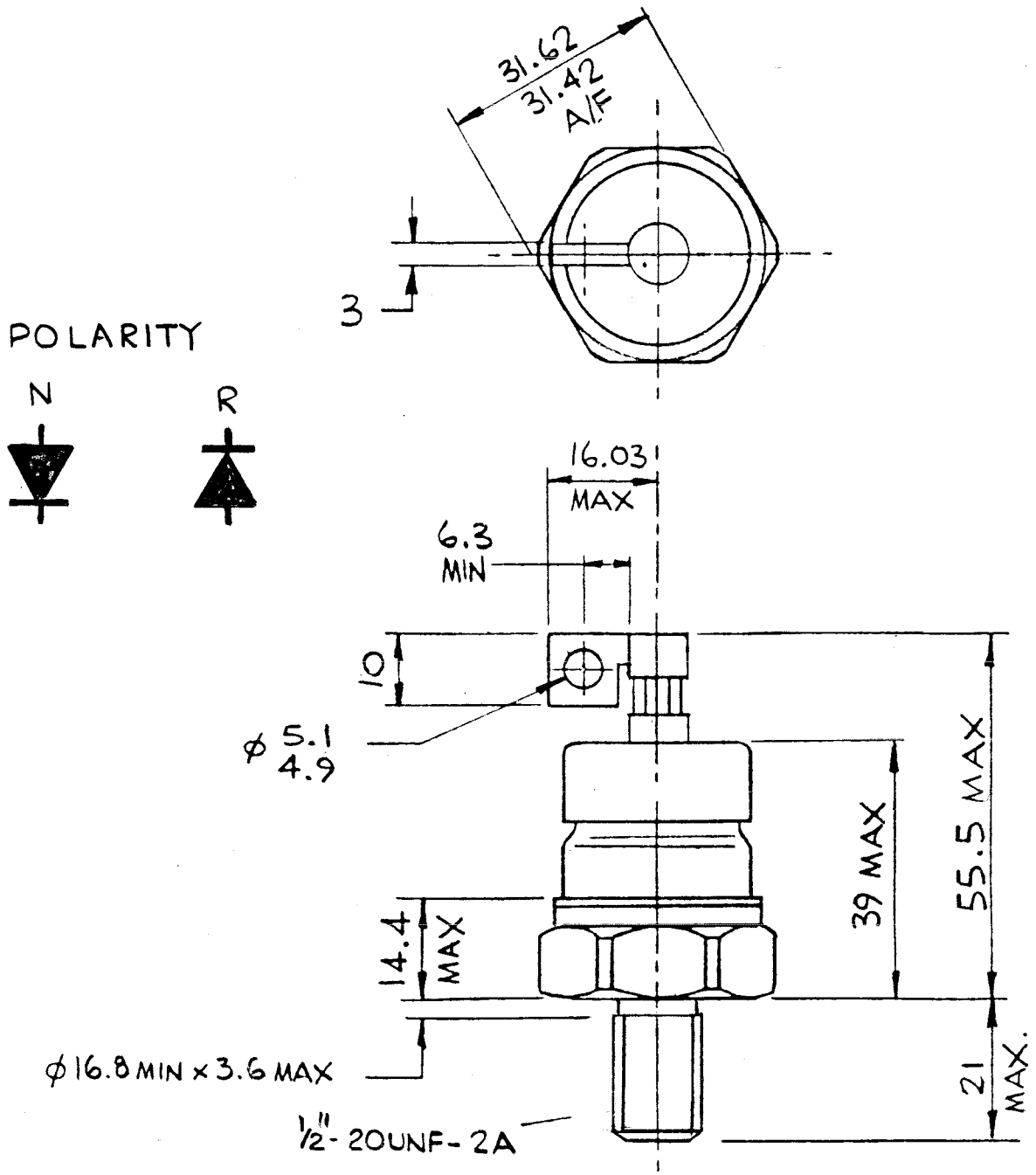
INTERNATIONAL OUTLINE No.
WEIGHT. 200 GRAMS

FINISH. BRIGHT NICKEL PLATE.
DEVICE MARKING INCLUDES MONOGRAM, TYPE No., SPEC. No. AND POLARITY SYMBOL.
DEVICE MOUNTING: MOUNTING TORQUE TO BE 14 Nm (1.45 kgf-m). THREADS MUST NOT BE LUBRICATED.

DIODE TYPE NUMBER

PCN144 PCR144
PCN134 PCR134

G.A. DRG. No. 102A231N & 102A231R.



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WESTINGHOUSE BRAKE AND SIGNAL CO. LTD.
CHIPPENHAM, WILTSHIRE, SN15 1JD, ENGLAND.

WESTCODE ® SEMICONDUCTORS

THIRD ANGLE PROJECTION

DIMNS. IN MILLIMETRES

DRG. No. 100A297

ISS	REVISIONS
1	28.11.88.
2	9.1.89 ½"-20UNF WAS ¾"-16UNF AWF
3	12.1.89 TYPE No. WAS PRN/R144 AWF
4	24.1.90 TYPE No. WAS PRN/R144 U9143 AWF
5	PCN/R134 ADDED. 21.5.90 AWF

SCALE	1/1
DRN	GB
HKD	GB
PPD	
	S A
S	NI

INTERNATIONAL OUTLINE No.

WEIGHT. 250 GRAMS.

FINISH. BRIGHT NICKEL PLATE.

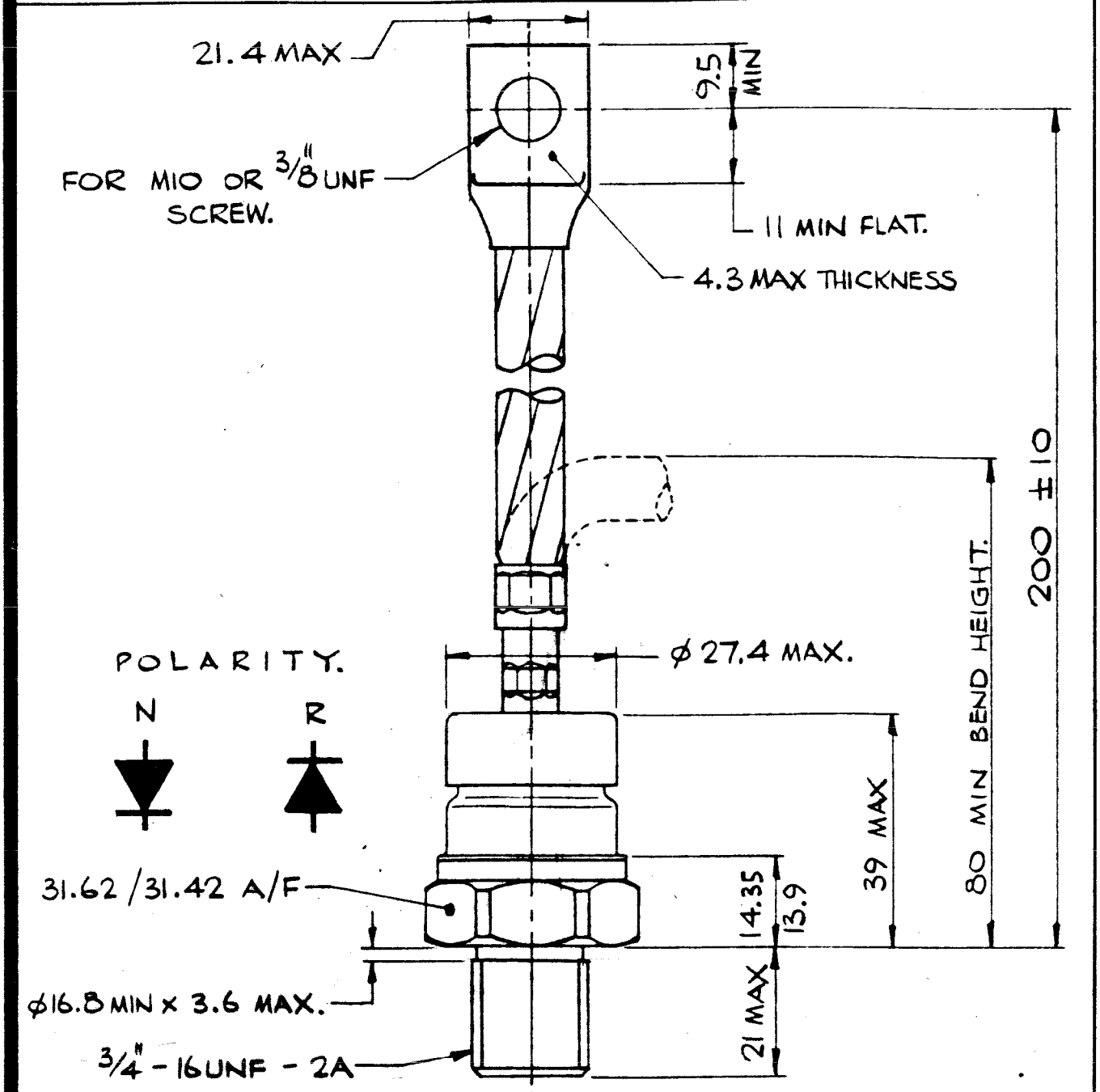
DEVICE MARKING INCLUDES MONOGRAM, TYPE No., SPEC. No. AND POLARITY SYMBOL.

DEVICE MOUNTING:

MOUNTING TORQUE TO BE 27 - 24.5 Nm (2.77 - 2.5 kgf m). THREAD MUST NOT BE LUBRICATED.

DIODE TYPE NUMBER	
PHN/R380	DHN/R400
PHN/R320	DHN/R300
PHN/R174	DHN/R170
PHN/R144	

G.A. DRG. No. 102A216H04.



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CHIPPENHAM, WILTSHIRE, SN15 1JD, ENGLAND.

WESTCODE ® SEMICONDUCTORS

THIRD ANGLE PROJECTION

DIMNS. IN MILLIMETRES

DRG. No. 100A280

ISS	REVISIONS
1	11.9.78.
4	12.12.79 M806 REDRAWN. DRG. No WAS 100A257.
5	27.11.84 M1218 FIN WAS ET
6	17.7.92 M1942 DHN/R400, 3006170 ADDED AWF