Fast Recovery Diode Stud
Types M0334S/RX120 to M0334S/RX180

The data sheet on the subsequent pages of this document is a scanned copy of existing data for this product.
(Rating Report 80NR15 Issue 2)

This data reflects the old part number for this product which is: SM12-18PHN/R174.
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/RJ outline drawing (W24) in datasheet

The following links will direct you to the appropriate outline drawings
Outline W22 – ¾" flag top ceramic stud
Outline W24 – ¾" leaded 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

M0334	S/RX	♦♦	**0**
Fixed Type Code	S/RC - ¾" flag top ceramic stud S/RJ - ¾" leaded ceramic stud	Voltage code V_{RRM}/100 12-18	Fixed Code

Typical Order Code: M0334RJ140, Reverse polarity, ¾" leaded ceramic stud, 1400V V_{RRM}

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QUALITY EVALUATION LABORATORY

Rating Report: 80NR15 (Issue 2) Date: 18th November, 1986

Origin: Pages: 22

Diode Type SM12-18PHN/R174

Written by: M.W. Dunlop Checked: MWD Approved: BRH

The SM12-18PHN/R diode series employs a 24 mm silicon slice mounted under spring pressure in a stud base, top hat housing with flexible lead.
The report supersedes Rating Report No. 80NR15.

RATINGS AND CHARACTERISTICS

Ratings

Voltage Grades	: 12-18
V_{RSM}	: 1300-1900V
V_{RRM}	: 1200-1800V

$I_F(AV)$; Single phase; 50 Hz, 180°C half sinewave; T_{CASE} = 100°C	: 150A
$I_F(rms)$ max.	: 400A
I_F d.c. max.	: 400A
I_{FSM} : t = 10 ms half sinewave; T_J(initial) = 125°C ; $V_{RM} = 0.6V_{RRM}$(MAX)	: 4500A
I_{FSM} : t = 10 ms half sinewave; T_J(initial) = 125°C ; V_{RM} = 10V	: 4950A
I^2t : t = 10 ms; T_J (initial) = 125°C ; $V_{RM} = 0.6V_{RRM}$(MAX)	: 101 x $10^3 A^2S$
I^2t : t = 10 ms; T_J(initial) = 125°C ; V_{RM} = 10V	: 122 x $10^3 A^2S$
I^2t : t = 3 ms; T_J (initial) = 125°C ; V_{RM} = 10V	: 91 x $10^3 A^2S$
T_C Operating Range	: -40 to 125°C
T_{stg} Non-operating	: -40 to 150°C

Characteristics

(maximum values unless otherwise stated)

$V_{O;}$ T_J = 125°C	: 1.00V
$r_{f;}$ T_J = 125°C	: 0.74mohms
V_{FM} ; I_{FM} = 470A T_{VJ} = 125°C	: 1.35V
$R_{th(J-C)}$	: 0.13°C/W
$R_{th(C-HS)}$	: 0.04°C/W
I_{RRM} : T_J = 125°C : V_{RM} = $V_{RRM(Max)}$	: 20mA
Q_{rr} (I_{FM} = 550A ;dI/dt = 40A/uS	: 160uC
t_{rr} (V_{RM} = 50V; T_{VJ} = 125°C	:
Mounting torque	: 2.5 - 2.77 Kg.f.m.
Outline drawing	: 100A280
JEDEC Outline No.	:

CONTENTS

80NR15 (issue 1) changes:

P1, 4 Max grade changed
V_{RWM} omitted
$T_{B(operating\ range)}$ MIN changed

Old pp 5,6,7,8 replaced

Old p9 Curves redrawn on separate sheets

Old p11	Omitted	Old p15	omitted
Old p12	redrawn	Old p20, 21	omitted
Old p13	redrawn	Old p26	omitted
Old p14	redrawn	Old pp16-27	redrawn

Voltage Ratings

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

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 "S" factors.

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 200 and 100A/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 $W_{AV} = Ep \times f$

$T_{CASE} = 125 - Ep \times f \times R_{th}$

(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.

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 be 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 $r_t = 1.64 \times 10^{-4} \sqrt{t}$

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

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

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) 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 voltage waveform should be carried out with an appropriate snubber of 0.1uF, 5 ohms connected across diode anode to cathode.

(b) Design Method

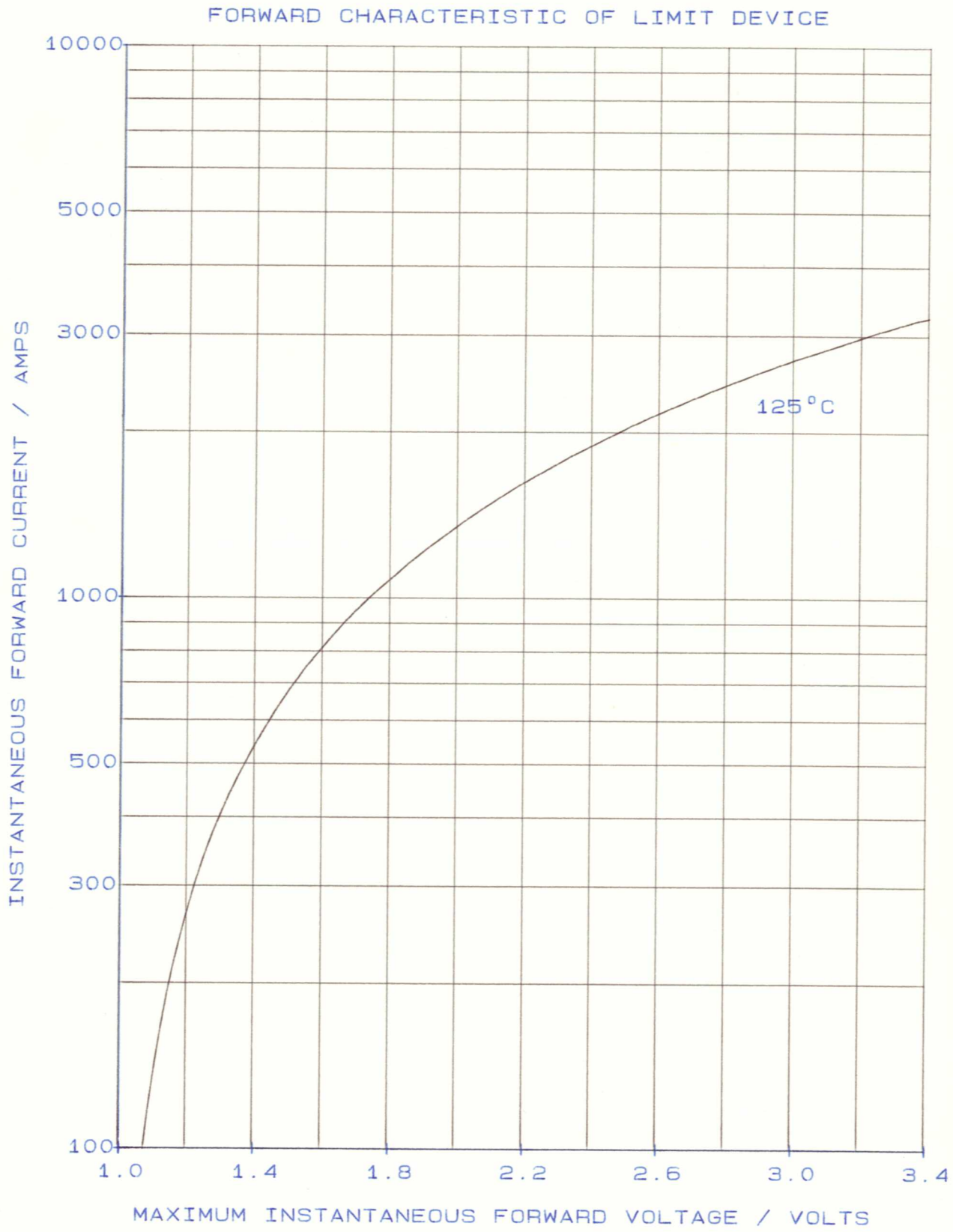
In circumstances where it is not possible to measure voltage and current conditions, or for design purposes, the additional losses may be estimated from curves on page 12.

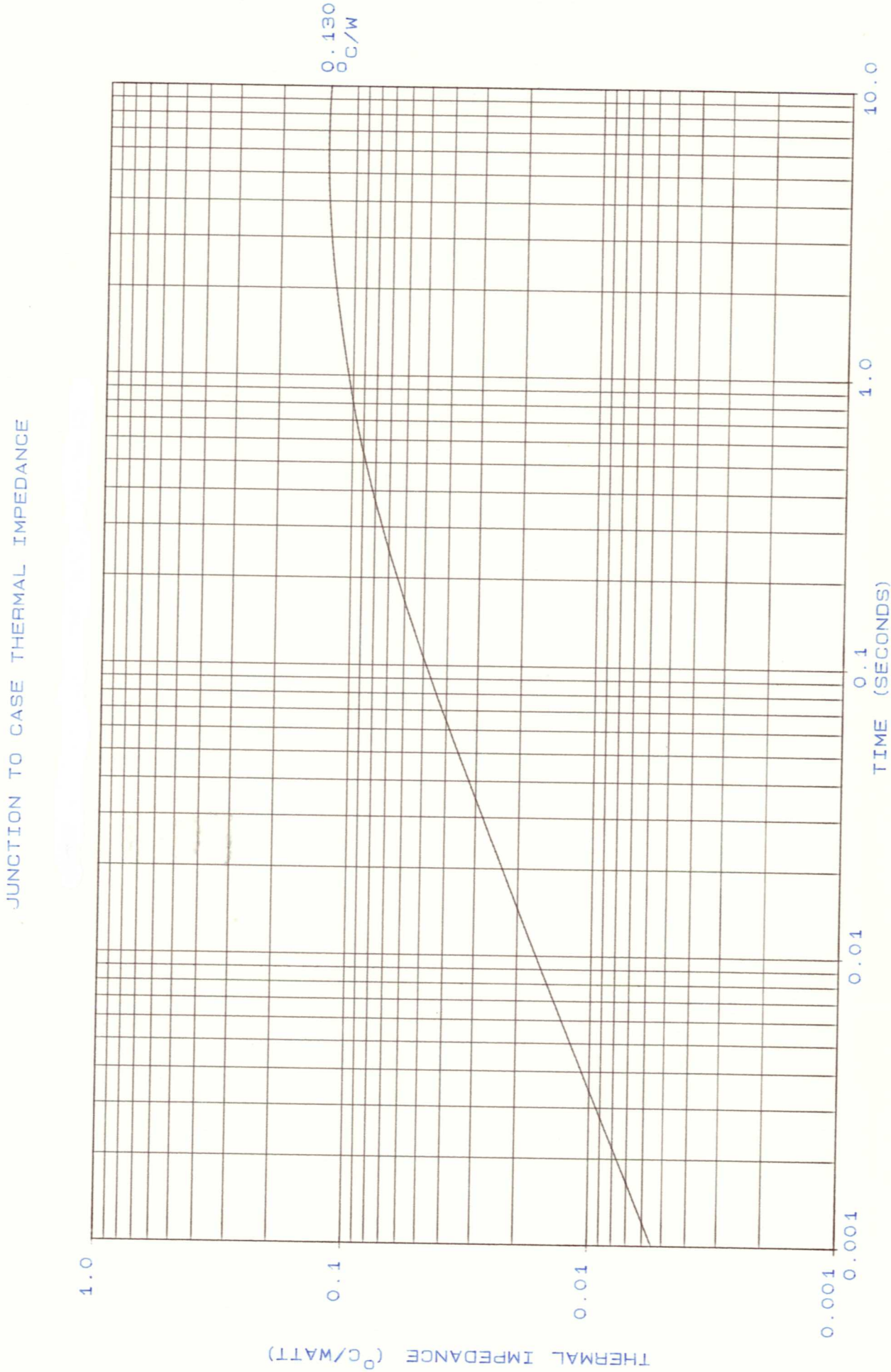
Let E be the value of energy per reverse cycle in joules (curves on page 12).

Let f be the operating frequency in Hz

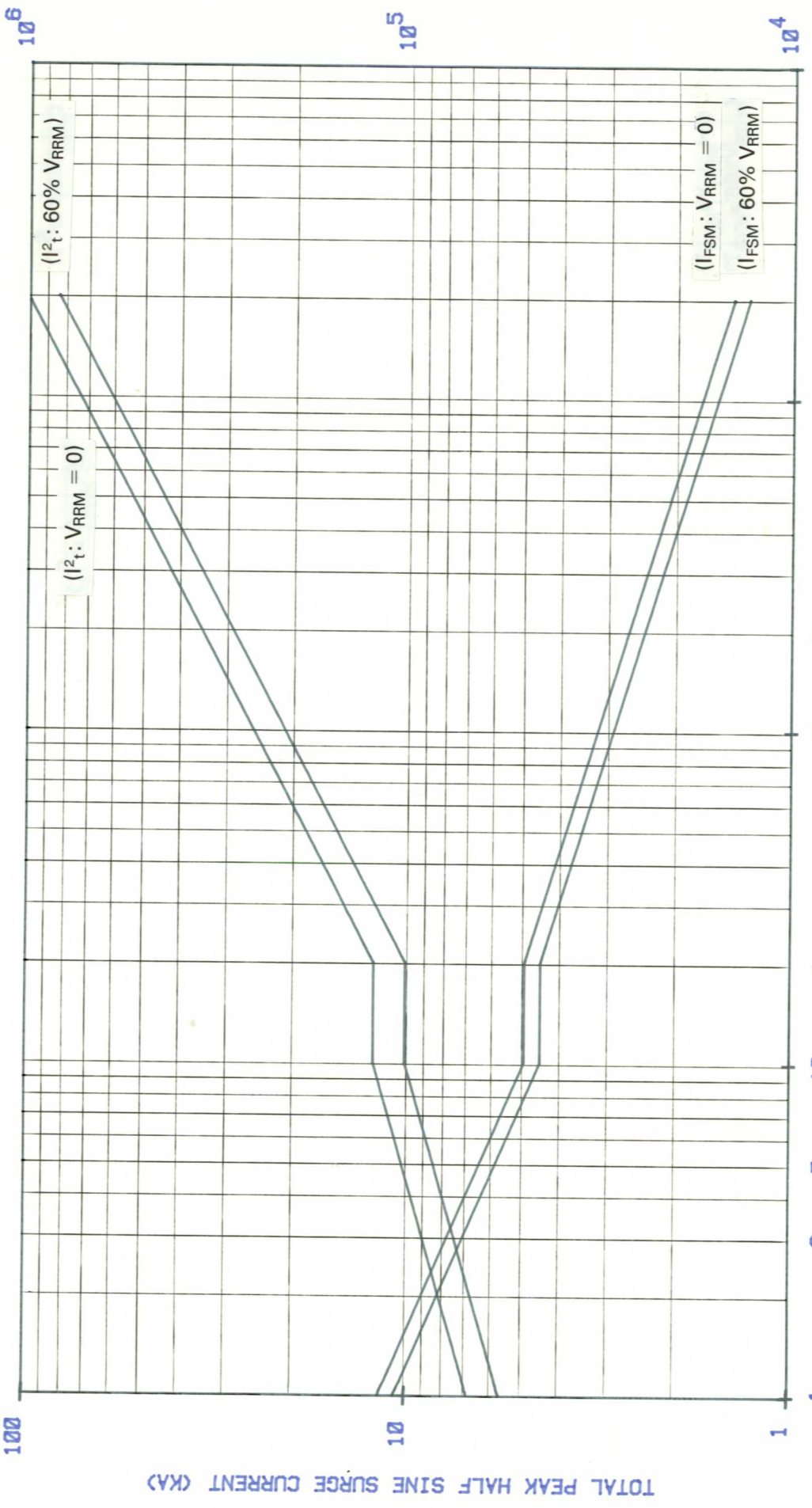
Then T_{CASE} new = T_{CASE} original - $ER_{th} \times f$

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

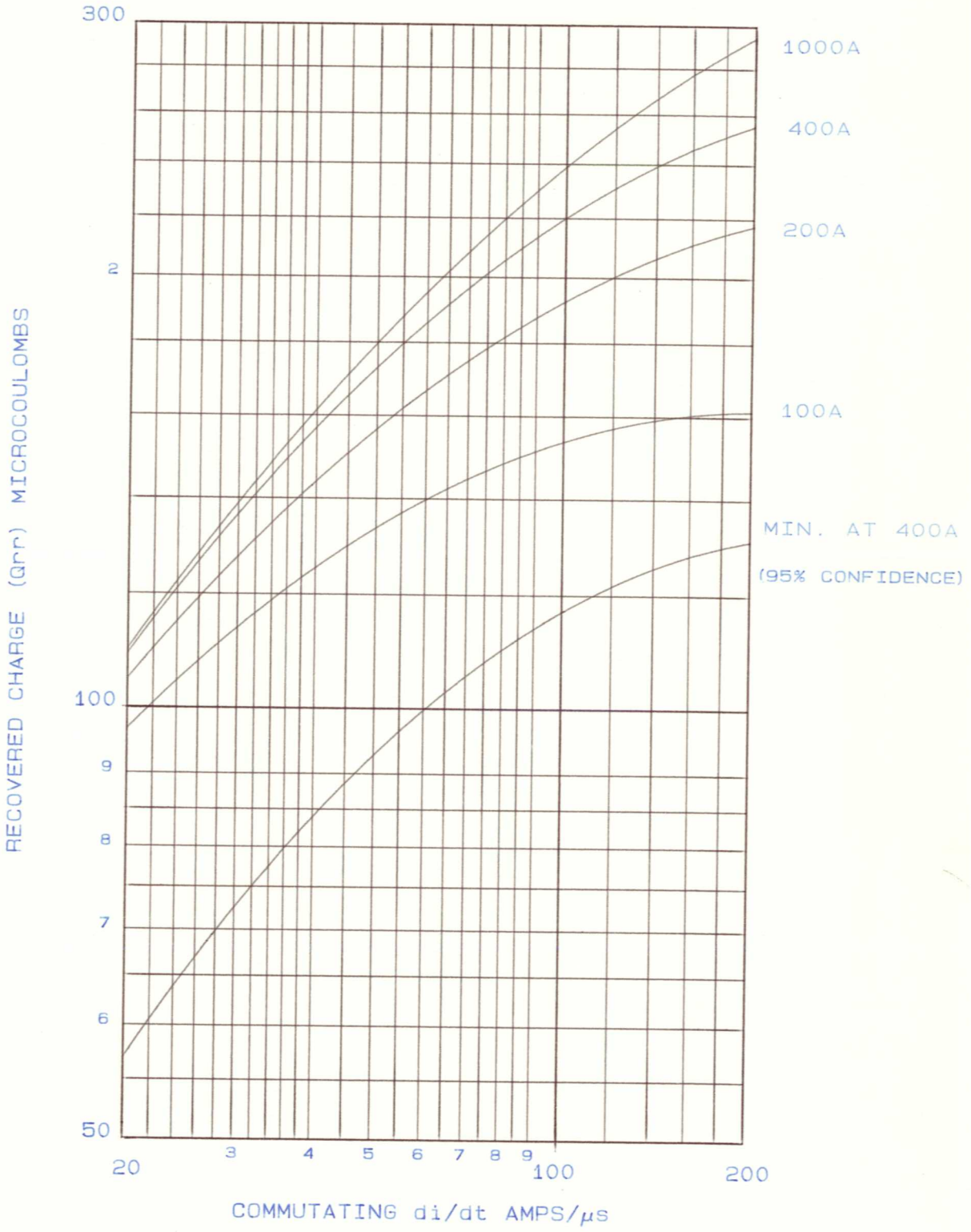

FORWARD CHARACTERISTIC OF LIMIT DEVICE
10000
5000
3000
1000
500
300
100
INSTANTANEOUS FORWARD CURRENT / AMPS
125°C
1.0
1.4
1.8
2.2
2.6
3.0
3.4
MAXIMUM INSTANTANEOUS FORWARD VOLTAGE / VOLTS


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

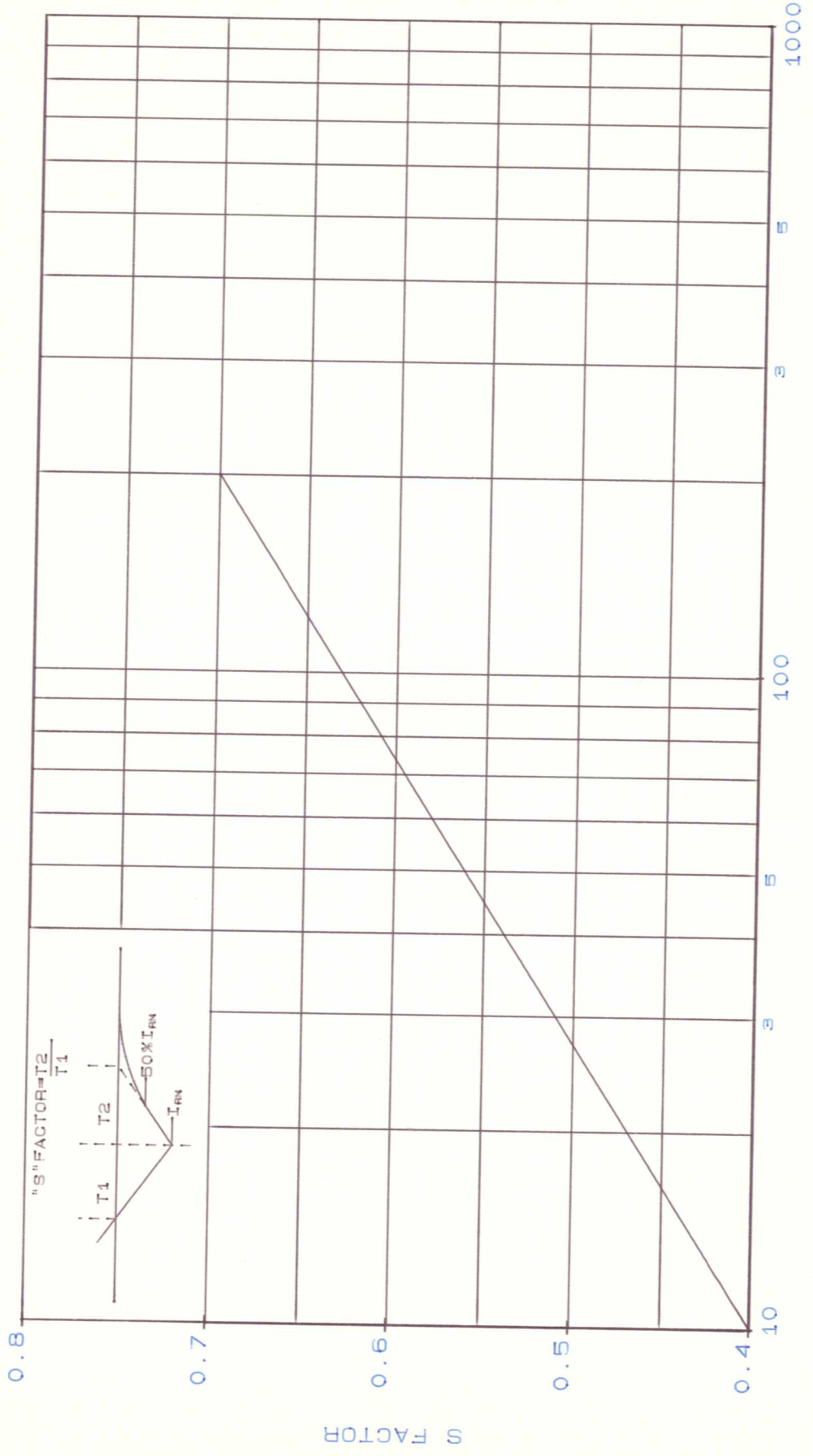
MAXIMUM NON REPETITIVE SURGE CURRENT AT INITIAL JUNCTION TEMPERATURE 125°C

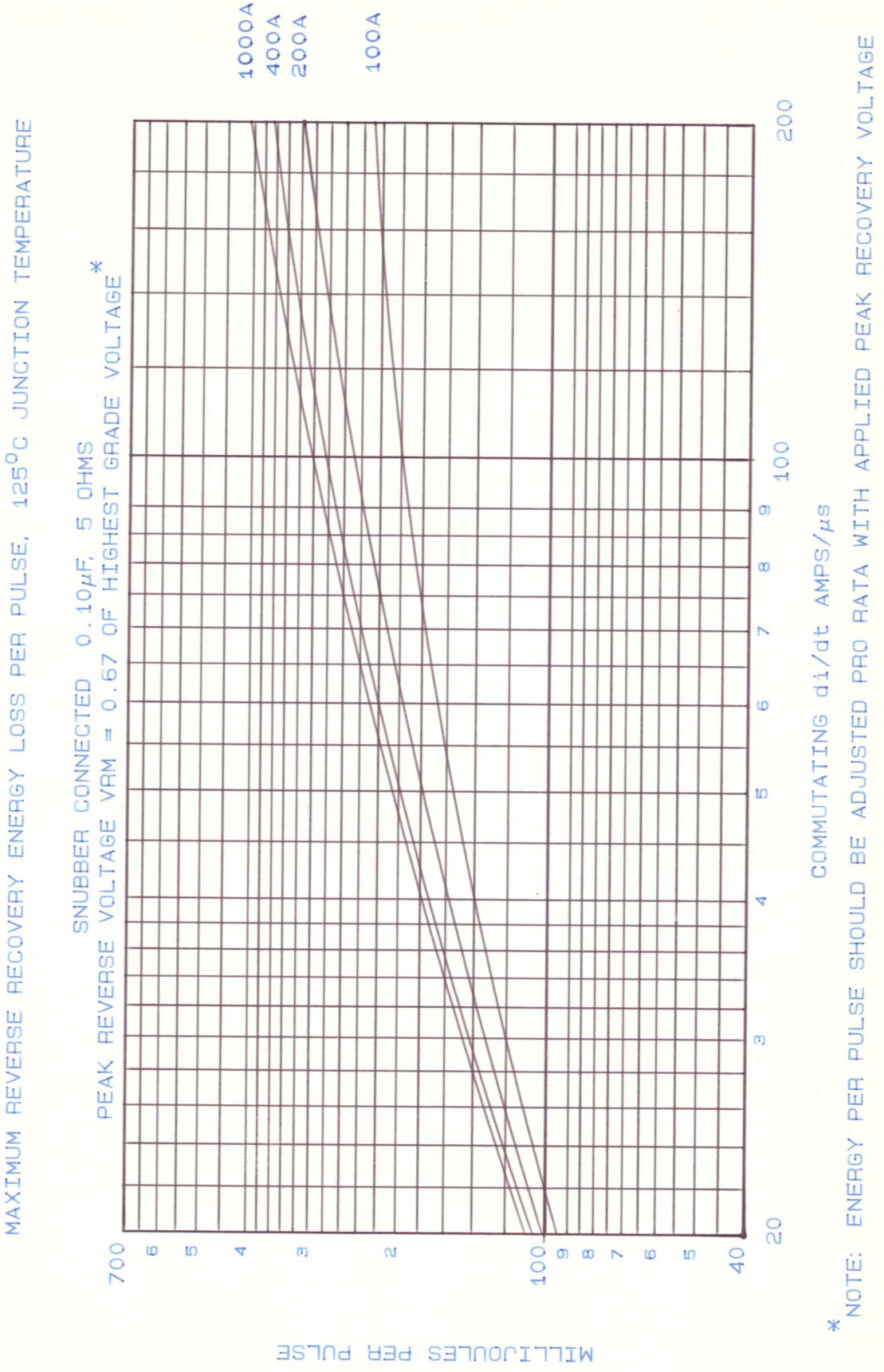


MAXIMUM RECOVERED CHARGE AT 125°C JUNCTION TEMPERATURE

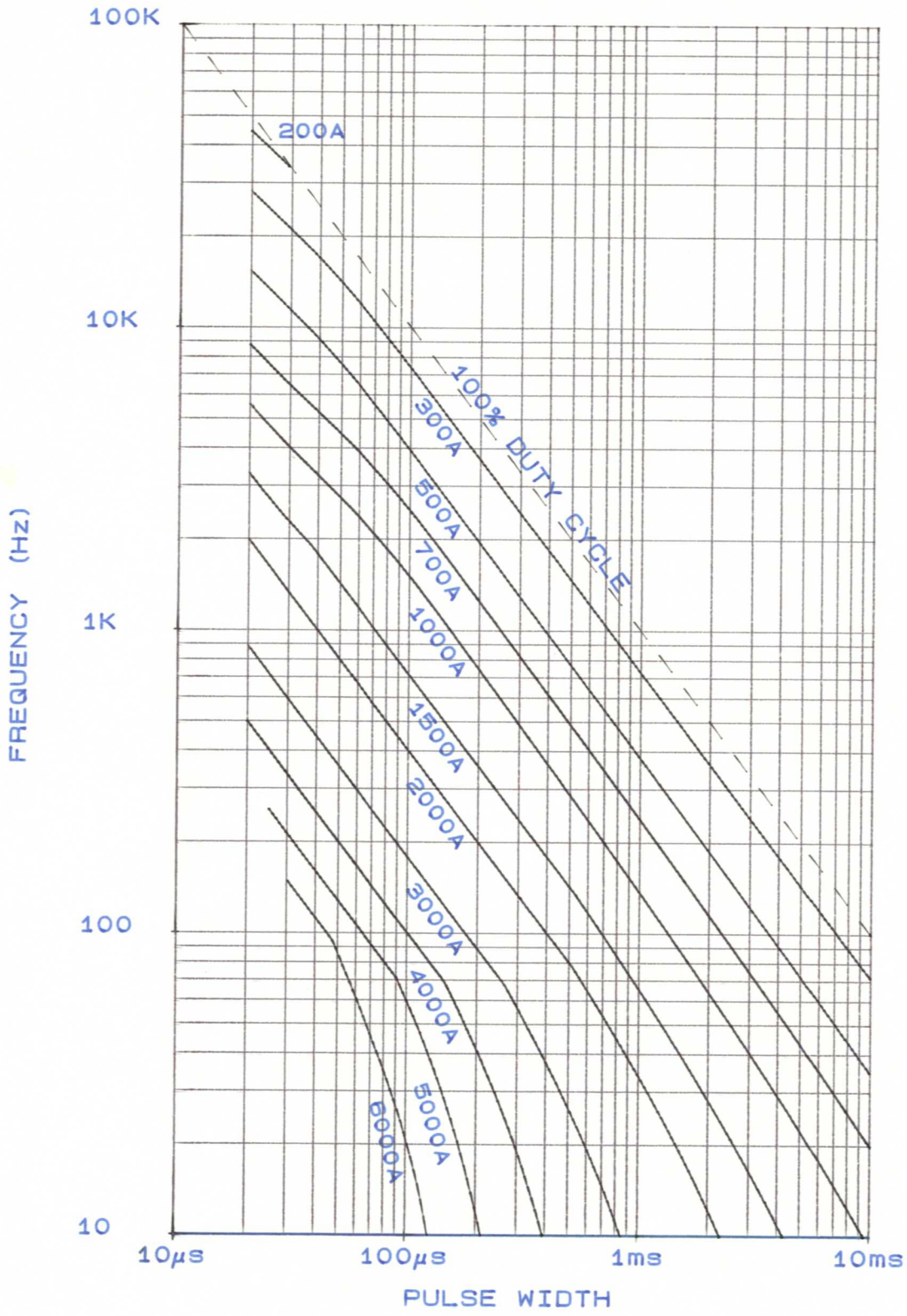


MINIMUM S FACTOR AT 125°C JUNCTION TEMPERATURE

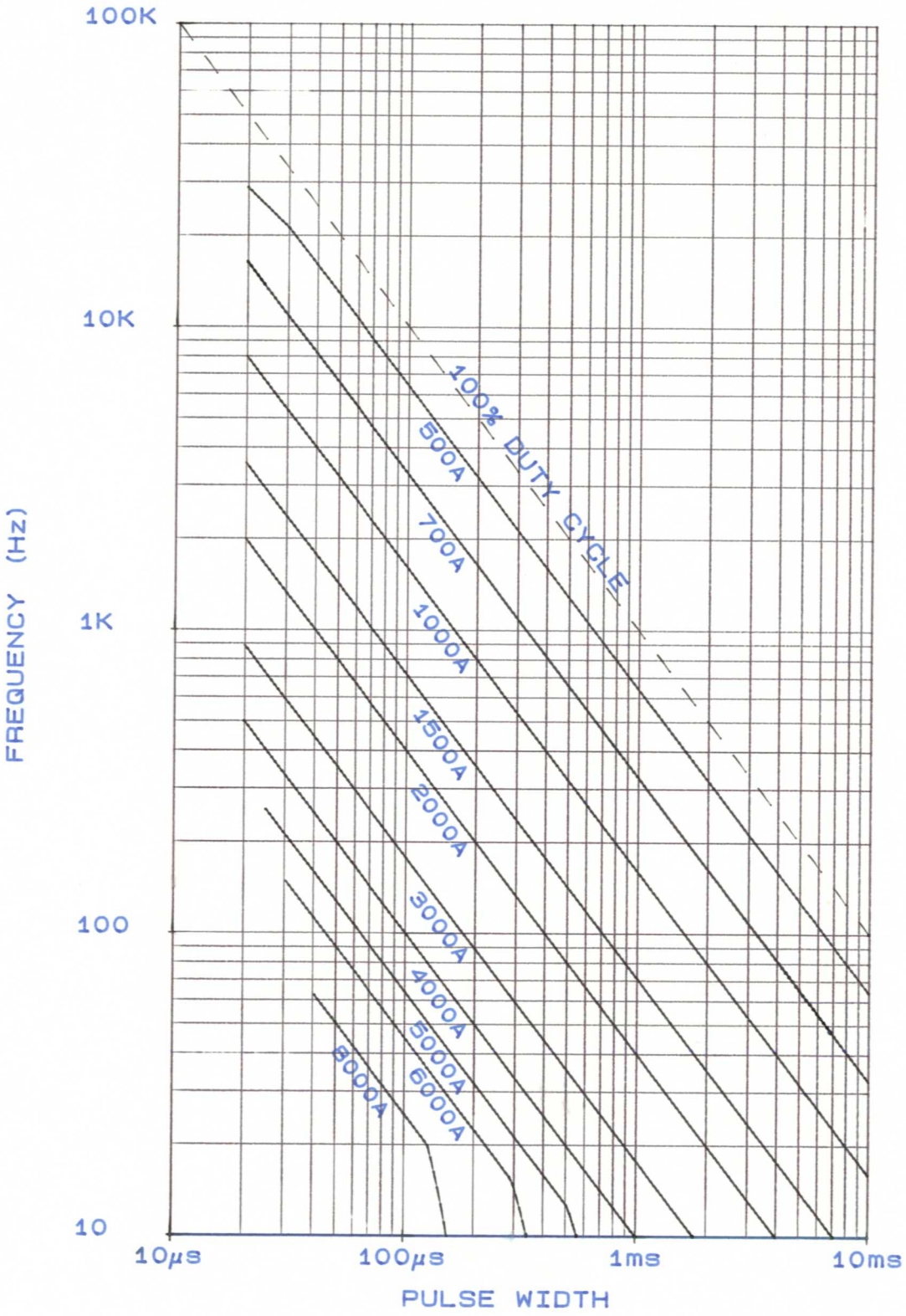


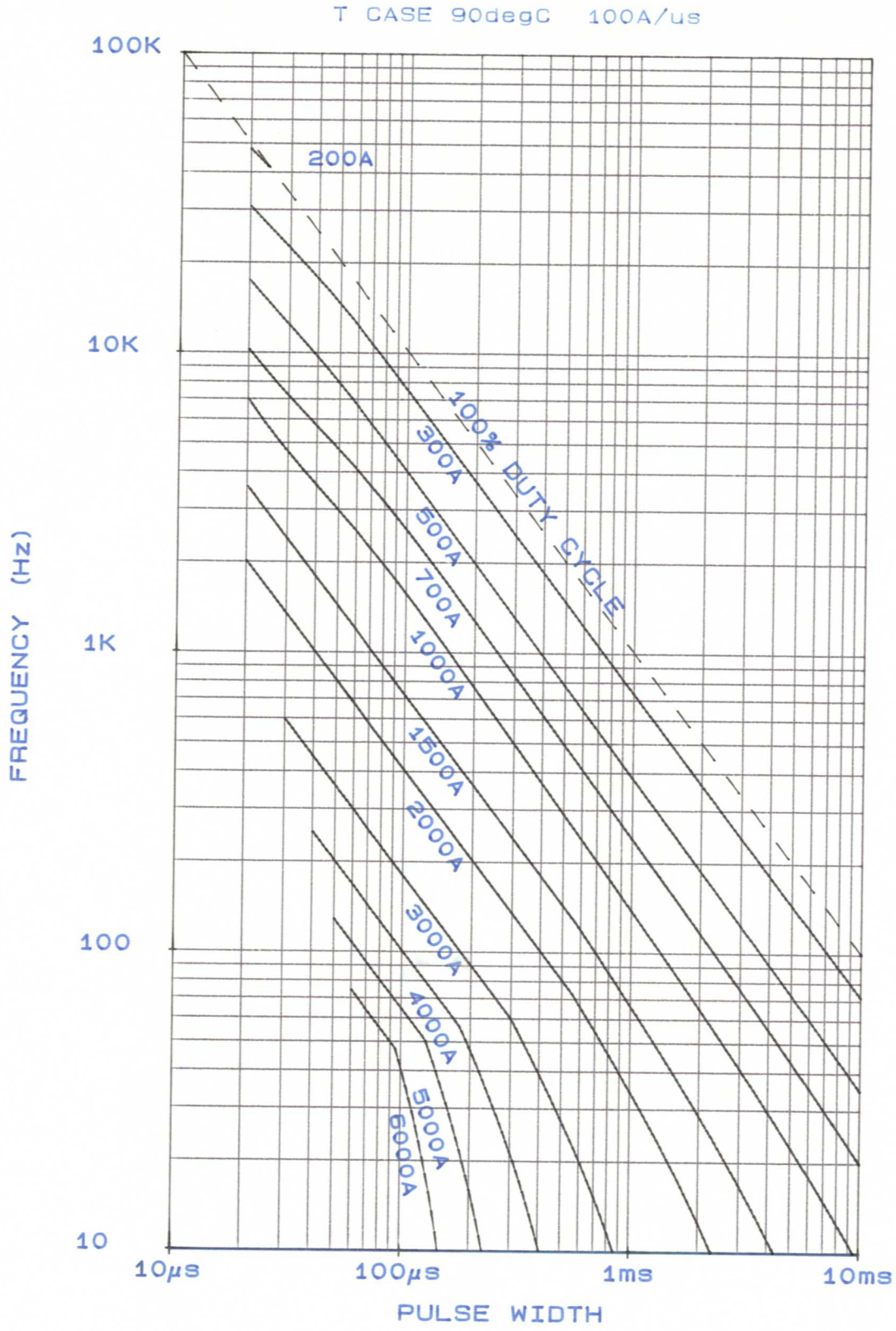

MAXIMUM REVERSE RECOVERY ENERGY LOSS PER PULSE, 125°C JUNCTION TEMPERATURE
SNUBBER CONNECTED 0.10μF, 5 OHMS
PEAK REVERSE VOLTAGE VRM = 0.67 OF HIGHEST GRADE VOLTAGE*
1000A
400A
200A
100A
MILLIJOULES PER PULSE
700
600
500
400
300
200
100
90
80
70
60
50
40
20
30
40
50
60
70
80
90
100
200
COMMUTATING di/dt AMPS/μs
*NOTE: ENERGY PER PULSE SHOULD BE ADJUSTED PRO RATA WITH APPLIED PEAK RECOVERY VOLTAGE

T CASE 90degC, 200A/µs

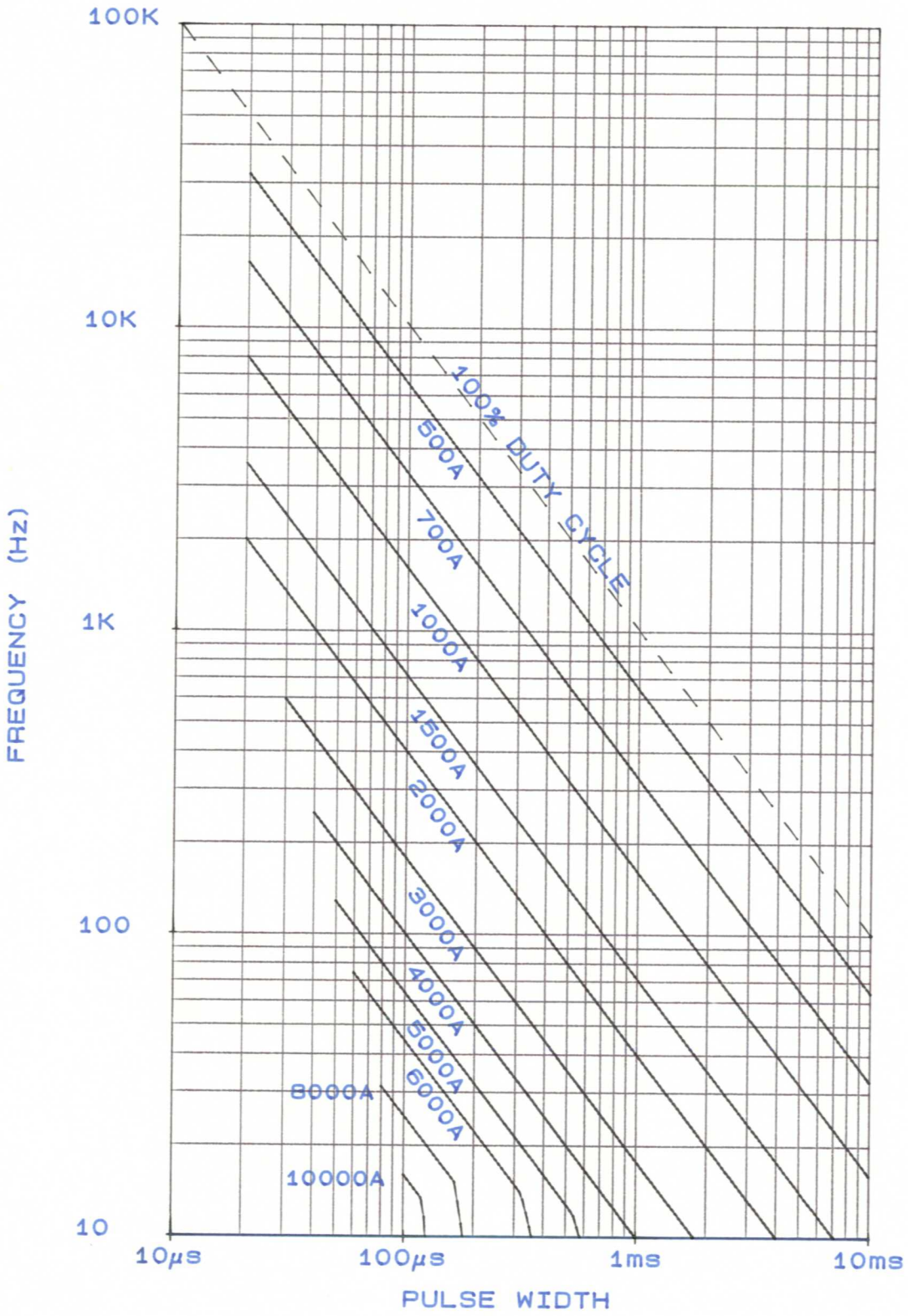


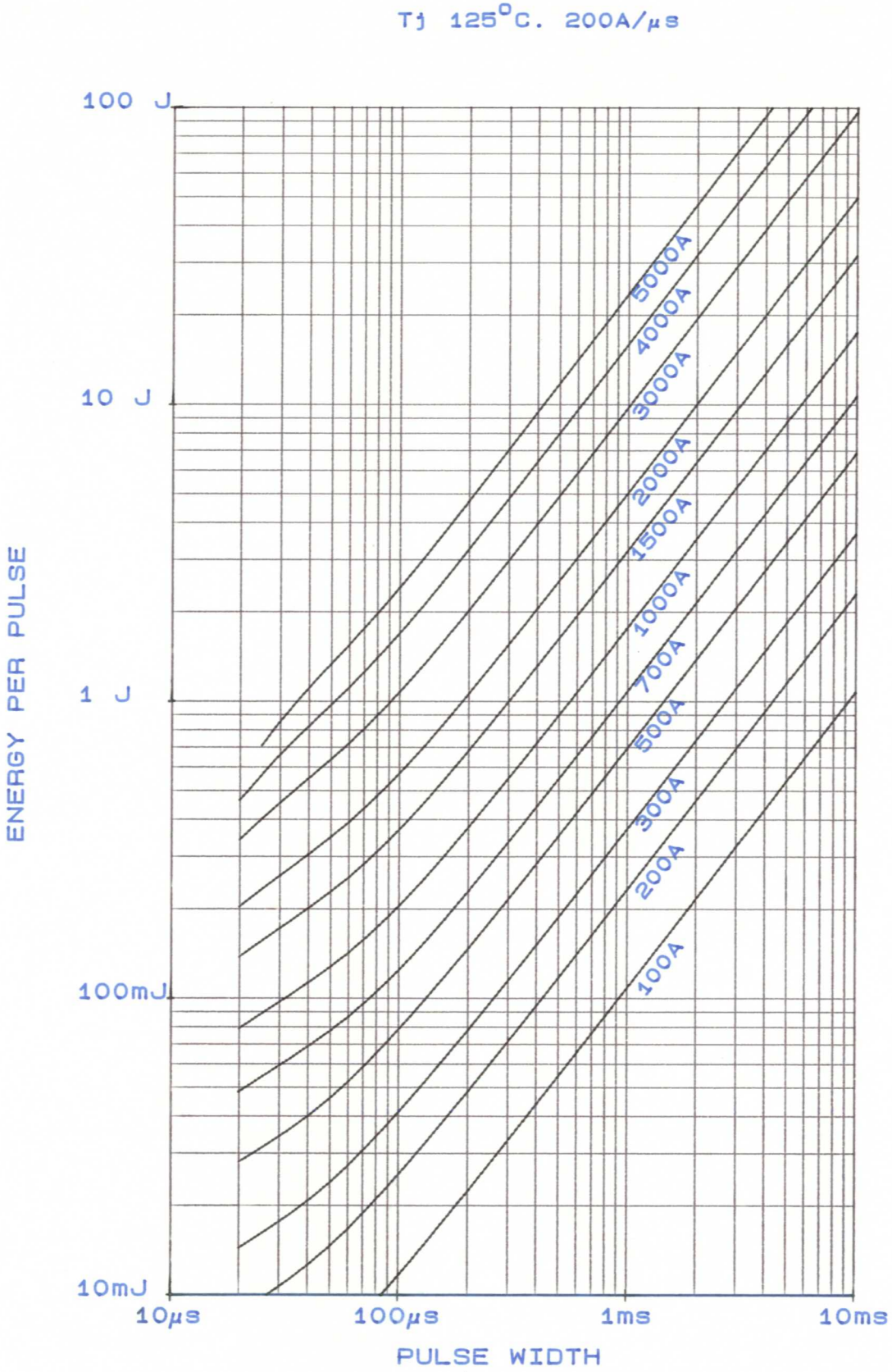
T CASE 60degC, 200A/µs

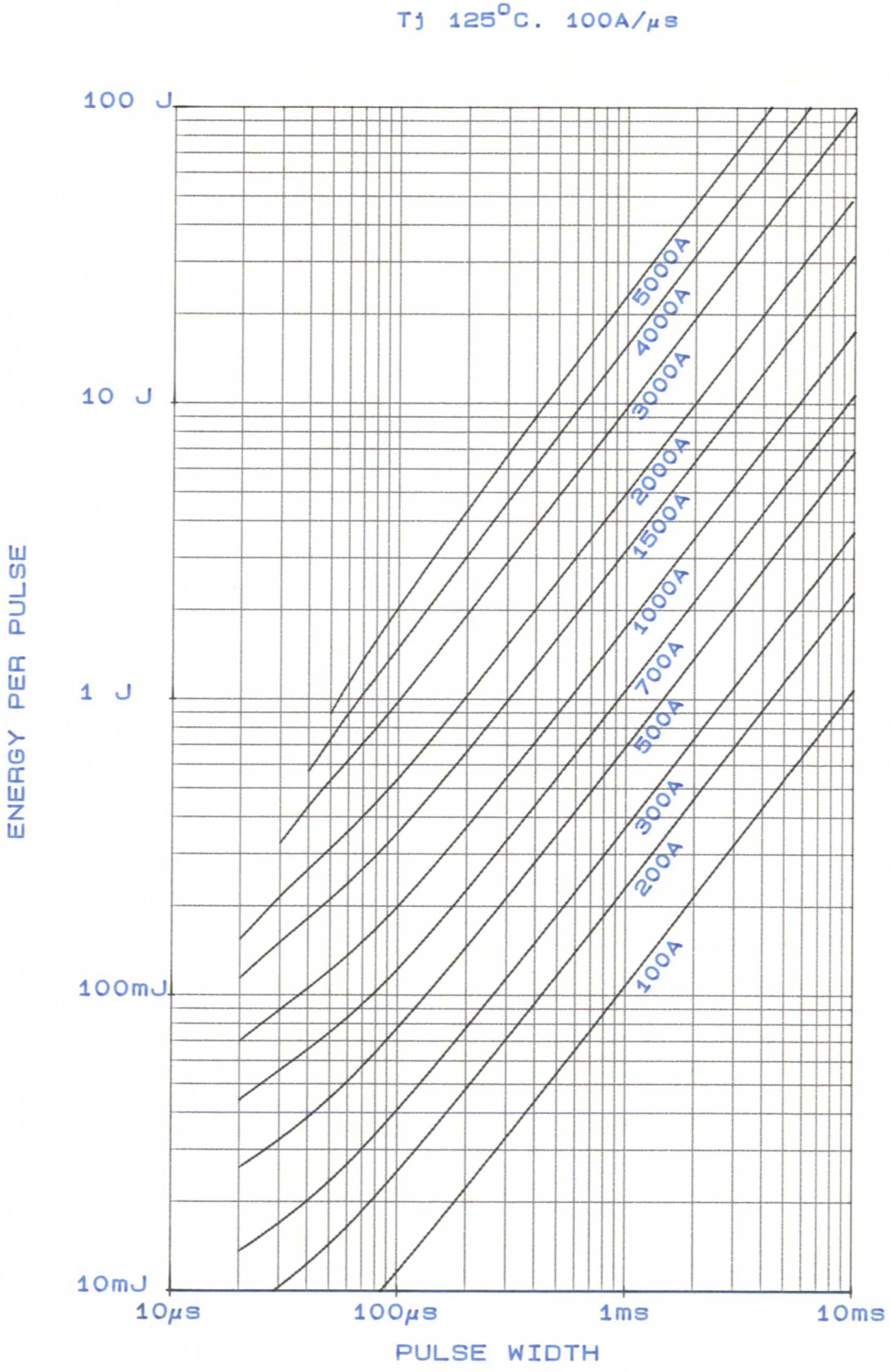



T CASE 90degC 100A/us
100K
10K
1K
100
10
FREQUENCY (Hz)
200A
100% DUTY CYCLE
300A
500A
700A
1000A
1500A
2000A
3000A
4000A
5000A
6000A
10µs
100µs
1ms
10ms
PULSE WIDTH

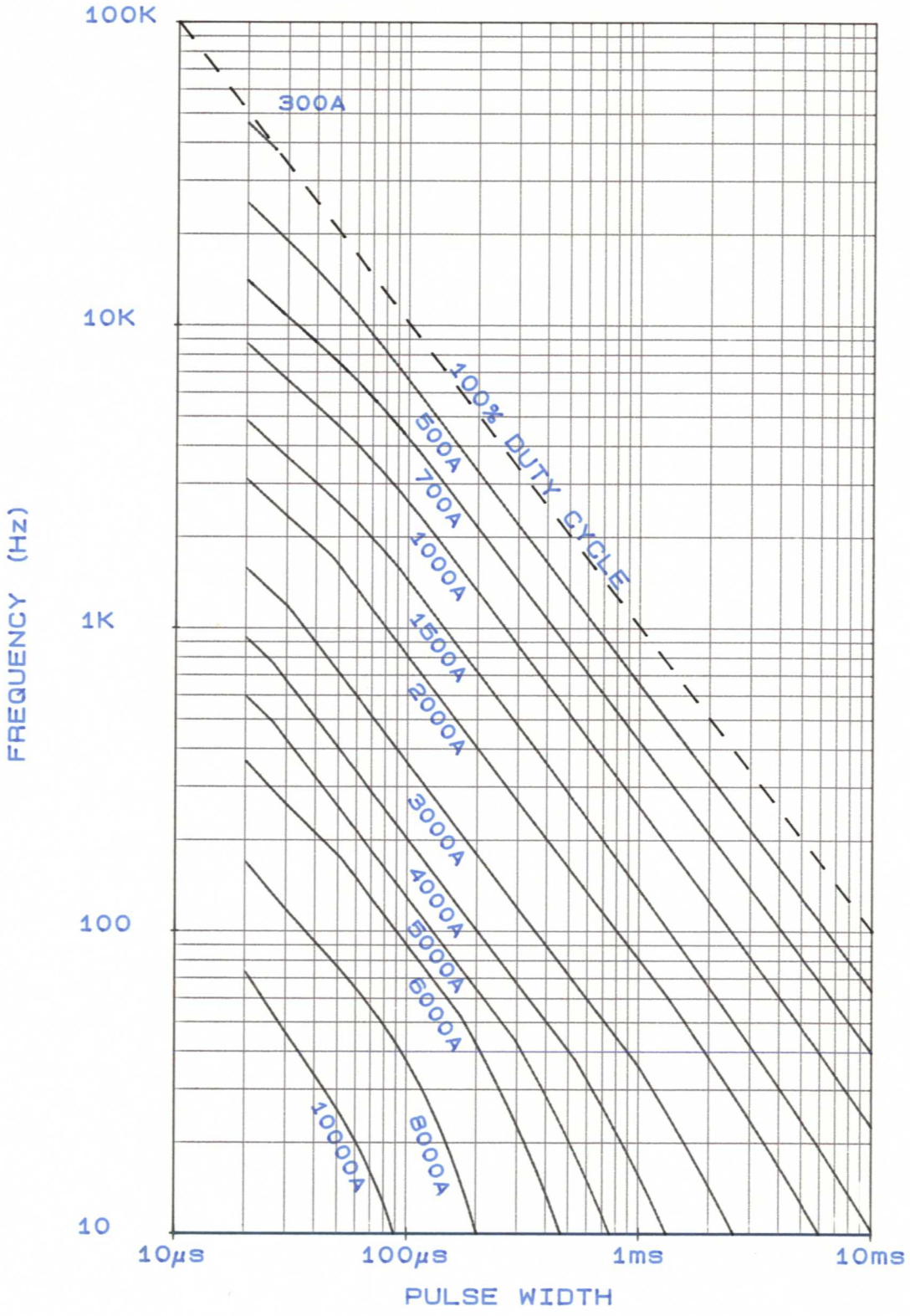
T CASE 60degC, 100A/µs

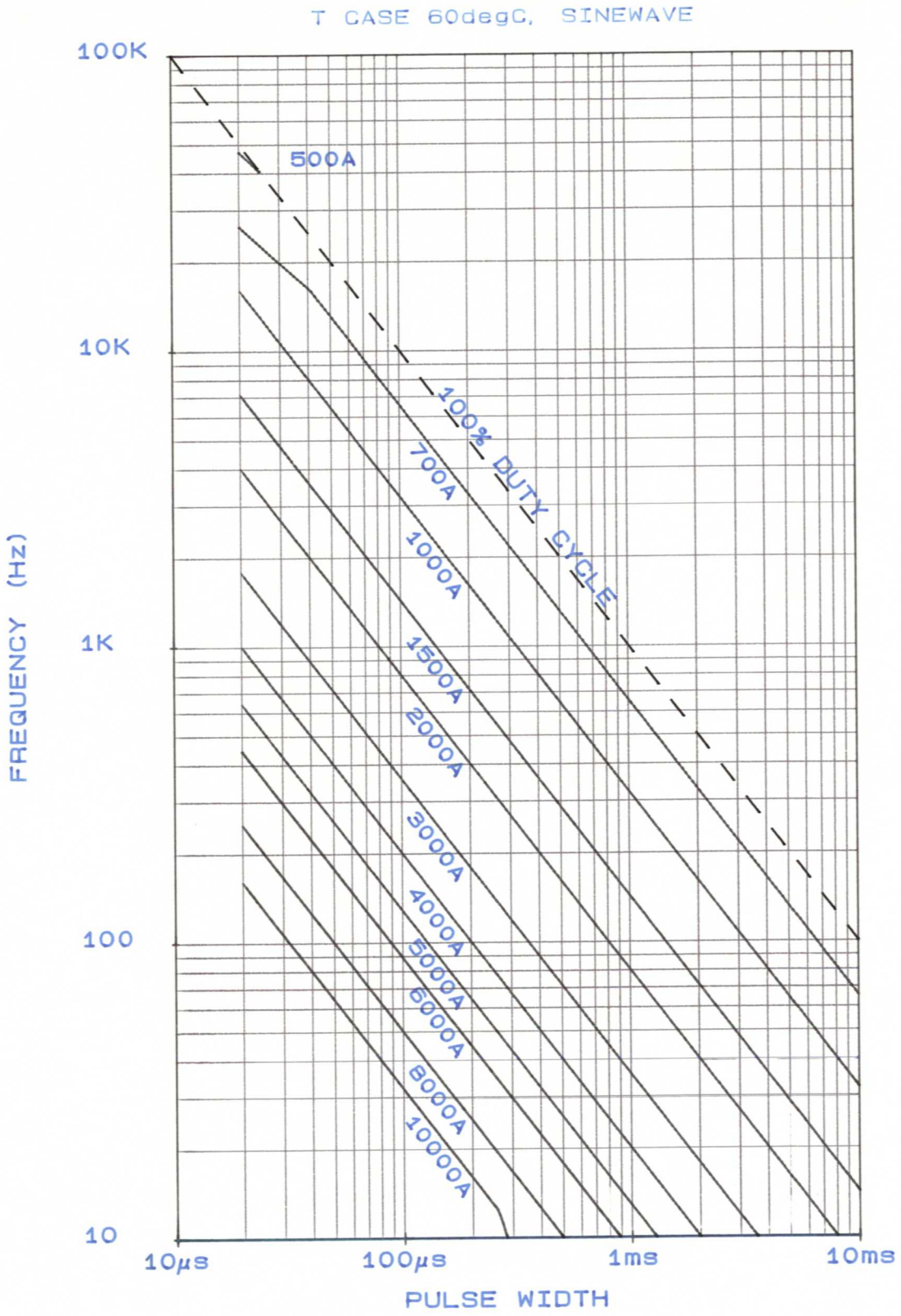


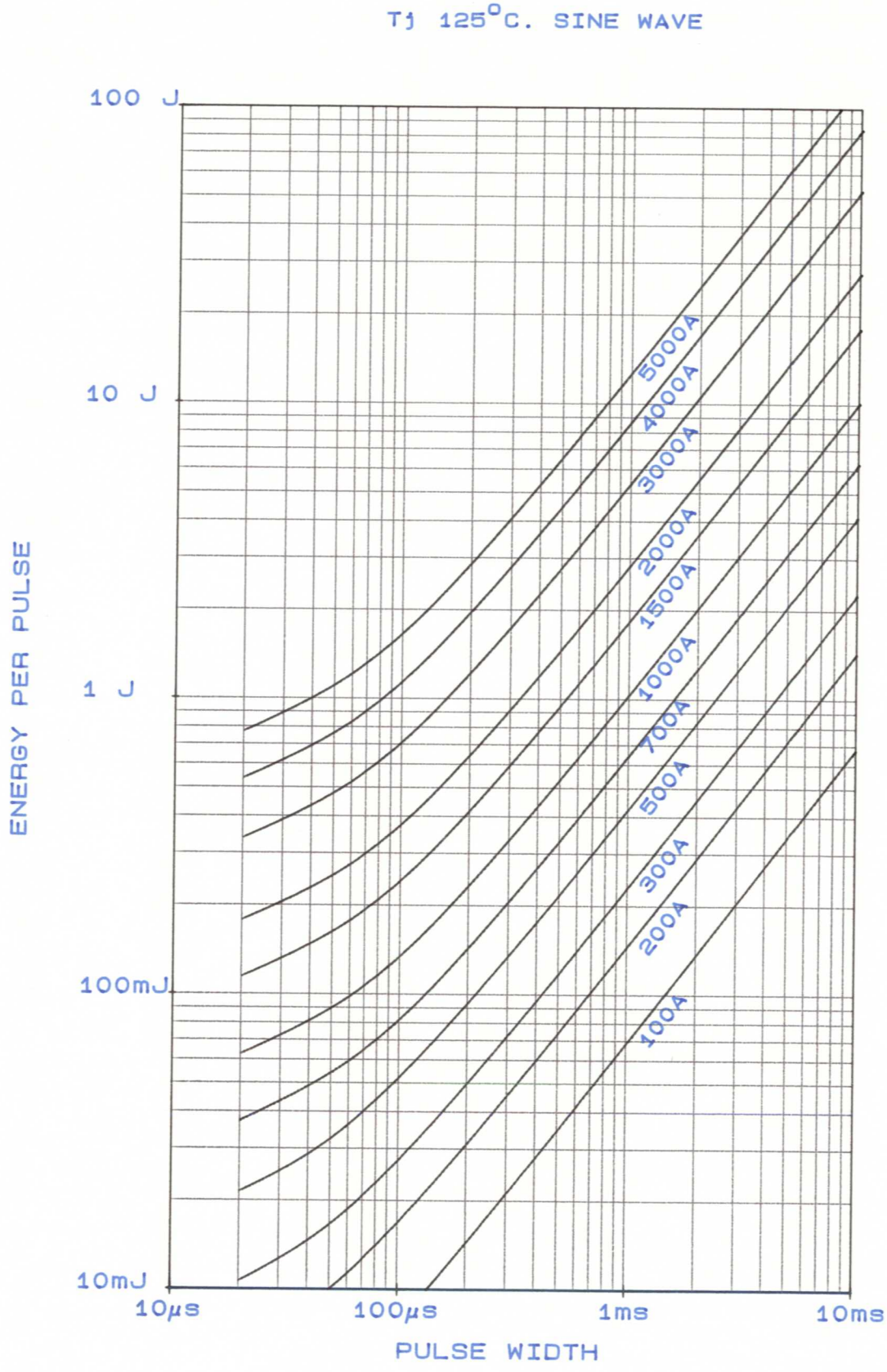

Tj 125°C. 200A/µs
100 J
10 J
1 J
100mJ
10mJ
ENERGY PER PULSE
5000A
4000A
3000A
2000A
1500A
1000A
700A
500A
300A
200A
100A
10µs
100µs
1ms
10ms
PULSE WIDTH


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

T CASE 90degC, SINEWAVE




T CASE 60degC, SINEWAVE
100K
10K
1K
100
10
FREQUENCY (Hz)
500A
100% DUTY CYCLE
700A
1000A
1500A
2000A
3000A
4000A
5000A
6000A
8000A
10000A
10µs
100µs
1ms
10ms
PULSE WIDTH


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

SCALE	1/1
DRN	BB
CHKD	BB
APPD	
S	A
S	NI

INTERNATIONAL OUTLINE No. 22

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.

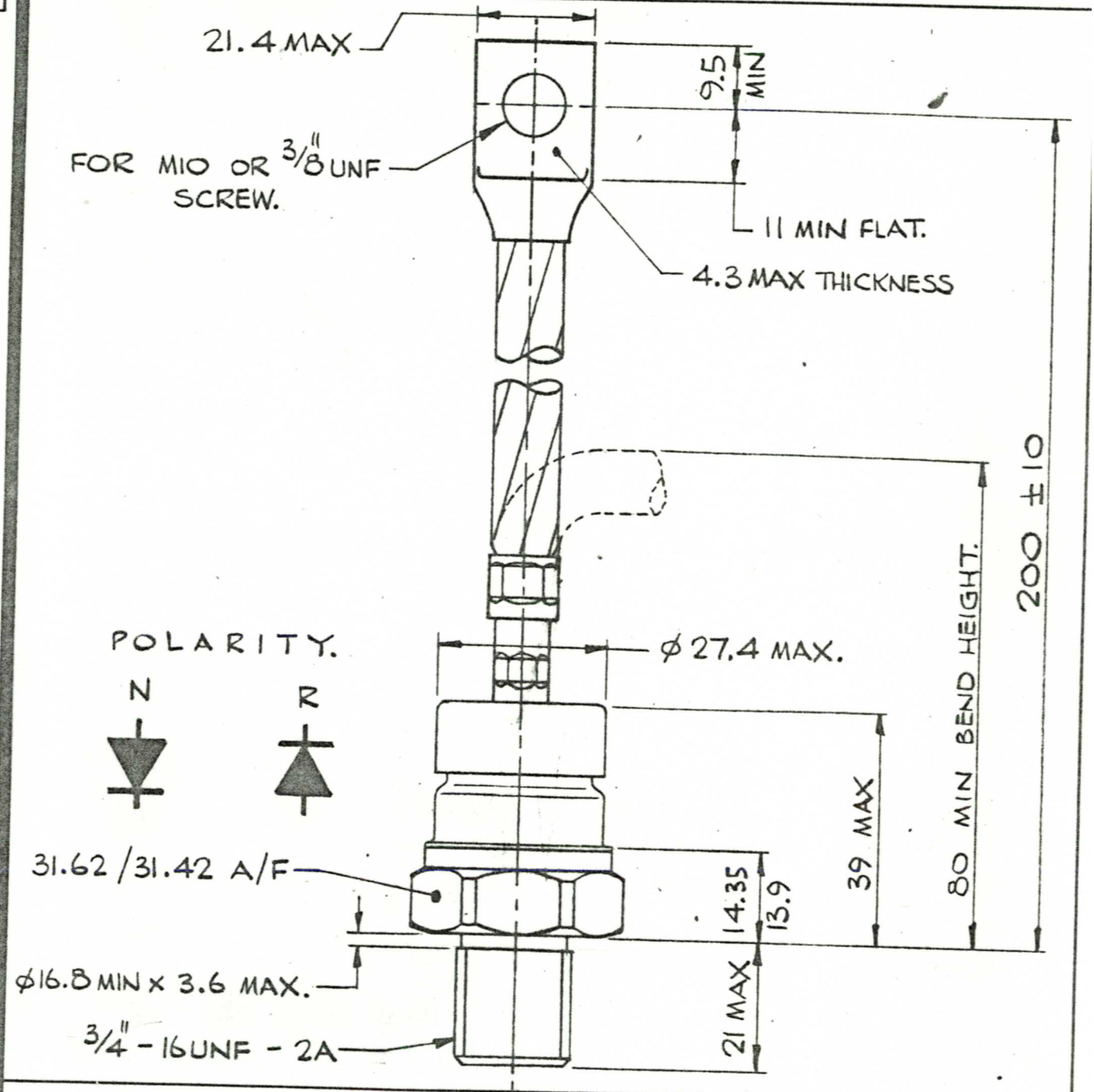
DIODE TYPE NUMBER

PHN/R 380

PHN/R320

PHN/R174

G.A. DRG. No. 102A216H04.



WESTINGHOUSE BRAKE AND SIGNAL CO. LTD.
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. BB
5	27.11.84 MI218 FIN WAS E7 BB