Soft Recovery Diode
Types M0451YX120 to M0451YX200

The data sheet on the subsequent pages of this document is a scanned copy of existing data for this product.
(Rating Report 83NR10 Issue 1)

This data reflects the old part number for this product which is: SM12-20CXC176.
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 YC outline drawing (W2) in datasheet

The following links will direct you to the appropriate outline drawings
Outline W2 – 15.1mm Clamp height
Outline W3 – 26.6mm Clamp height

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

M0451	YX	♦♦	**0**
Fixed Type Code	YC - 14.5mm Clamp height YH – 26mm Clamp height	Voltage code V_{RRM}/100 12-20	Fixed Code
Typical Order Code: M0451YH160, 26mm Clamp height, 1600V V_{RRM}			

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QUALITY EVALUATION LABORATORY

Rating Report: 83NR10 Date: 5th December, 1983

Origin: Pages: 28

Diode Type SM12-M20CXC176

Written: B.W.P. Brown Checked: Approved:

The CXC176 is a high power, high voltage, fast recovery, all diffused diode based on a slice diameter of 24 mm and provides an extension of voltage range above that of the type CXC170. For use in inverters and transistor switching regulators.

Ratings and Characteristics

Ratings

Voltage Grades		: 12-20
V_{RSM}		: 1300-2100V
V_{RRM}		: 1200-2000V
V_{RWM}		: 1050-1800V
$I_{F(AV)}$	: Single phase; 50Hz, 180° half sinewave; (converter ratings)	:
	Double side cooled. T_{HS} = 55°C, 100°C	: 434A; 202A
	Single side cooled. T_{HS} = 100°C	: 114A
$I_{F(rms)}$	T_{HS} = 25°C	: 870A
I_F	T_{HS} = 25°C	: 724A
I_{FSM}	: t = 10ms half sinewave; T_J (initial) = 125°C; V_{RM} = 0.6 V_{RRM}(MAX)	: 4500A
I_{FSM}	: t = 10ms half sinewave; T_J (initial) = 125°C; $V_{RM} \leq 10V$	: 4950A
I^2t	: t = 10ms; T_J (initial) = 125°C; V_{RM} = 0.6 V_{RRM}(MAX)	: 101 x $10^3 A^2 SEC$
I^2t	: t = 10ms; T_J (initial) = 125°C; $V_{RM} \leq 10V$	: 122 x $10^3 A^2 SEC$
I^2t	: t = 3ms; T_J (initial) = 125°C; $V_{RM} \leq 10V$	: 91 x $10^3 A^2 SEC$
T_{HS} operating range		: -40 to +125°C
T_{stg}; non-operating		: -40 to +150°C

Characteristics

(Maximum values unless stated otherwise)

V_D : T_J = 125°C	: 1.00V
r_s : T_J = 125°C	: 8.74 mohms
V_{FM} : I_{FM} = 635A T_{VJ} = 125°C	: 1.47V
R_{th}(J-HS) Double side cooled	: 0.085°C/W
Single side cooled	: 0.17°C/W
I_{RRM} : T_J = 125°C V_{RM} = $V_{RRM(MAX)}$	: 20mA
Q_{rr} : I_{FM} = 550A ; dI/dt = 40A/uS	: 160uC max.
V_{RM} = 50V T_{VJ} = 125°C	:
Mounting Force :	: 330-55Kg.f
Outline Drawing :	: 101A260

CONTENTS

Voltage Ratings

Voltage Class	V_{RRM} V	V_{RSM} V
12	1200	1300
14	1400	1500
16	1600	1700
18	1800	1900
20	2000	2100

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 cold-weld capsules with 24 mm all diffused silicon slices. All these diodes have controlled reverse recovery characteristics with good "S" factors. These devices will find applications as "free wheel" diodes in transistor switching circuits.

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 and 200/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

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

c) Junction temperature rise per pulse

Junction temperature rise at end of conduction over a single pulse is given but is only required for low duty cycle ($\leq$ 1%) or single pulse operation.

$T_{SINK} = 125 - T - EpfR_{th}$

where f = number of pulses per second, Hz

and T = temperature rise for single pulse, deg. C.

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 heat sink temperature can then be evaluated from:

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

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 heat sink 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 voltage waveform should be carried out with an appropriate snubber of 0.1uF and 5ohms in series 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 and transient junction temperature rise may be estimated from curves on pages 14 and 15.

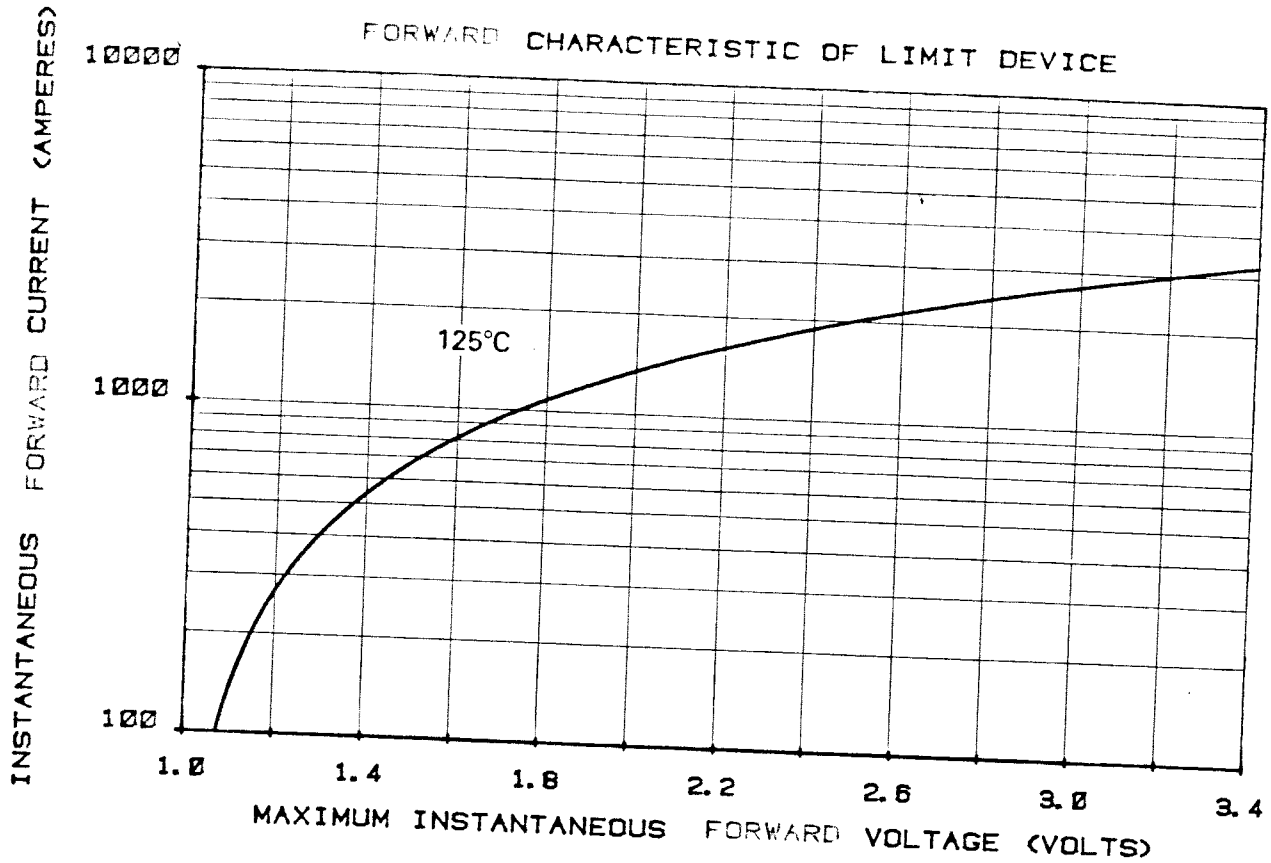
Let E be the value of energy per reverse cycle in joules (curves on p. 14)

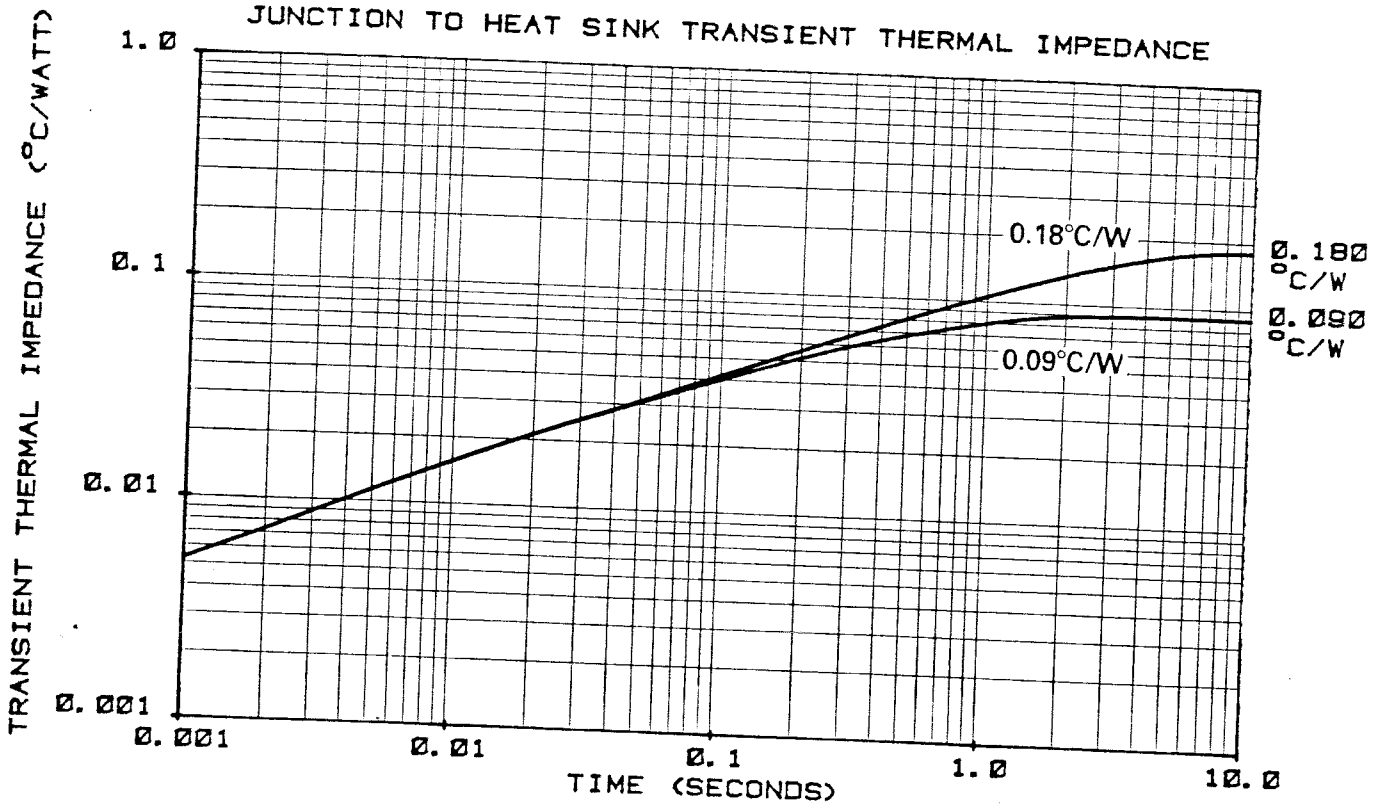
Let θ be the value of temperature rise per reverse recovery cycle (degrees centigrade) (curves on p. 15)

Let f be the operating frequency in Hz

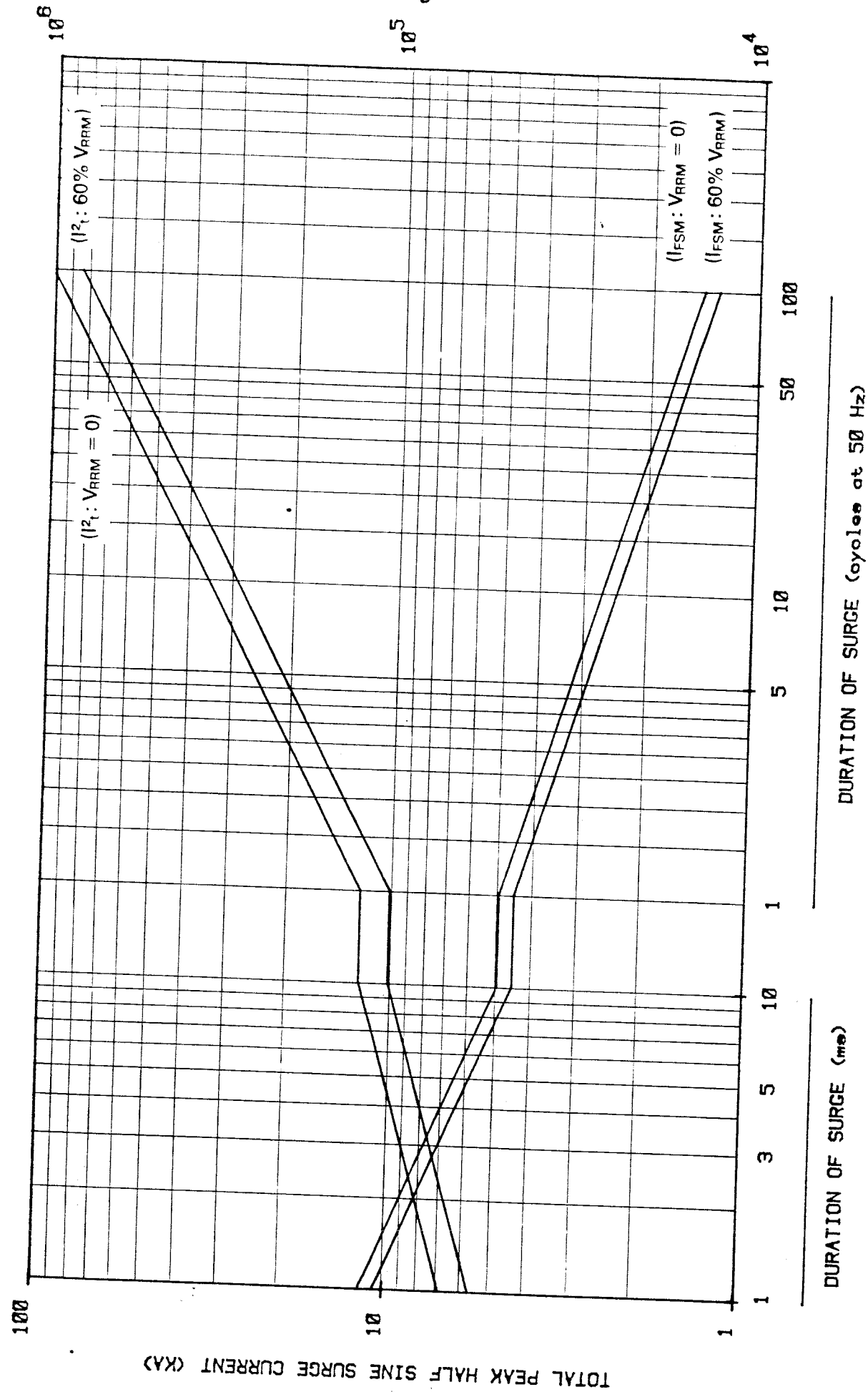
Then $T_{SINK\ new} = T_{SINK\ original} - \theta - ER_{th}\ f$

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

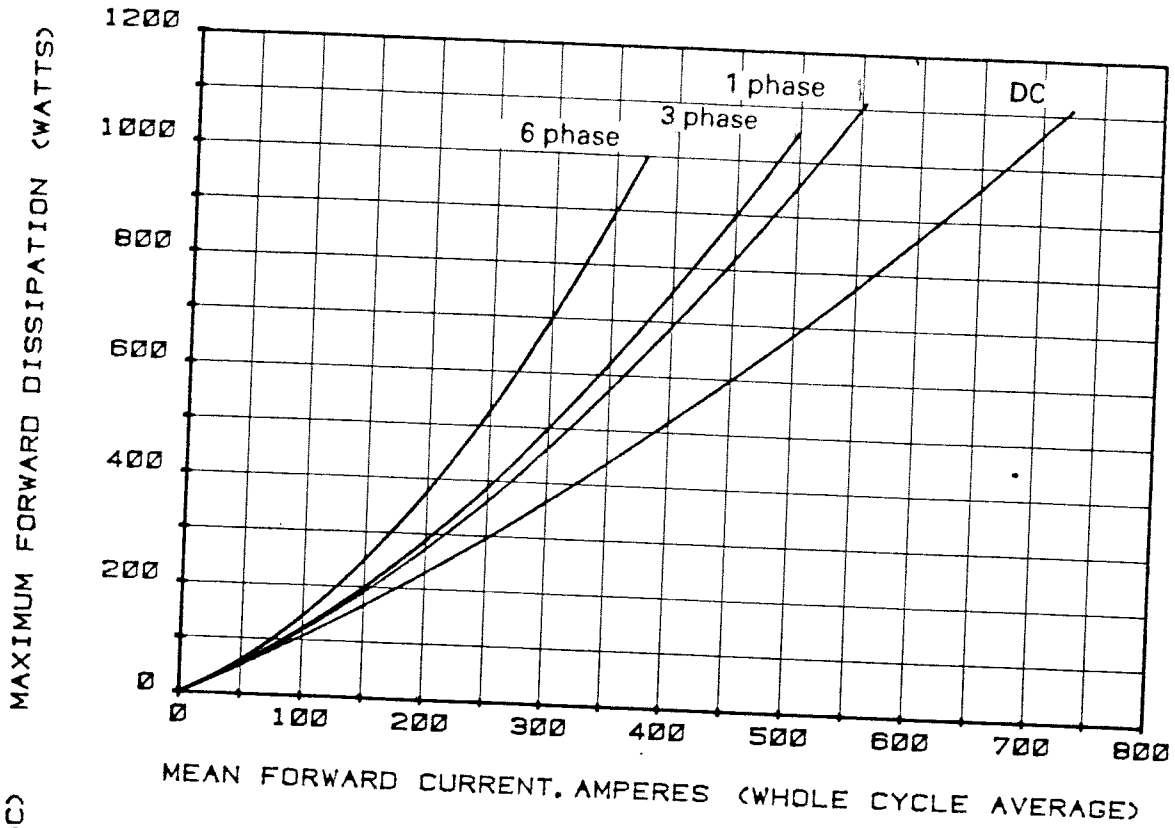

FORWARD CHARACTERISTIC OF LIMIT DEVICE
INSTANTANEOUS FORWARD CURRENT (AMPERES)
10000
1000
100
125°C
1.0
1.4
1.8
2.2
2.6
3.0
3.4
MAXIMUM INSTANTANEOUS FORWARD VOLTAGE (VOLTS)

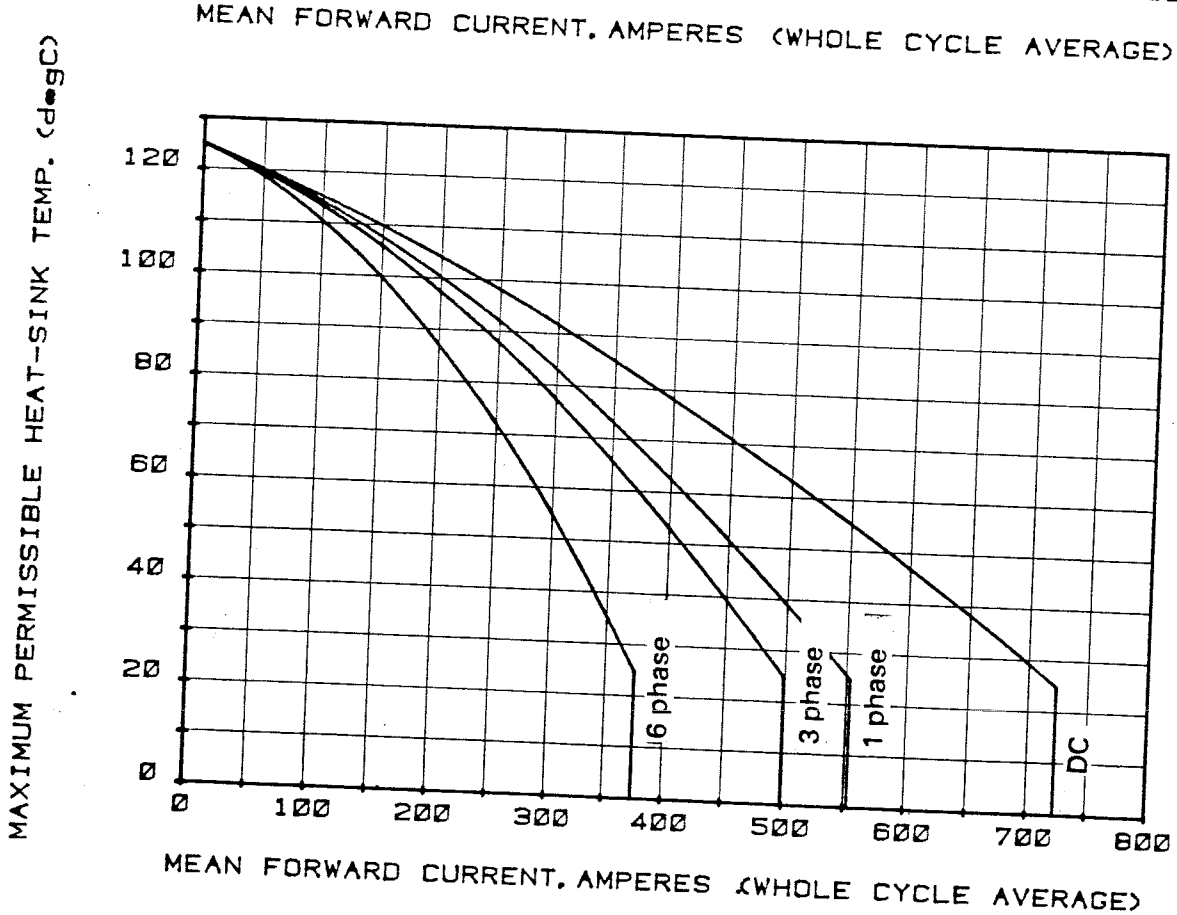

JUNCTION TO HEAT SINK TRANSIENT THERMAL IMPEDANCE
TRANSIENT THERMAL IMPEDANCE (°C/WATT)
1.0
0.1
0.01
0.001
0.18°C/W
0.09°C/W
0.180 °C/W
0.090 °C/W
0.001
0.01
0.1
1.0
10.0
TIME (SECONDS)

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

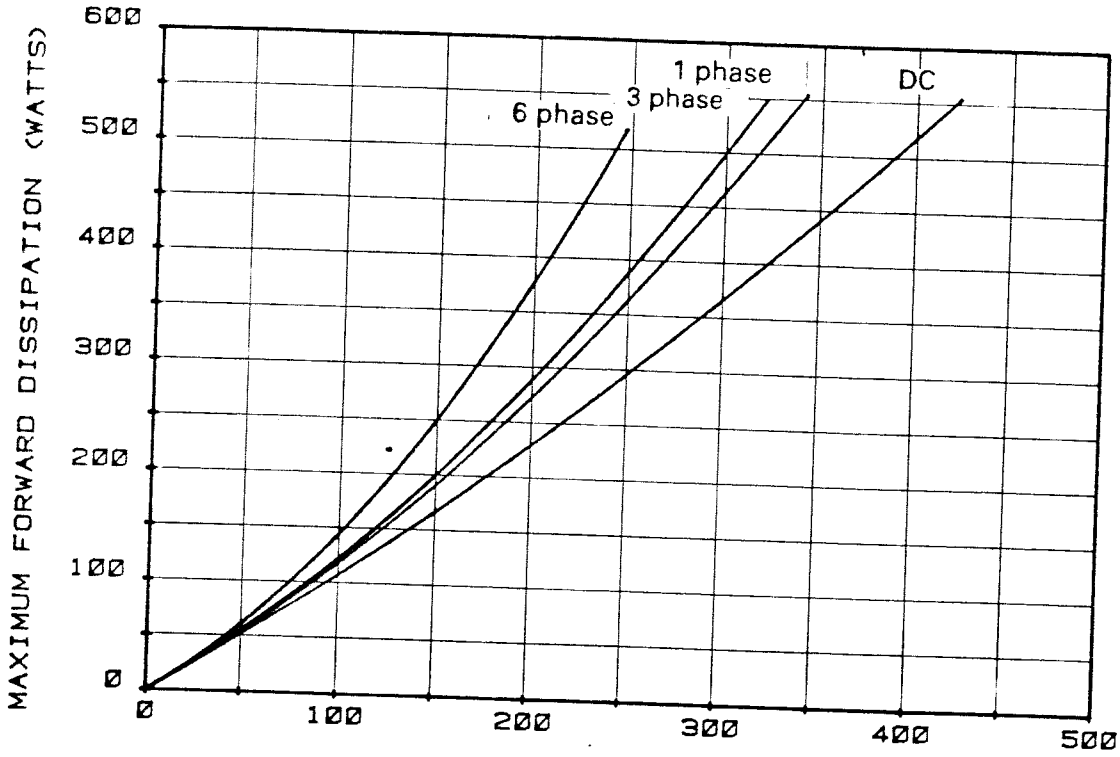


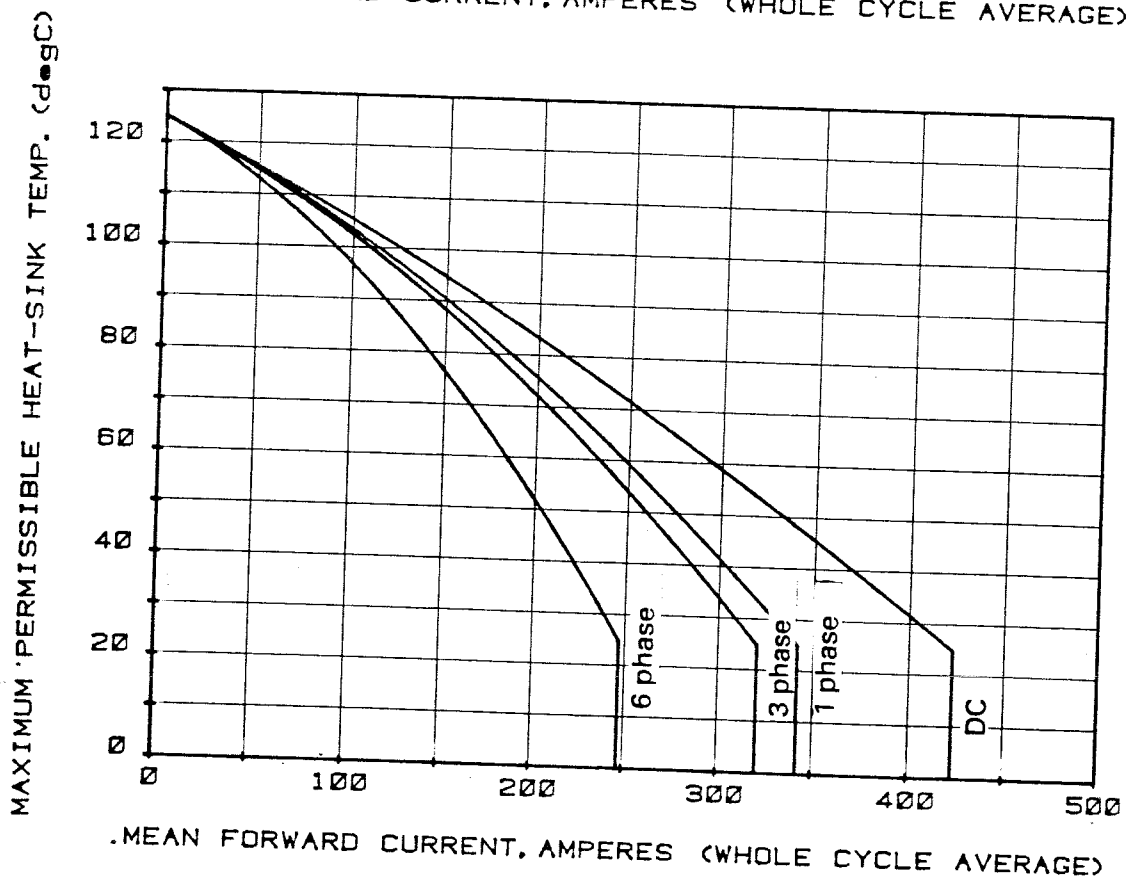
DOUBLE SIDE COOLED

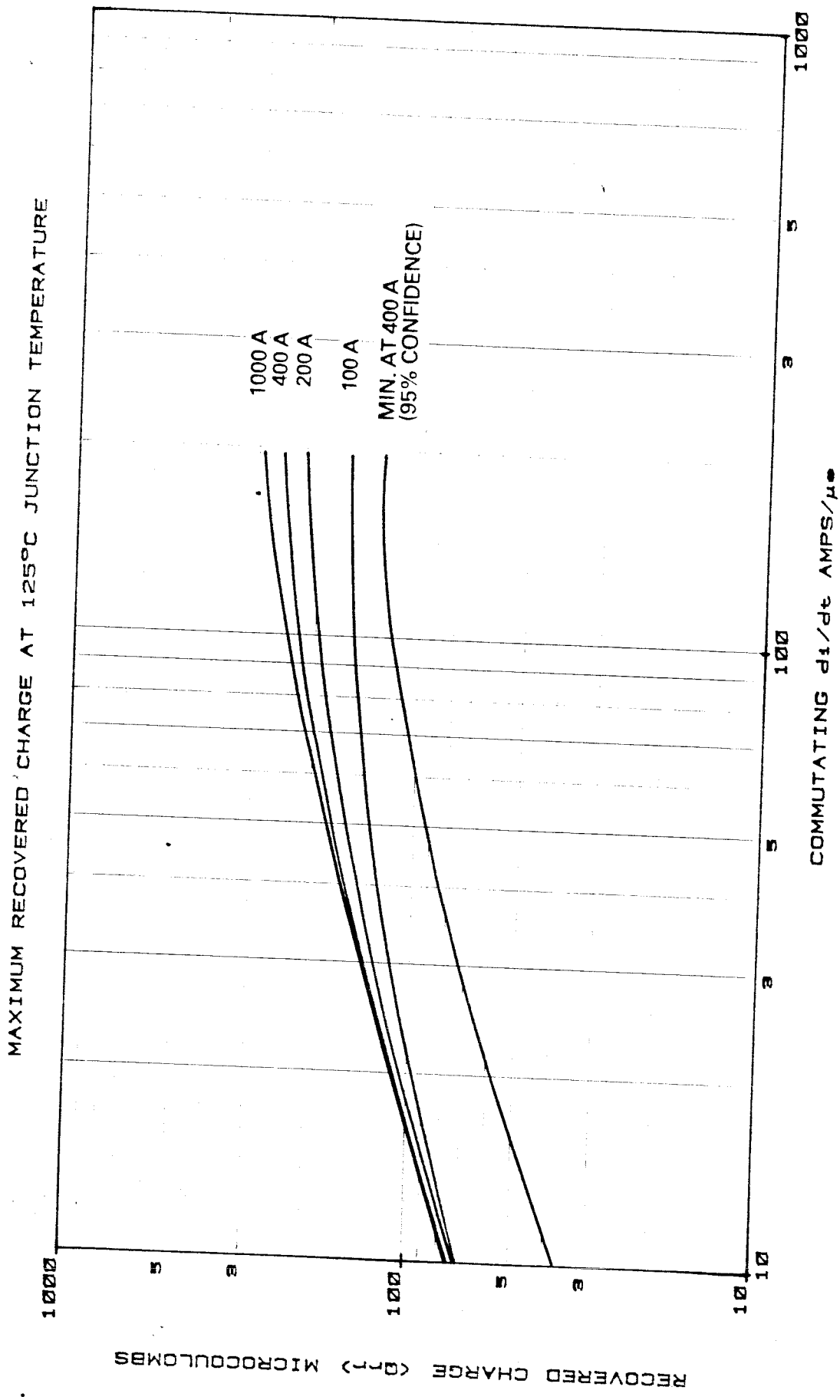


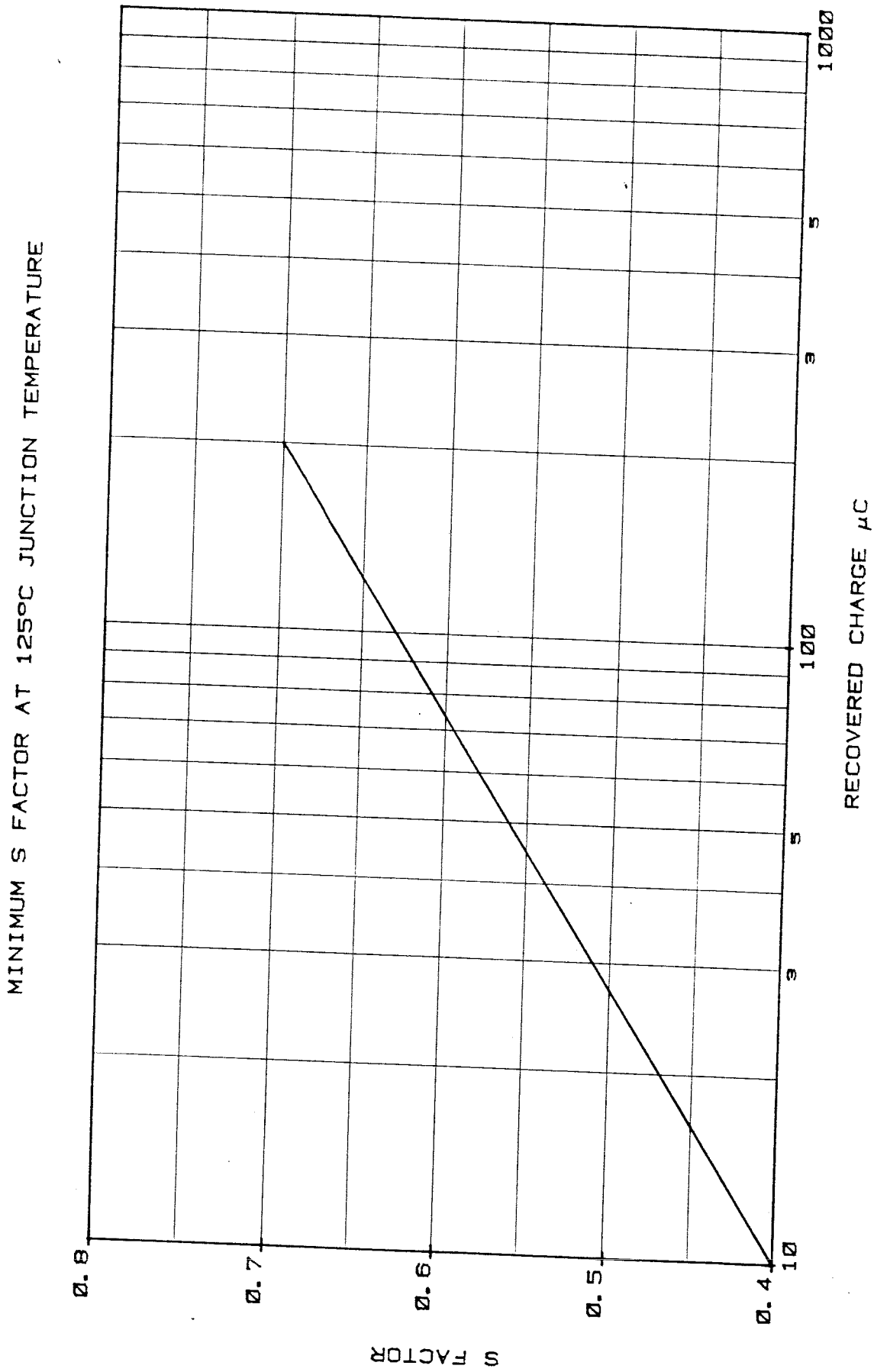


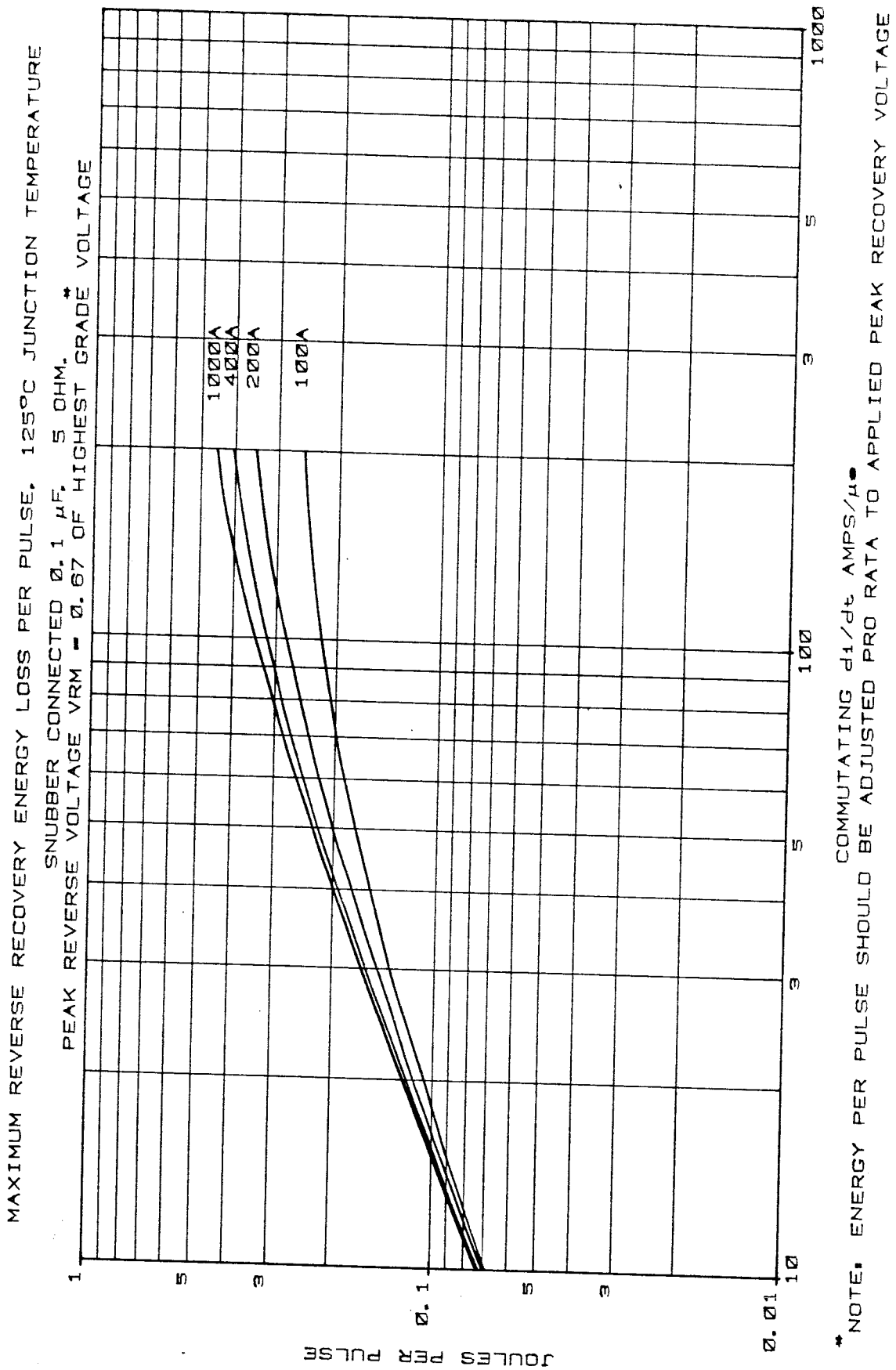
SINGLE SIDE COOLED

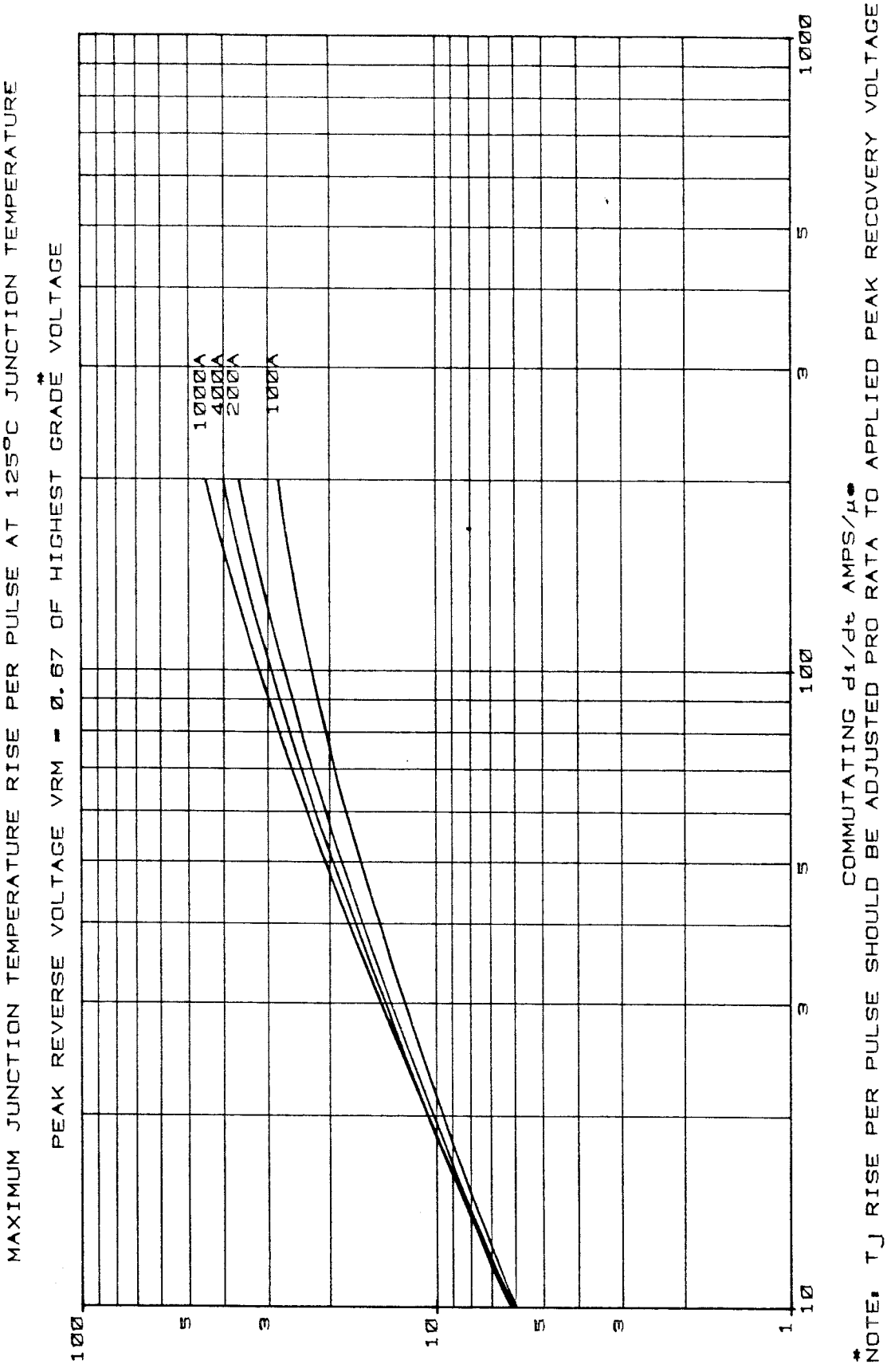





MAXIMUM RECOVERED CHARGE AT 125°C JUNCTION TEMPERATURE
1000 A
400 A
200 A
100 A
MIN. AT 400 A
(95% CONFIDENCE)
RECOVERED CHARGE (Qrr) MICROCOULOMBS
COMMUTATING di/dt AMPS/μs
1000
100
10
1000
100
10

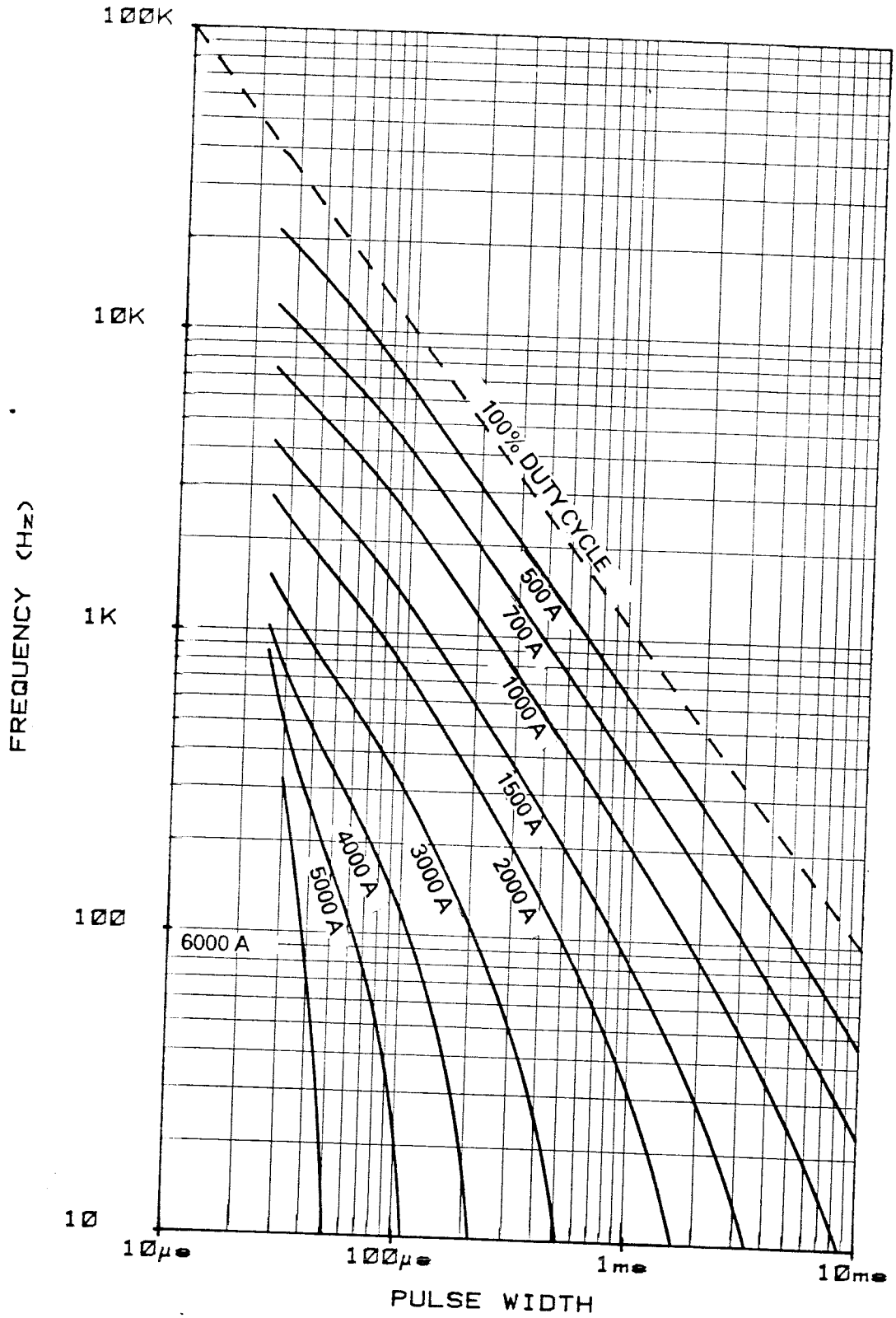

MINIMUM S FACTOR AT 125°C JUNCTION TEMPERATURE
S FACTOR
Ø.8
Ø.7
Ø.6
Ø.5
Ø.4
RECOVERED CHARGE μC
10
3
5
100
3
5
1000


MAXIMUM REVERSE RECOVERY ENERGY LOSS PER PULSE, 125°C JUNCTION TEMPERATURE
SNUBBER CONNECTED Ø.1 μF, 5 OHM.
PEAK REVERSE VOLTAGE VRM = Ø.67 OF HIGHEST GRADE* VOLTAGE
1000A
400A
200A
100A
JOULES PER PULSE
1
5
3
Ø.1
5
3
Ø.Ø1
10
3
5
100
3
5
1000
COMMUTATING di/dt AMPS/μs
*NOTE: ENERGY PER PULSE SHOULD BE ADJUSTED PRO RATA TO APPLIED PEAK RECOVERY VOLTAGE

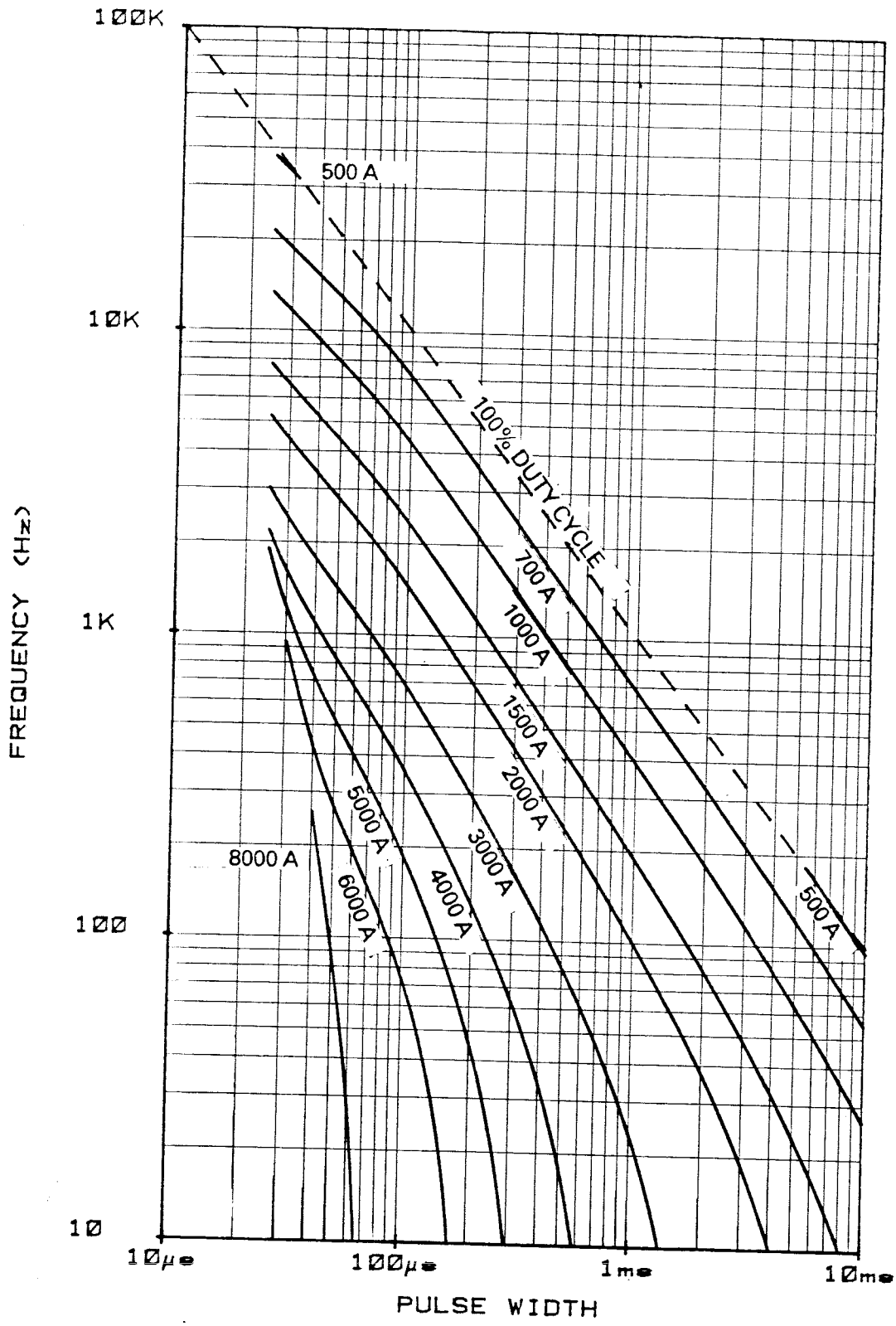


*NOTE: TJ RISE PER PULSE SHOULD BE ADJUSTED PRO RATA TO APPLIED PEAK RECOVERY VOLTAGE

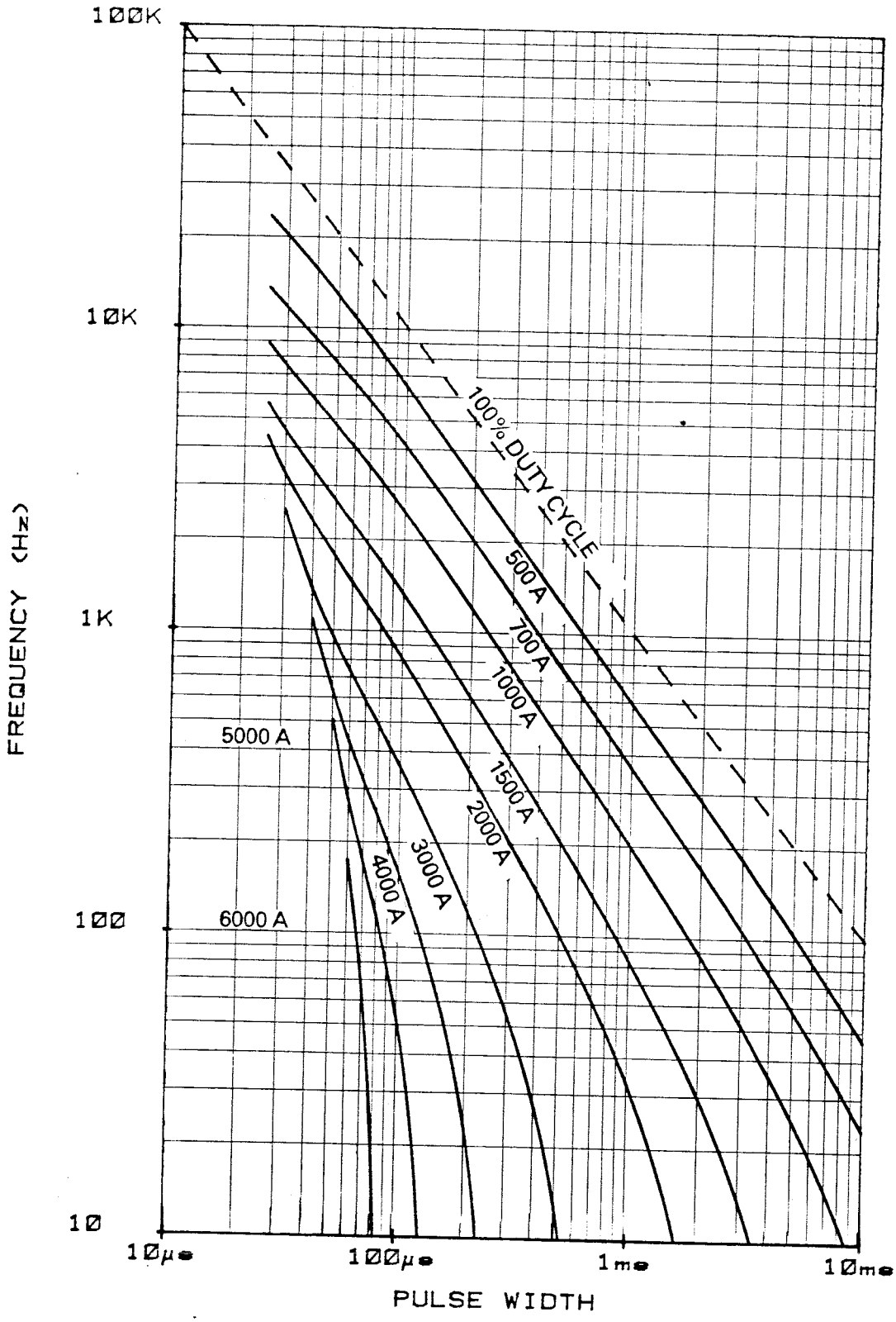
T SINK 85°C. 200A/μs



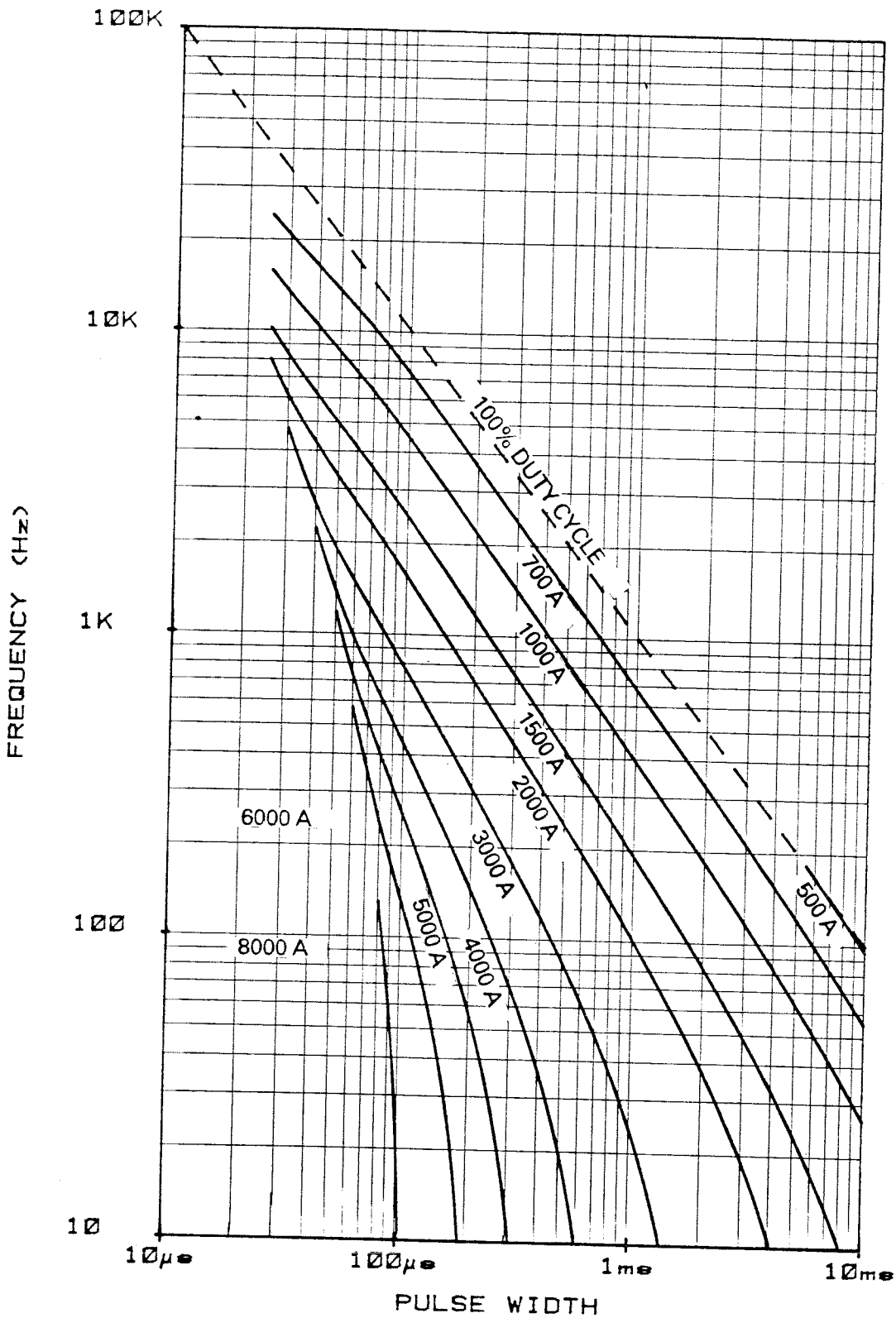
T SINK 55°C. 200A/μs



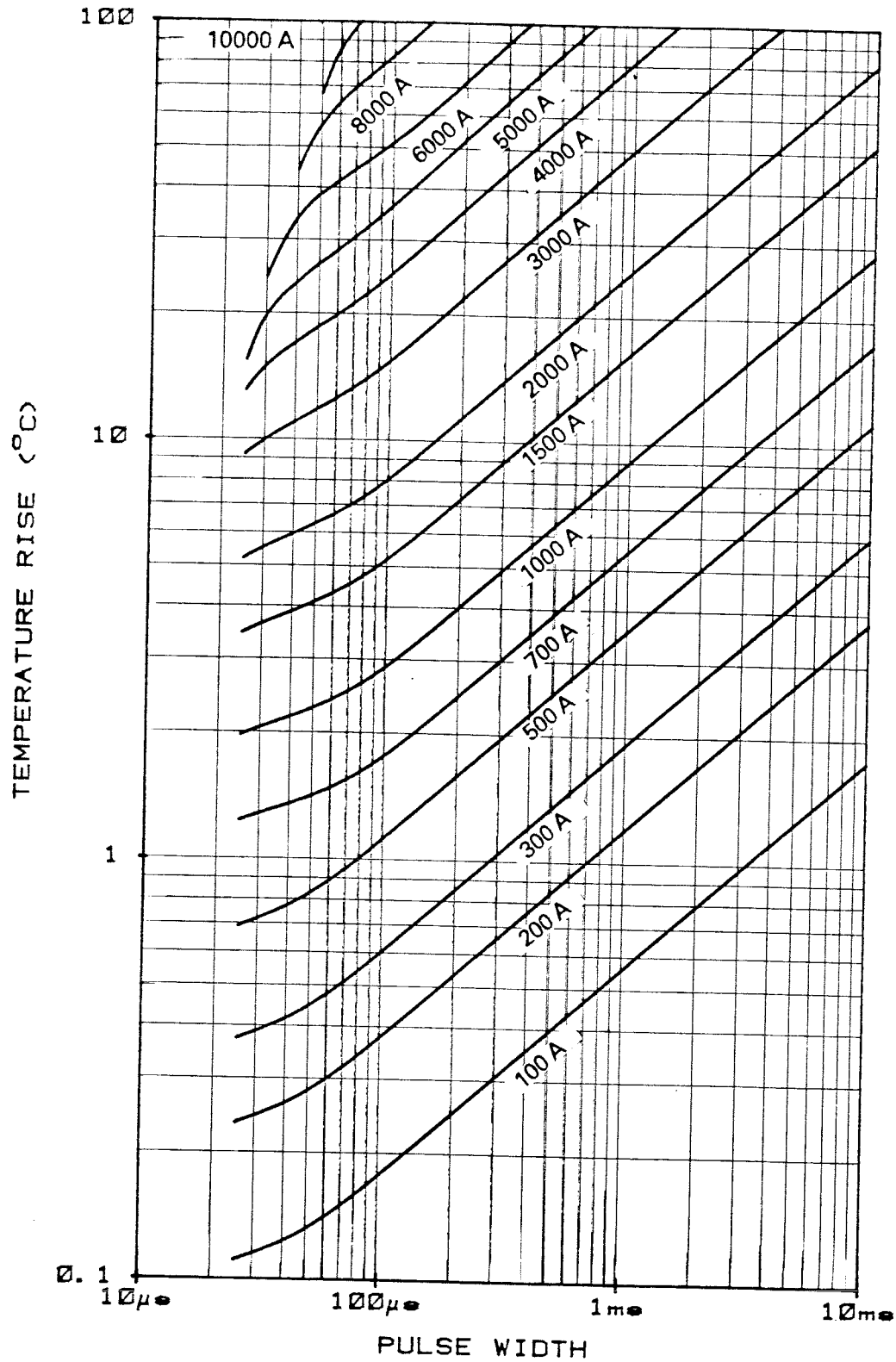
T SINK 85°C. 100A/μs



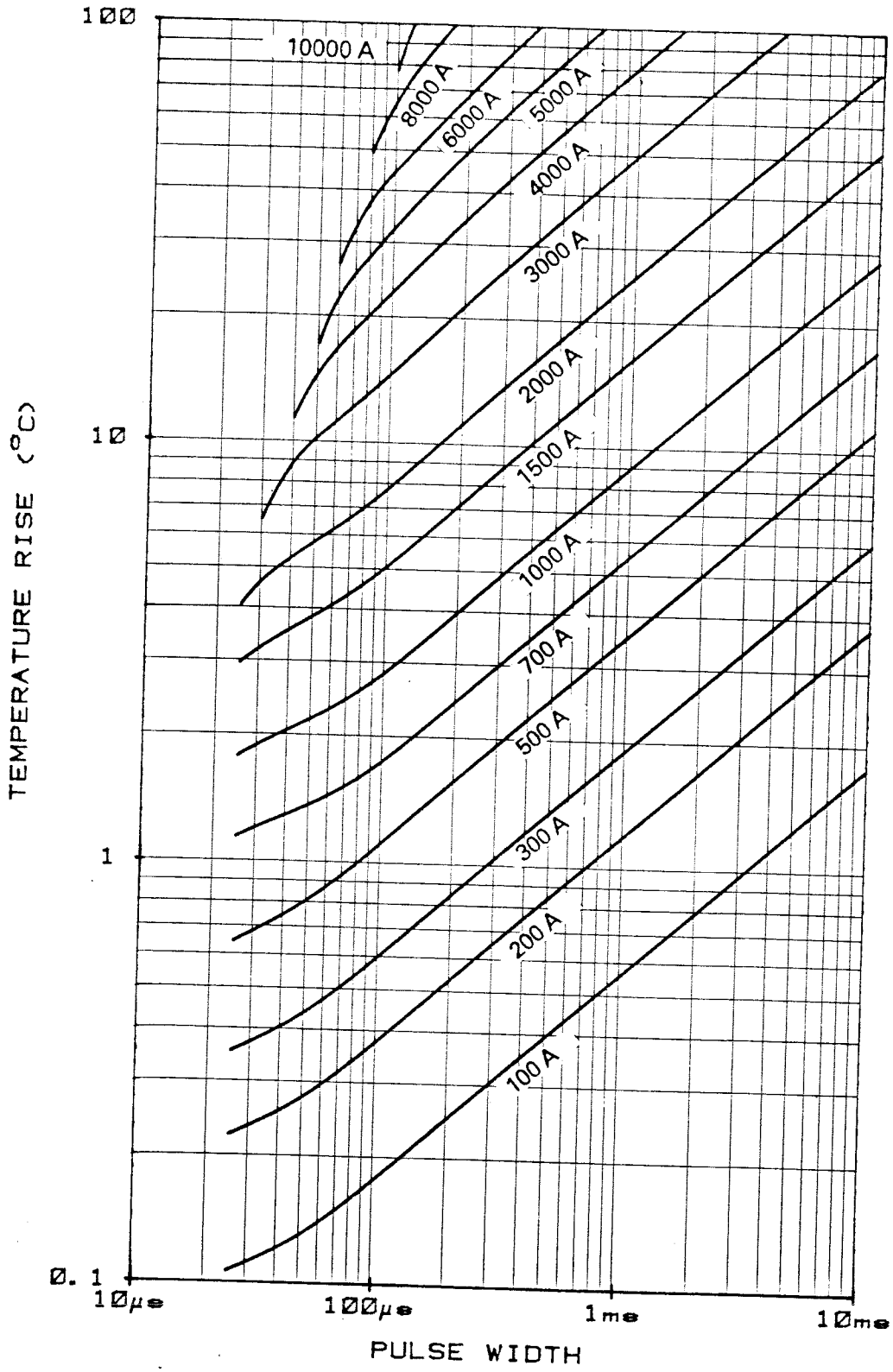
T SINK 55°C. 100A/μs



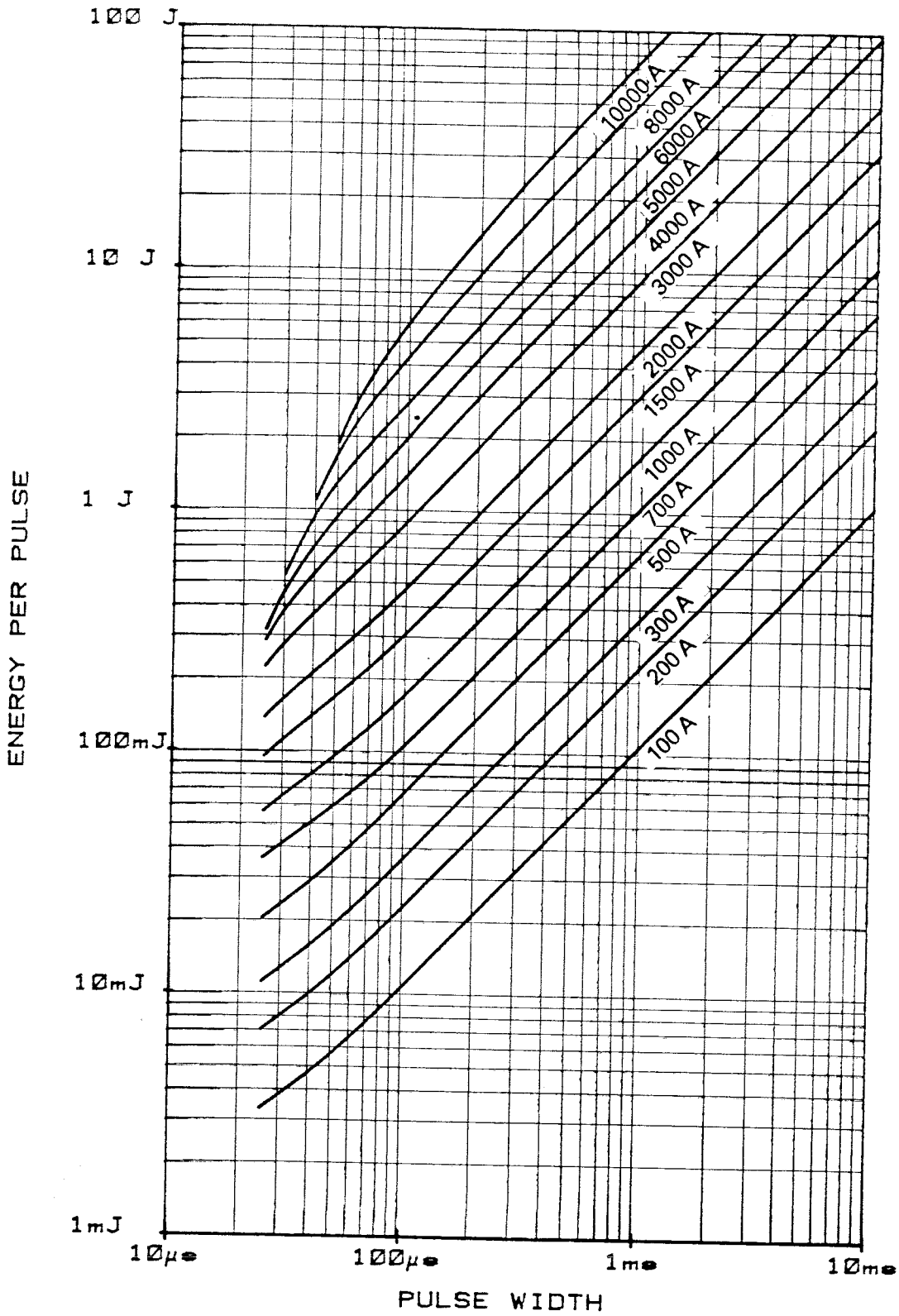
TJ 125°C. 200A/μs



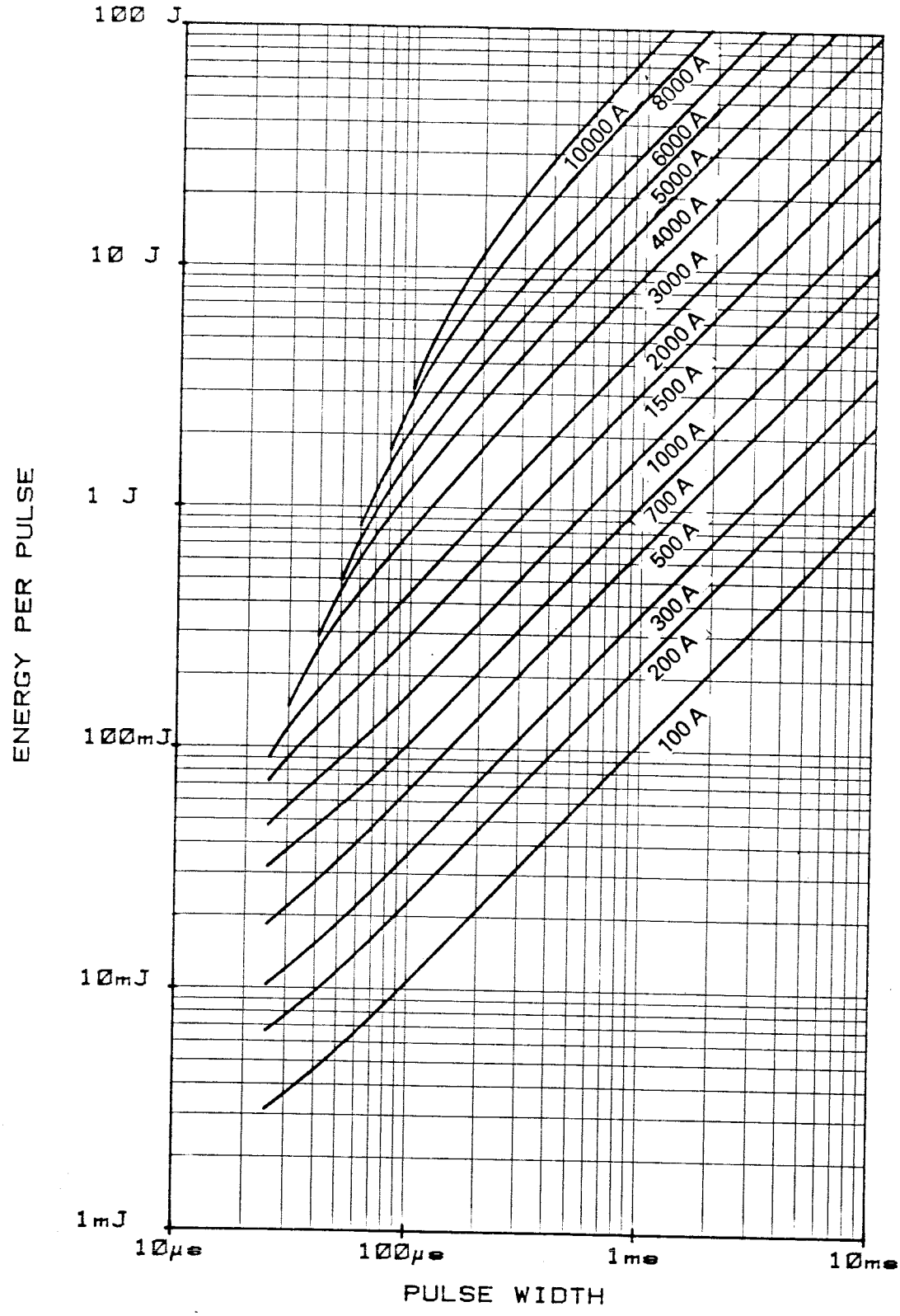
TJ 125°C. 100A/μs



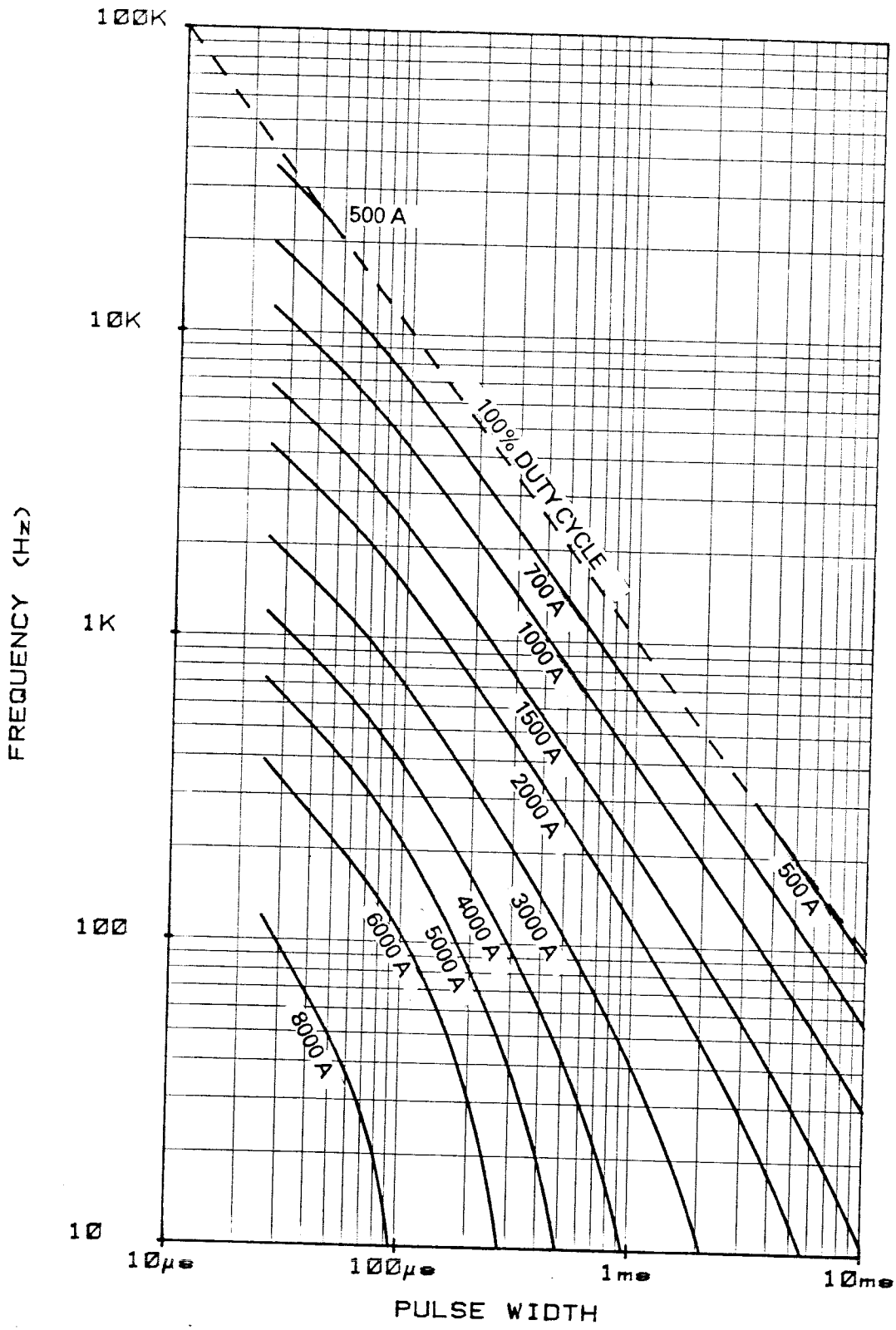
T_J 125°C. 200A/μs



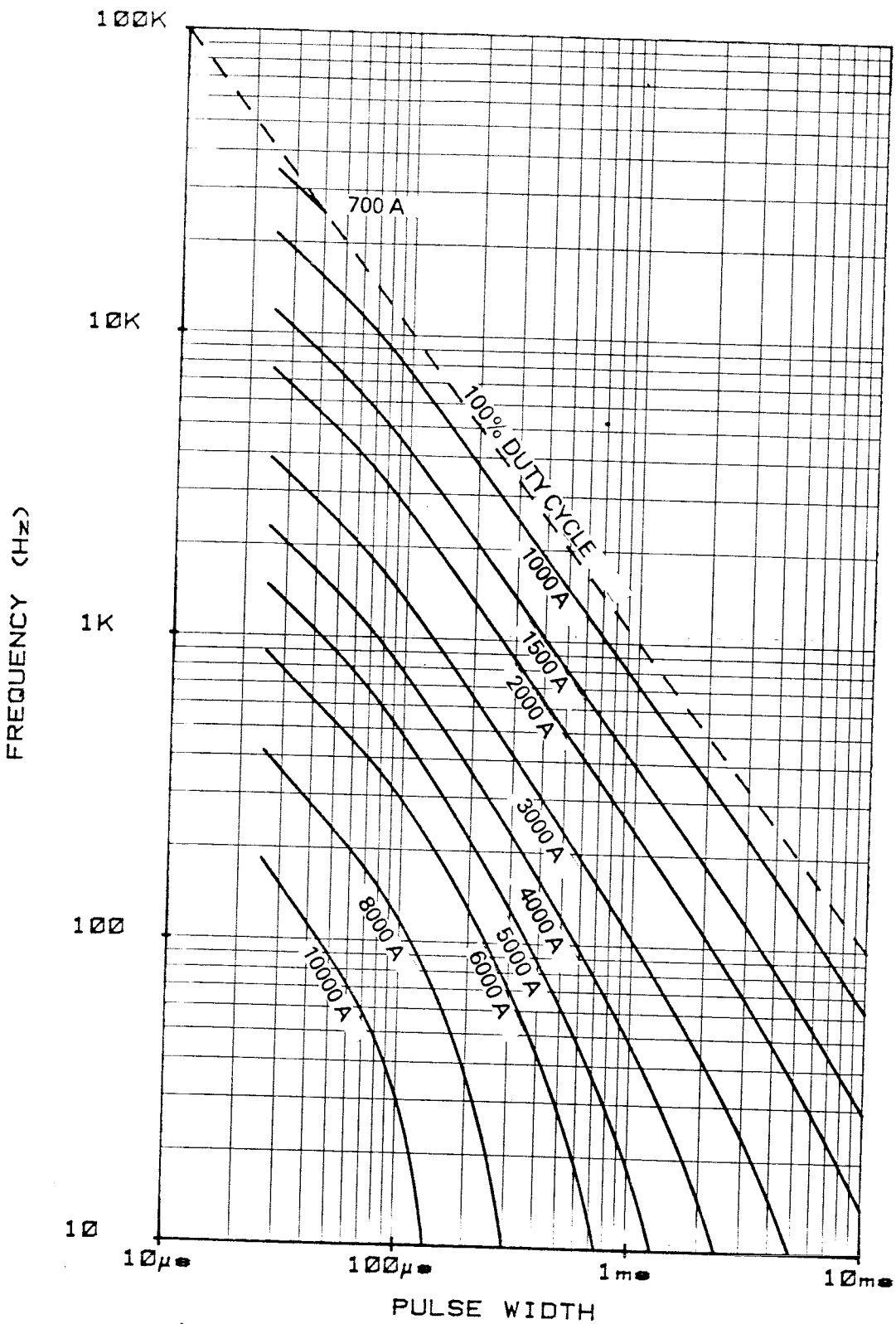
T_J 125°C. 100A/µs



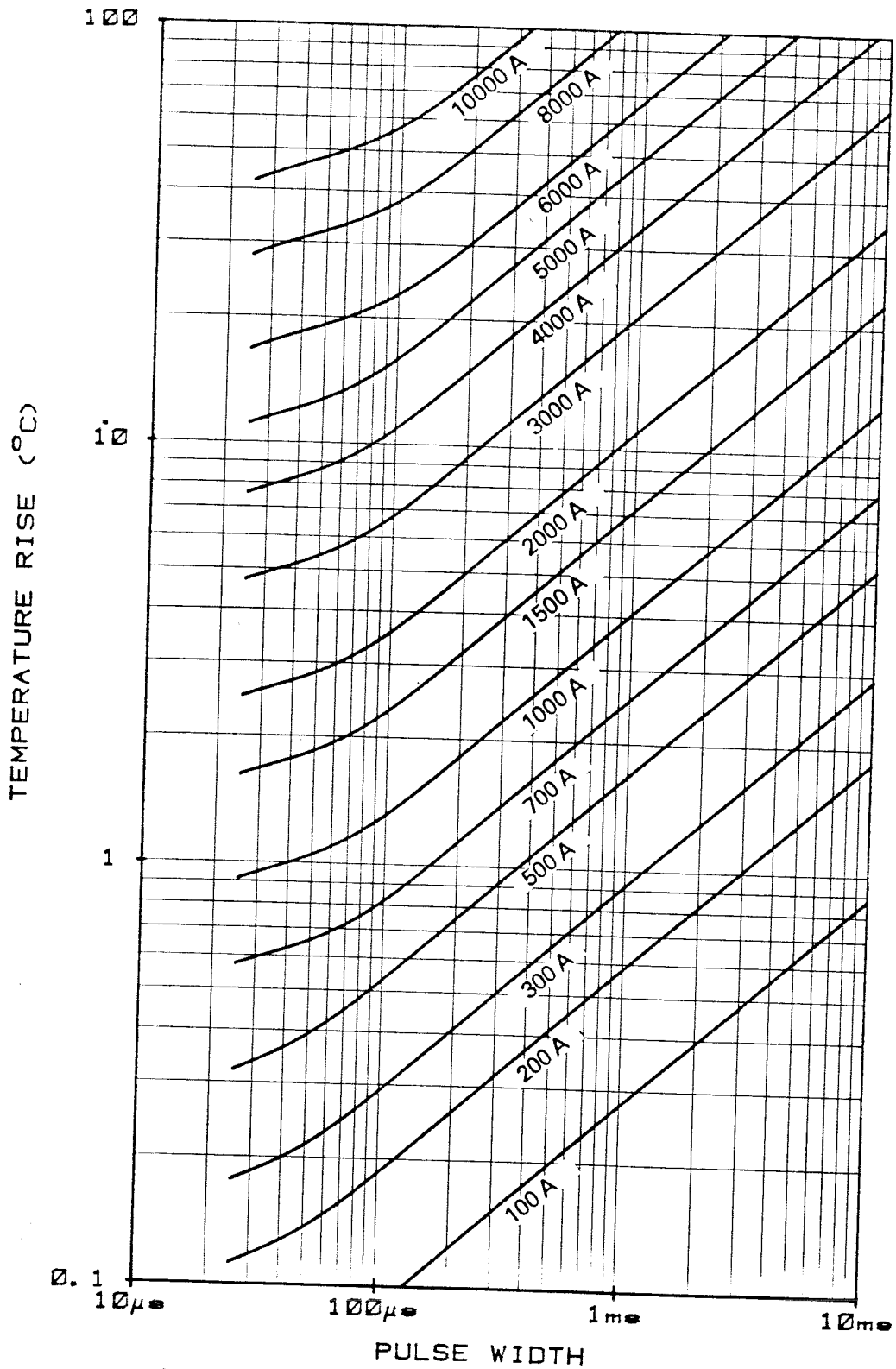
T SINK 85°C. SINE WAVE



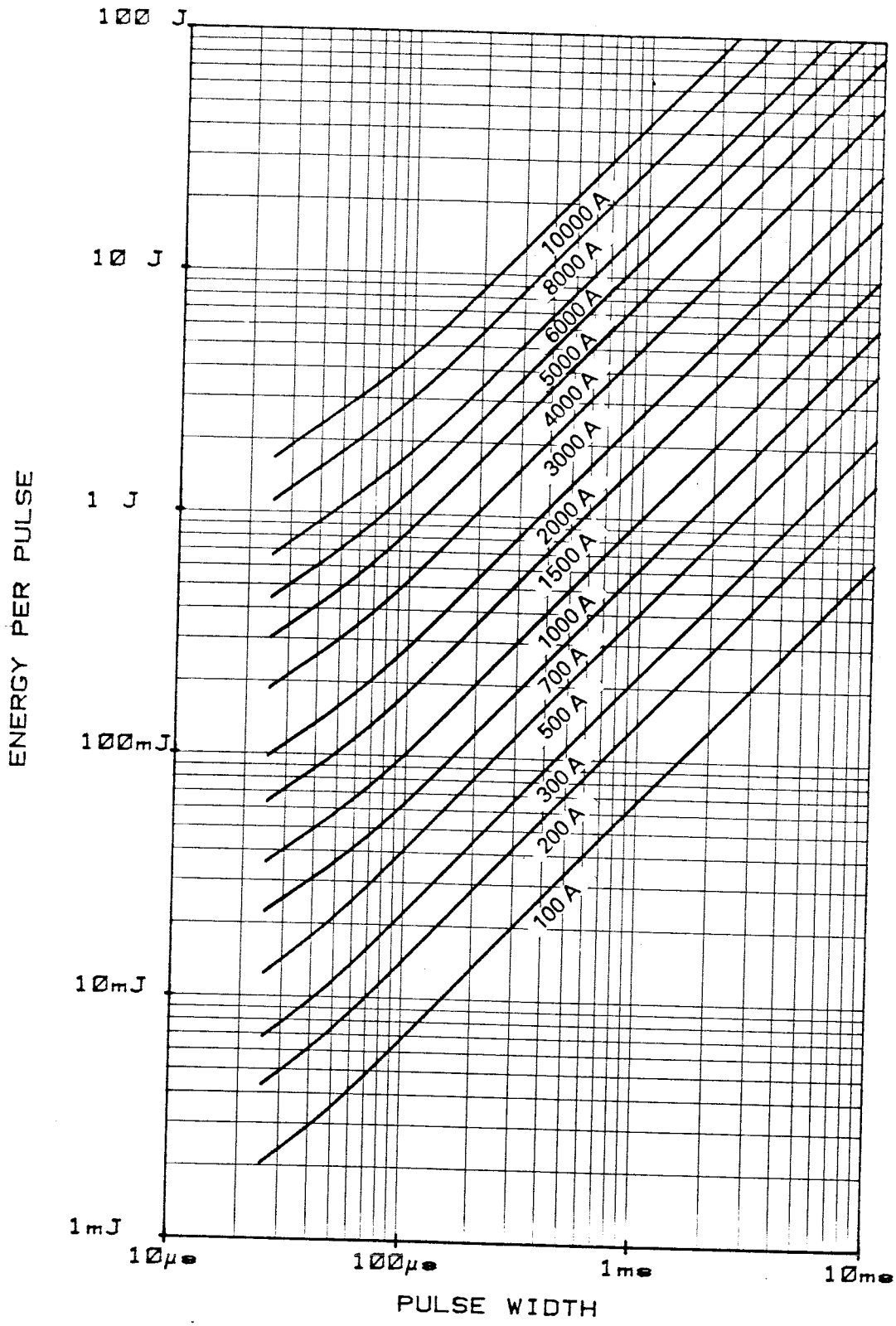
T SINK 55°C. SINE WAVE



TJ 125°C. SINE WAVE



T_J 125°C. SINE WAVE



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INTERNATIONAL OUTLINE No. L -28-

WEIGHT. 90 GRAMS

FINISH. NICKEL PLATE.

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

DEVICE MOUNTING: CLAMPING FORCE TO BE APPLIED ON ℄ 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.

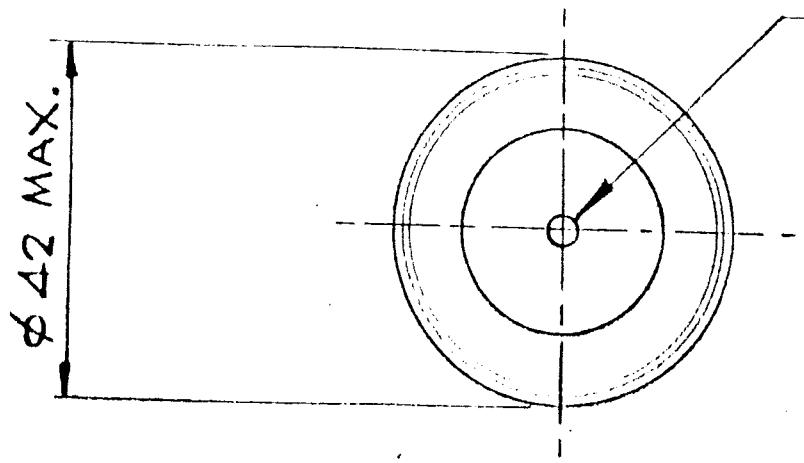
CLAMPING FORCE = 330 - 550 kgf.

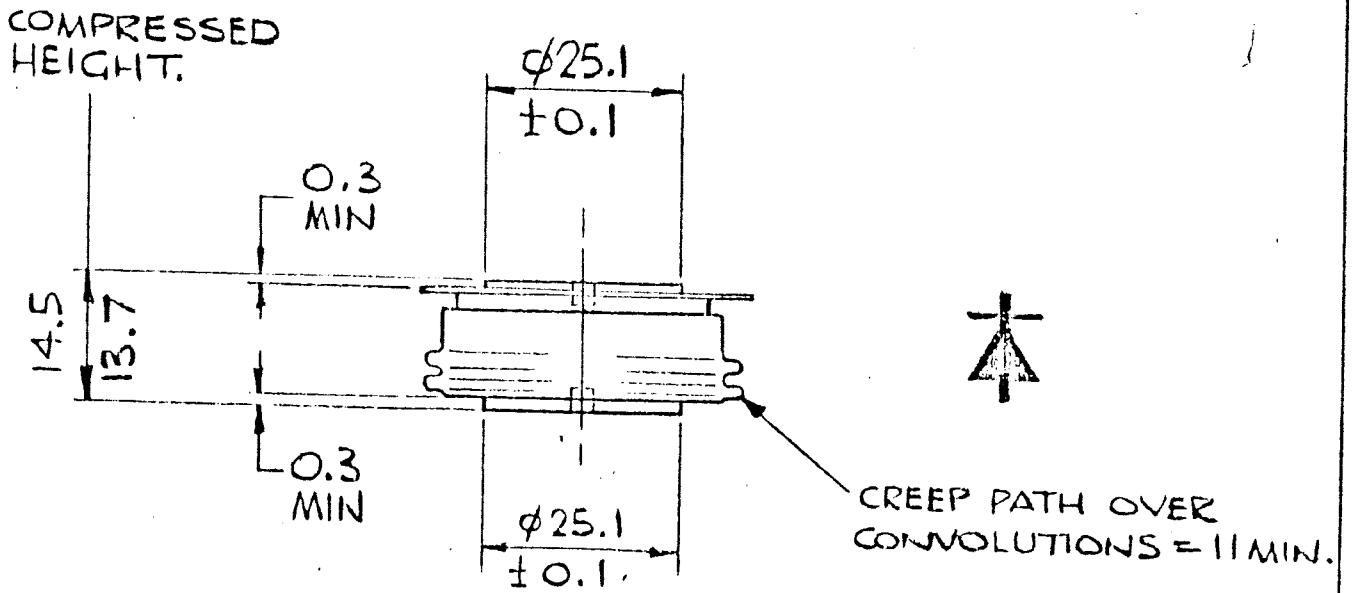
SUITABLE CLAMPS : BOX TYPE 101A226B, POWER CLAMP 101A260 SERIES.

G.A. DRG. No. 159B100H122

TYPE NUMBER

C176





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

WESTCODE ®
SEMICONDUCTORS

THIRD ANGLE PROJECTION

DIMNS. IN MILLIMETRES

DRG. No. 100A295

ISSI	REVISIONS
1	19.9.83 M1175