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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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. Short.   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°C	: 58A
$I_{F(rms)}$ max. (T_{CASE} 72°C) Housing limited	: 175A
I_F max. (T_{CASE} 48°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	
VRM $\leq$ 10V	: 2700A
I^2t : t = 10ms; T_J (initial) = 125°C; $V_{RM} = 0.6V_{RRM}$(MAX)	: 3.0 x 10^4A^2SEC
I^2t : t = 10ms; T_J (initial) = 125°C; $V_{RM} \leq$ 10V	: 3.65 x 10^4A^2SEC
I^2t : t = 3ms; T_J (initial) = 125°C; $V_{RM} \leq$ 10V	: 2.7 x 10^4A^2SEC
T_{CASE} Operating Range	: -40 to +125°C
T_{stg} : Non-operating	: -40 to +150°C

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 : $T_J = 25°C$)	:
B : $T_J = 25°C$)	:
C : $T_J = 25°C$)	:
D : $T_J = 25°C$)	:
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.

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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.

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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/μS and 100 A/μS.

(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 x f

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

(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.

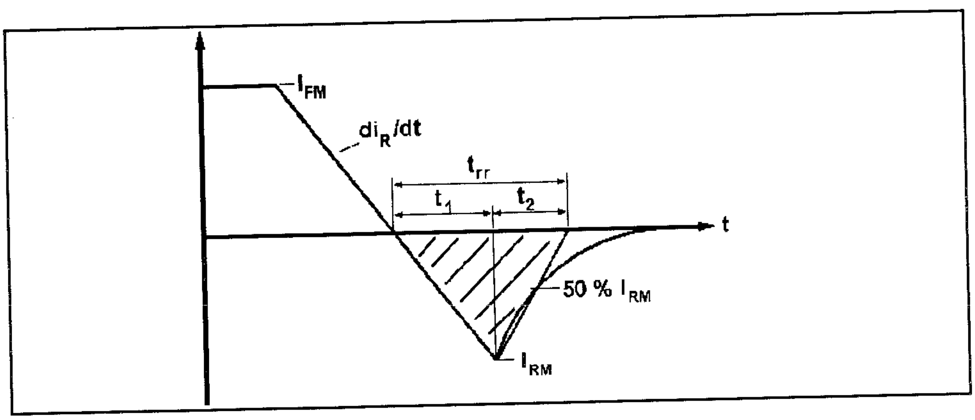
(d) ABCD Constants

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:

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

(e) Reverse recovery ratings

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



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

$$\text{i.e.}\quad Q_{RR} = \int_{t=o}^{150uS} i_{RR} \cdot dt$$

(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:

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

where $r_t = 4.42 \times \sqrt{t} . 10^{-4}$ (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

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

(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

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

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

NOTE 1

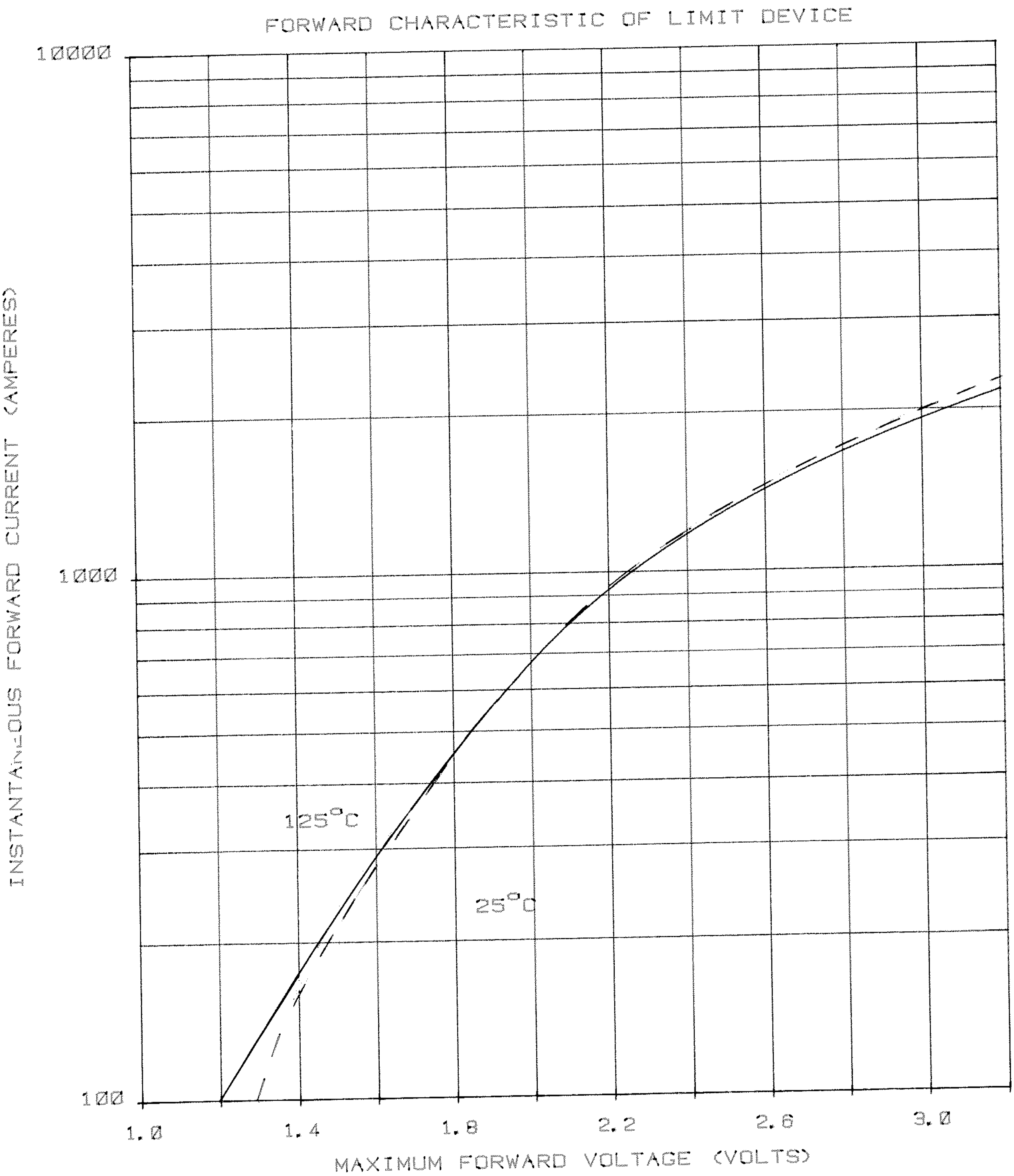
Reverse Recovery Loss by Measurement

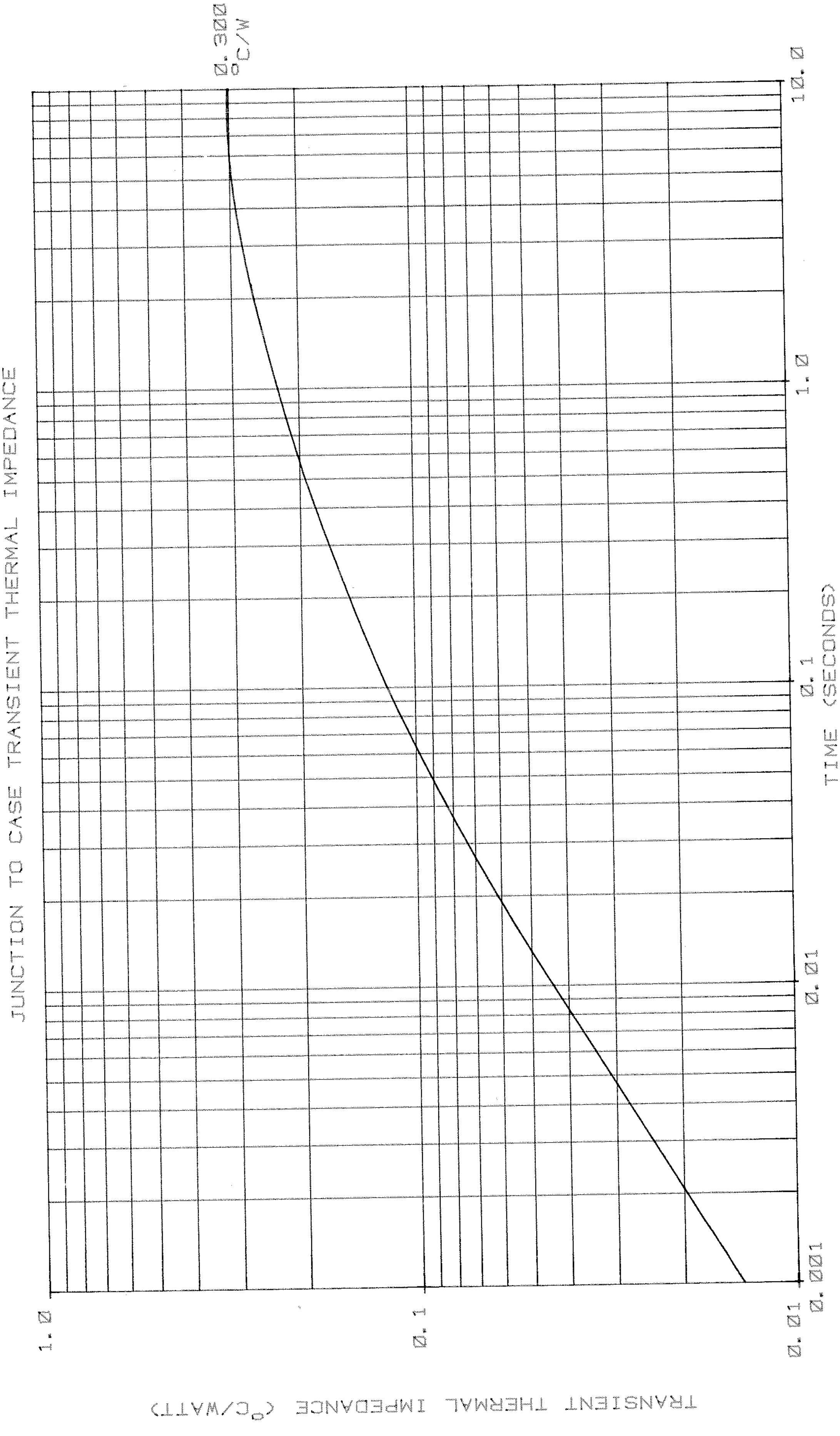
This device has a low reverse recovered charge and peak reverse recovery current. When measuring the charge care must be taken to ensure that:

(a) a.c. coupled devices such as current transformers are not affected by prior passage of high amplitude forward current.

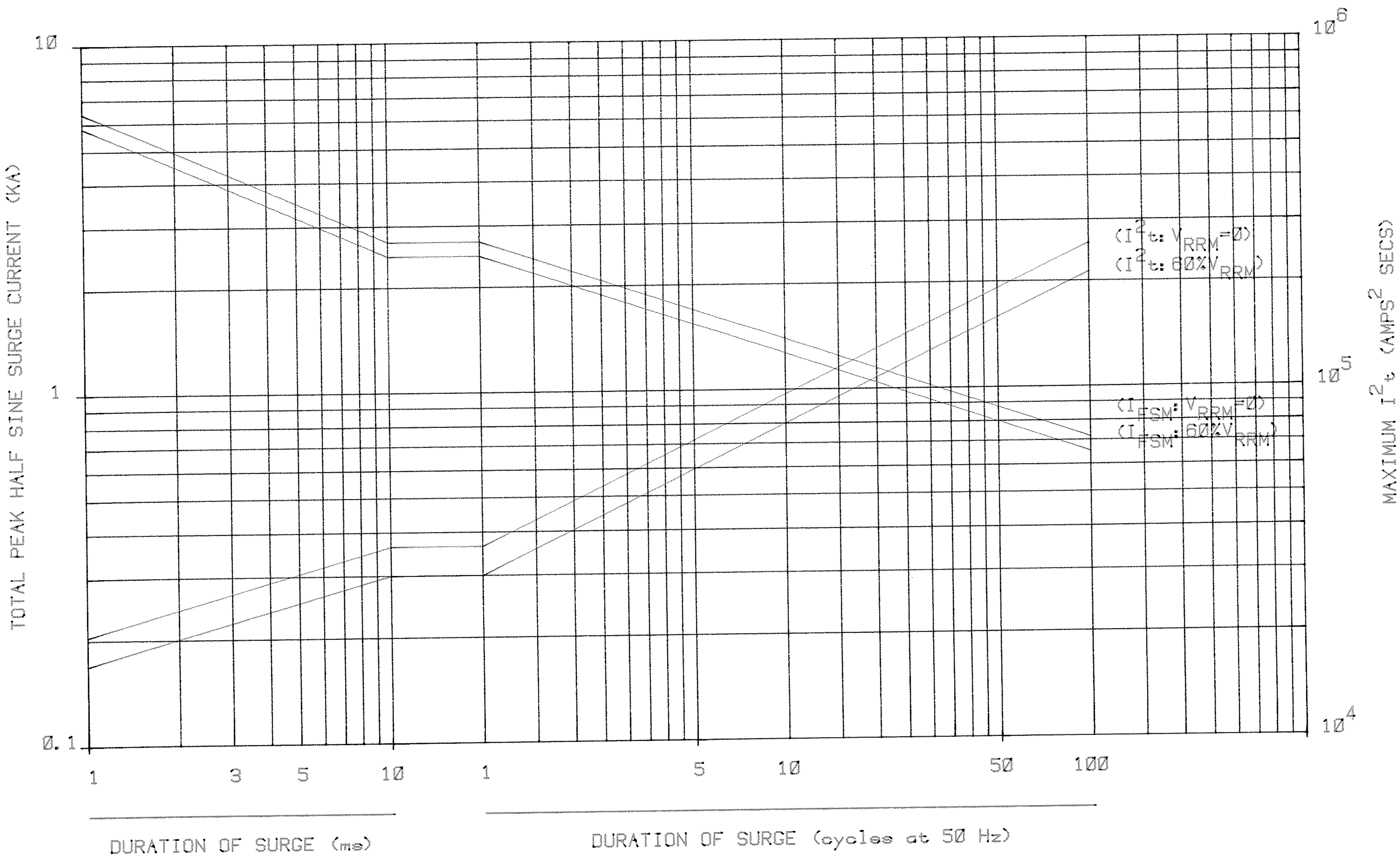
(b) A suitable, polarised, clipping circuit must be connected to the input of the measuring oscilloscope to avoid overloading the internal amplifiers by the relatively high amplitude forward current signal.

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

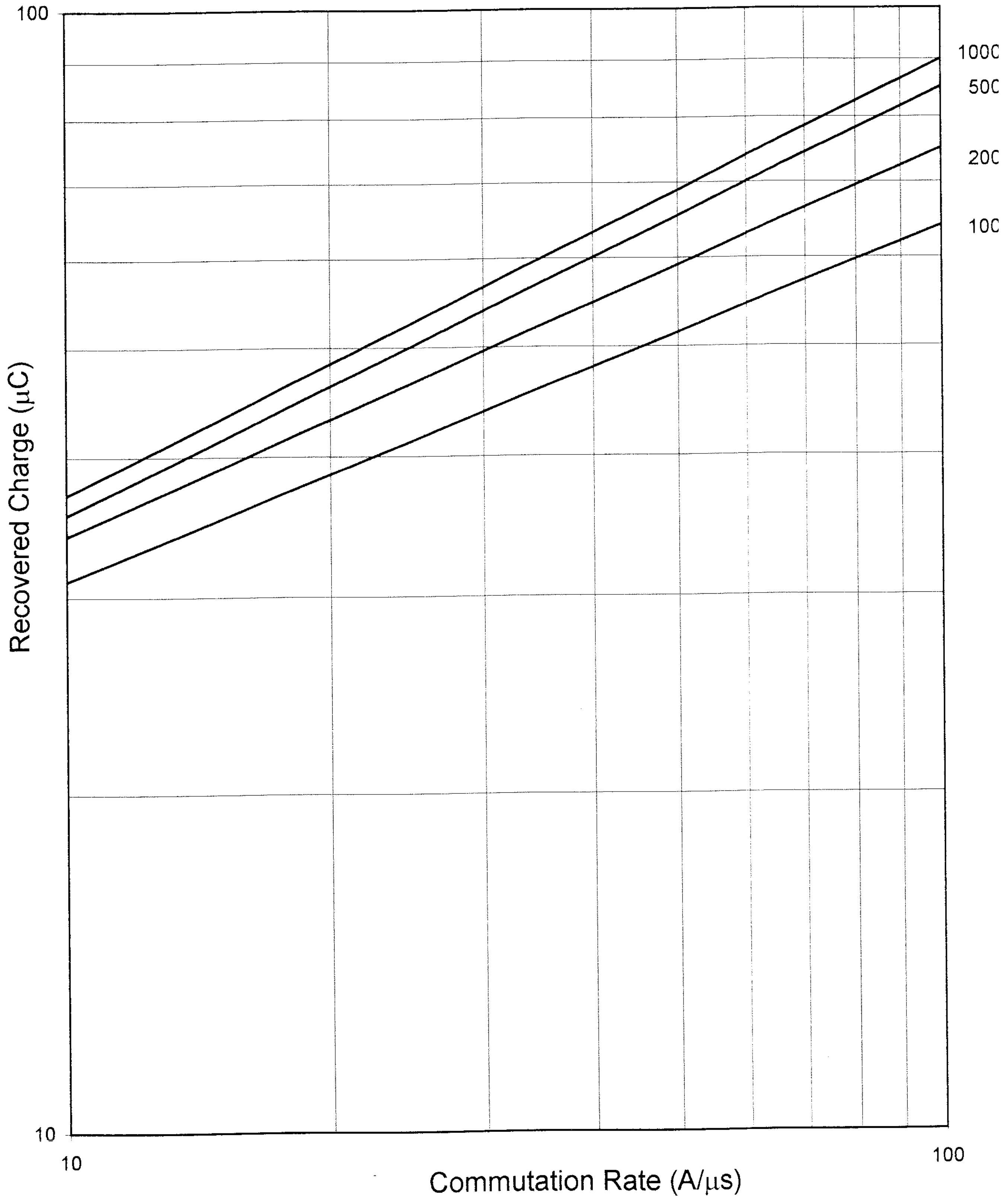

FORWARD CHARACTERISTIC OF LIMIT DEVICE
10000
1000
100
INSTANTANEOUS FORWARD CURRENT (AMPERES)
125°C
25°C
1.0
1.4
1.8
2.2
2.6
3.0
MAXIMUM FORWARD VOLTAGE (VOLTS)

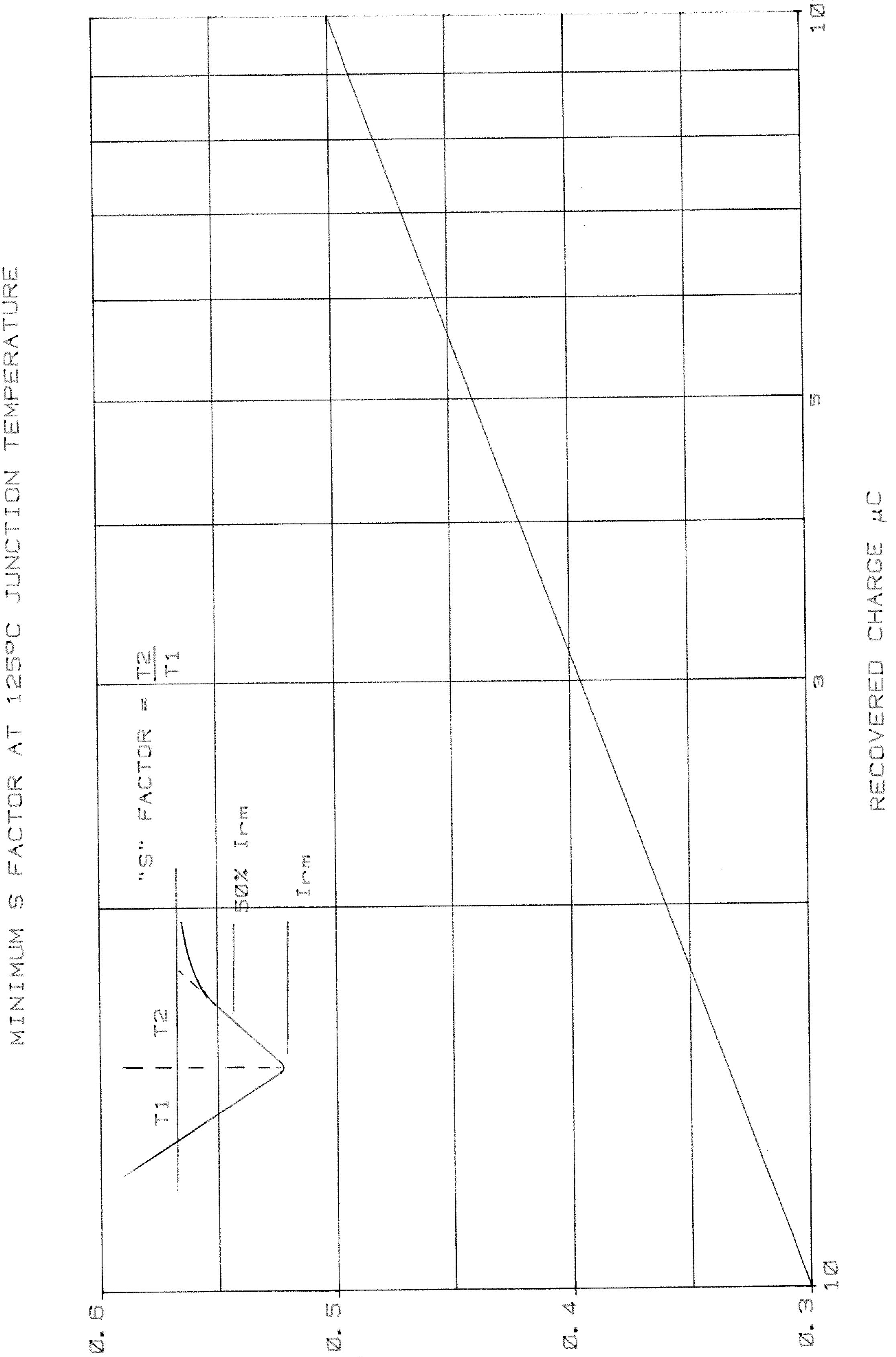

JUNCTION TO CASE TRANSIENT THERMAL IMPEDANCE
Ø.300 °C/W
TRANSIENT THERMAL IMPEDANCE (°C/WATT)
1.Ø
Ø.1
Ø.Ø1
TIME (SECONDS)
Ø.ØØ1
Ø.Ø1
Ø.1
1.Ø
1Ø.Ø

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

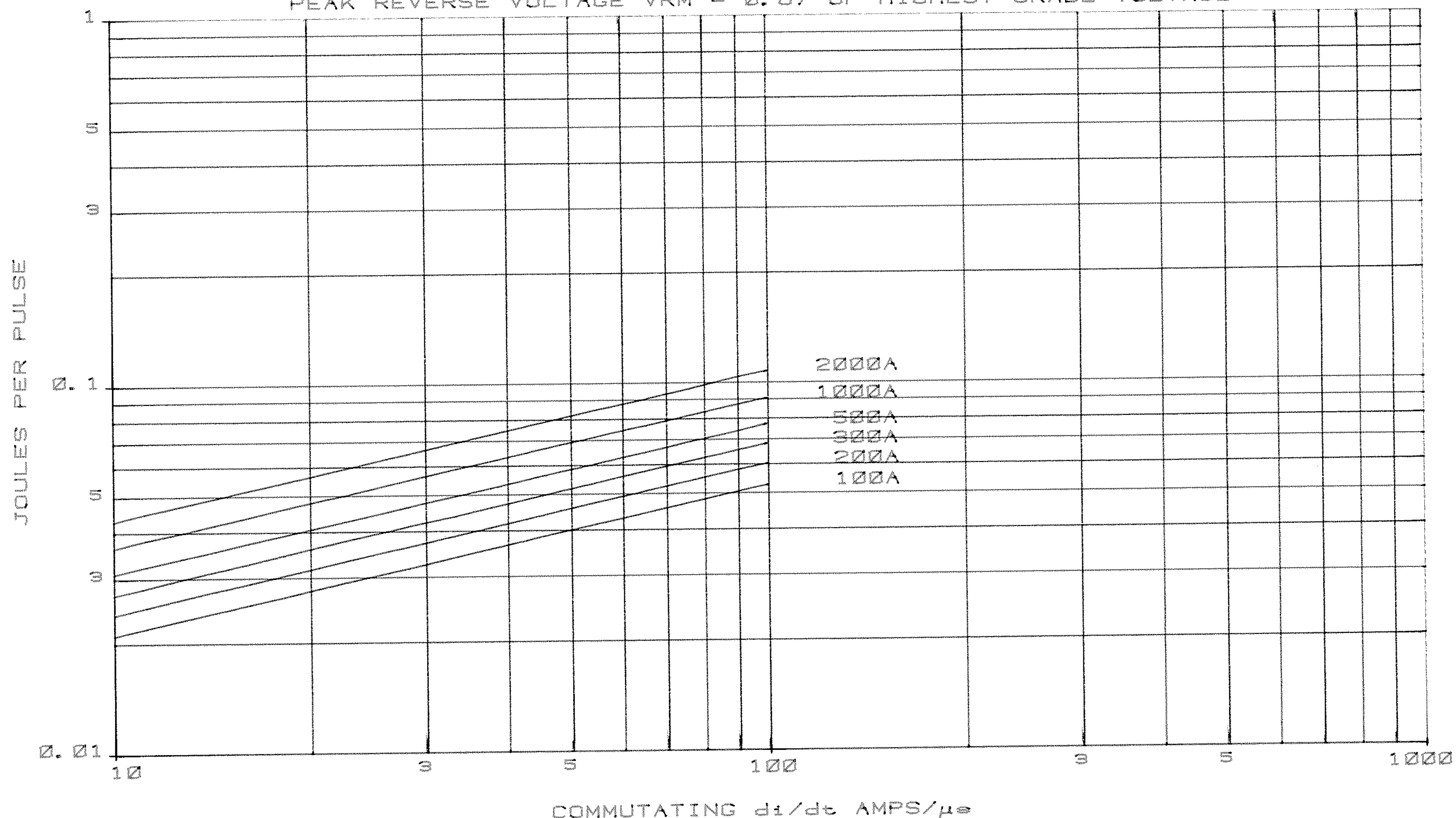


Maximum Recovered Charge Qra 50 % Chord @125 °C Junction Temperature

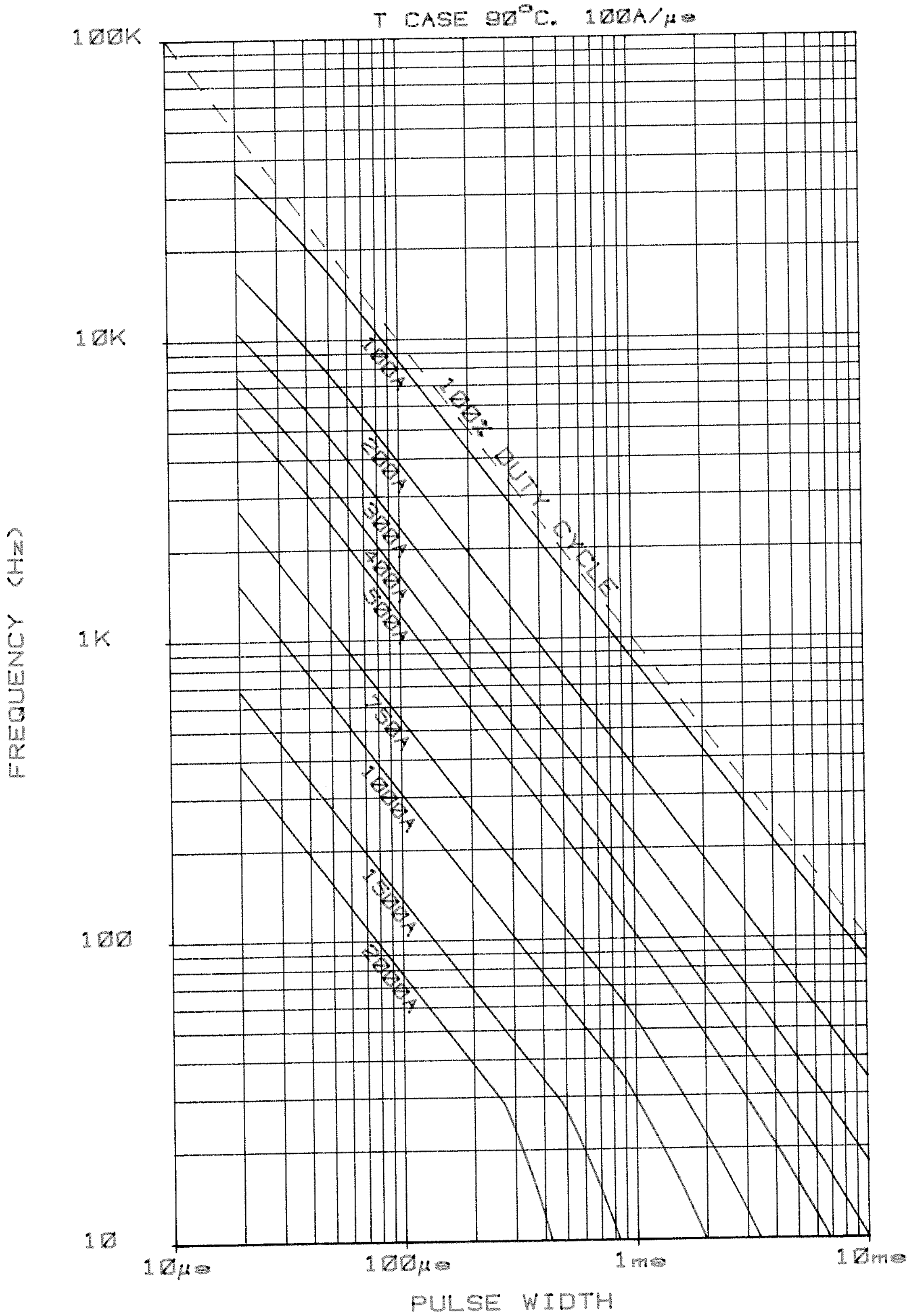


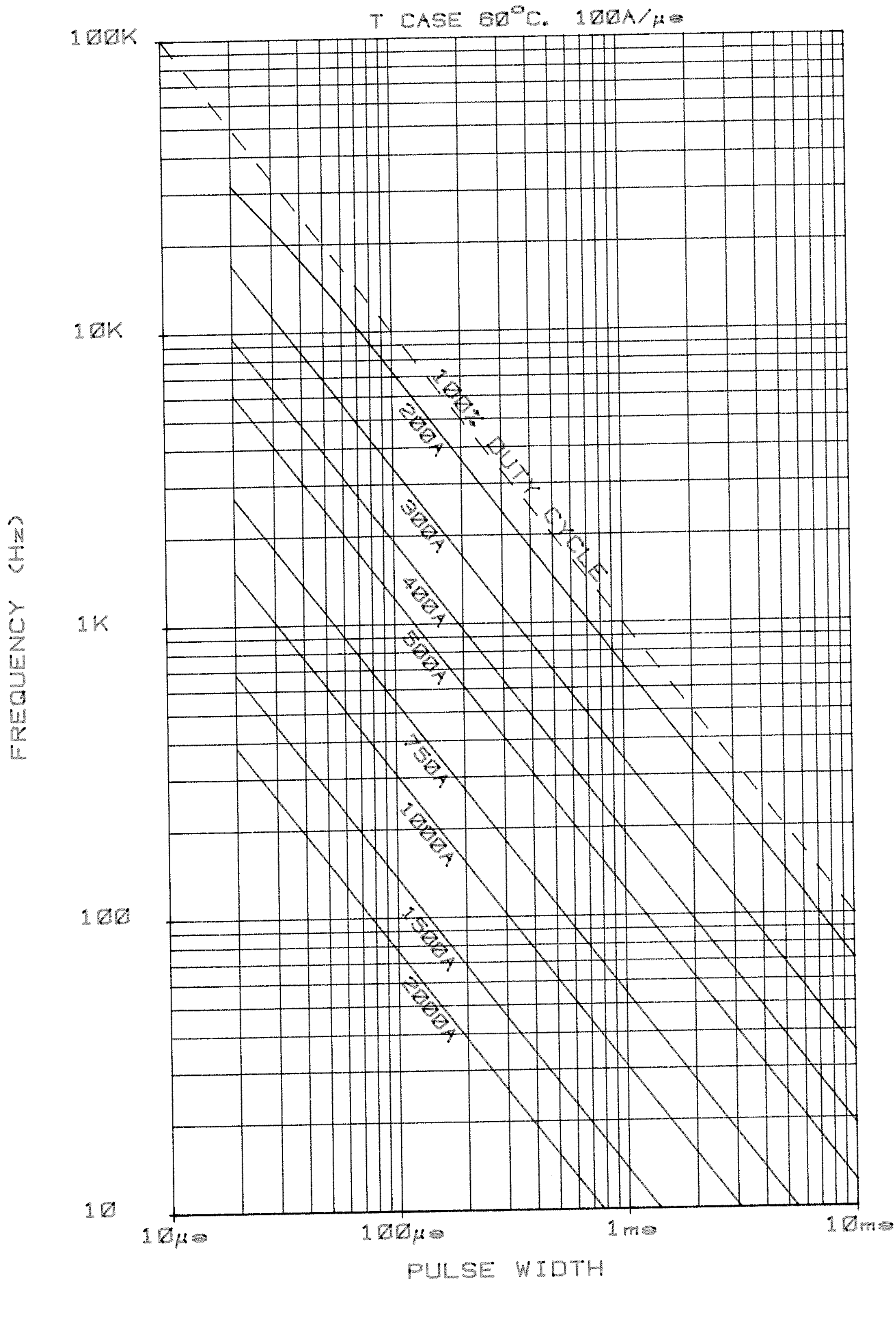

MINIMUM S FACTOR AT 125°C JUNCTION TEMPERATURE
"S" FACTOR = T2/T1
T1
T2
50% Irm
Irm
Ø.6
Ø.5
Ø.4
Ø.3
S FACTOR
1Ø
3
5
1ØØ
RECOVERED CHARGE μC

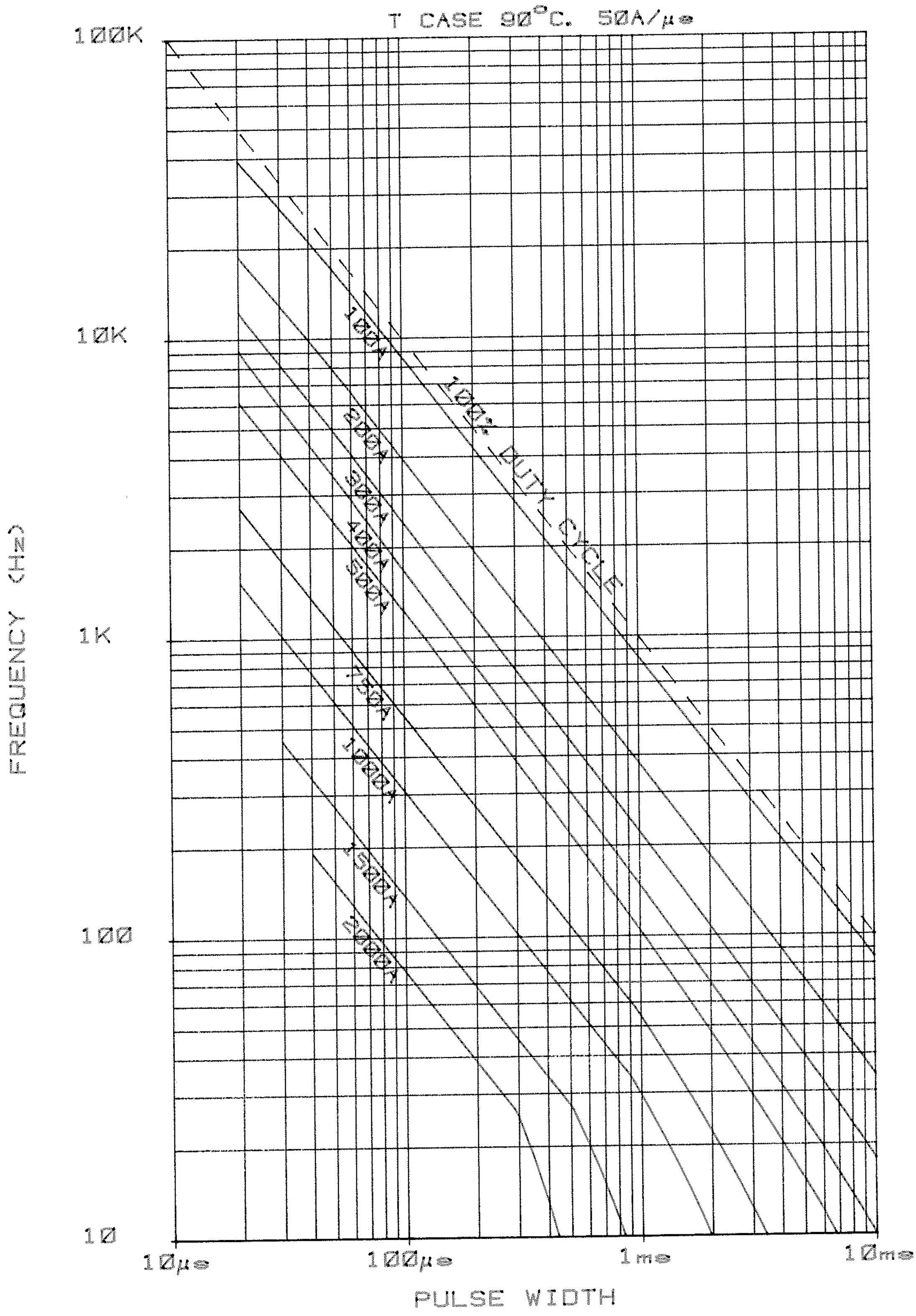
MAXIMUM REVERSE RECOVERY ENERGY LOSS PER PULSE. 125°C JUNCTION TEMPERATURE
SNUBBER CONNECTED 0.1μF. 5 OHM.
PEAK REVERSE VOLTAGE VRM = 0.67 OF HIGHEST GRADE* VOLTAGE

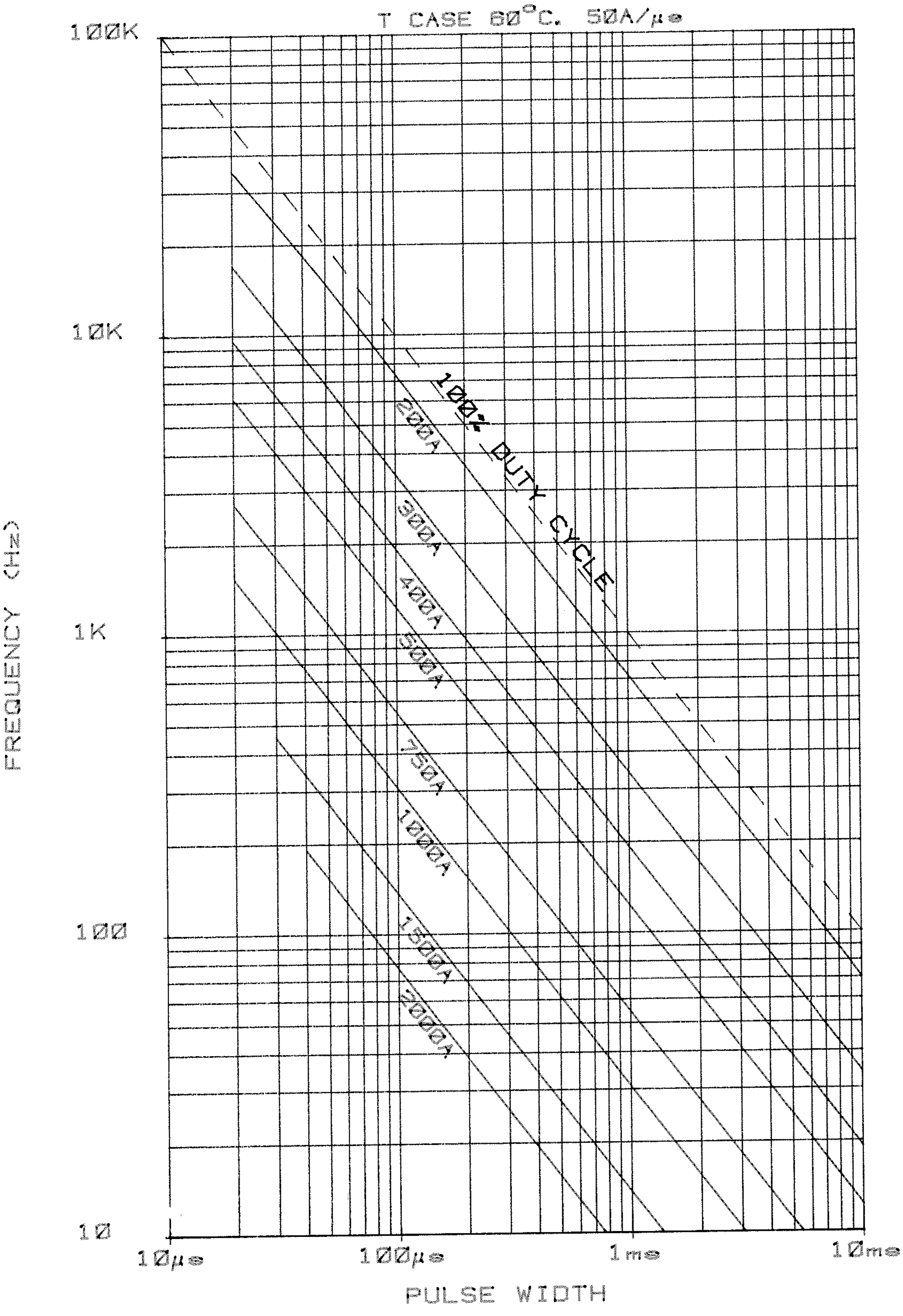


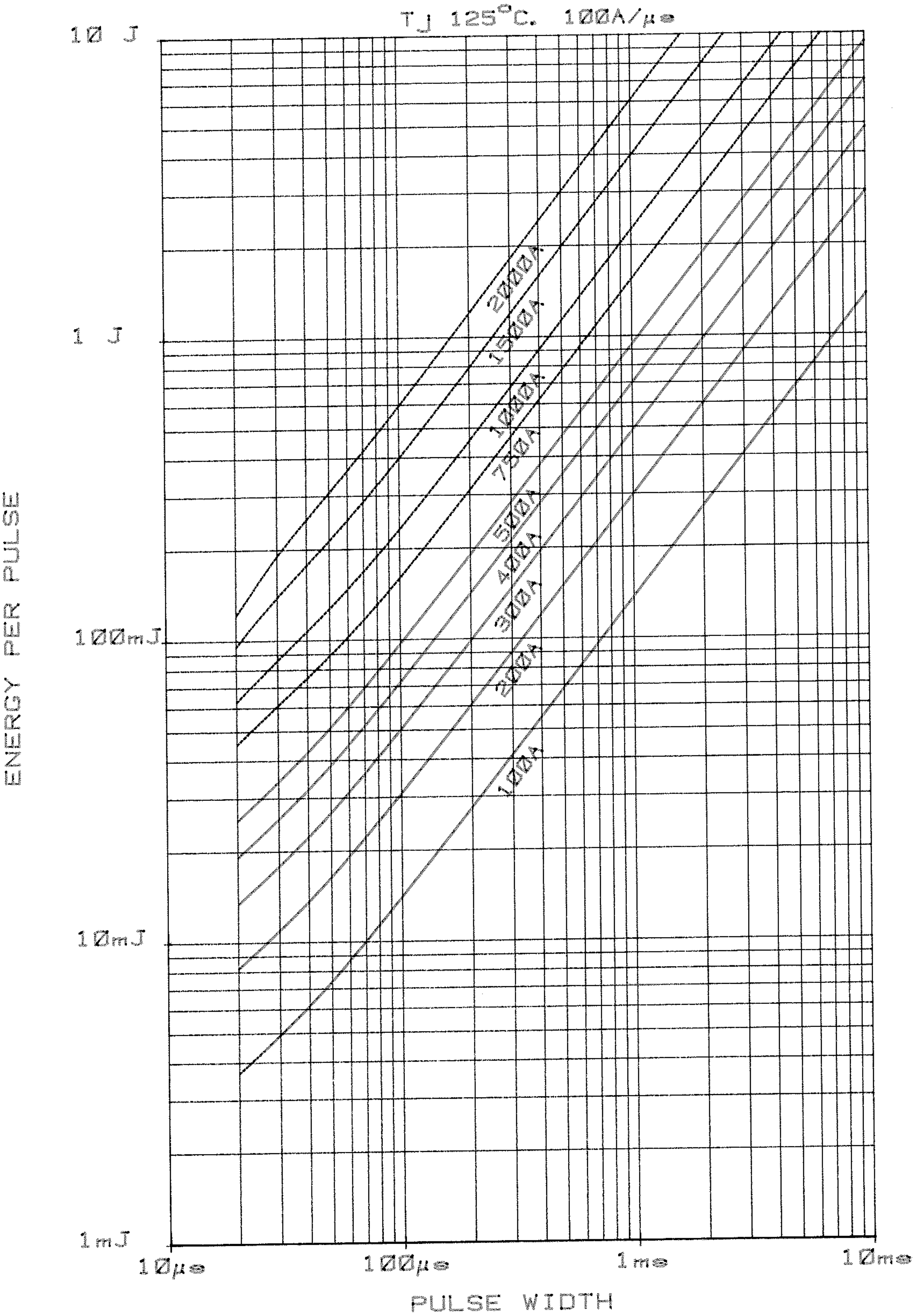
*NOTE: ENERGY PER PULSE SHOULD BE ADJUSTED PRO RATA TO APPLIED PEAK RECOVERY VOLTAGE


T CASE 90°C. 100A/μs
100K
10K
1K
100
10
FREQUENCY (Hz)
10μs
100μs
1ms
10ms
PULSE WIDTH
100A
100% DUTY CYCLE
200A
300A
400A
500A
750A
1000A
1500A
2000A

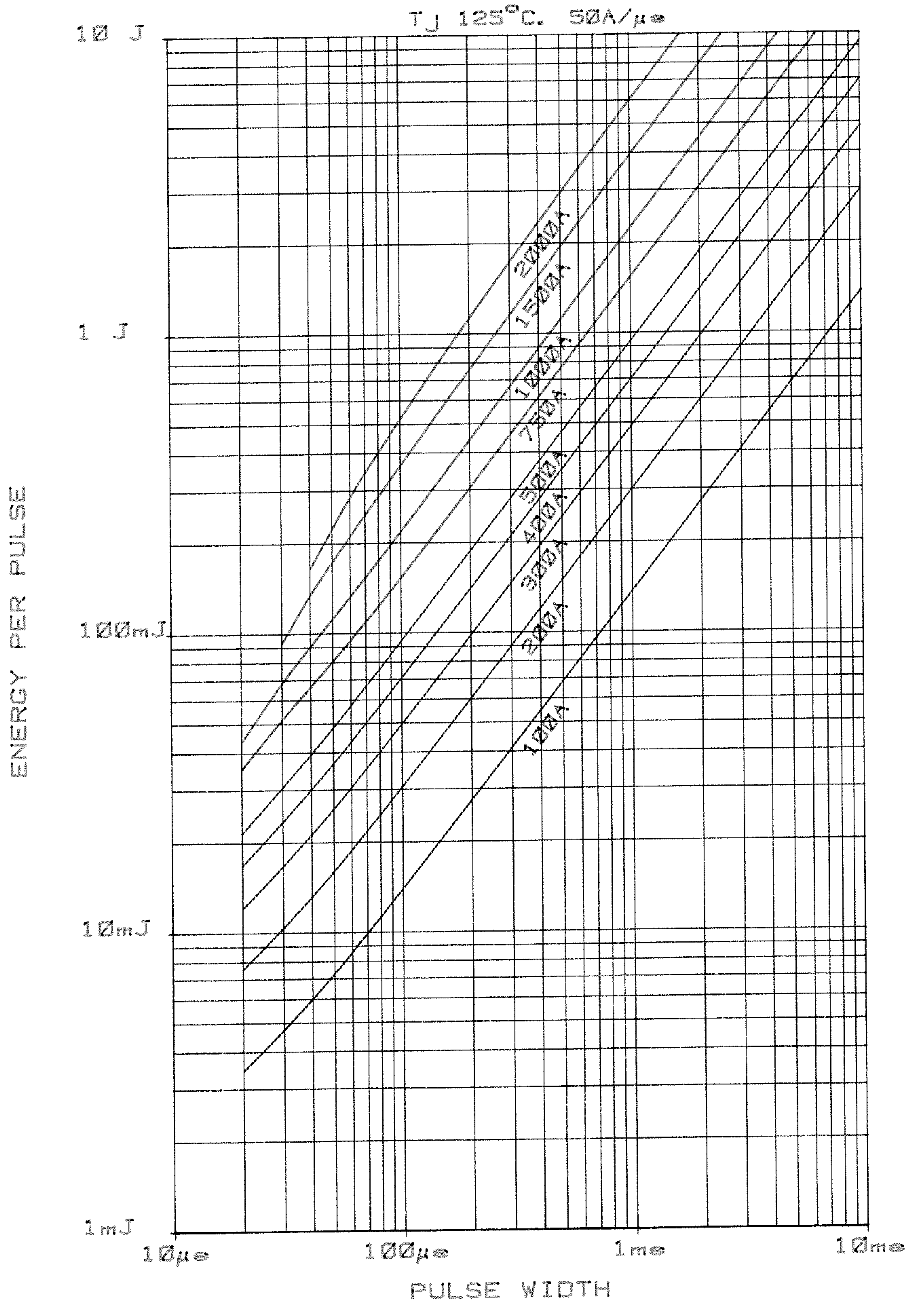

T CASE 60°C. 100A/μs
100K
10K
1K
100
10
FREQUENCY (Hz)
10μs
100μs
1ms
10ms
PULSE WIDTH
100% DUTY CYCLE
200A
300A
400A
500A
750A
1000A
1500A
2000A

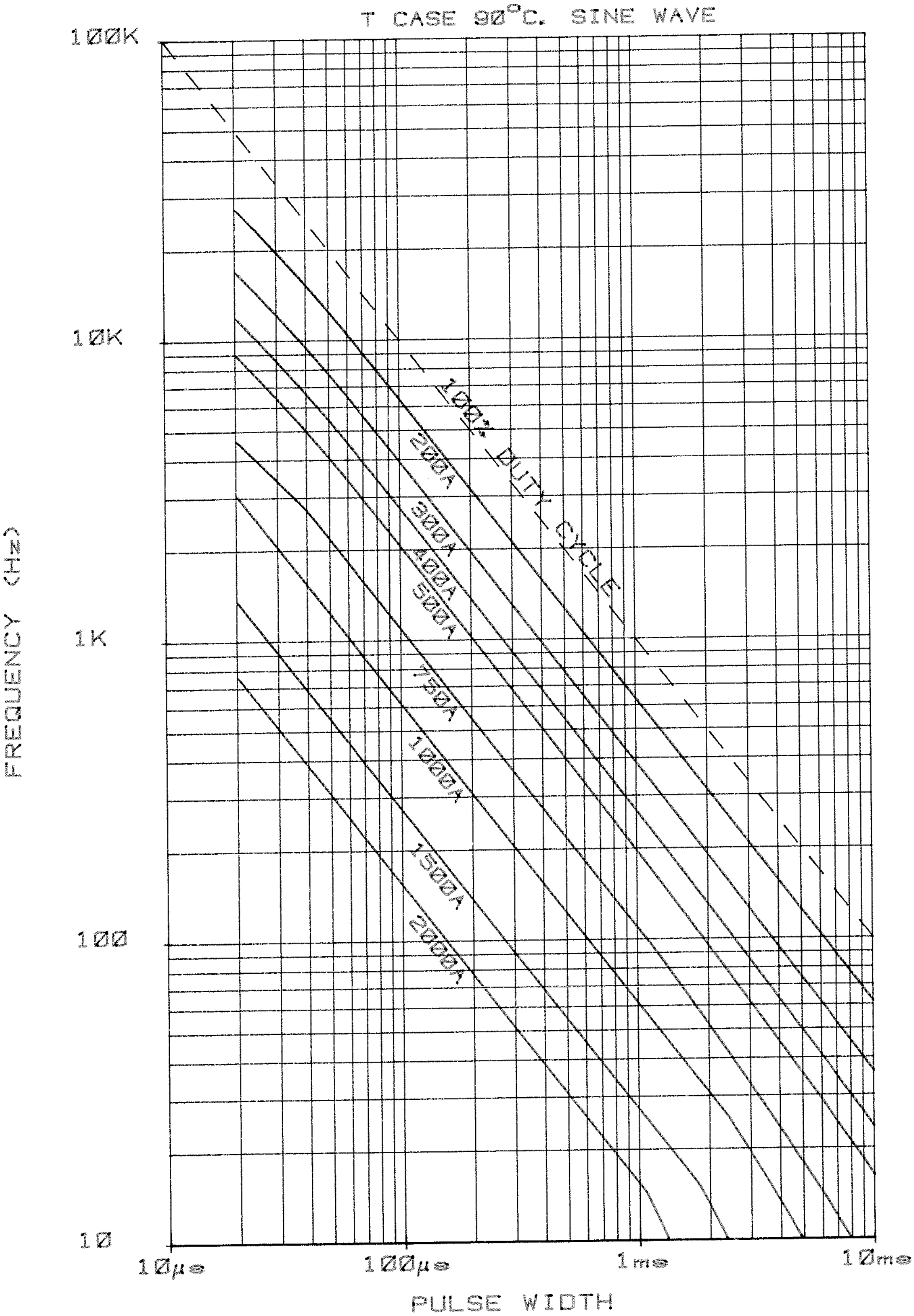

T CASE 90°C. 50A/μs
100K
10K
1K
100
10
FREQUENCY (Hz)
10μs
100μs
1ms
10ms
PULSE WIDTH
100A
100% DUTY CYCLE
200A
300A
400A
500A
750A
1000A
1500A
2000A

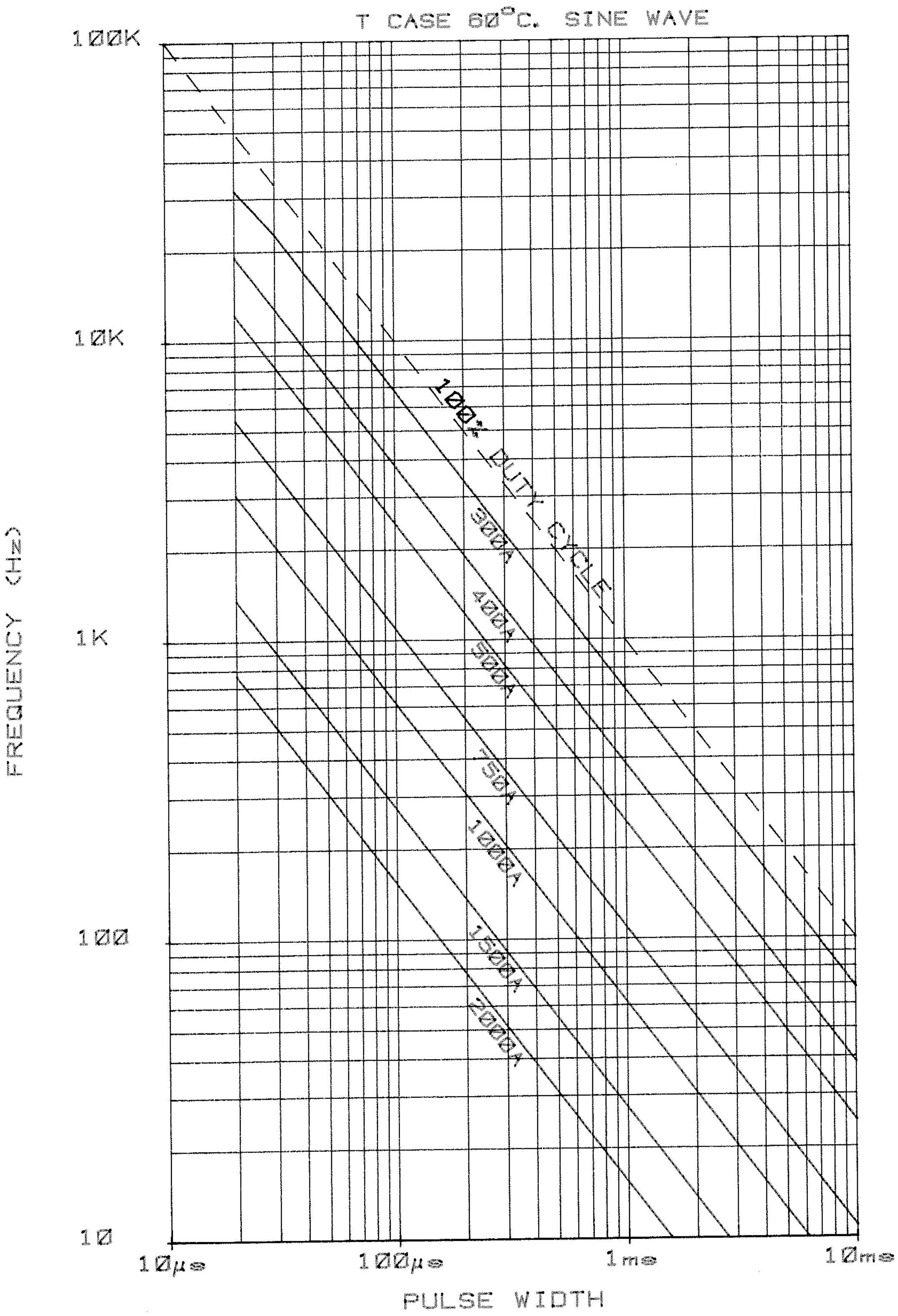

T CASE 60°C. 50A/µs
100K
10K
1K
100
10
FREQUENCY (Hz)
10µs
100µs
1ms
10ms
PULSE WIDTH
100% DUTY CYCLE
200A
300A
400A
500A
750A
1000A
1500A
2000A

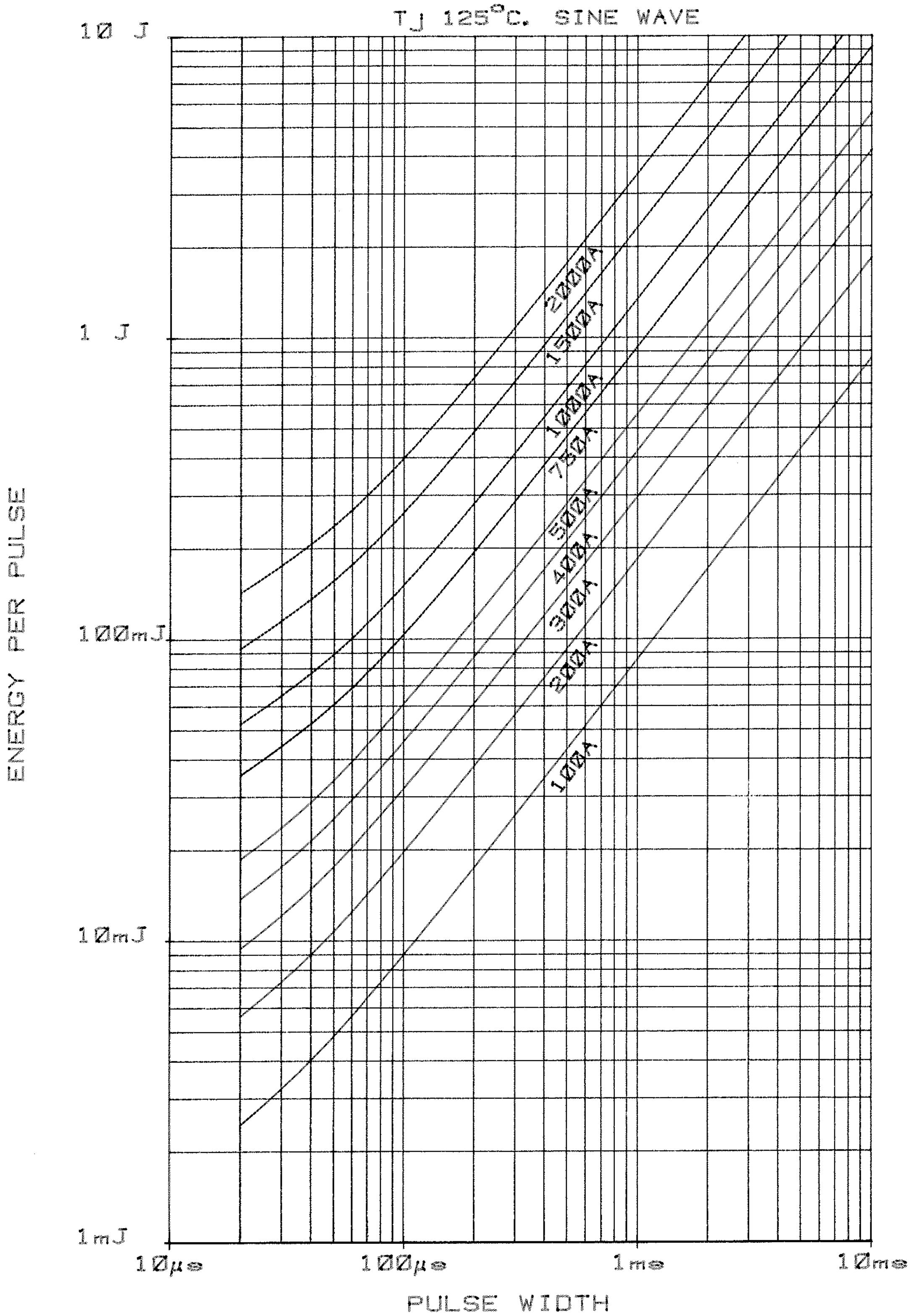


TJ 125°C. 100A/μs
10 J
1 J
100mJ
10mJ
1mJ
ENERGY PER PULSE
2000A
1500A
1000A
750A
500A
400A
300A
200A
100A
10μs
100μs
1ms
10ms
PULSE WIDTH


TJ 125°C. 50A/μs
10 J
1 J
100mJ
10mJ
1mJ
ENERGY PER PULSE
2000A
1500A
1000A
750A
500A
400A
300A
200A
100A
10μs
100μs
1ms
10ms
PULSE WIDTH


T CASE 90°C. SINE WAVE
100K
10K
1K
100
10
FREQUENCY (Hz)
100% DUTY CYCLE
200A
300A
400A
500A
750A
1000A
1500A
2000A
10µs
100µs
1ms
10ms
PULSE WIDTH

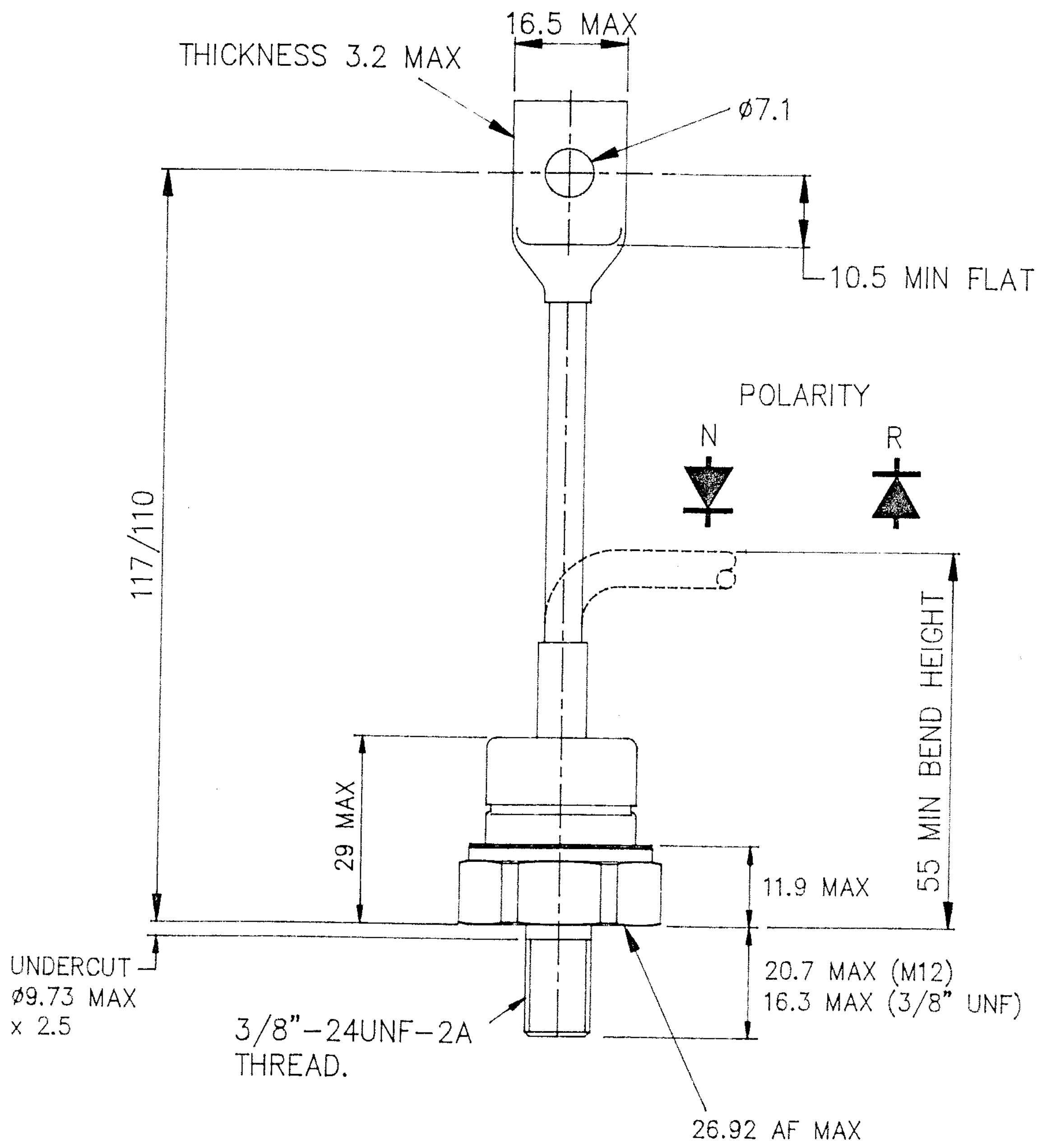

T CASE 60°C. SINE WAVE
100K
10K
1K
100
10
FREQUENCY (Hz)
100% DUTY CYCLE
300A
400A
500A
750A
1000A
1500A
2000A
10μs
100μs
1ms
10ms
PULSE WIDTH


TJ 125°C. SINE WAVE
10 J
1 J
100mJ
10mJ
1mJ
ENERGY PER PULSE
10μs
100μs
1ms
10ms
PULSE WIDTH
2000A
1500A
1000A
750A
500A
400A
300A
200A
100A

ACAD REF: 100A294

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



ISS	REVISIONS
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

A

THIRD ANGLE PROJECTION.
DWG. COMPLIES WITH BS 308.
DIMNS. IN MILLIMETRES.
DWG No. 100A294

SCALE 1/1
DRAWN RFOB

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