Fast Recovery Diode
Types M3770Z#200 to M3770Z#300

The data sheet on the subsequent pages of this document is a scanned copy of existing data for this product.
(Rating Report 94DR02 Issue 1)

This data reflects the old part number for this product which is: SM20-30C/DXC964.
This part number must **NOT** be used for ordering purposes – please use the ordering particulars detailed below.

The following links will direct you to the appropriate outline drawings
Outline W7 – 37mm clamp height capsule
Outline W42 – 26mm clamp height capsule

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

M3770	Z#	♦♦	0
Fixed Type Code	ZC – 37mm clamp height capsule ZD – 26mm clamp height capsule	Voltage code $V_{RRM}/100$ 20-30	Fixed Code
Typical Order Code: M3770ZC220, 37mm clamp height capsule, 2200V V_{RRM}/V_{DRM}			

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QUALITY AND EVALUATION LABORATORY

Rating Report No: 94DR02 — Date: 7th September, 1994

Origin: Q.E.L. — Pages: 27

Diode Capsule SM20 - 30C/DXC974

Written by: M Baker Checked: M. Short. Approved: [signature]

This diode consists of a diffused 76 mm diameter silicon slice, reference FQJ, mounted in a cold weld capsule.

This report supersedes Advance Data AD94D11, dated 14th July, 1994.

Ratings

Voltage Grades	) A blocking voltage derating factor) of 0.13% per deg. Celsius is applicable	: 20 - 30
V_{RSM}	) to this device for T_j below 25°C)	: 2100 - 3100 V
V_{RRM}	) (Note 1 & 2 page 4)	: 2000 - 3000 V
$I_{F(AV)}$: Single phase: 50 Hz, 180° half sinewave;		
Double Side Cooled T_{HS} = 55°C, 100°C		: 3775 A, 2405 A
Single Side Cooled T_{HS} = 100°C		: 1415 A
$I_{F(rms)}$ T_{HS} = 25°C	)) Double side cooled	: 7115 A
I_F T_{HS} = 25°C	)	: 6000 A
I_{FSM} : t = 10ms half sinewave; T_J (initial) = 150°C $V_{RM} = 0.6V_{RRM(MAX)}$		: 44.0 kA
I_{FSM} : t = 10ms half sinewave; T_J (initial) = 150°C $V_{RM} \leq 10V$		: 48.4 kA
I^2t : t = 10ms; T_J (initial) = 150°C; $V_{RM} = 0.6V_{RRM}(MAX)$		: $9.68 \times 10^6 A^2s$
I^2t : t = 10ms; T_J (initial) = 150°C; $V_{RM} \leq 10V$		: $11.7 \times 10^6 A^2s$
I^2t : t = 3ms; T_J (initial) = 150°C; $V_{RM} \leq 10V$		: $8.66 \times 10^6 A^2s$
T_{HS} Operating Range		: -40 To +150 °C
T_{stg} : Non-operating		: -55 To +150 °C

Characteristics (Maximum values unless otherwise stated)

V_o		: 1.19 V
r_s		: 0.118 mΩ
A : $T_J = 25°C$	)	: 0.596789
B : $T_J = 25°C$	) Valid range 200 A to 8000 A	: 0.04632052
C : $T_J = 25°C$	)	: 3.04052E-5
D : $T_J = 25°C$	)	: 0.008459116
A : Constant	)	: 0.423553
B : $\ln(i_F)$	) Valid range 200 A to 8000 A	: 0.02954106
C : i_F	)	: 1.73642E-5
D : $\sqrt{i_F}$	)	: 0.0140443
V_{FM} at I_{FM} = 4700 A		: 1.74 V
$R_{th(J-HS)}$ Double side cooled	) Steady-state d.c. and	: 0.011 K/W
Single side cooled	) 1 ϕ a.c. resistive load	: 0.022 K/W
I_{RRM} : at $V_{RRM(MAX)}$		: 150 mA
V_{fr} : at dI/dt = 1000 A/µs		: 23.8 V

Reverse recovery at I_{FM} = 1000 A; t_p = 1000 µs
di_R/dt = 60A/µs; V_{RM} = 50 V

Q_{RR} (total area)		: 2265 µC
Q_{RA} (50% chord)		: 1500 µC
t_{rr} (50% chord)		: 7 µs
I_{RM}		: 340 A
Mounting Force		: 27 - 47 kN (2700 - 4700 kg.f)
Outline Drawing	C Outline	: 100A293
	D Outline	: 100A310
JEDEC Outline No.		: ---

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

CONTENTS

Voltage Ratings Table

Voltage Class	V_{RRM} V	V_{RSM} V
20	2,000	2,100
22	2,200	2,300
24	2,400	2,500
26	2,600	2,700
28	2,800	2,900
30	3,000	3,100

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.

INTRODUCTION

This diode series comprises fast recovery capsule 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 free-wheel applications.

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 500 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. Let f be the repetition rate, in Hertz. Let R_{thJ-HS} be the steady state d.c. thermal resistance (junction to heat sink).

Then $W_{AV} = E_P * f$

$$T_{SINK} = T_{J(MAX)} - (E_P * f * R_{thJ-HS})$$

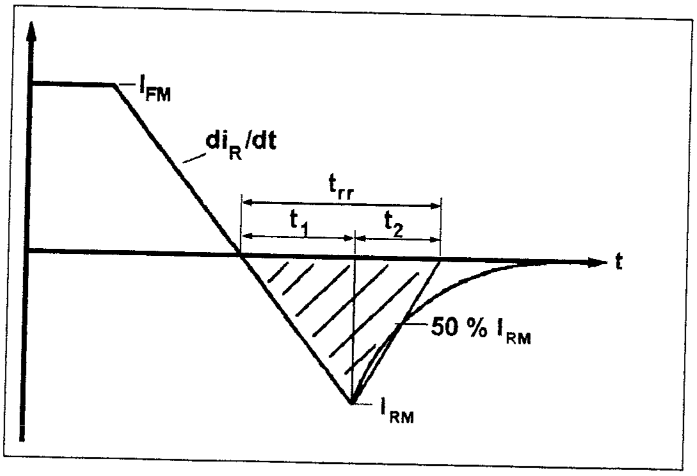
(c) ABCD Constants

These constants (applicable only over current range of V_F characteristic on page 8) are the coefficients 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.

(d) Reverse recovery ratings

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



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

i.e. $$Q_{RR} = \int_{t=0}^{150\mu s} i_{RR}.dt$$

(iii) $$K \ factor = \frac{t1}{t2}$$

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 E joules per pulse. A new sink temperature can then be evaluated from:

$$T_{SINK(new)} = T_{SINK(original)} - E * (k + f * R_{th(J-HS)})$$

where k = 0.287 (K/W)/s
E = Area under reverse loss waveform per pulse in joules (W.s.)
f = Rated frequency in Hz at the original sink temperature.
R_{thJ-HS} = d.c. thermal resistance (K/W)

The total dissipation is now given by $W_{(tot)} = W_{(original)} + E * f$

(b) Determination without Measurement

In circumstances where it is not possible to measure voltage and current conditions, or for design purposes, the additional losses E in joules may be estimated as follows.

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

Let f be the operating frequency in Hz

then $T_{SINK(new)} = T_{SINK(original)} - (E * f * Rth)$

where $T_{SINK(new)}$ is the required maximum heat sink temperature and $T_{SINK(original)}$ 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 other than 0.67 of Grade, the reverse loss may be approximated by a pro rata adjustment of the maximum value obtained from the curves.

NOTE 1

Reverse Recovery Loss by Measurement

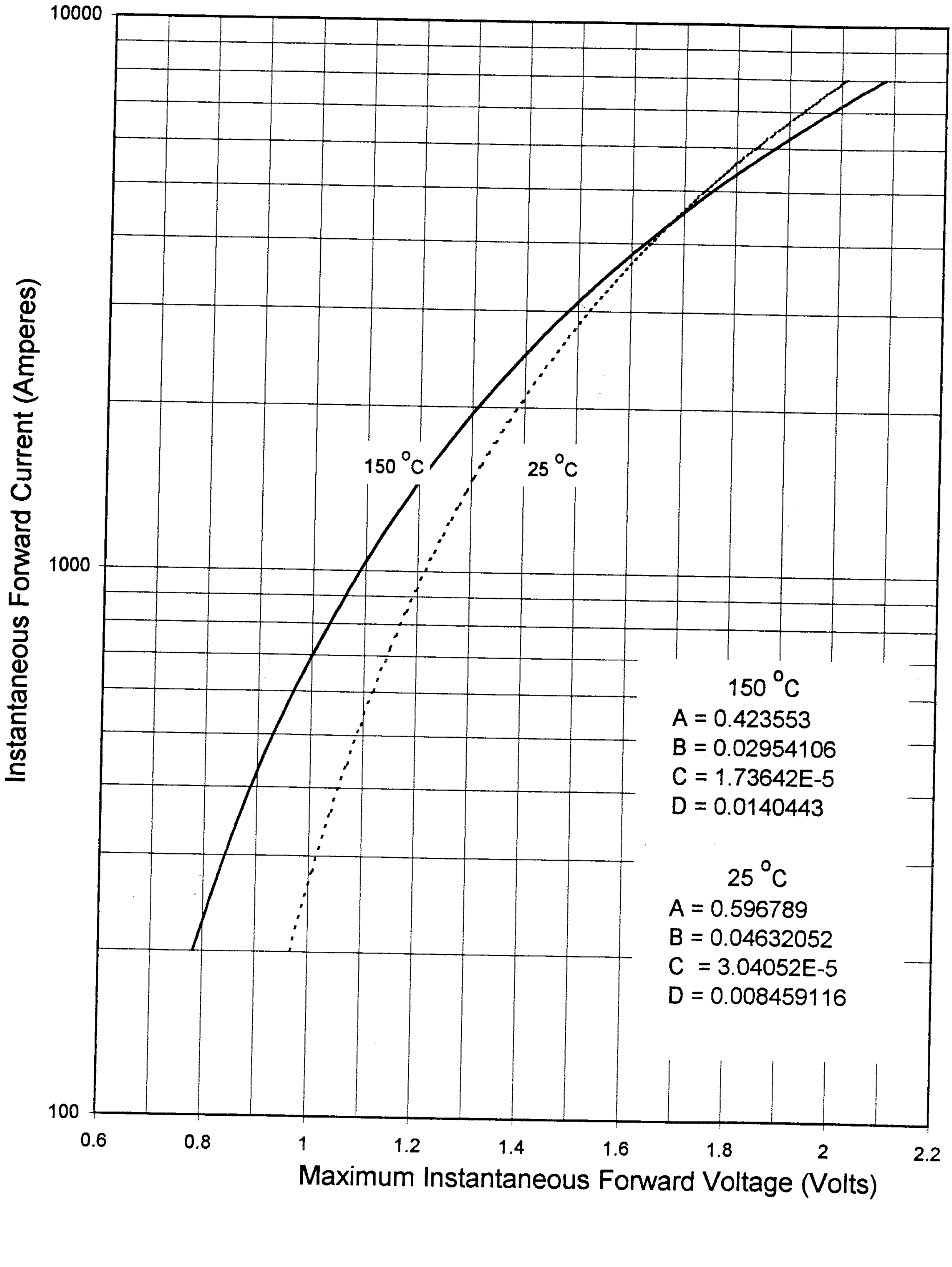
This device has a low reverse recovered charge and peak reverse recovery current. When measuring the charge care must be taken to ensure that:

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

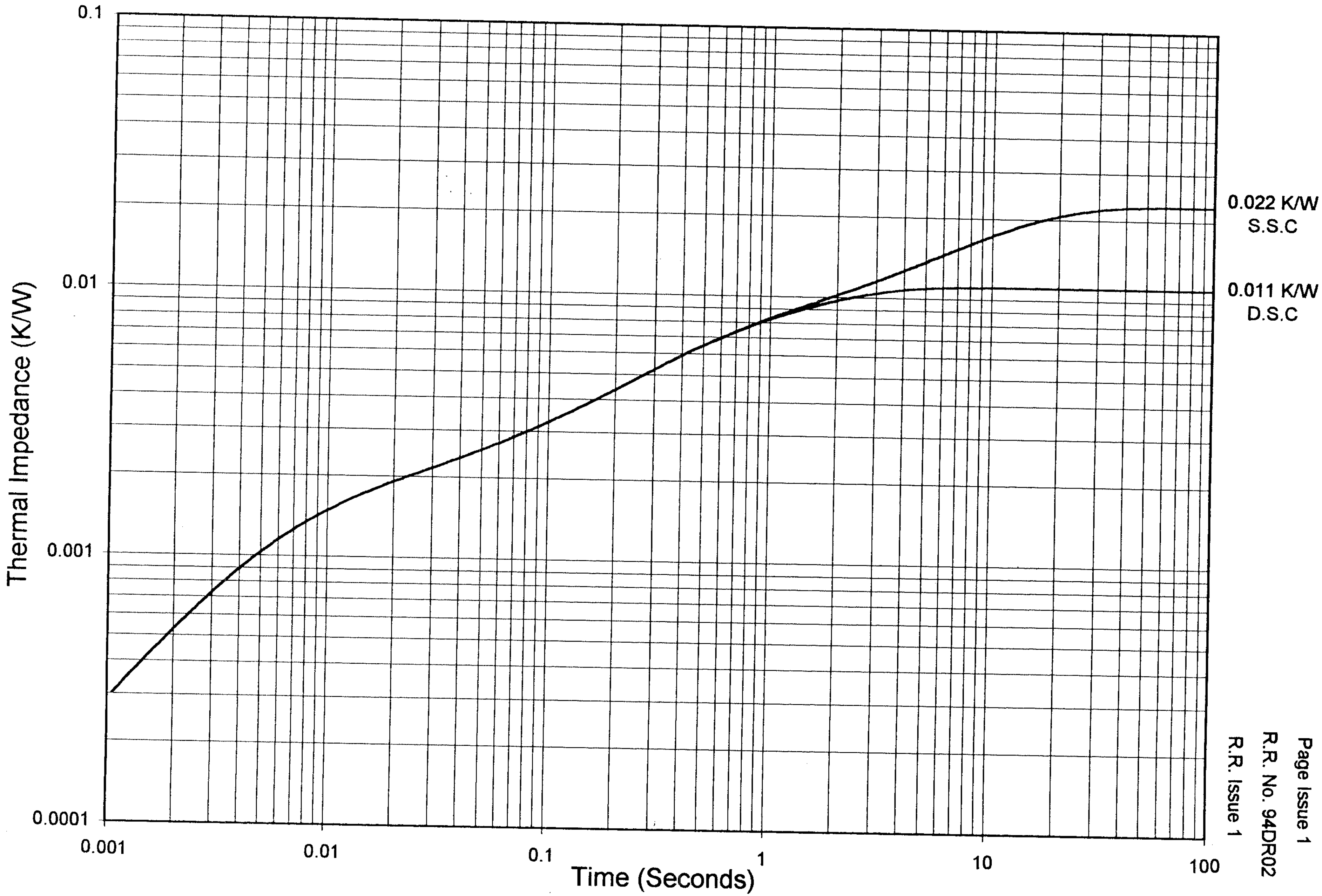
(b) A suitable, polarised, clipping circuit must be connected to the input of the measuring oscilloscope to avoid overloading the internal amplifiers by the relatively high amplitude forward current signal.

(c) Measurement of reverse recovery waveform should be carried out with an appropriate snubber of 0.5uF, 2.2 ohms connected across diode anode to cathode.

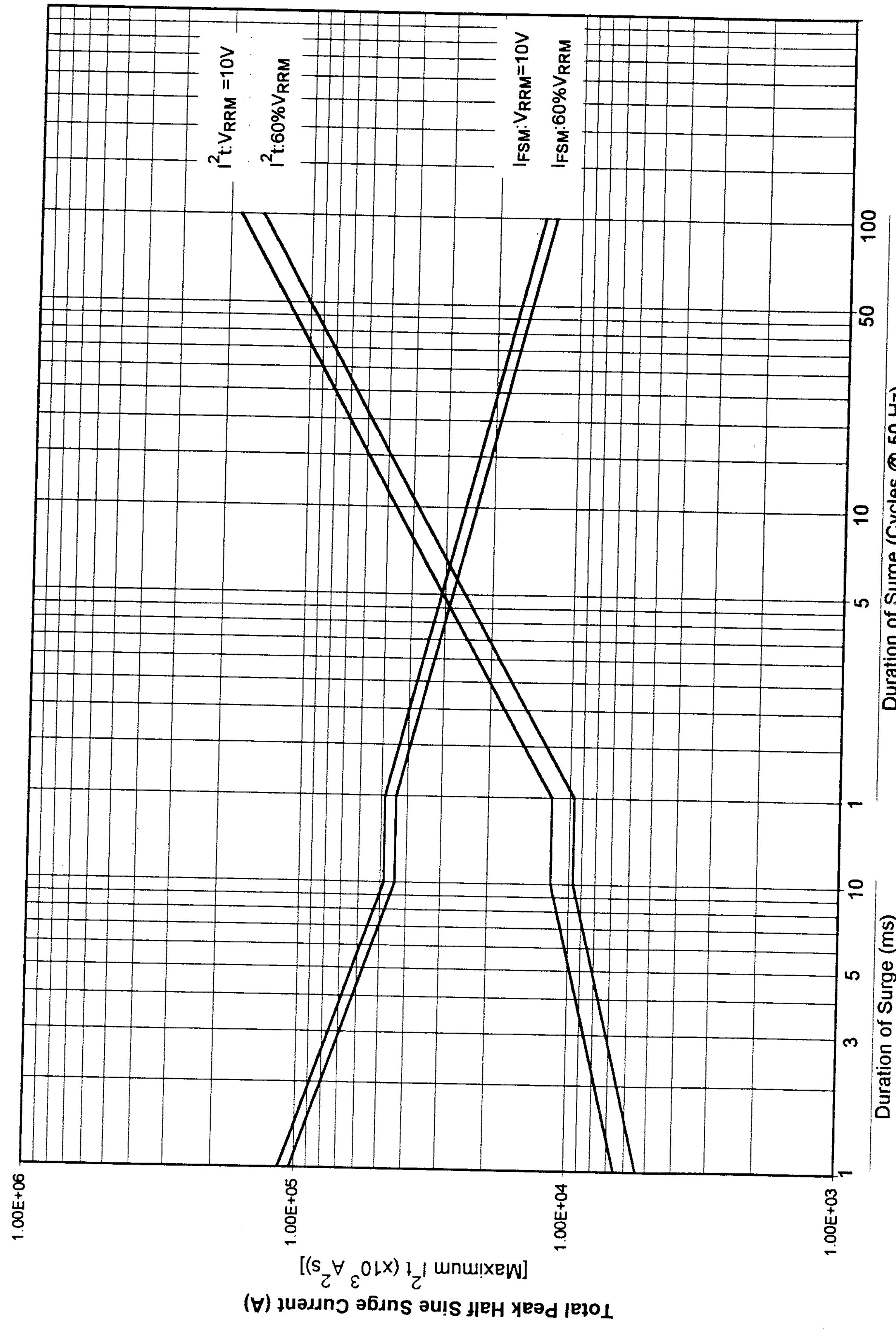
Forward Characteristic of Limit Device



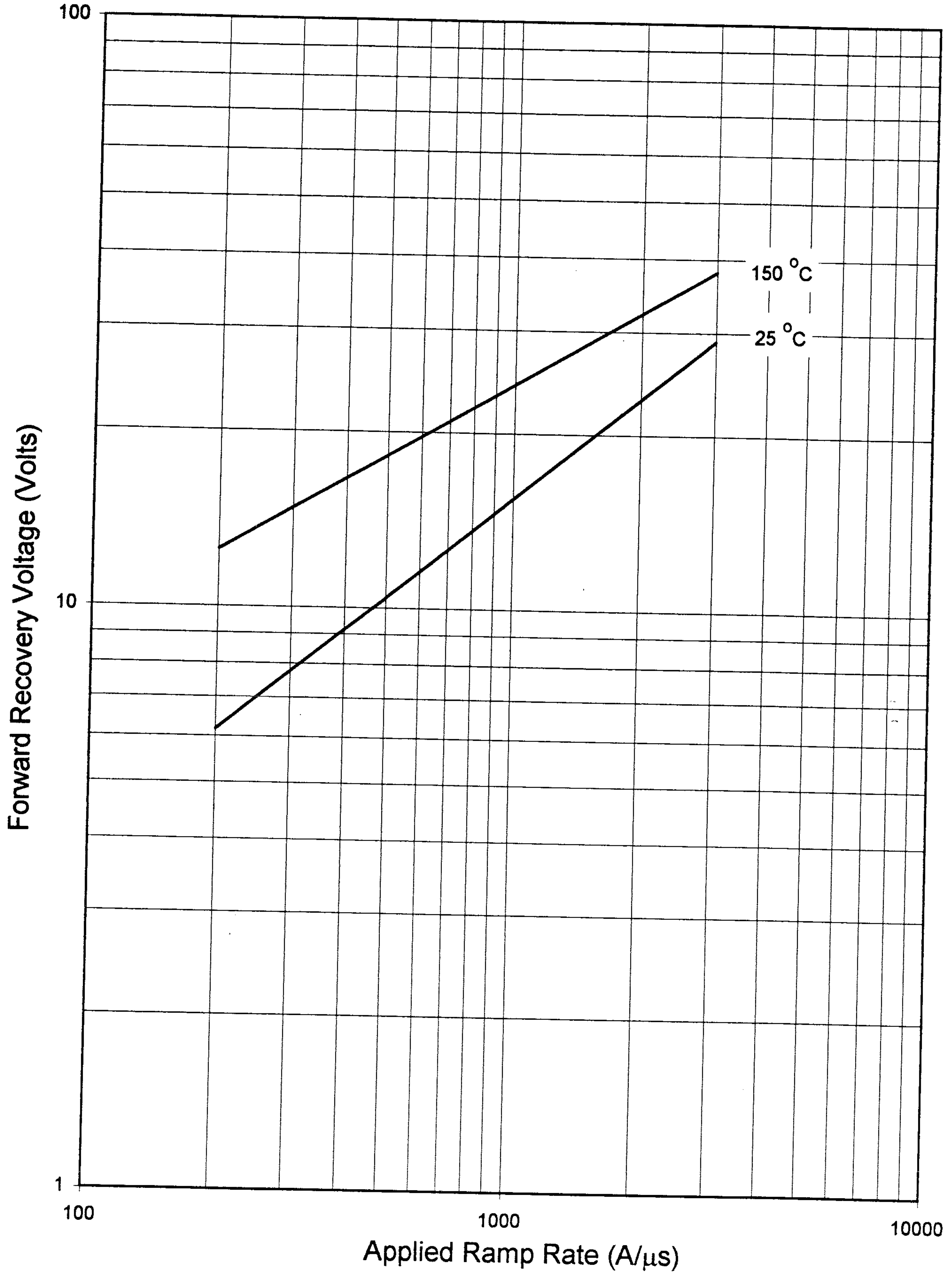
Transient Thermal Impedance (Junction to Heat Sink)



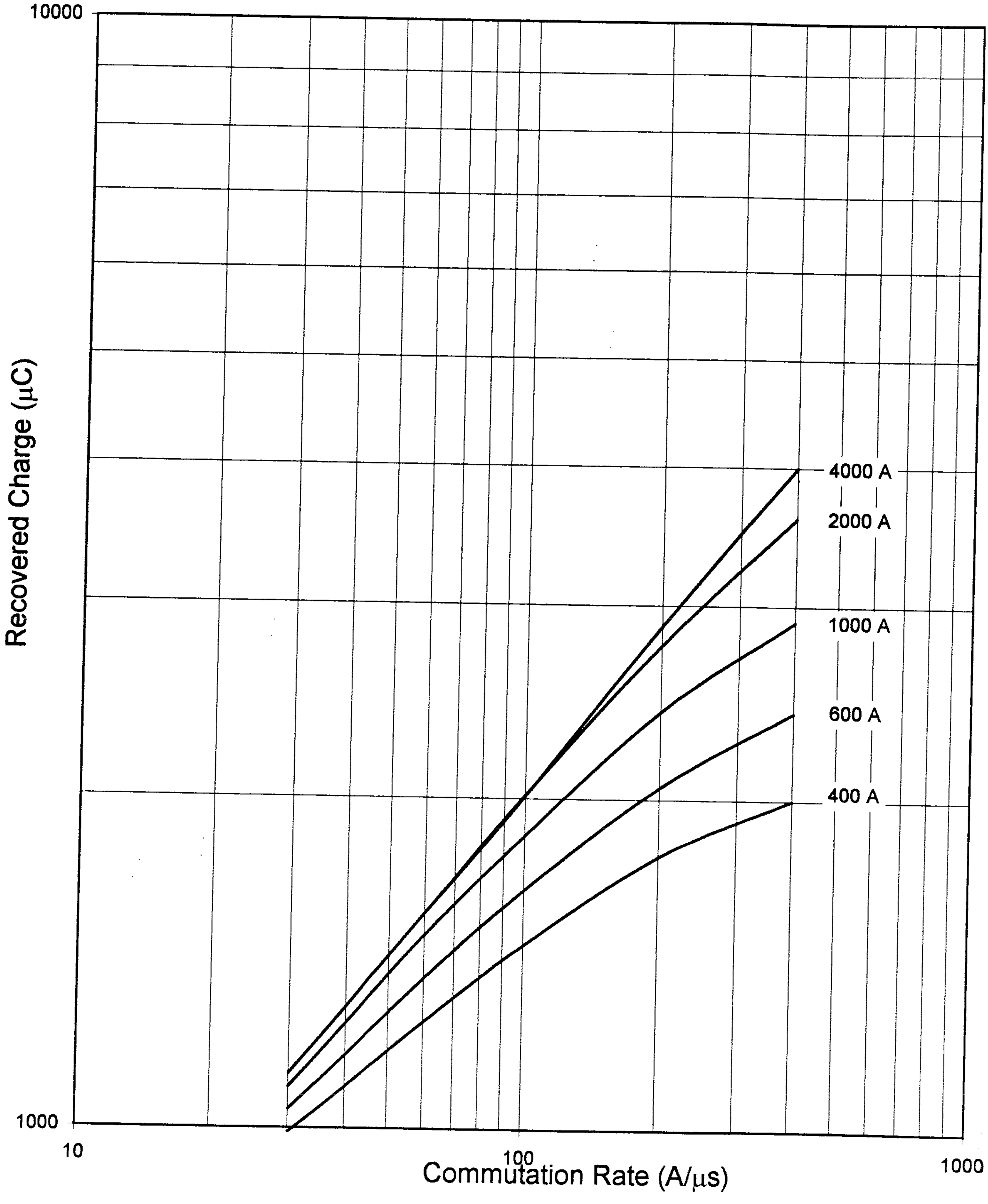
Maximum Non-Repetitive Surge Current @ Initial Junction Temperature 150 °C



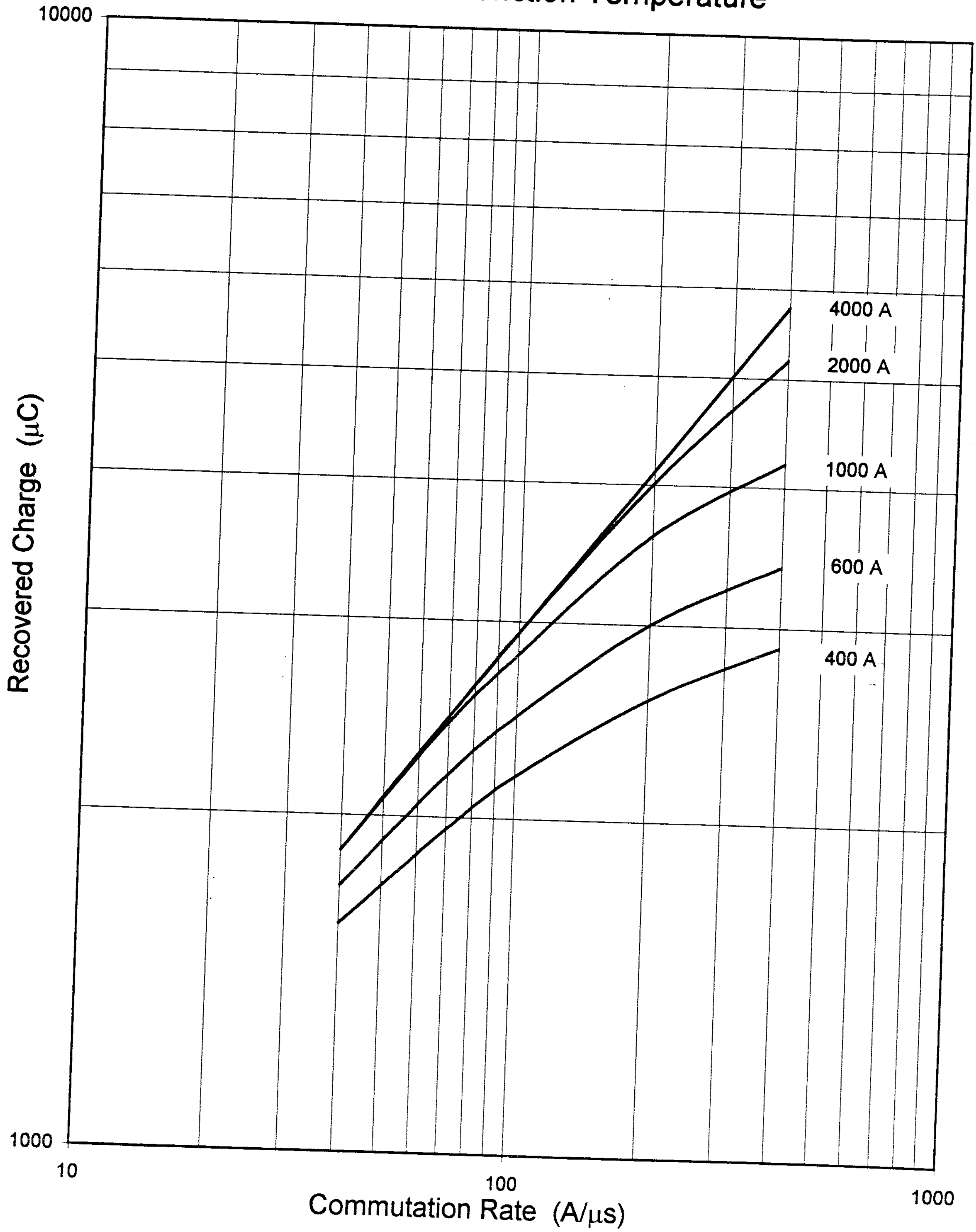
Forward Recovery Voltage
(Maximum Peak)



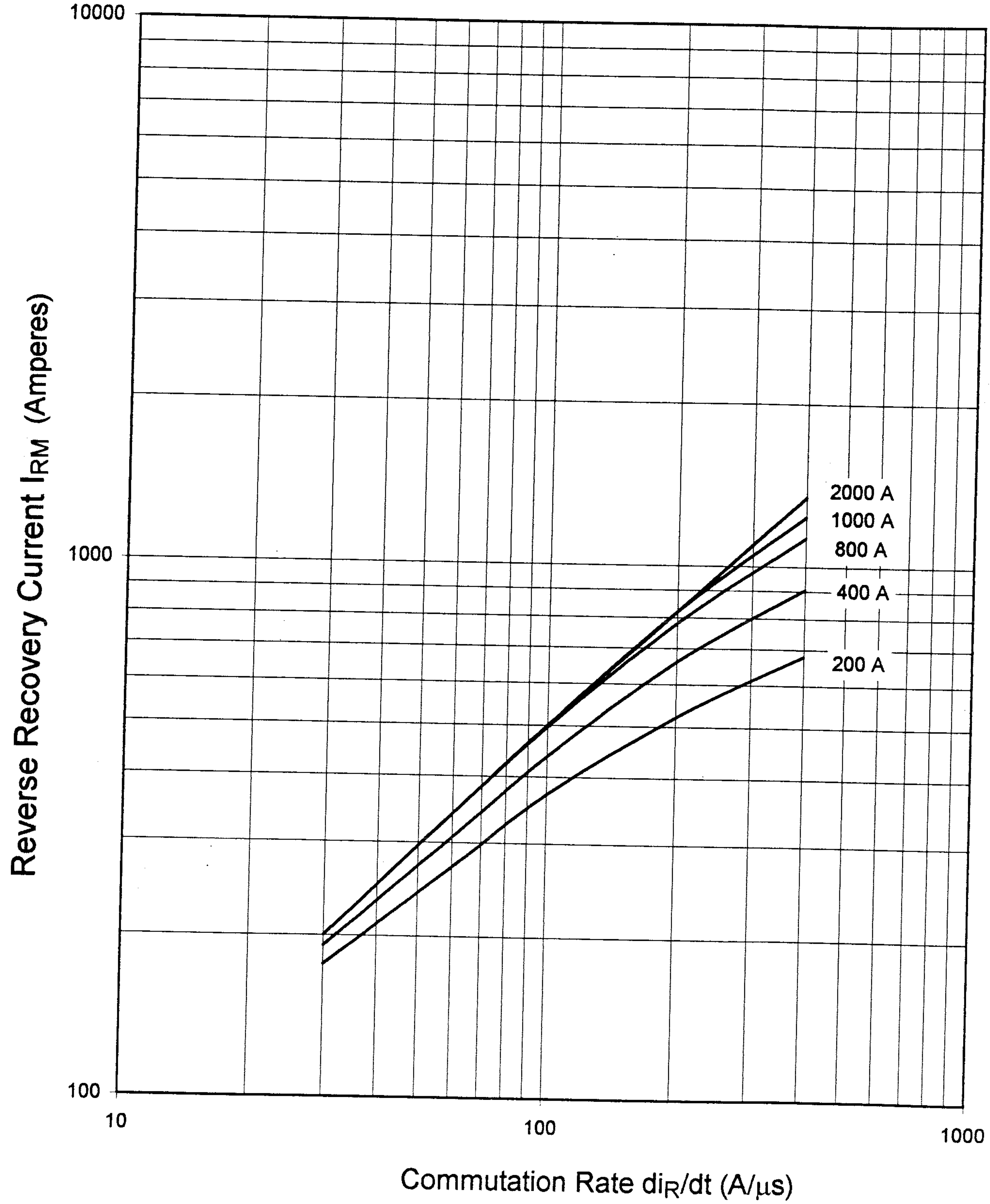
Maximum Recovered Charge Qra 50 % Chord @150 °C Junction Temperature



Maximum Total Recovered Charge Qrr @ 150 °C Junction Temperature

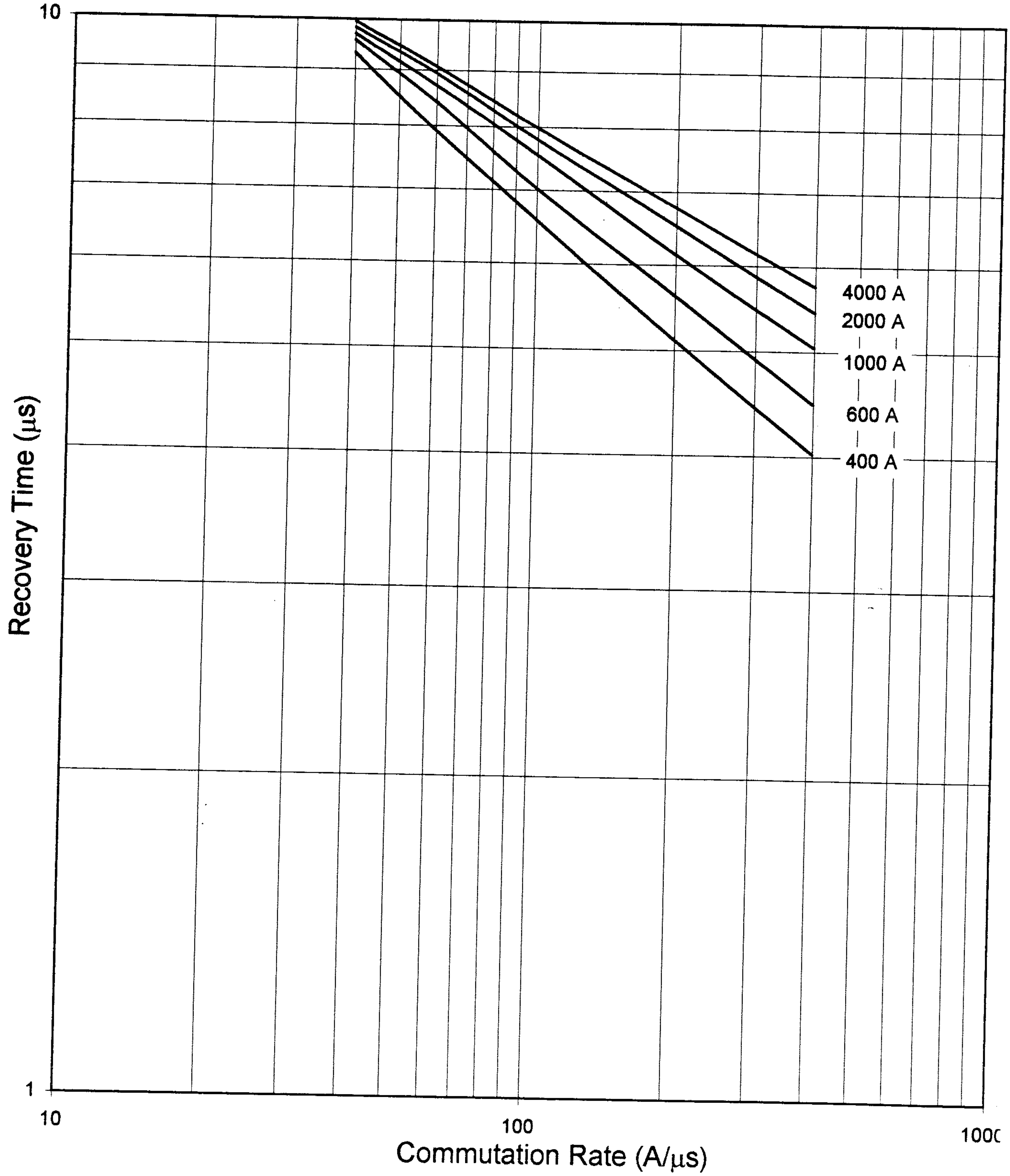


Maximum Peak Recovered Current I_{RM} @ 150 °C Junction Temperature



Maximum Recovery Time t_{rr}

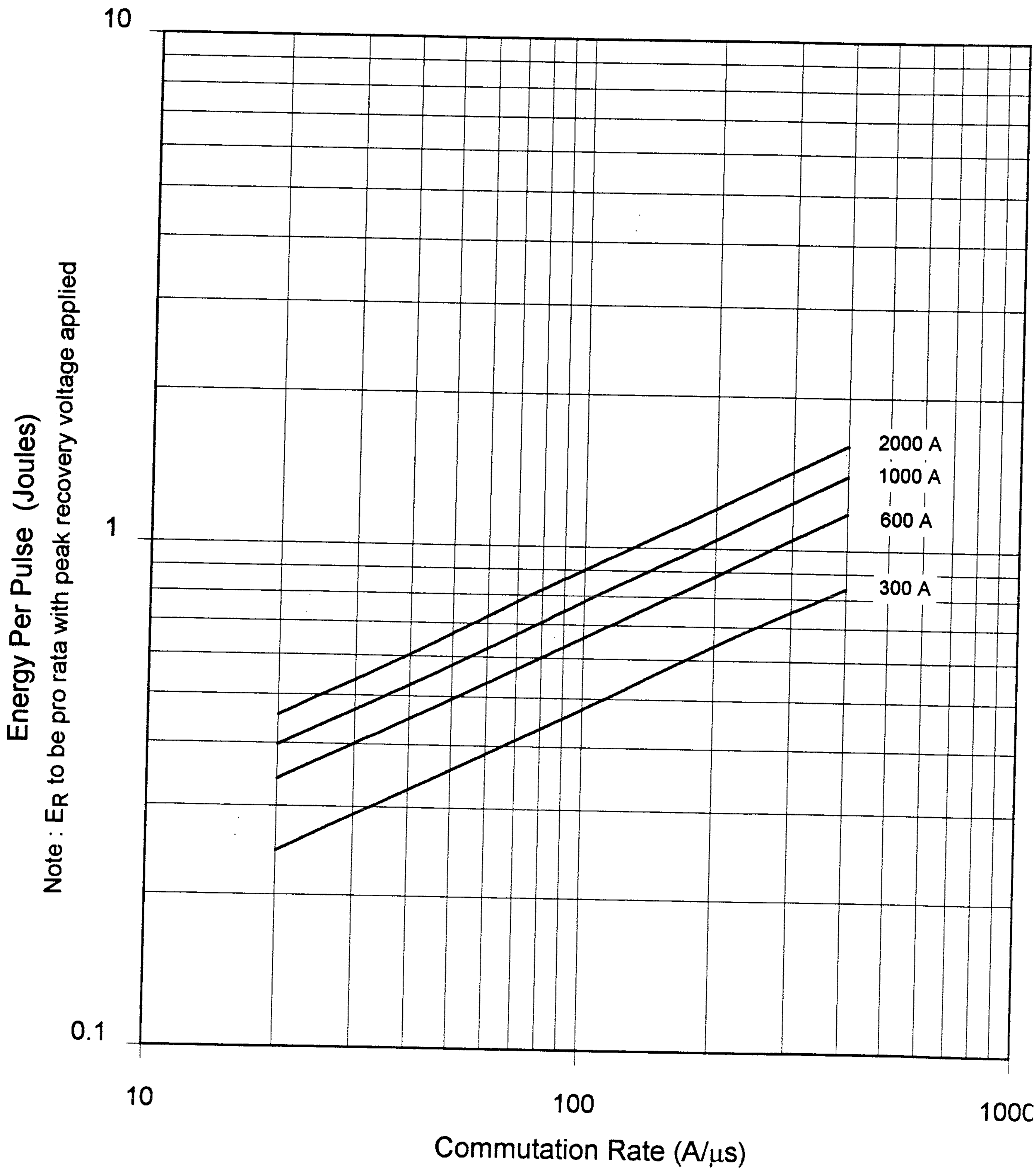
@150 °C Junction Temperature, 50% Chord



Maximum Reverse recovered Energy Loss Per Pulse

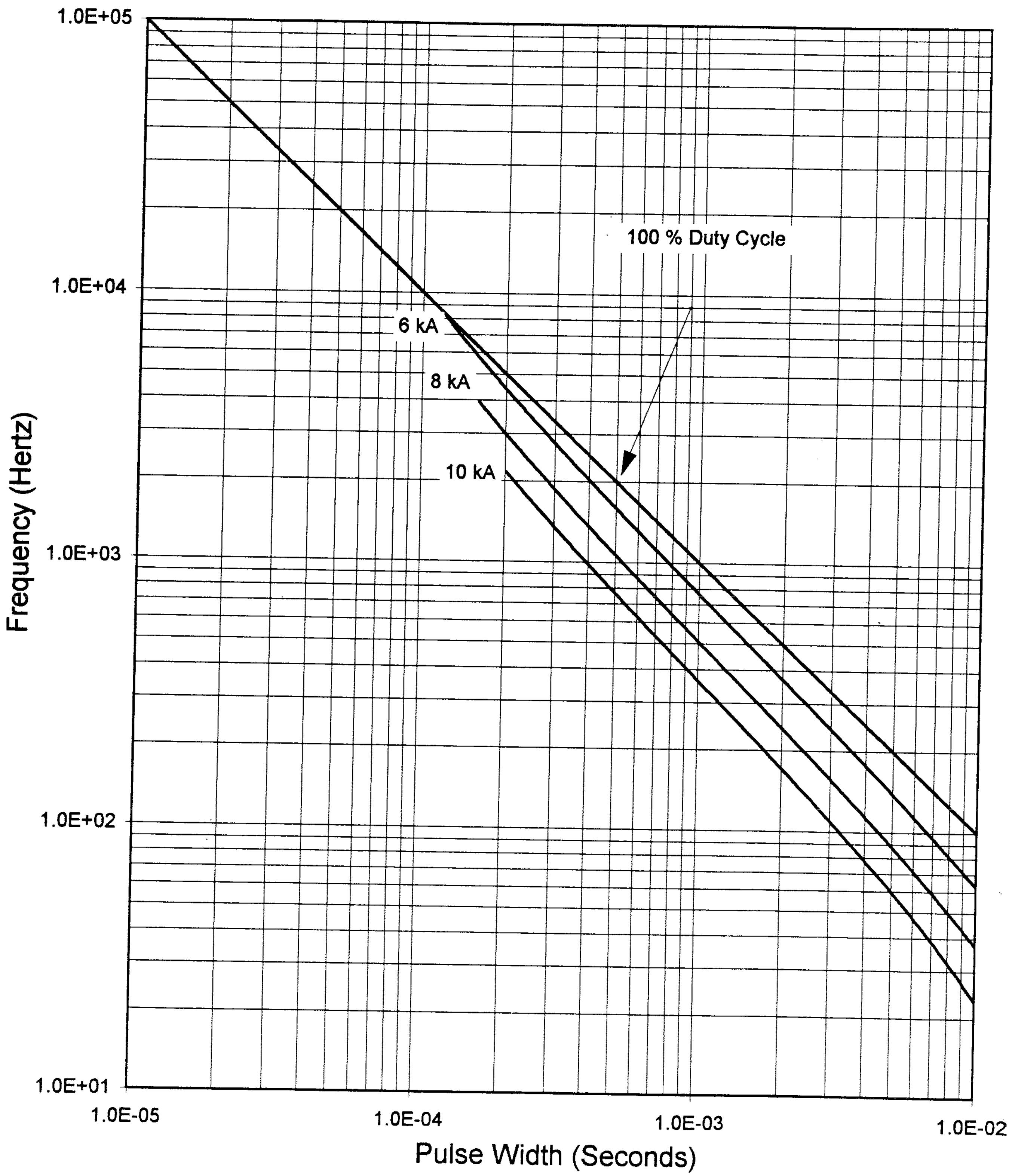
E_R @ 150 °C Junction Temperature

Snubber 0.5 μF & 2.2 Ω. V_{RM} =0.67 Voltage Grade



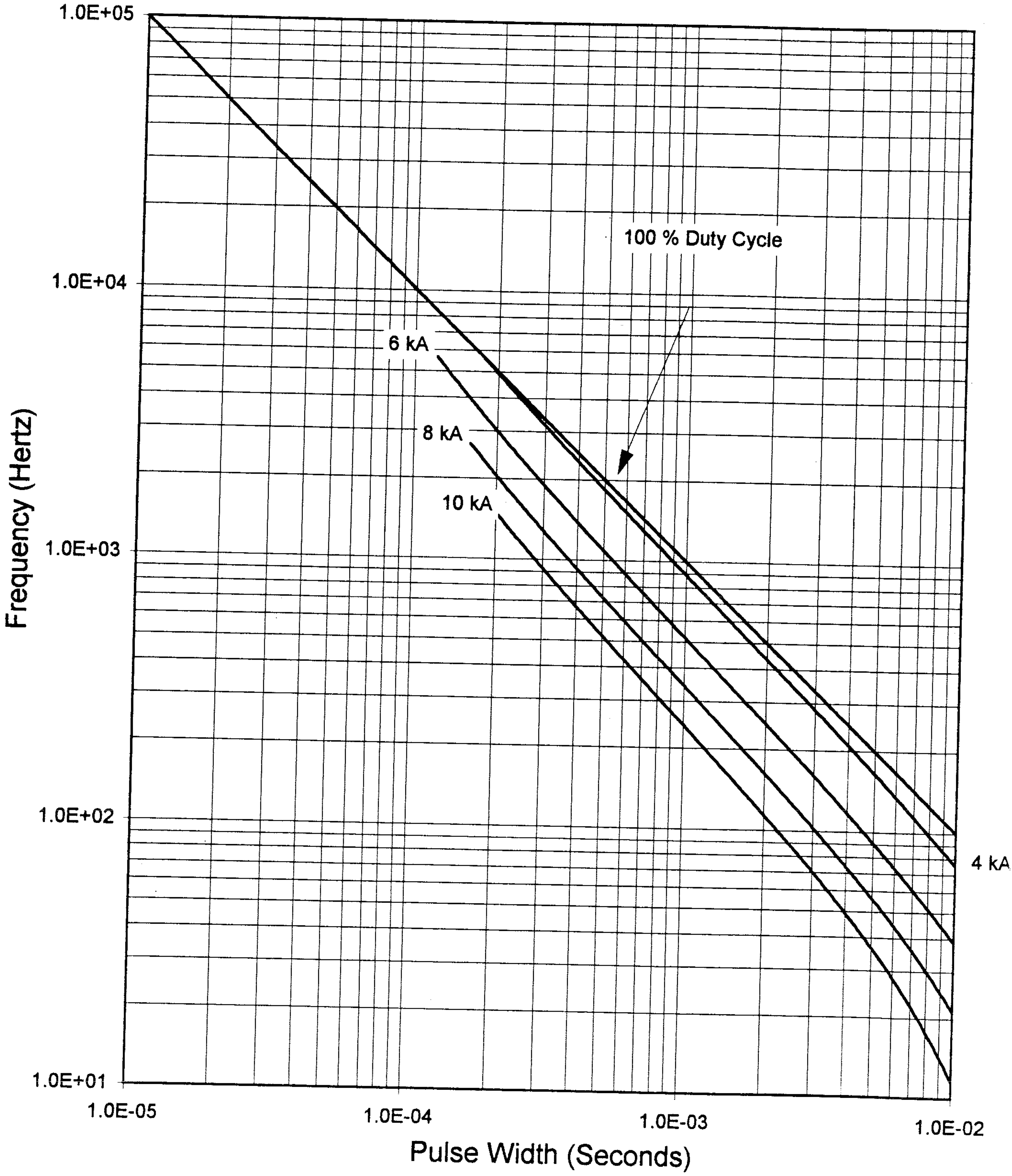
Frequency vs Pulse Width

Heat Sink Temperature 55°C, di/dt 100 A/μs



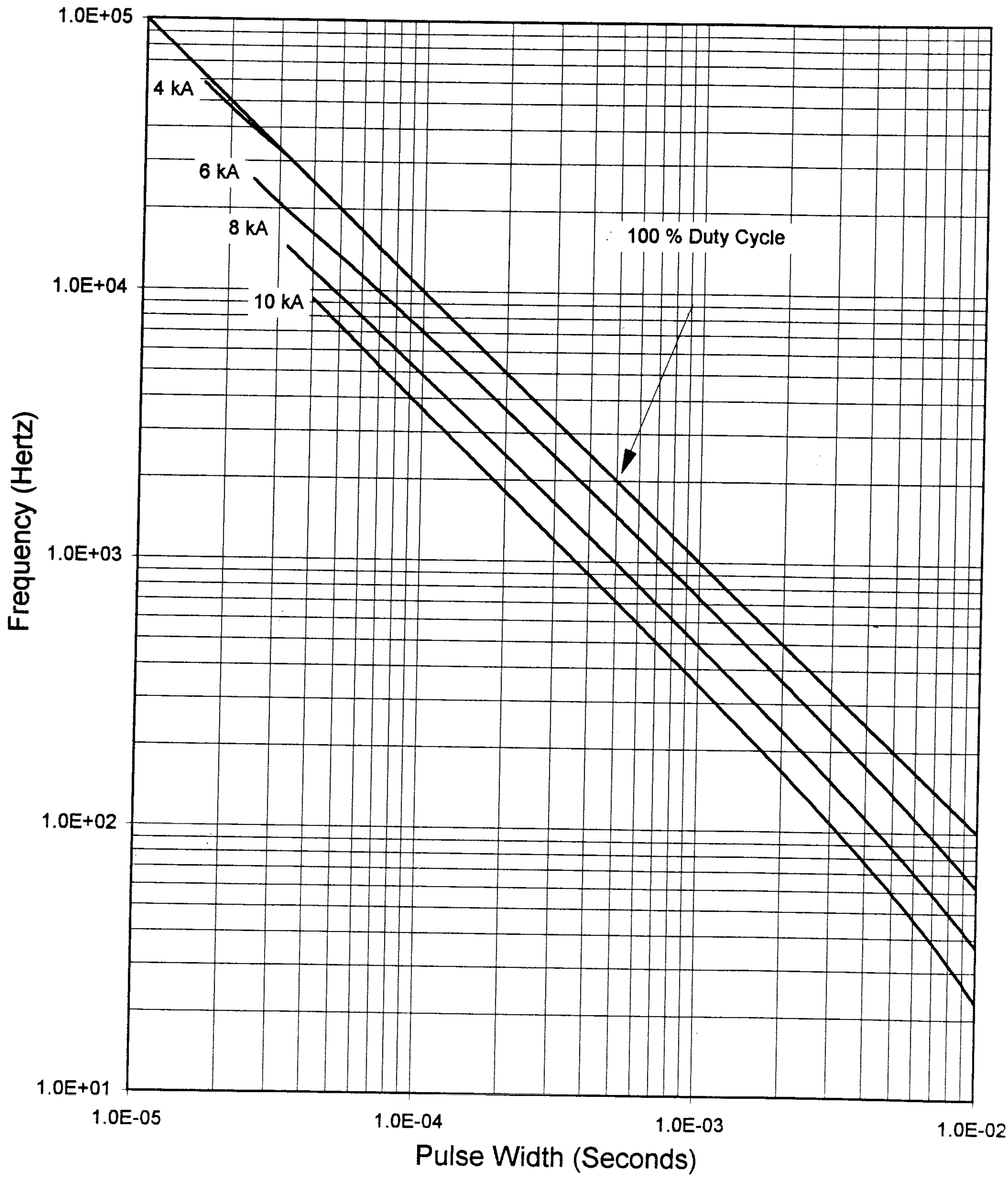
Frequency vs Pulse Width

Heat Sink Temperature 85°C, di/dt 100 A/μs



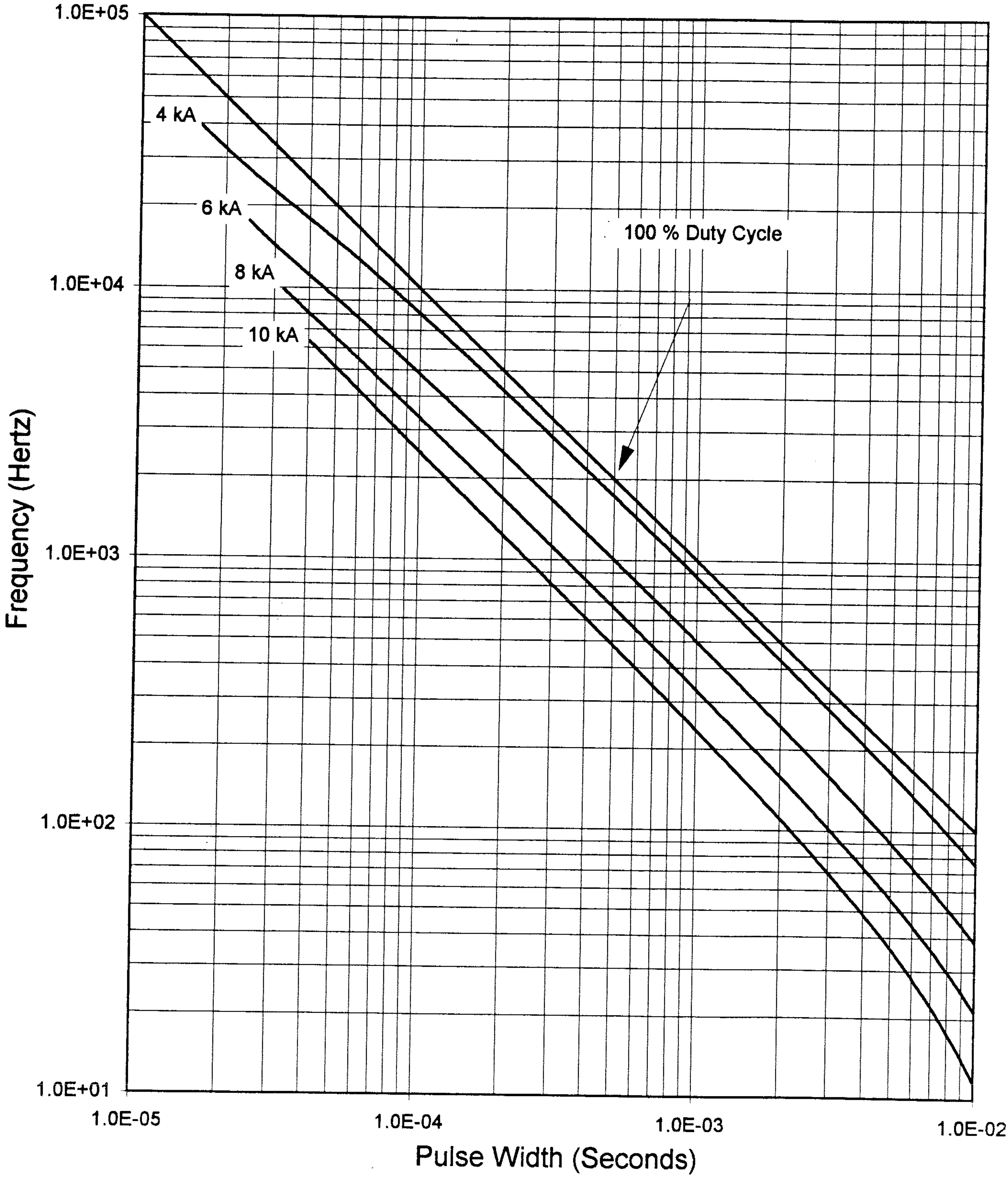
Frequency vs Pulse Width

Heat Sink Temperature 55°C, di/dt 500 A/μs



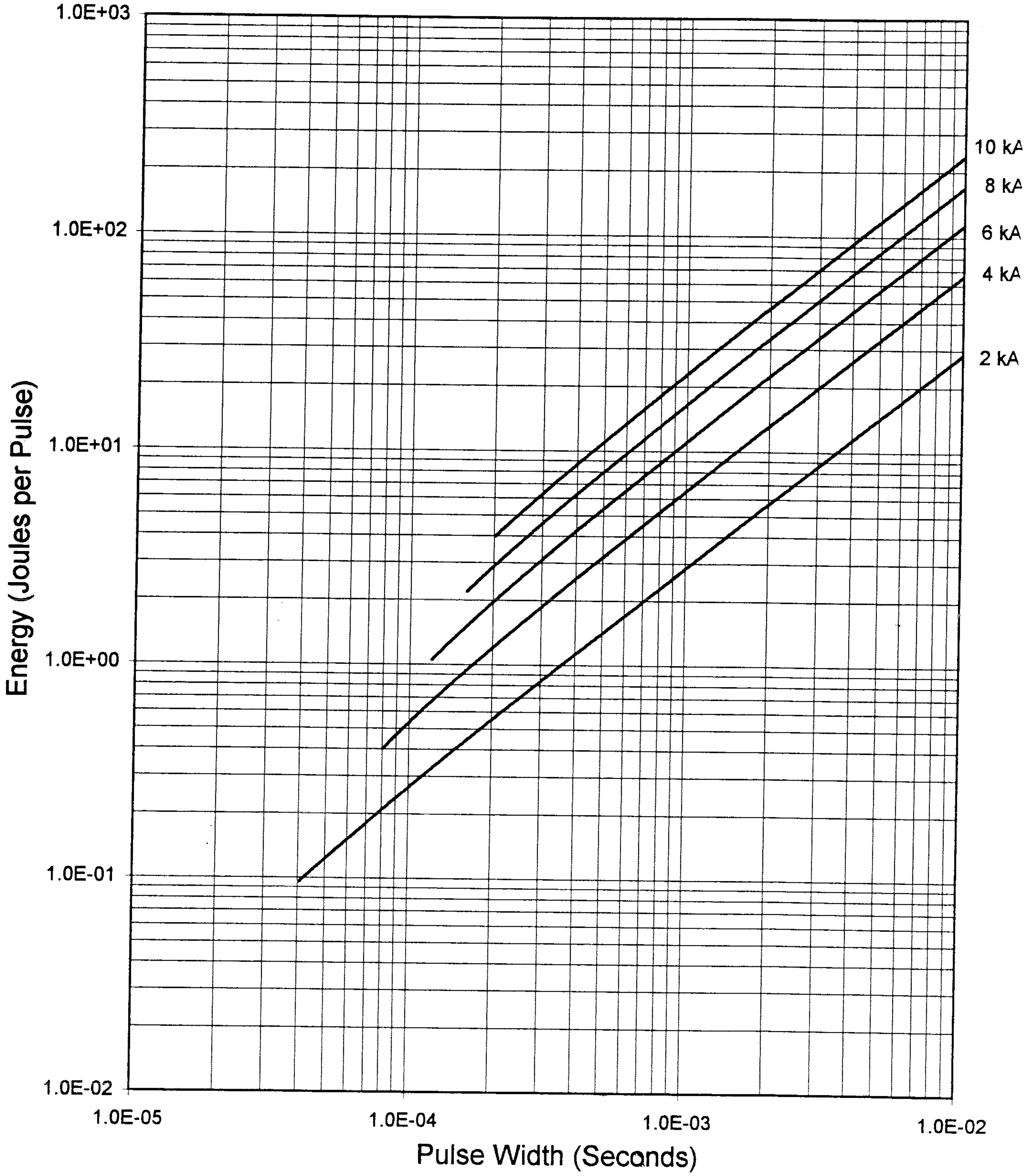
Frequency vs Pulse Width

Heat Sink Temperature 85°C, di/dt 500 A/µs



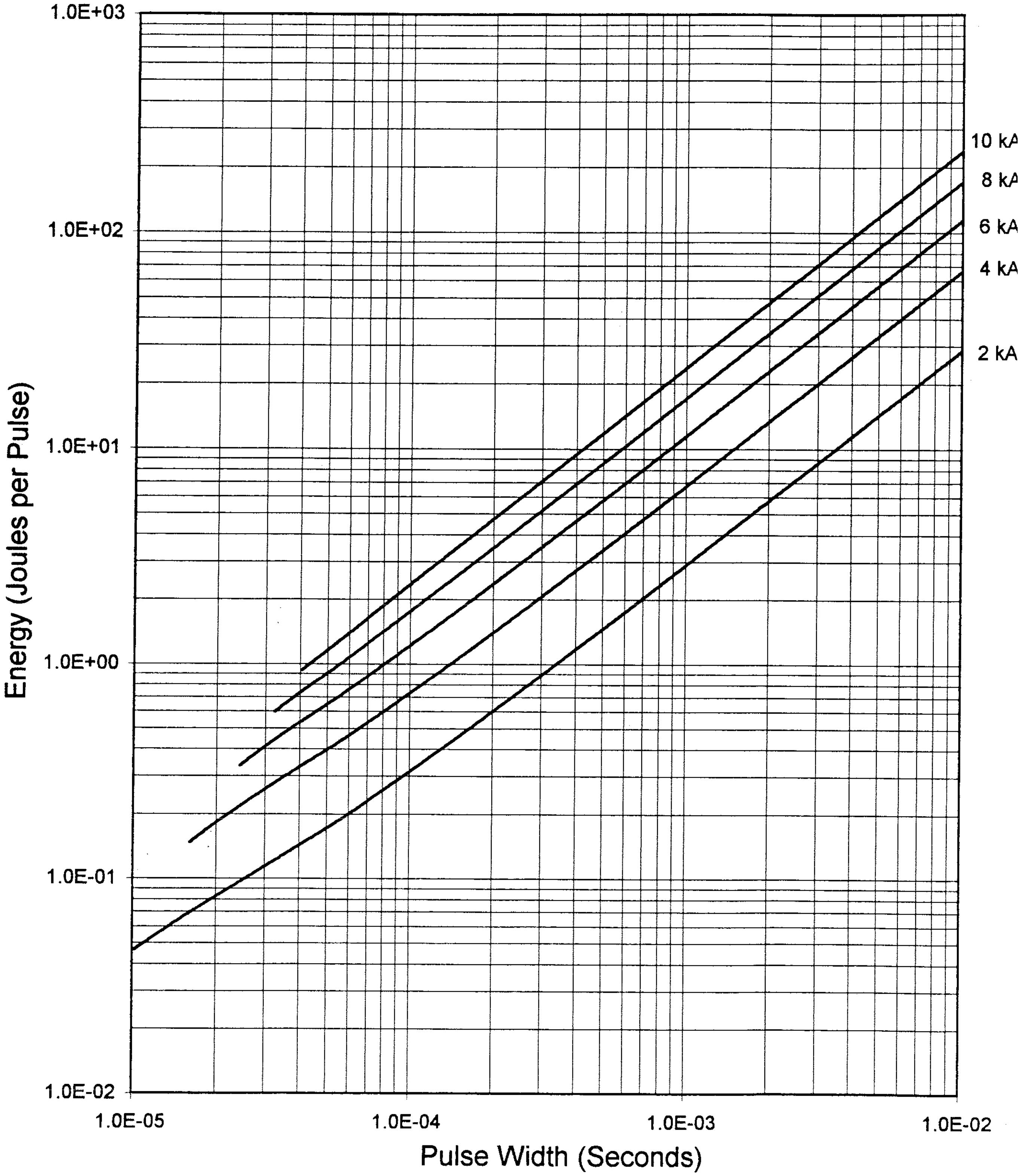
Energy vs Pulse Width

Junction Temperature 150 °C, di/dt 100 A/µs



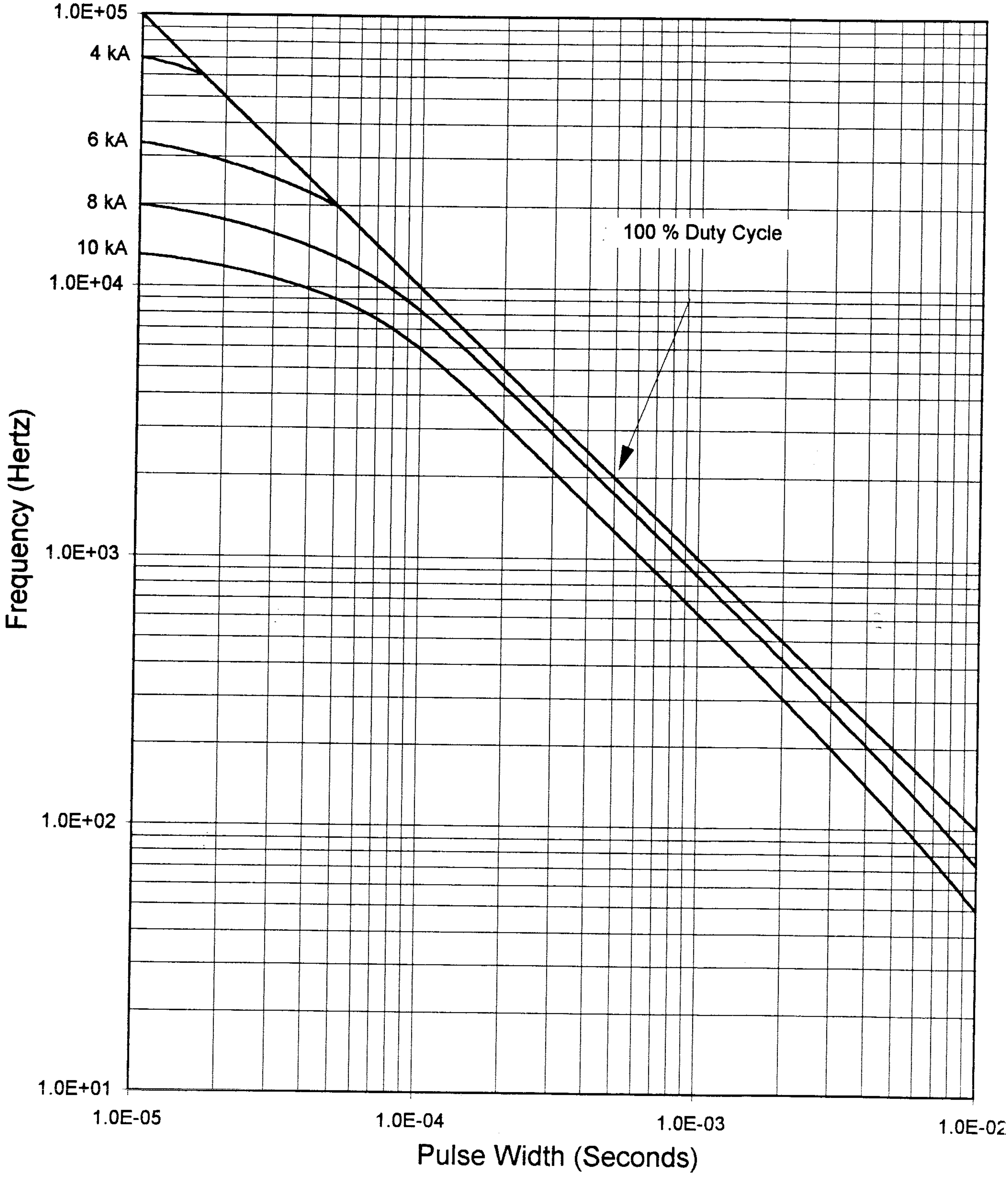
Energy vs Pulse Width

Junction Temperature 150 °C, di/dt 500 A/μs



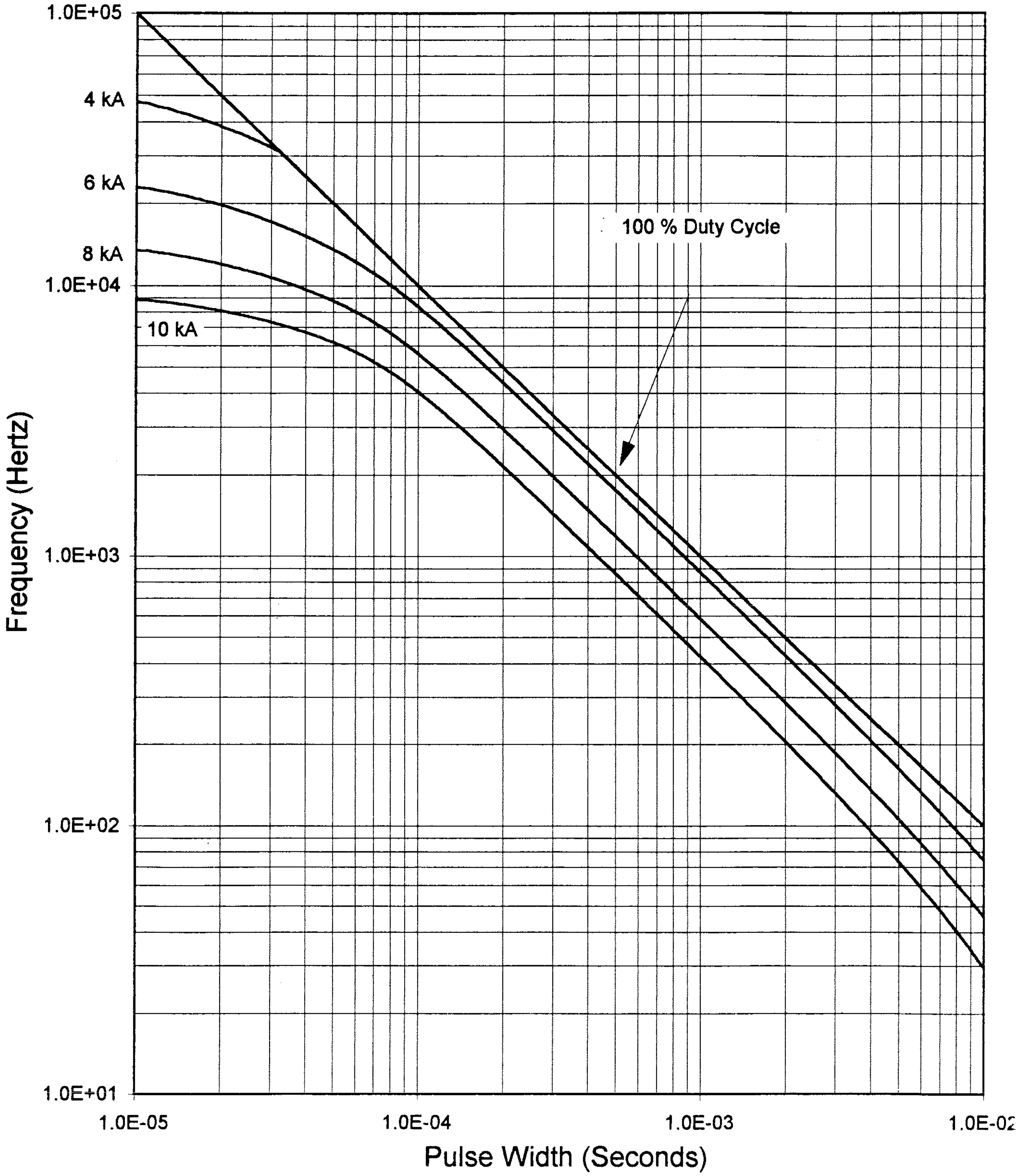
Frequency vs Pulse Width

Heat Sink Temperature 55°C, Sine Wave



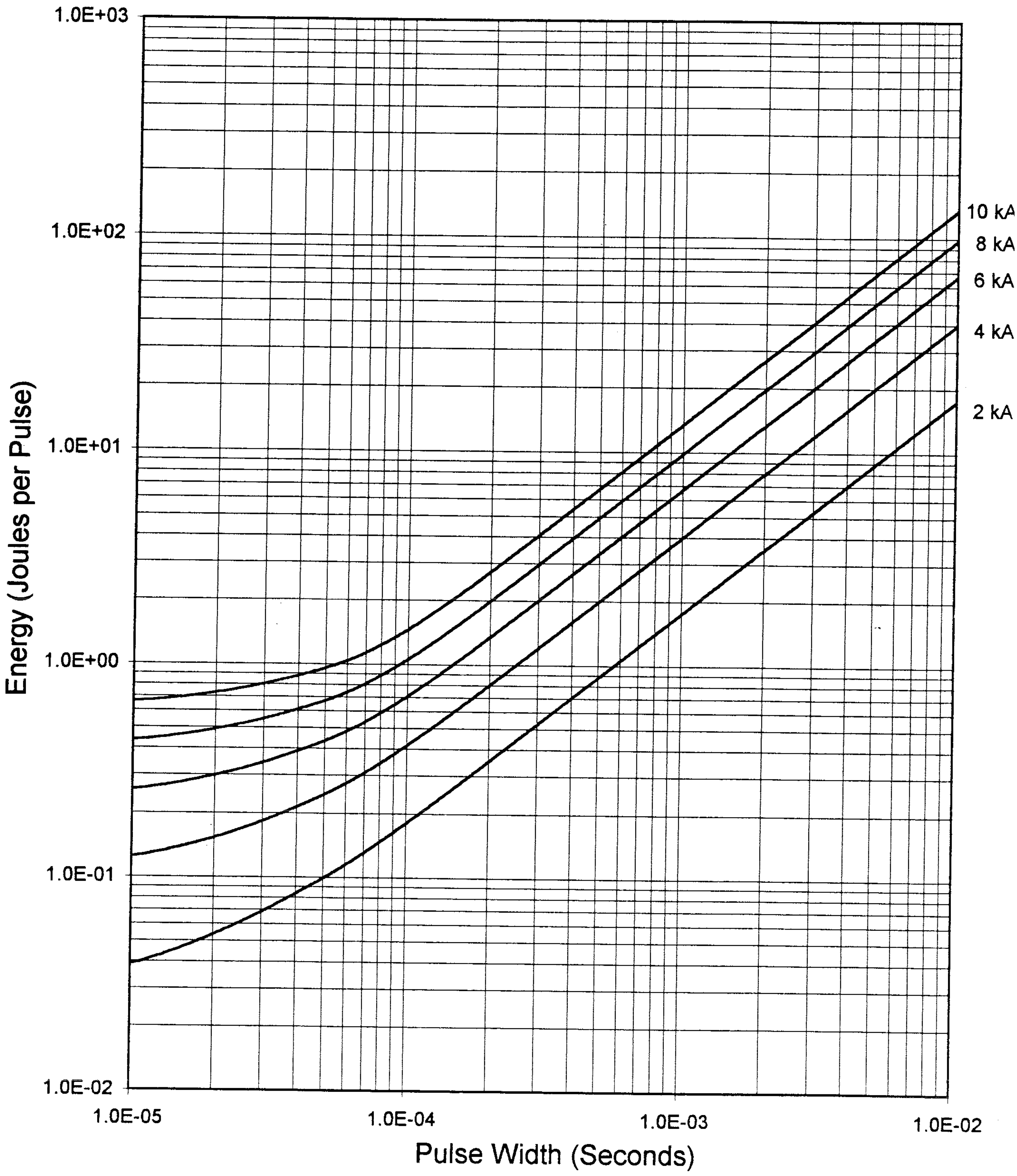
Frequency vs Pulse Width

Heat Sink Temperature 85°C, Sine Wave



Energy vs Pulse Width

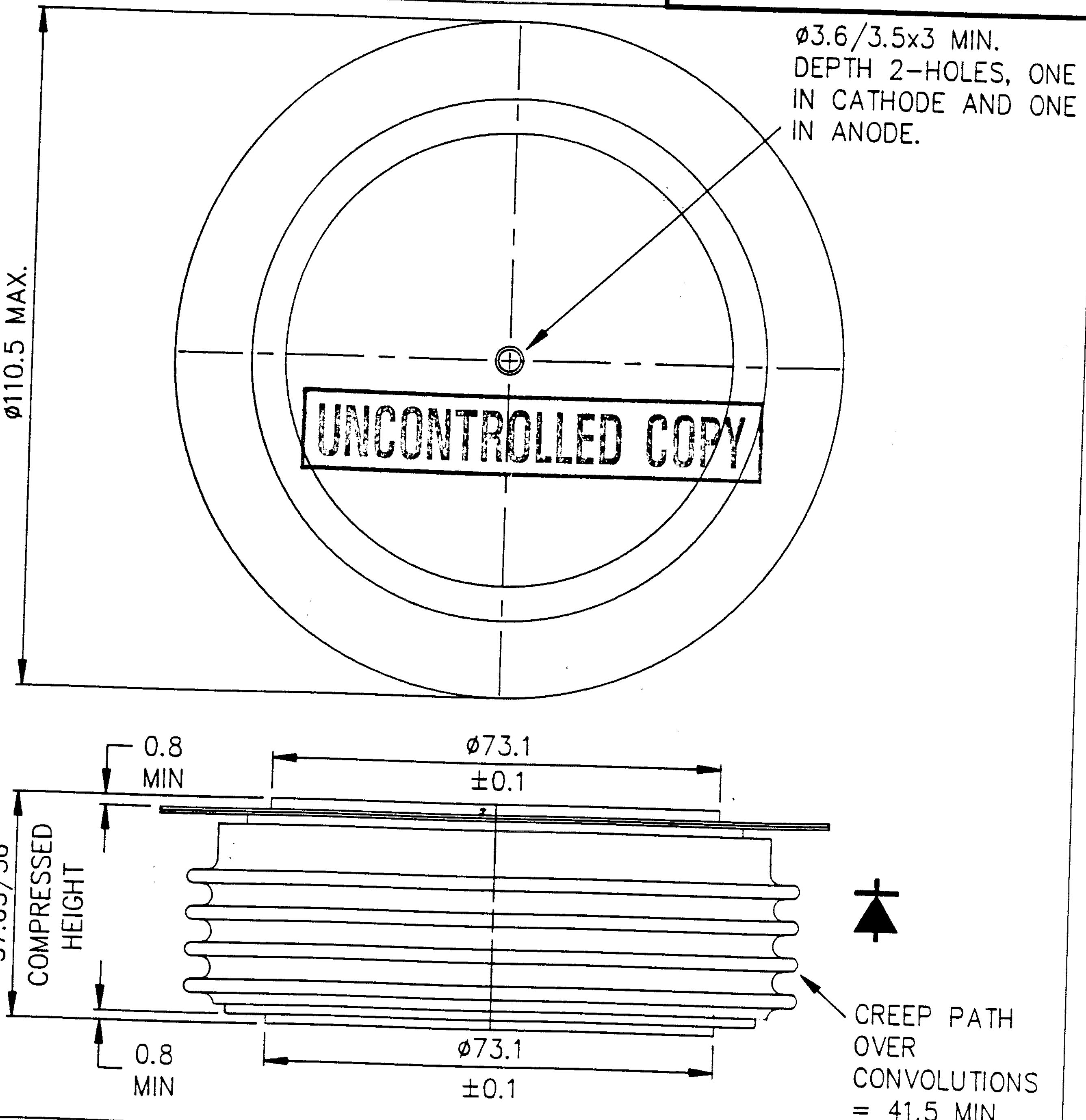
Junction Temperature 150 °C, Sine Wave



INTERNATIONAL OUTLINE No.
G.A. DWG No. 159B100H601
WEIGHT. 1.7kg
FINISH. NICKEL PLATE
DEVICE MOUNTING: CLAMPING FORCE TO BE APPLIED ON CENTRE LINE 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 = 3700±1000kgf. (37±10kN)

TYPE NUMBER

CXC974 CXC32C
CXC15C
CXC18C
CXC20C
CXC21C
CXC26C
CXC30C



ISS	REVISIONS
4	13-09-90 REDRAWN ON CAD HDN
5	M1644. TYPE No. CXC26C ADDED 11.4.91 HDN
6D	26.8.93. M2312. CXC18C ADDED. HN
7D	11.1.94. M2408. CXC974 ADDED. HN

SCALE 1/1
DRAWN HDN
ST: A

THIRD ANGLE PROJECTION.
DWG. COMPLIES WITH BS 308.
DIMNS. IN MILLIMETRES.
DWG No. 100A293

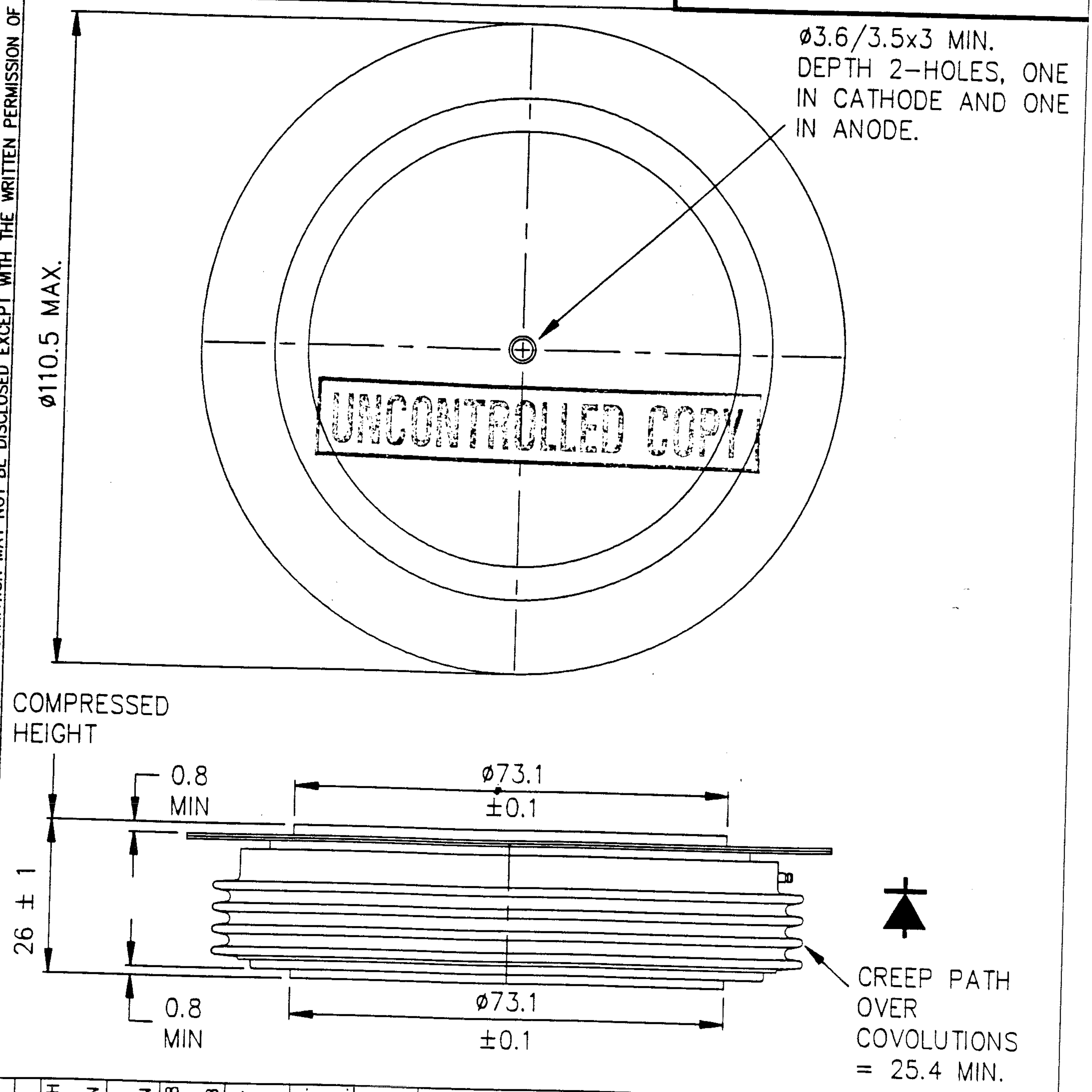
WESTCODE SEMICONDUCTORS LTD.,
P.O. BOX 57, CHIPPENHAM, WILTSHIRE, SN15 1JL, ENGLAND.

INTERNATIONAL OUTLINE No.
G.A. DWG No. 159B100H661
WEIGHT. 1.2kg
FINISH. NICKEL PLATE

DEVICE MOUNTING: CLAMPING FORCE TO BE APPLIED ON CENTRE LINE 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 = 3700±1000kgf. (37±10kN)

TYPE NUMBER

DXC974
DXC15C
DXC18C
DXC20C
DXC21C
DXC26C
DXC30C
DXC32C



ISS	REVISIONS
1	27.9.90
2	MIN CREEP PATH WAS INCORRECT 10.7.91 HDN
3	DXC26C ADDED 4.9.91 HDN
4A	14.8.92 M1948 26 ± 1 WAS 25.6/26.9. RFCB
5D	26.8.93. M2312. DXC18C ADDED. HN
6D	11.1.94. M2408. DXC974 ADDED. HN.
7D	30.3.94. M2531. WEIGHT WAS 1.7kg. HN.

SCALE 1/1
DRAWN HDN
ST: A

THIRD ANGLE PROJECTION.
DWG. COMPLIES WITH BS 308.
DIMNS. IN MILLIMETRES.
DWG No. 100A310

WESTCODE SEMICONDUCTORS LTD.,
P.O. BOX 57, CHIPPENHAM, WILTSHIRE, SN15 1JL, ENGLAND.