Fast turn-off Thyristor
P0366WC04# to P0366WC08#

The data sheet on the subsequent pages of this document is a scanned copy of existing data for this product.
(Rating Report 83TR3 Issue 4)

This data reflects the old part number for this product which is: P214CH02-08. 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 grade 02 (200V V_{RRM}/V_{DRM})

Please use the following link to view an up to date outline drawing for this device
Outline W8

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

P0366	WC	♦♦	#
Fixed Type Code	Fixed Outline Code	Voltage code $V_{DRM}/100$ 04-08	Fixed Turn-off Time Code A = 10µs, B = 12µs, C = 15µs
Typical Order Code: P0366WC06B, 14mm clamp height, 600V V_{RRM}/V_{DRM}, 12µs t_q			

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WESTCODE SEMICONDUCTORS

Technical Publication **TP214C**

Inverter Grade Capsule Thyristor Type P214C
370 amperes average: up to 800 volts V_{RRM}/V_{DRM}

Ratings (Maximum values at 125°C Tj unless stated otherwise)

RATING	CONDITIONS	SYMBOL	
Average on-state current	Half sine wave, 55°C heatsink temperature (double side cooled)	$I_{T(AV)}$	370 A
	Half sine wave, 85°C heatsink temperature (single side cooled)		130 A
R.M.S. on-state current	25°C heatsink temperature, double side cooled	$I_{T(RMS)}$	756 A
Continuous on-state current	25°C heatsink temperature, double side cooled	I_T	590 A
Peak one-cycle surge (non-repetitive) on state current	10ms duration, 60% V_{RRM} re-applied	$I_{TSM(1)}$	4700 A
	10ms duration, $V_R \leq$ 10 volts	$I_{TSM(2)}$	5170 A
Maximum permissible surge energy	10ms duration, $V_R \leq$ 10 volts	I^2t (2)	134000 A^2s
	3ms duration, $V_R \leq$ 10 volts	I^2t	98000 A^2s
Peak forward gate current	Anode positive with respect to cathode	I_{FGM}	18 A
Peak forward gate voltage	Anode positive with respect to cathode	V_{FGM}	12 V
Peak reverse gate voltage		V_{RGM}	5 V
Average gate power		P_G	1.5 W
Peak gate power	100μs. pulse width	P_{GM}	60 W
Rate of rise of off-state voltage	To 80% V_{DRM} gate open-circuit	dv/dt	*200 V/μs
Rate of rise of on-state current (repetitive)	Gate drive 20 volts, 20 ohms with $t_r \leq 1\mu s$.	di/dt (1)	500 A/μs
Rate of rise of on-state current (non-repetitive)	Gate drive 20 volts, 20 ohms with $t_r \leq 1\mu s$. Anode voltage ≤ 80% V_{DRM}	di/dt (2)	1000 A/μs
Operating temperature range		T_{hs}	−40 + 125°C
Storage temperature range		T_{stg}	−40 + 150°C

Characteristics (Maximum values at 125°C Tj unless stated otherwise)

CHARACTERISTIC	CONDITIONS	SYMBOL	
Peak on-state voltage	At 715 A, I_{TM}	V_{TM}	1.88 V
Forward conduction threshold voltage		V_O	1.40 V
Forward conduction slope resistance		r	0.67 mΩ
Repetitive peak off-state current	At V_{DRM}	I_{DRM}	30 mA
Repetitive peak reverse current	At V_{RRM}	I_{RRM}	30 mA
Maximum gate current required to fire all devices	At 25°C, V_A = 6 V, I_A = 1A	I_{GT}	200 mA
Maximum gate voltage required to fire all devices	At 25°C, V_A = 6 V, I_A = 1A	V_{GT}	3 V
Maximum holding current	At 25°C, V_A = 6 V, I_A = 1A	I_H	600 mA
Maximum gate voltage which will not trigger any device		V_{GD}	0.25 V
Stored charge	I_{TM} = 300 A, dir/dt 20 A/μs, V_{RM} = 50V, 50% chord value	Q_{rr} typical	25 μC
Circuit commutated turn-off time available down to	I_{TM} = 300 A, dir/dt = 20A/μs, V_{RM} = 50V, 200V/μs to 80% V_{DRM}	tq	15–30 μs
	I_{TM} = 300 A, dir/dt = 20A/μs, V_{RM} = 50V, 20V/μs to 80% V_{DRM}	tq typical	10–20 μs
Thermal resistance, junction to heat sink, for a device with a maximum forward volt drop characteristic	Double side cooled	$R_{th(j-hs)}$	0.095°C/W
	Single side cooled		0.190°C/W

VOLTAGE CODE		H02	H03	H04	H06	H08			
Repetitive peak voltages Non-repetitive peak off-state voltage	V_{RRM} V_{DRM} V_{DSM}	200	300	400	600	800			
Non-repetitive peak reverse blocking voltage	V_{RSM}	300	400	500	700	900			

Ordering Information (Please quote device code as explained below)

P 2 1 4 C	● ● ●	●	●	0
Fixed type code	Voltage Code (see ratings)	dv/dt code to 80% V_{DRM} C = 20V/μs E = 100V/μs D = 50V/μs F = 200V/μs	Turn-off time H = 30 μs J = 25 μs K = 20 μs L = 15 μs N = 10 μs	

Typical code: P214CH06FJ0 = 600 V_{RRM} 600 V_{DRM} 200 V/μs dv/dt to 80% V_{DRM} 25 μs turn-off

*Other values of dv/dt up to 1000 V/μs, and turn-off time may be available.

1. INTRODUCTION

The P214C thyristor series are diffused regenerative gate devices employing a 24 mm slice in a cold weld housing.

2. NOTES ON THE RATINGS

(a) **Rate of rise of on-state current**
The maximum un-primed rate of rise of on-state current must not exceed 1000 A/μs at any time during turn-on on a non-repetitive basis. For repetitive performance the on-state rate of rise of current must not exceed 500 A/μs at any time during turn-on. Note that these values of current rate of rise apply to the circuit external to the device and its specified snubber network and device current rates of rise will be higher.

(b) **Square wave ratings**
These ratings are given for leading edge linear rates of rise of forward current of 100 and 500 A/μs.

(c) **Duty Cycle Lines**
The 100% duty cycle line appears on all these ratings. These frequency ratings are presented in the form that all duty cycles may be represented by straight parallel lines.

(d) **Maximum operating Frequency**
The maximum operating frequency, f_{max}, is set by the time required for the thyristor to turn off (tq) and for the off-state voltage to reach full value (tv), i.e.

$$f_{max} = \frac{1}{t_{pulse} + tq + tv}$$

(e) **Energy per pulse characteristics**
These curves enable rapid estimation of device dissipation to be obtained for conditions not covered by the frequency ratings.

Let E_p be the Energy per pulse for a given current and pulse width, in joules.

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

3. 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 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

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

(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 **p. 10.**. A typical R-C snubber network is connected across the thyristor to control the transient reverse voltage waveform.

Let E be the value of energy per reverse cycle in joules **page 10.**

Let f be the operating frequency in Hz

then T_{SINK} new = T_{SINK} original – $ER_{th} \times f$

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.

4. GATE DRIVE

The recommended gate drive is 20 V, 20 ohms with a short-circuit current rise time of not more than 1 μs. This gate drive must be applied when using the full di/dt capability of the device.

5. THE DV/DT SUPPRESSION NETWORK

The effect of a conventional resistor-capacitor snubber of 0.22 μF 5 ohms has been included in these ratings and all rating di/dt values apply to the circuit external to the thyristor and its suppression network.

Snubber Network Values
A series connected C-R filter may be required across the anode to cathode terminals of the thyristor for the purpose of reducing off-state voltage overshoot.

The optimum values for C and R depend partly on the circuits connected to the thyristor. For most applications the snubber design values should not exceed a maximum of 0.22 μF or a minimum of 5 ohms. Please consult Westcode for values outside these limits.

6. NOTE 1

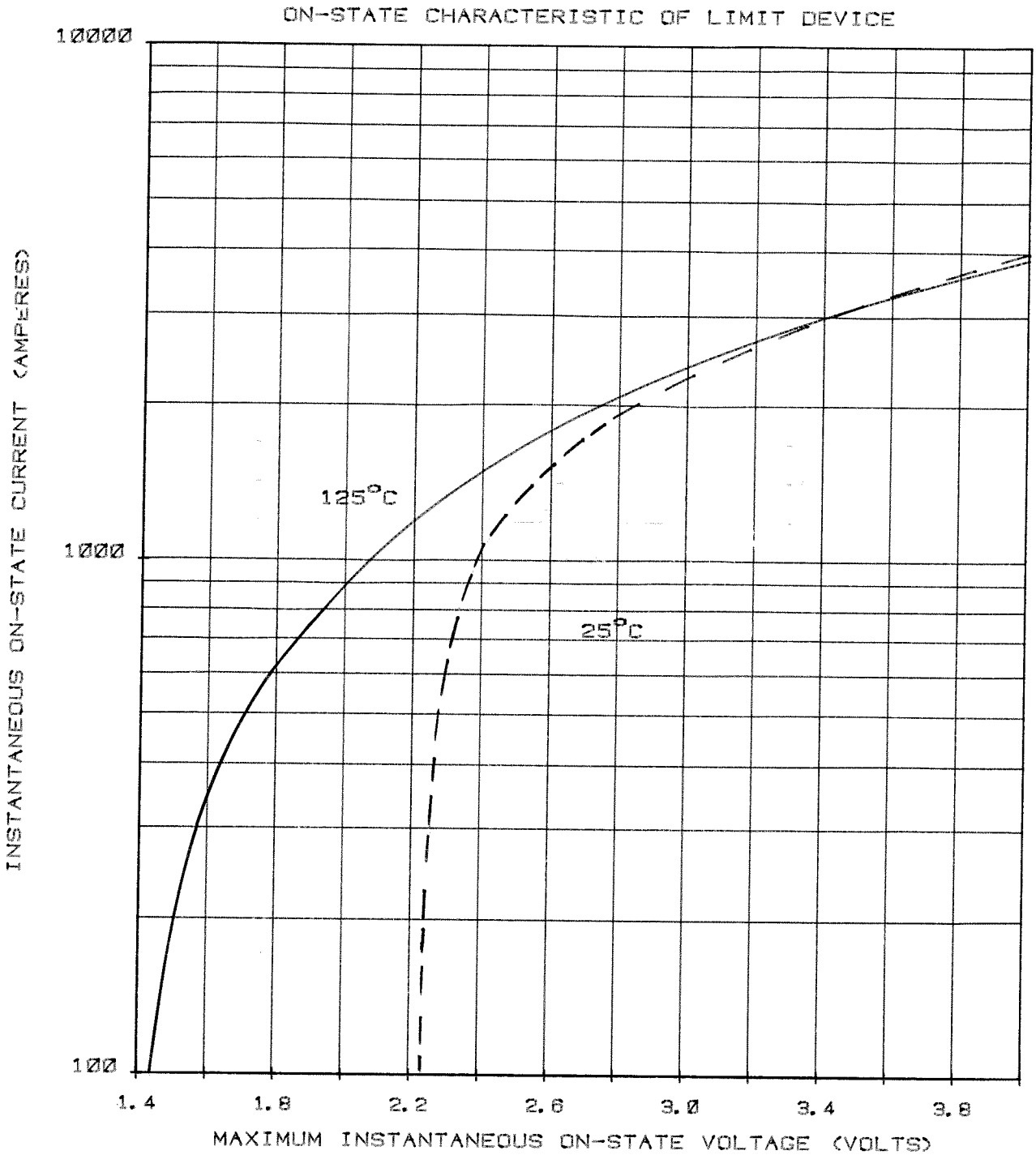
REVERSE RECOVERY LOSS BY MEASUREMENT

This thyristor 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.

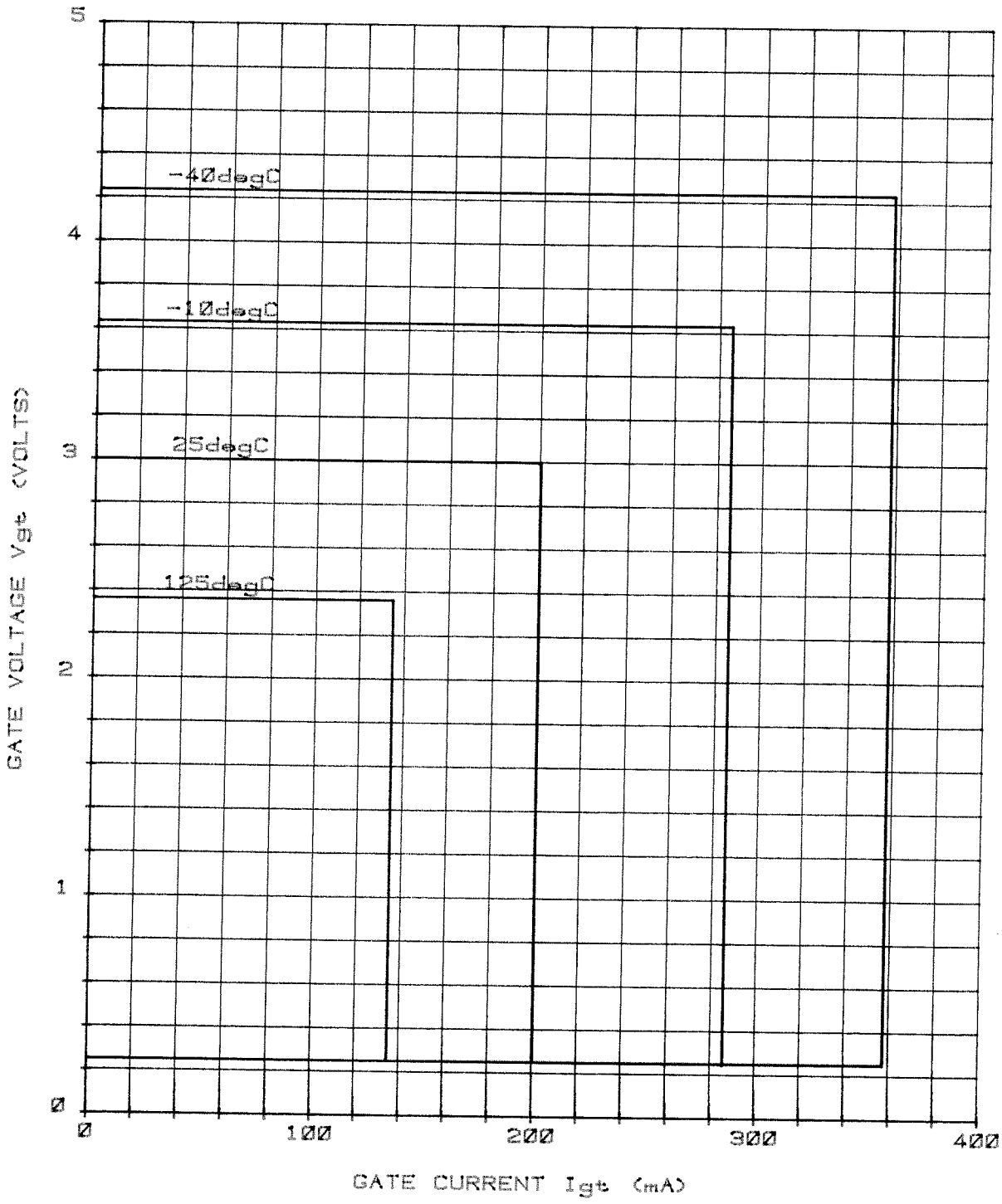
(b) The measuring oscilloscope has adequate dynamic range — typically 100 screen heights — to cope with the initial forward current without overload.

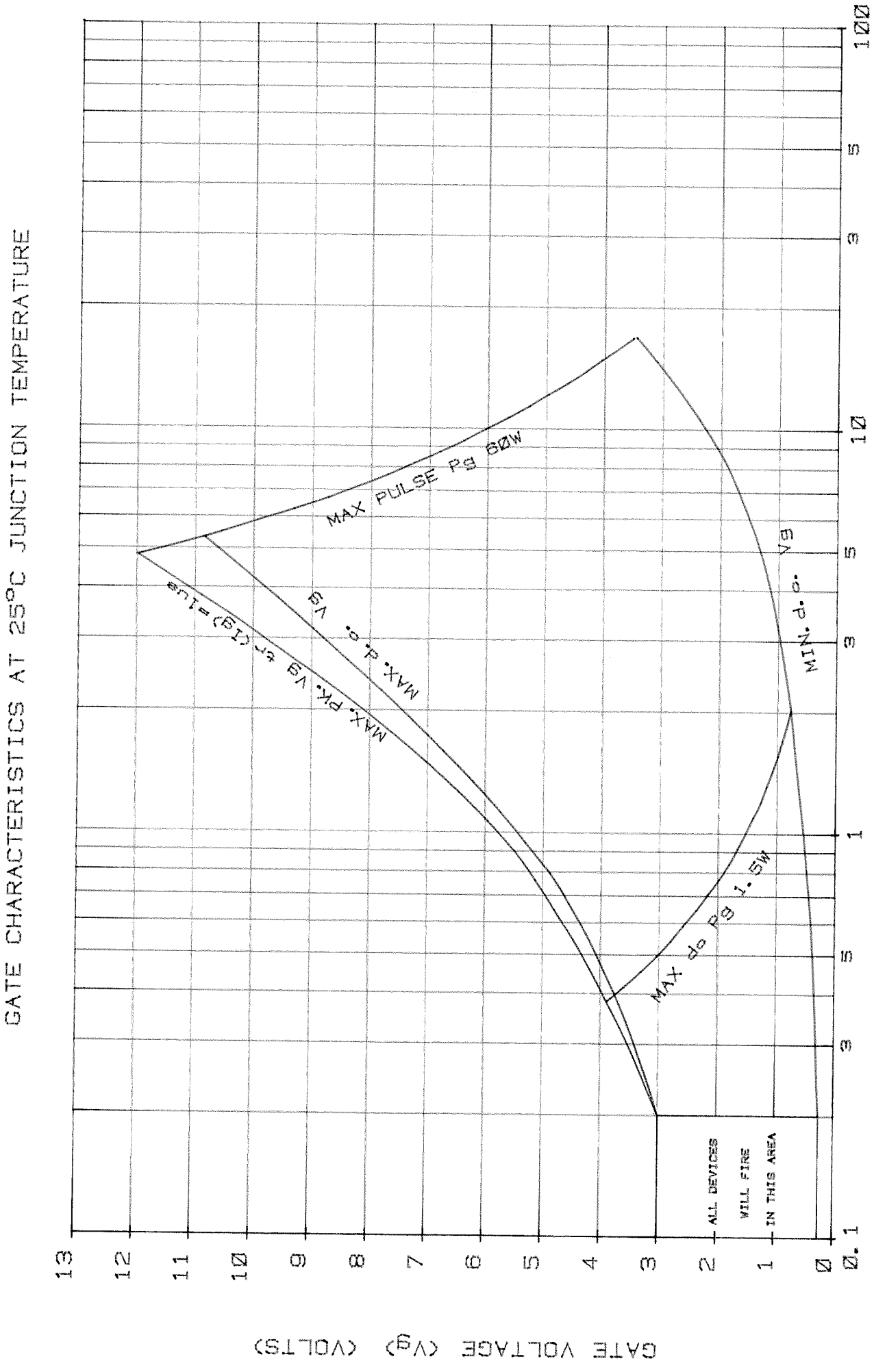
CONTENTS

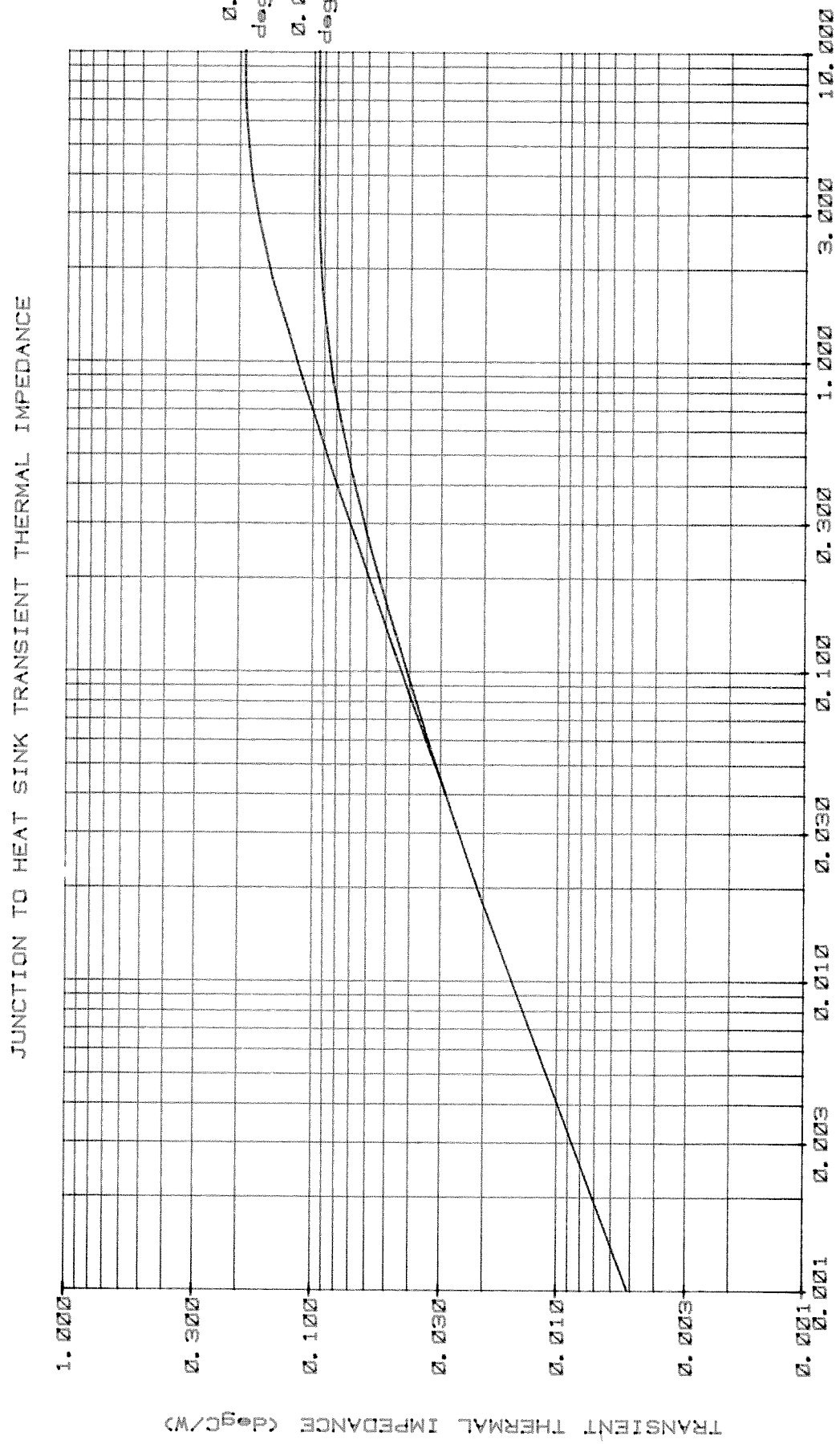

ON-STATE CHARACTERISTIC OF LIMIT DEVICE
10000
1000
100
INSTANTANEOUS ON-STATE CURRENT (AMPERES)
125°C
25°C
1.4
1.8
2.2
2.6
3.0
3.4
3.8
MAXIMUM INSTANTANEOUS ON-STATE VOLTAGE (VOLTS)

GATE TRIGGERING CHARACTERISTICS

(TRIGGER POINTS OF ALL THYRISTORS LIE IN THE AREAS SHOWN)

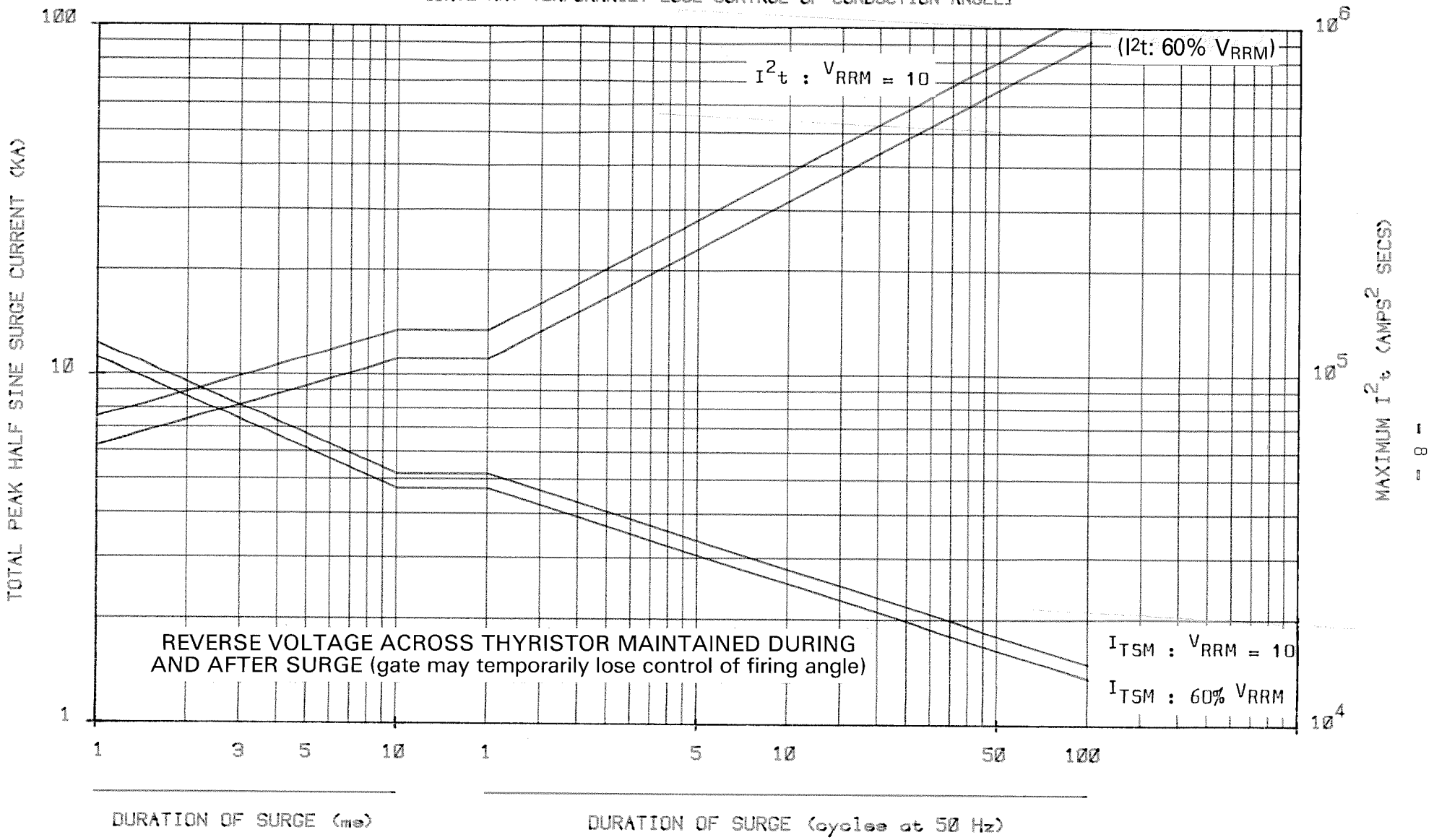



GATE CHARACTERISTICS AT 25°C JUNCTION TEMPERATURE
GATE VOLTAGE (V_g) (VOLTS)
GATE CURRENT (AMPS)
MAX PULSE Pg 60W
MAX. d.c. Vg
MAX. PK. Vg @ $T_C(T_g)$=1us
MIN. d.c. Vg
MAX dc Pg 1.5W
ALL DEVICES WILL FIRE IN THIS AREA
13
12
11
10
9
8
7
6
5
4
3
2
1
0
0.1
1
3
5
10
3
5
100

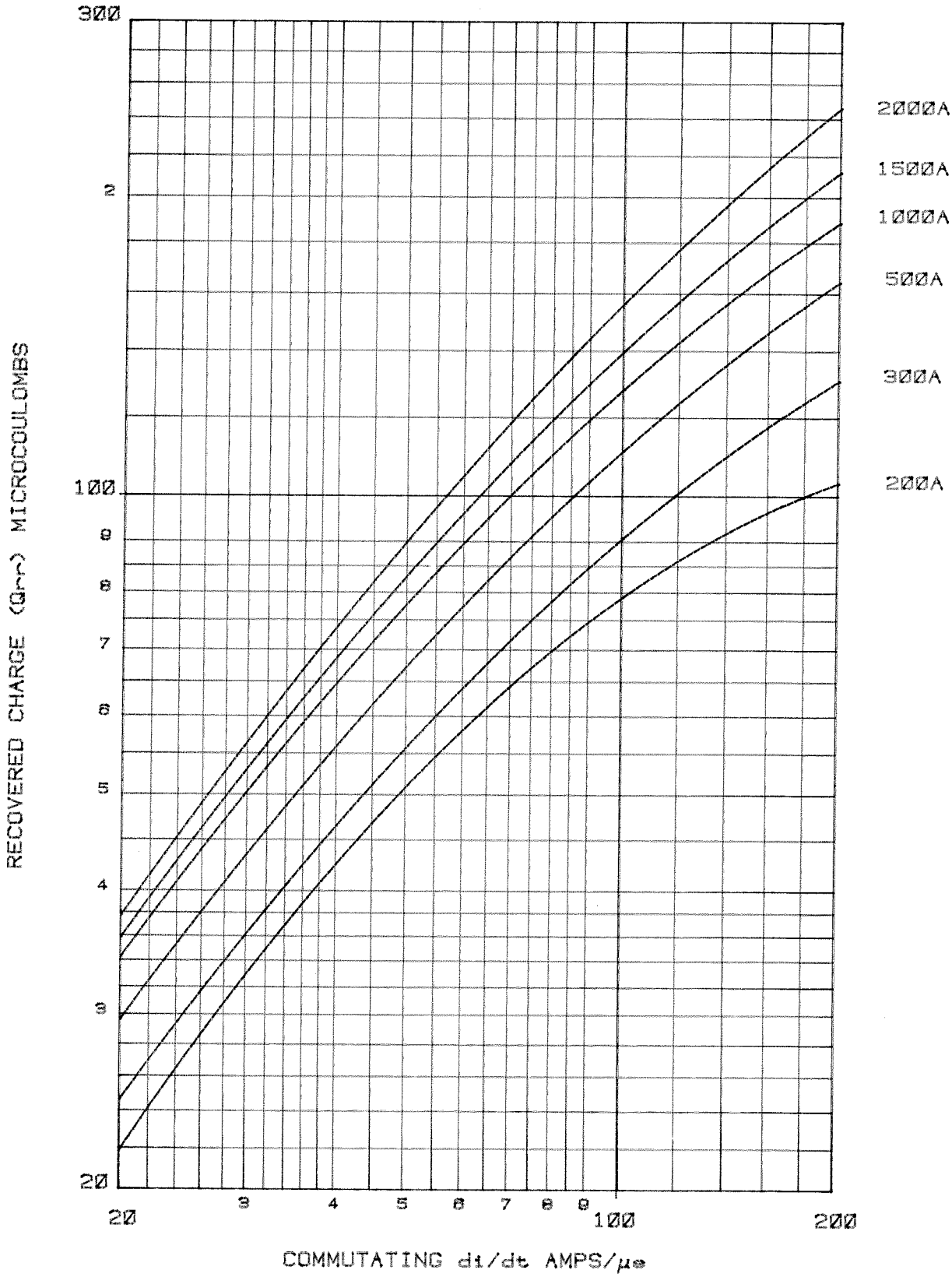

JUNCTION TO HEAT SINK TRANSIENT THERMAL IMPEDANCE
Ø.19 degC/W
Ø.095 degC/W
1.000
Ø.300
Ø.100
Ø.030
Ø.010
Ø.003
Ø.001
Ø.001
Ø.003
Ø.010
Ø.030
Ø.100
Ø.300
1.000
3.000
10.000
TRANSIENT THERMAL IMPEDANCE (degC/W)
TIME (SECONDS)

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

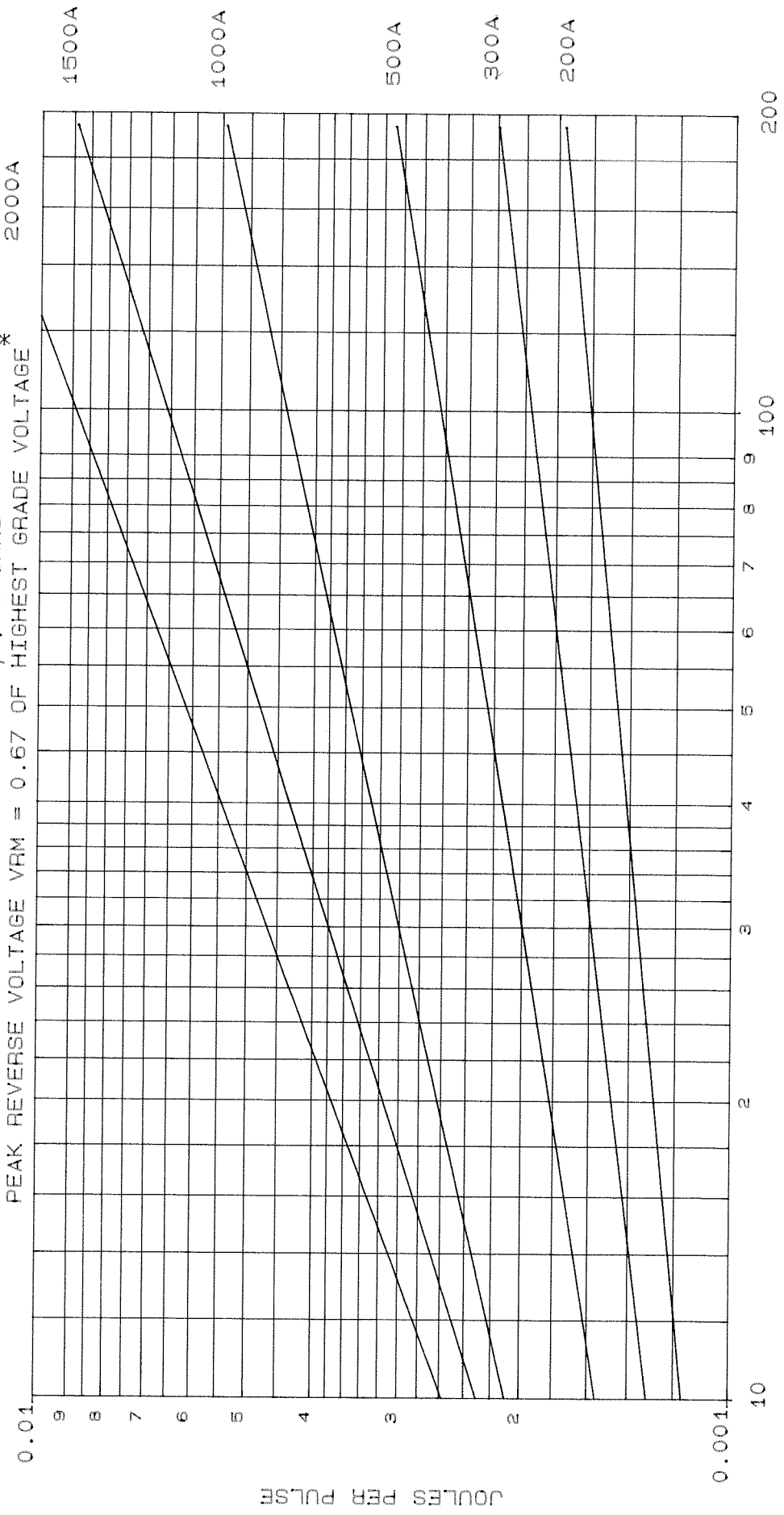
[GATE MAY TEMPORARILY LOSE CONTROL OF CONDUCTION ANGLE]



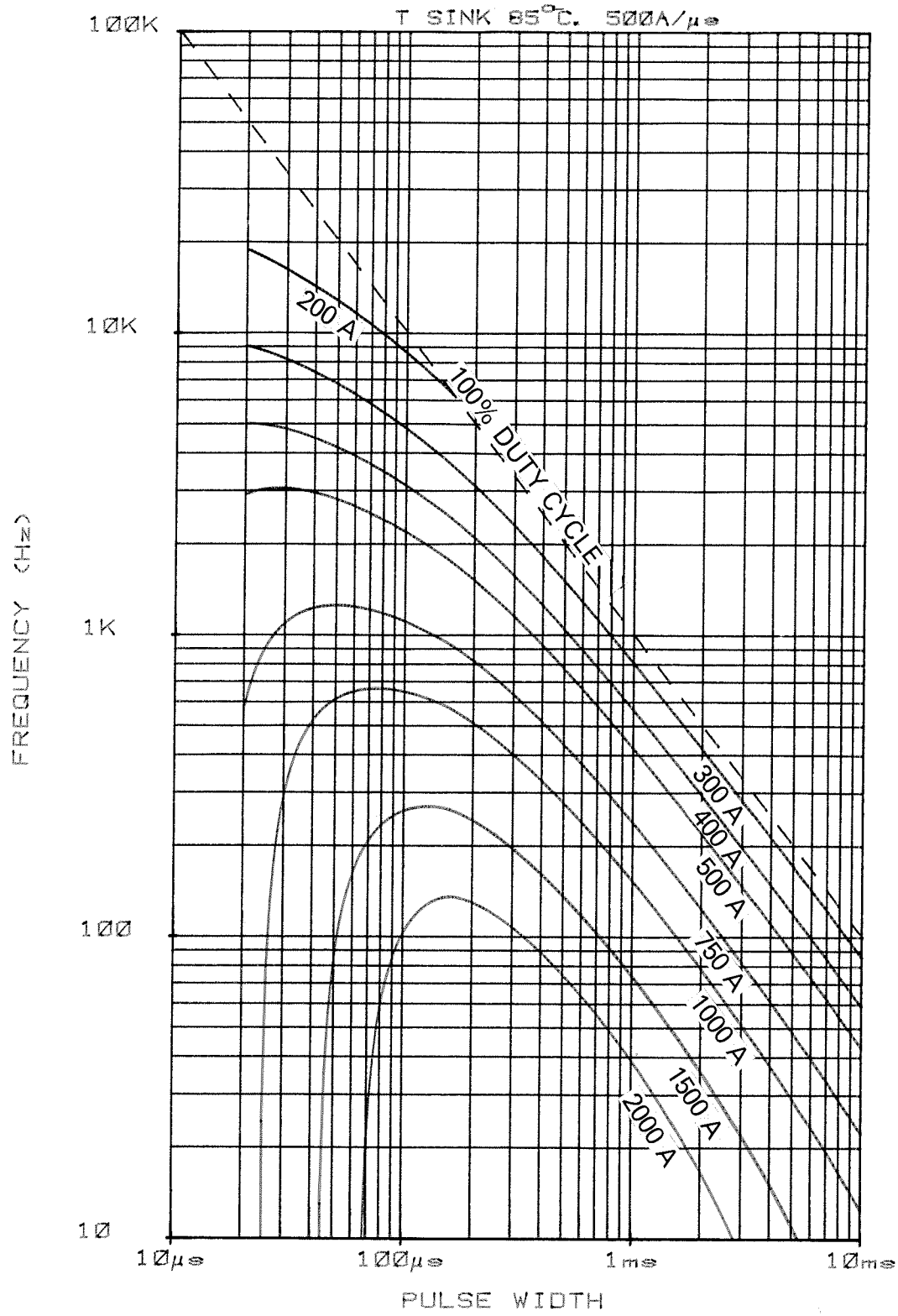
TYPICAL RECOVERED CHARGE AT 125°C JUNCTION TEMPERATURE

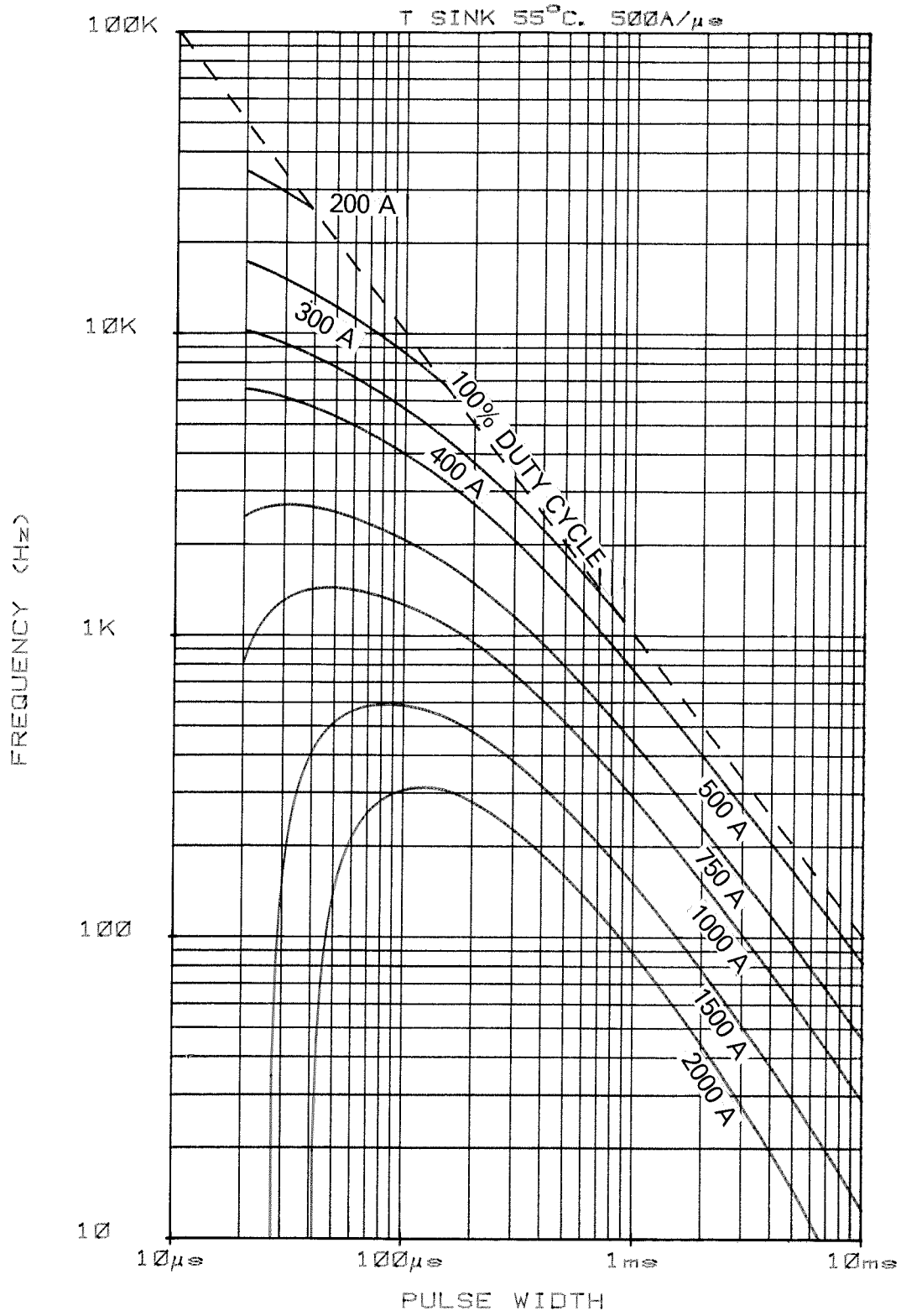


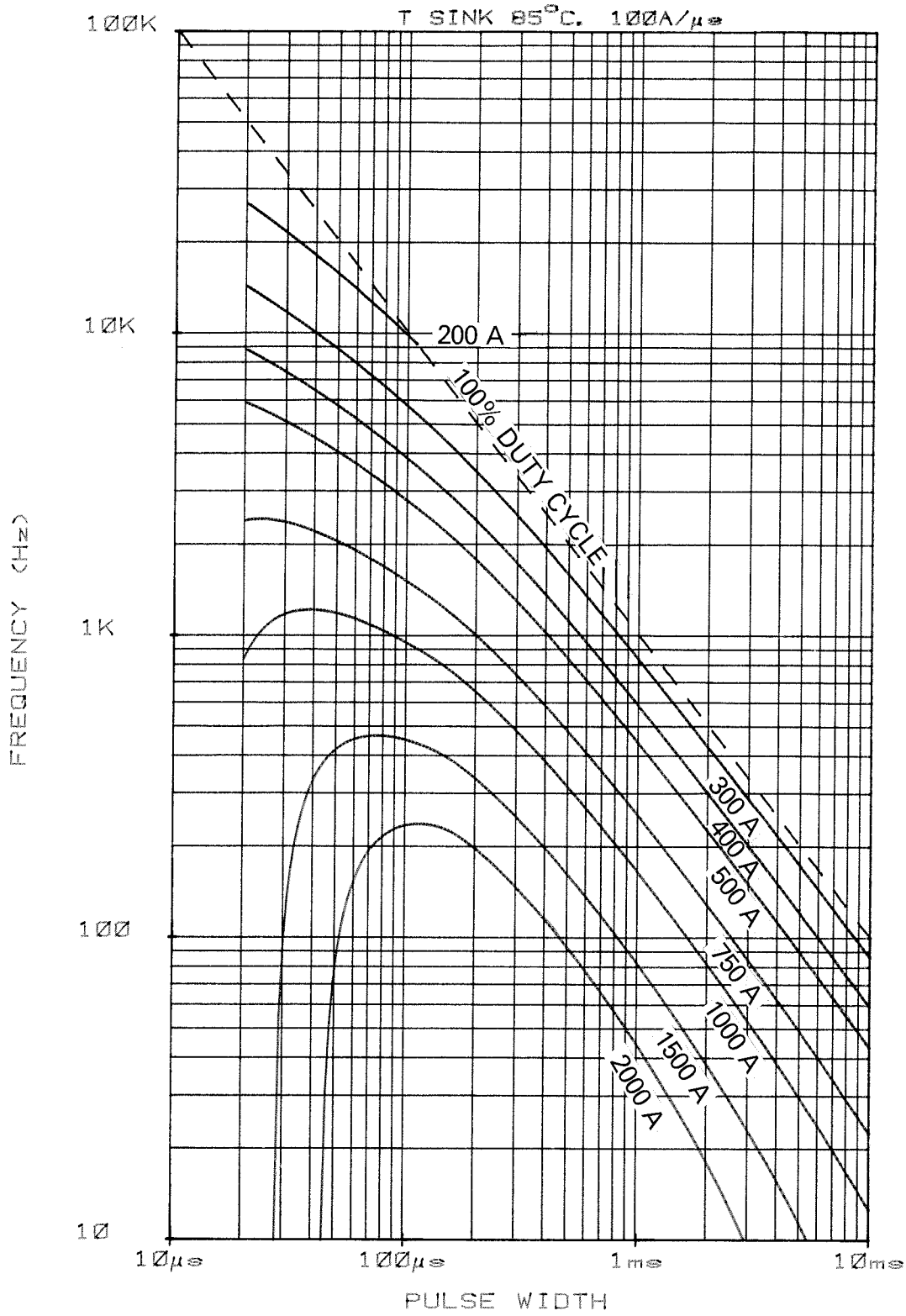
MAXIMUM REVERSE RECOVERY ENERGY LOSS PER PULSE, 125°C JUNCTION TEMPERATURE

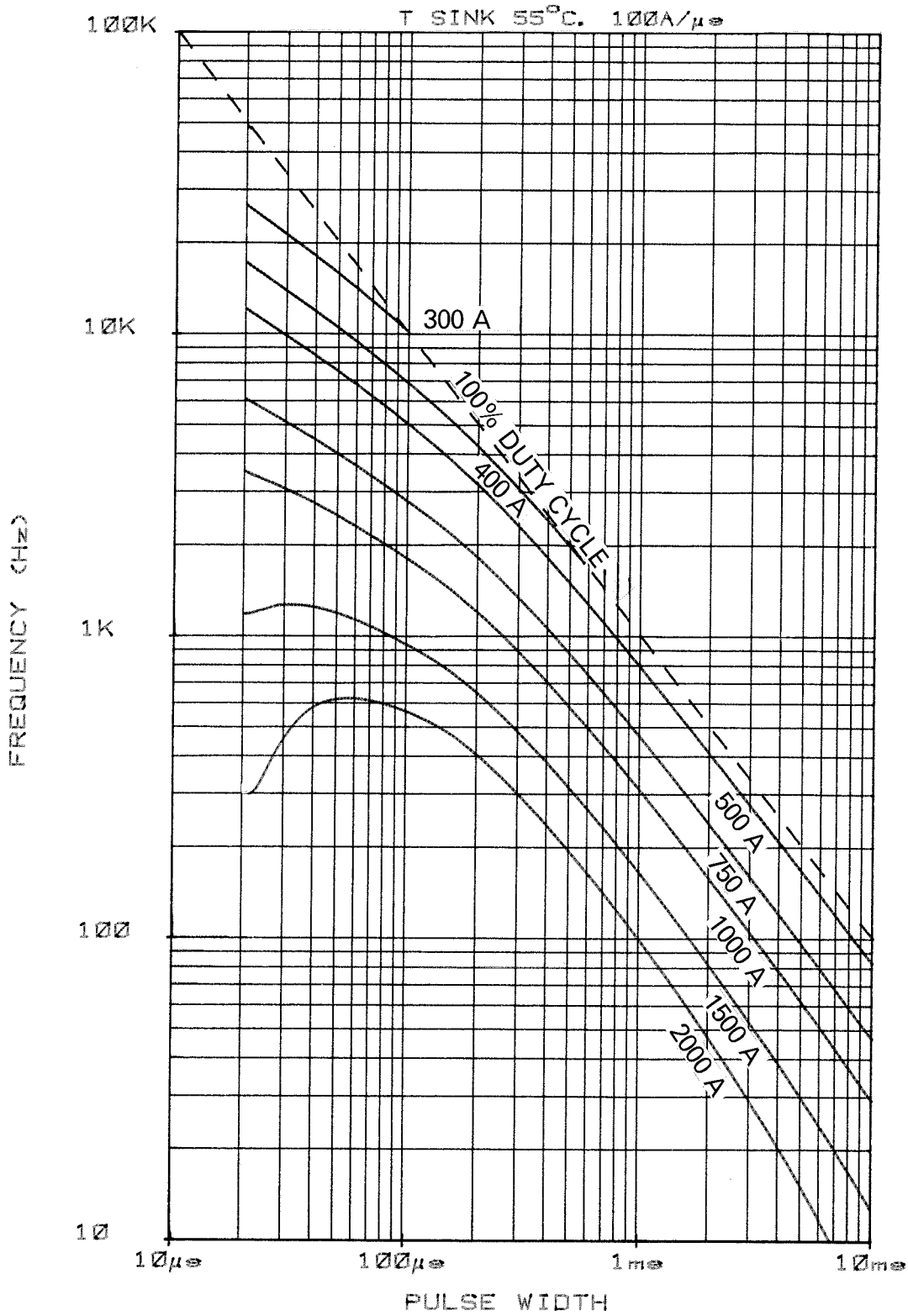


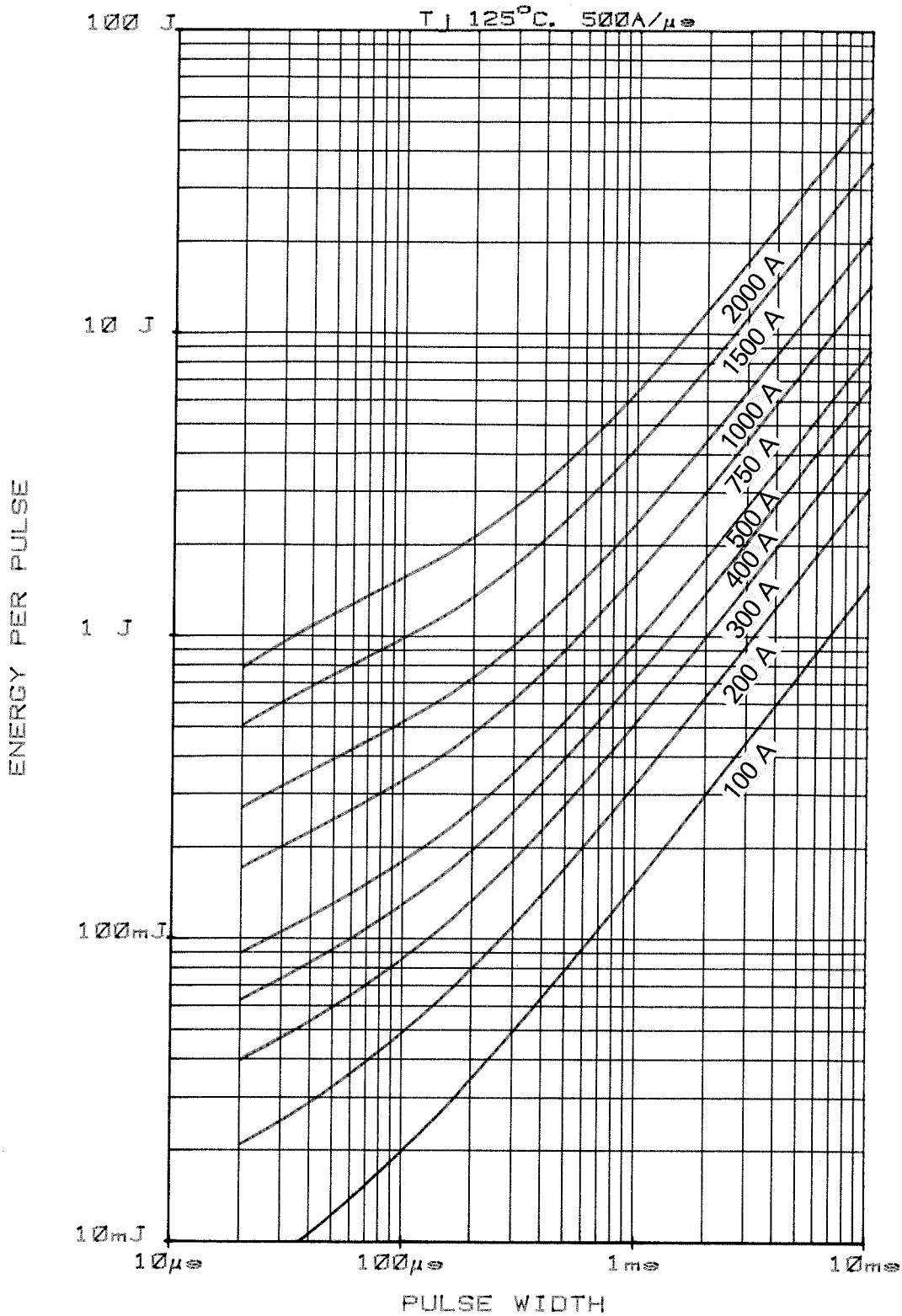
*NOTE: ENERGY PER PULSE SHOULD BE ADJUSTED PRO RATA WITH APPLIED PEAK RECOVERY VOLTAGE

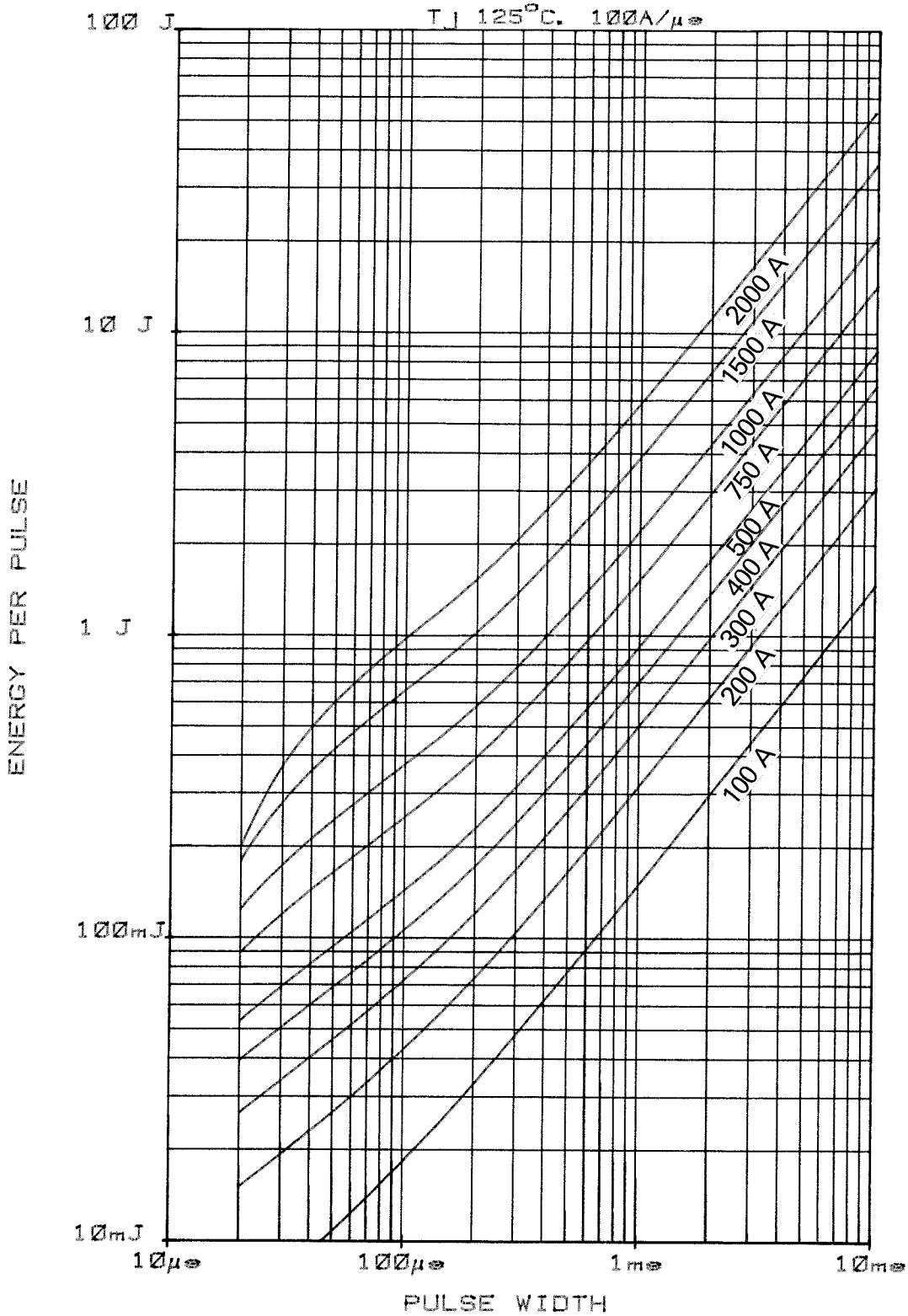

T SINK 85°C. 500A/μs
100K
10K
1K
100
10
FREQUENCY (Hz)
200 A
100% DUTY CYCLE
300 A
400 A
500 A
750 A
1000 A
1500 A
2000 A
10μs
100μs
1ms
10ms
PULSE WIDTH

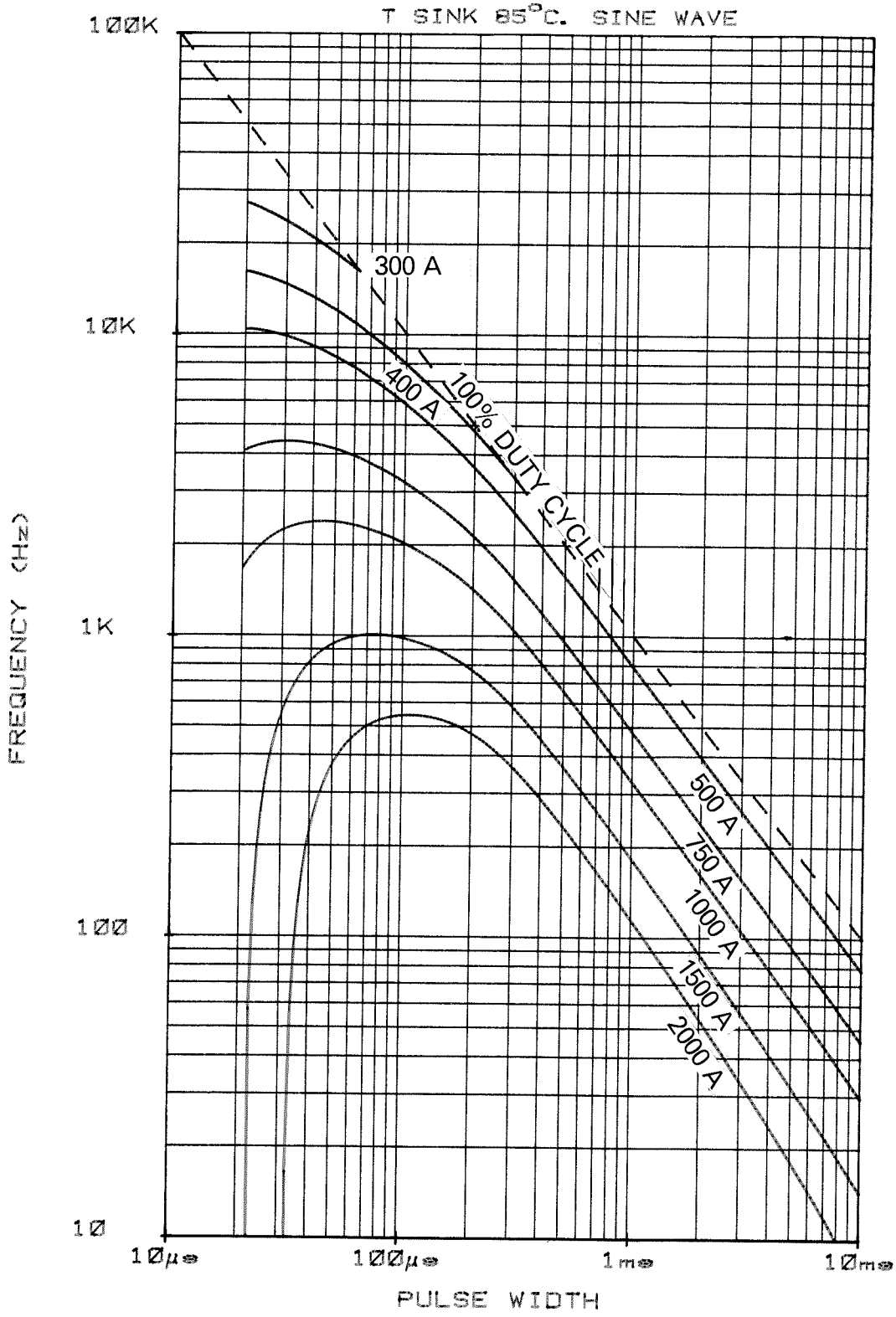

T SINK 55°C. 500A/µs
100K
10K
1K
100
10
200 A
300 A
400 A
100% DUTY CYCLE
500 A
750 A
1000 A
1500 A
2000 A
FREQUENCY (Hz)
10µs
100µs
1ms
10ms
PULSE WIDTH

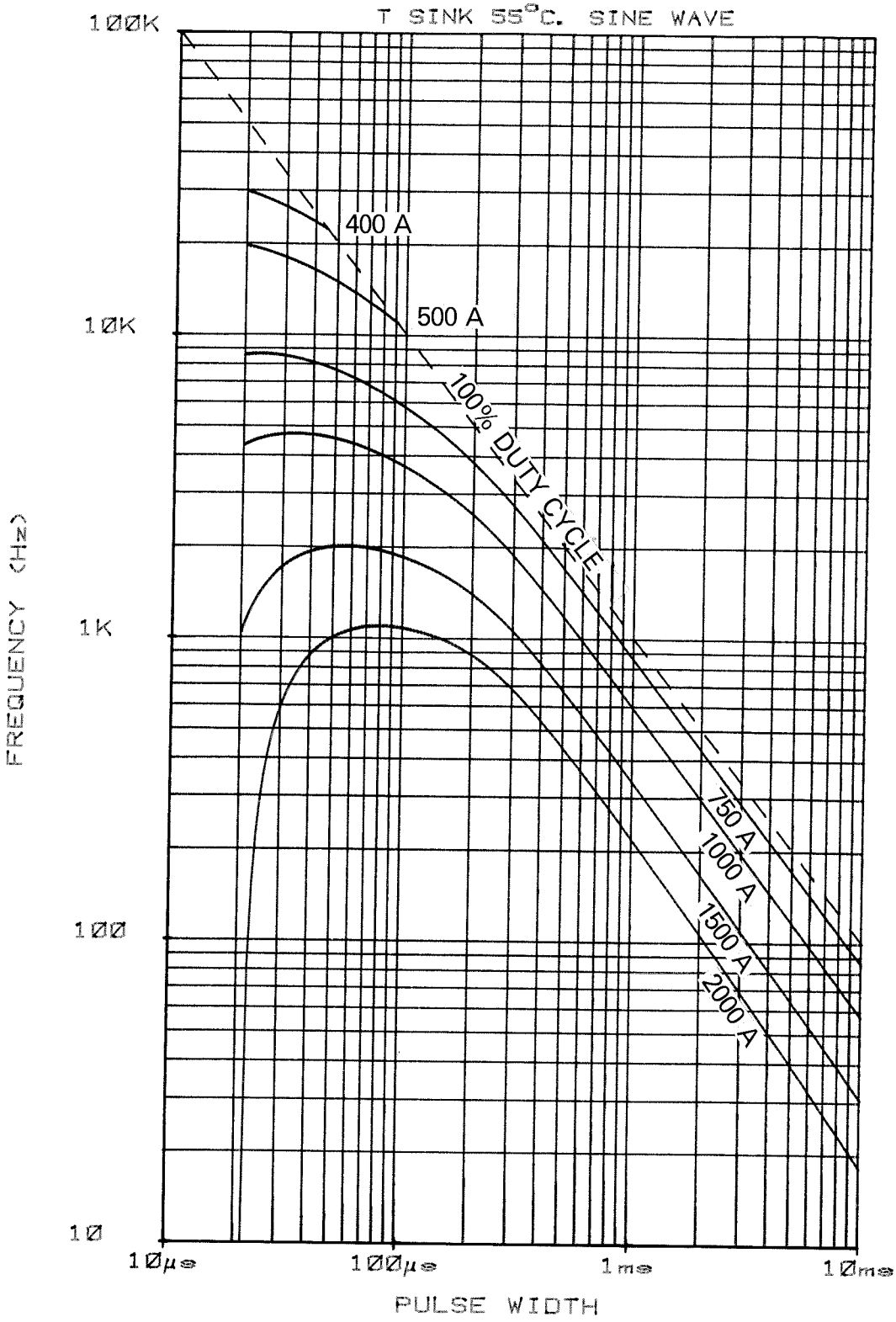

T SINK 85°C. 100A/μs
100K
10K
1K
100
10
FREQUENCY (Hz)
200 A
100% DUTY CYCLE
300 A
400 A
500 A
750 A
1000 A
1500 A
2000 A
10μs
100μs
1ms
10ms
PULSE WIDTH

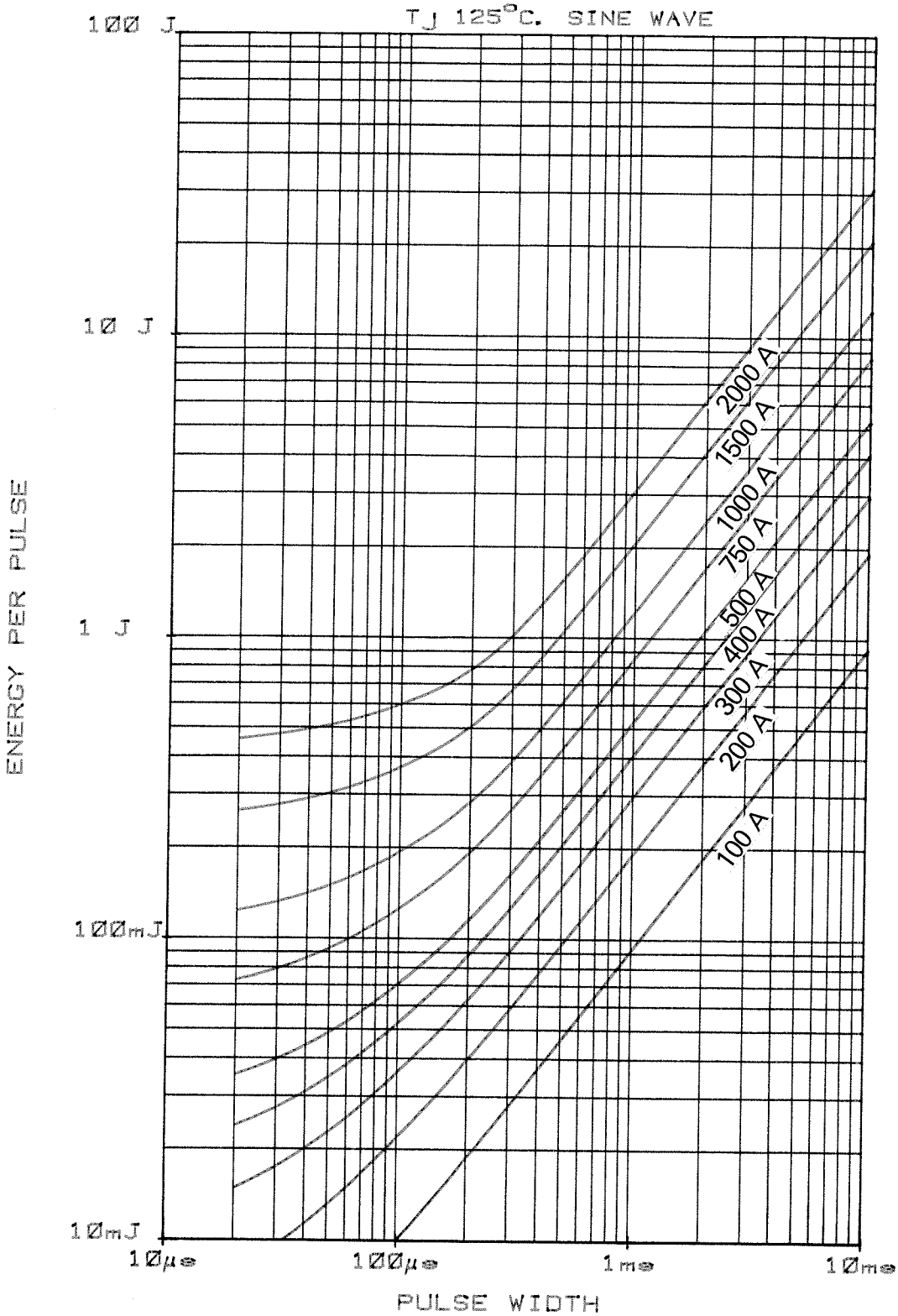

T SINK 55°C. 100A/μs
100K
10K
1K
100
10
FREQUENCY (Hz)
10μs
100μs
1ms
10ms
PULSE WIDTH
300 A
100% DUTY CYCLE
400 A
500 A
750 A
1000 A
1500 A
2000 A


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


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


T SINK 85°C. SINE WAVE
100K
10K
1K
100
10
FREQUENCY (Hz)
300 A
400 A
100% DUTY CYCLE
500 A
750 A
1000 A
1500 A
2000 A
10µs
100µs
1ms
10ms
PULSE WIDTH


T SINK 55°C. SINE WAVE
100K
10K
1K
100
10
400 A
500 A
100% DUTY CYCLE
750 A
1000 A
1500 A
2000 A
FREQUENCY (Hz)
10µs
100µs
1ms
10ms
PULSE WIDTH


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

SCALE	1/1
DRN	
CHKD	
APPD	
	~~GEC 1~~
	CS 1
	QA 1
	LP 2
	HP 2
S	6
S	NI

INTERNATIONAL OUTLINE No. TO-200AB

WEIGHT. 70 GRAMS.

FINISH. NICKEL-PLATE. - 20 -

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

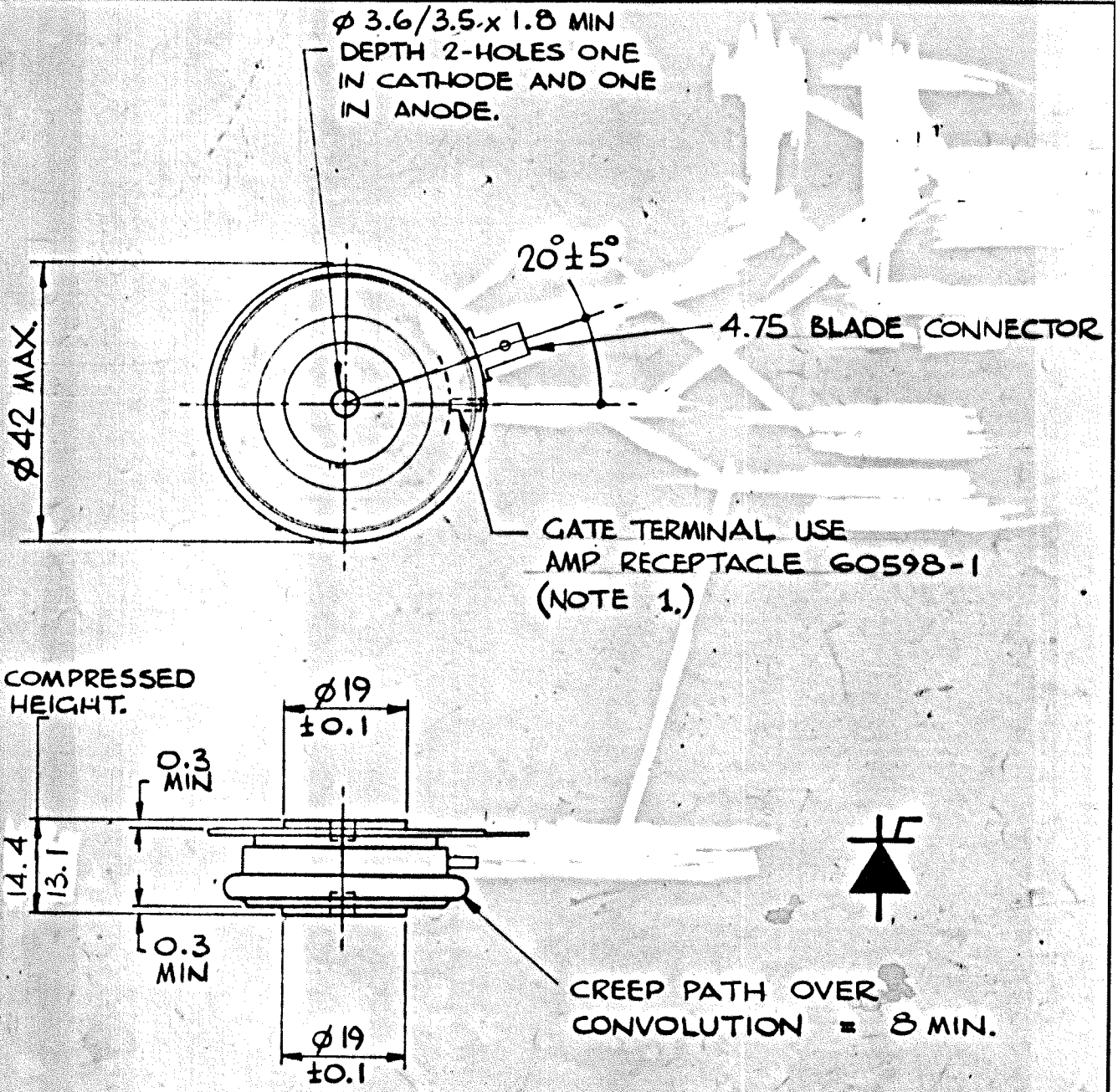
DEVICE MOUNTING: CLAMPING FORCE TO BE APPLIED ON ℄ OF LOCATION HOLES AND BE EVENLY DISTRIBUTED OVER AREA OF CONTACT. FLAT TOL ON SURFACES TO WHICH DEVICE IS CLAMPED TO BE 0.04 WIDE.

CLAMPING FORCE = 330 - 550 kgf.

NOTE 1. 300mm LONG GATE LEADS ARE AVAILABLE IF REQD.

G.A. DRG. No. 159B100H100-H110. 103B211. 103B212.

TYPE NUMBER		
N086C	P070C	P205C
N105C	P086C	P214C
N140C	P095C	P215C
N170C	P105C	P270C
N195C	P200C	
N275C	P202C	
	P204C	
	P100C	



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

WESTCODE ® SEMICONDUCTORS

THIRD ANGLE PROJECTION

DIMNS. IN MILLIMETRES

DRG. No. 101A212

ISS	REVISIONS
1	9.9.76 P118
2	P304 17.5.78 REDRAWN. ϕ19 WAS ϕ29. 0.3 ADDED. 15.2/14 WAS 15.2/12.5. LEADS ADDED. AJ
3	M613 14.6.78 LEAD COLOURS CHANGED. LL
4	M636 7.8.78 LEADS DELETED LL
5	11.9.78 CLAMP FORCE WAS 500-1200 kgf. ϕ42 WAS ϕ43. NOTE 1 ADDED. 14.35/13.08 WAS 15.2/14.1 LL
6	19.9.78 14.4/13.1 WAS 14.35/13.08 LL
7	30.10.78 M670 TYPE Nos ADDED. LL
8	17.9.79 M773 550kgf WAS 700kgf. LL