

# Fast turn-off Thyristor

## P0515WC04# to P0515WC06#

The data sheet on the subsequent pages of this document is a scanned copy of existing data for this product.

(Rating Report 85TR6 Issue 1)

This data reflects the old part number for this product which is: P270CH02-05. 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                                                                   |                    |                                        |                                                          |
|----------------------------------------------------------------------------------------|--------------------|----------------------------------------|----------------------------------------------------------|
| P0515                                                                                  | WC                 | ◆◆                                     | #                                                        |
| Fixed Type Code                                                                        | Fixed Outline Code | Voltage code<br>$V_{DRM}/100$<br>04-06 | Fixed Turn-off Time Code<br>B = 12μs, C = 15μs, D = 20μs |
| Typical Order Code: P0515WC06C, 14mm clamp height, 600V $V_{RRM}/V_{DRM}$ , 15μs $t_q$ |                    |                                        |                                                          |

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In the interest of product improvement, Westcode reserves the right to change specifications at any time without prior notice.

Devices with a suffix code (2-letter, 3-letter or letter/digit/letter combination) added to their generic code are not necessarily subject to the conditions and limits contained in this report.

QUALITY EVALUATION LABORATORY

Rating Report: 85TR6

Date: 11th July, 1985

Origin;

Pages: 24

Thyristor Type P270CH02-H05

Written by: M.F.W. Dunlop Checked: mfwd

Approved: BLWA

The P270C thyristor series are diffused regenerative gate devices employing a 24 mm slice in a cold weld housing.

RATINGS

Ratings and Characteristics

|                                                                                                                                                             |   |                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----------------------------------------|
| Voltage Grades                                                                                                                                              | : | H02-H05                                |
| V <sub>DSM</sub>                                                                                                                                            | : | 200-500V                               |
| V <sub>RSM</sub>                                                                                                                                            | : | 300-600V                               |
| V <sub>DRM</sub> , V <sub>RRM</sub>                                                                                                                         | : | 200-500V                               |
| I <sub>T(AV)</sub> : Single phase; 50 Hz, 180° sinewave                                                                                                     | : |                                        |
| Double side cooled, T <sub>HS</sub> = 55°C; 85°C                                                                                                            | : | 516A; 334A                             |
| Single side cooled, T <sub>HS</sub> = 85°C                                                                                                                  | : | 187A                                   |
| I <sub>T(rms)</sub> Double side cooled, T <sub>HS</sub> = 25°C                                                                                              | : | 1053A                                  |
| I <sub>T d.c.</sub> Double side cooled, T <sub>HS</sub> = 25°C                                                                                              | : | 833A                                   |
| I <sub>TSM</sub> : t = 10 ms half sinewave; T <sub>J(initial)</sub> = 125°C; V <sub>RM</sub> = 0.6V <sub>RRM</sub> (MAX)                                    | : | 6500A                                  |
| I <sub>TSM</sub> : t = 10 ms half sinewave; T <sub>J(initial)</sub> = 125°C; V <sub>RM</sub> ≤ 10V                                                          | : | 7150A                                  |
| I <sup>2</sup> <sub>t</sub> : t = 10 ms; T <sub>J(initial)</sub> = 125°C; V <sub>RM</sub> = 0.6V <sub>RRM</sub> (MAX)                                       | : | 211 × 10 <sup>3</sup> A <sup>2</sup> S |
| I <sup>2</sup> <sub>t</sub> : t = 10 ms; T <sub>J(initial)</sub> = 125°C; V <sub>RM</sub> ≤ 10V                                                             | : | 256 × 10 <sup>3</sup> A <sup>2</sup> S |
| I <sup>2</sup> <sub>t</sub> : t = 3 ms; T <sub>J(initial)</sub> = 125°C; V <sub>RM</sub> ≤ 10V                                                              | : | 187 × 10 <sup>3</sup> A <sup>2</sup> S |
| di/dt : (Repetitive) : T <sub>J</sub> 125°C Gate: 20V. 20  Rise time 1μS | : | 500A/μS                                |
| I <sub>FGM</sub> : Anode positive with respect to cathode                                                                                                   | : | 18A                                    |
| V <sub>FGM</sub> : Anode positive with respect to cathode                                                                                                   | : | 12V                                    |
| V <sub>RGM</sub> :                                                                                                                                          | : | 5V                                     |
| P <sub>G(AV)</sub> :                                                                                                                                        | : | 1.5W                                   |
| P <sub>GM</sub> :                                                                                                                                           | : | 60W                                    |
| V <sub>GD</sub> :                                                                                                                                           | : | 0.25V                                  |
| T <sub>HS</sub> operating range                                                                                                                             | : | -40 to 125°C                           |
| T <sub>stg</sub> Non operating                                                                                                                              | : | -40 to 150°C                           |

# Characteristics

(maximum values unless stated otherwise)

|                     |                                                                                                |                                        |                      |                     |       |
|---------------------|------------------------------------------------------------------------------------------------|----------------------------------------|----------------------|---------------------|-------|
| $I_{GT}$ :          | $T_J = 25^{\circ}C$ )                                                                          |                                        | :                    | 200mA               |       |
| $I_H$ :             | $T_J = 25^{\circ}C$ )                                                                          | $V_A = 6V$ :                           | $I_A = 1A$           | :                   | 600mA |
| $V_{GT}$ :          | $T_J = 25^{\circ}C$ )                                                                          |                                        | :                    | 3V                  |       |
| $V_O$ :             | $T_J = 125^{\circ}C$                                                                           |                                        | :                    | 0.95V               |       |
| $r_T$ :             | $T_J = 125^{\circ}C$                                                                           |                                        | :                    | 0.377mohms          |       |
| $V_{TM}$ :          | $I_{TM} = 1160A$                                                                               | $T_{VJ} = 125^{\circ}C$                | :                    | 1.39V               |       |
| $R_{th}(J-HS)$      | Double side cooled                                                                             |                                        | :                    | 0.095 $^{\circ}C/W$ |       |
|                     | Single side cooled                                                                             |                                        | :                    | 0.19 $^{\circ}C/W$  |       |
| $dV/dt$ :           | Linear ramp to 0.8 $V_{DRM(max)}$ $T_J = 125^{\circ}C$ ; Gate O/C repetitive : 200V/ $\mu S$ * |                                        |                      |                     |       |
| $I_{DRM}$ :         | $T_J = 125^{\circ}C$ :                                                                         | $V_{DM} = V_{DRM(max)}$                | :                    | 30mA                |       |
| $I_{RRM}$ :         | $T_J = 125^{\circ}C$ :                                                                         | $V_{RM} = V_{RRM(max)}$                | :                    | 30mA                |       |
| $Q_{RR}$ :          | $I_{TM} = 300A$ :                                                                              | $dI/dt : 20 A/\mu S$ , 50% chord value |                      |                     |       |
|                     | $V_{RM} : 50V$                                                                                 | $T_{VJ} = 125^{\circ}C$                | :                    | 106 $\mu C$ Typ.    |       |
| $t_q$ :             | $I_{TM} = 300A$ :                                                                              | $dI/dt : 20 A/\mu S$ :                 | $T_J = 125^{\circ}C$ | $V_{RM} = 50V$      |       |
|                     |                                                                                                | $dV/dt = 200V/\mu S$ to 0.8 $V_{DRM}$  | :                    | 10-25 $\mu S$       |       |
|                     |                                                                                                | 20V/ $\mu S$ to 0.8 $V_{DRM}$ Typical  | :                    | 8-20 $\mu S$        |       |
| Mounting force:     |                                                                                                |                                        | :                    | 330-550Kg.F         |       |
| Outline Drawing:    |                                                                                                |                                        | :                    | 101A212             |       |
| Outline (JEDEC No.) |                                                                                                |                                        | :                    | TO-200AB            |       |

## Extension of Turn-off Time

This Report is applicable to other  $t_q$ /reapplied  $dv/dt$  combinations when supply has been agreed by Sales/Production.

### \*Repetitive $dv/dt$

Higher  $dv/dt$  selections are available up to 1000V/ $\mu S$  on request.

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| "   "       "       "       55°C Sink   "             | 16          |
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| "   "       "       500 A/uS                          | 20          |
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Voltage Ratings

| Voltage<br>Grade | $V_{DSM}$<br>$V_{DRM}$<br>$V_{RRM}$<br>V | $V_{RSM}$<br><br>V | $V_D$<br>$V_R$<br><br>DC |
|------------------|------------------------------------------|--------------------|--------------------------|
| H02              | 200                                      | 300                | 140                      |
| 04               | 400                                      | 500                | 280                      |
| 05               | 500                                      | 600                | 350                      |

Extension of Voltage Grades

This report is applicable to other and higher voltage grades when supply has been agreed by Sales/Production.

## 2. INTRODUCTION

The P270C thyristor series are diffused regenerative gate devices employing a 24 mm slice in a cold weld housing.

## 3. 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 1000A/uS 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 500A/uS 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/uS.

### 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 is set by the time required for the thyristor to turn off ( $t_q$ ) and for the off-state voltage to reach full value ( $t_v$ ), i.e.

$$f_{\text{max.}} = \frac{1}{t_{\text{pulse}} + t_q + t_v}$$

### 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

Let  $R_{th}$  be the steady-state thermal resistance (junction to sink)

and  $T_{SINK}$  be the heat sink temperature

Then the average dissipation will be

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

and

$$T_{SINK} = 125 - W_{AV} \cdot R_{th}$$

#### 4. 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:

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

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

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

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

##### b) Determination without Measurement

In circumstances where it is not possible to measure voltage and current conditions, or for design purposes, the additional losses may be estimated from curves on page 14. 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 (curves on p. 14)

Let f be the operating frequency in Hz

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

where  $T_{\text{SINK new}}$  is the required maximum heat sink temperature

and  $T_{\text{SINK original}}$  is the heat sink temperature given with the frequency ratings.

5. GATE DRIVE

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

6. THE DV/DT SUPPRESSION NETWORK

The effect of a conventional resistor-capacitor snubber of 0.22 uf 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.

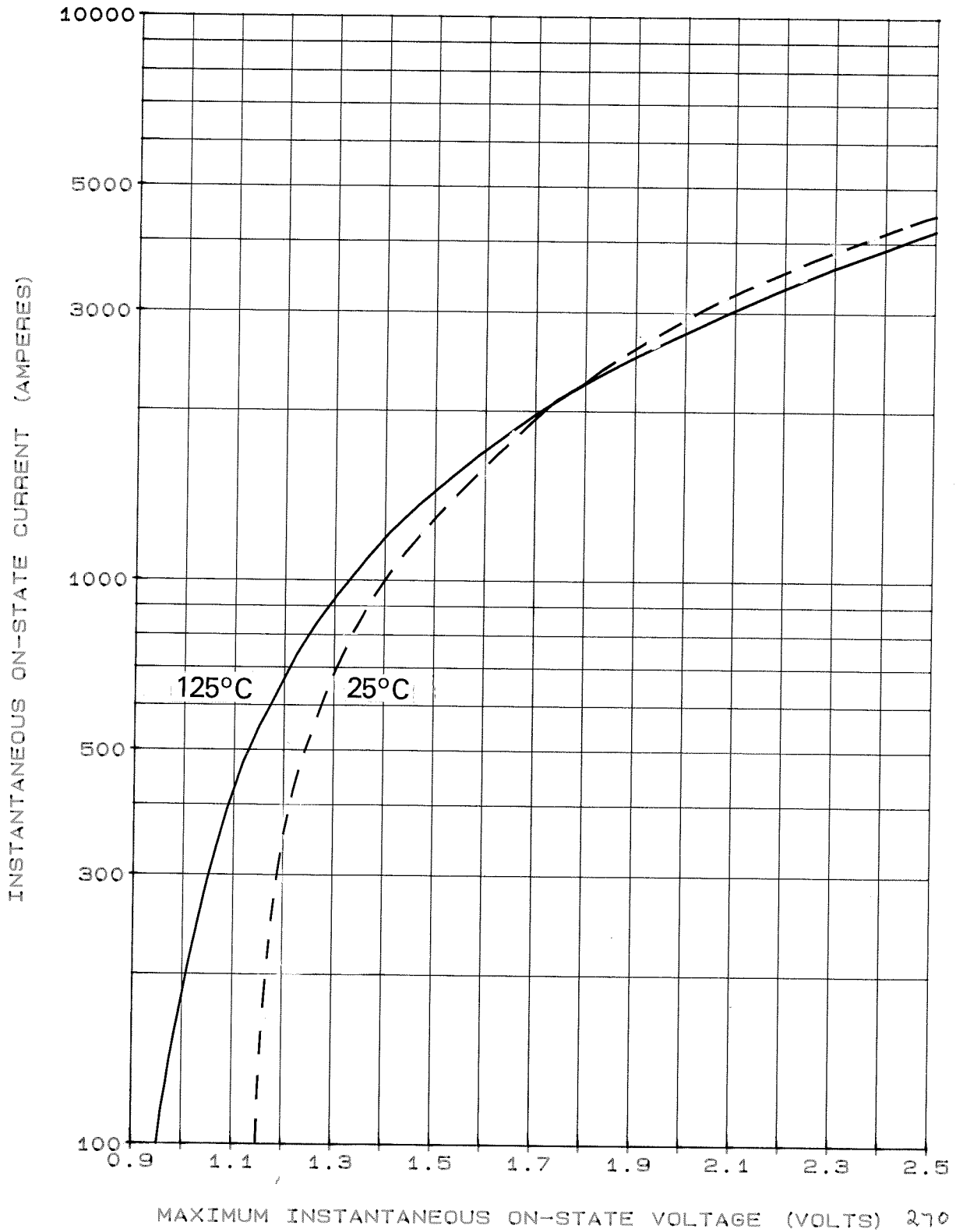
7. NOTE 1

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.

ON-STATE CHARACTERISTIC OF LIMIT DEVICE

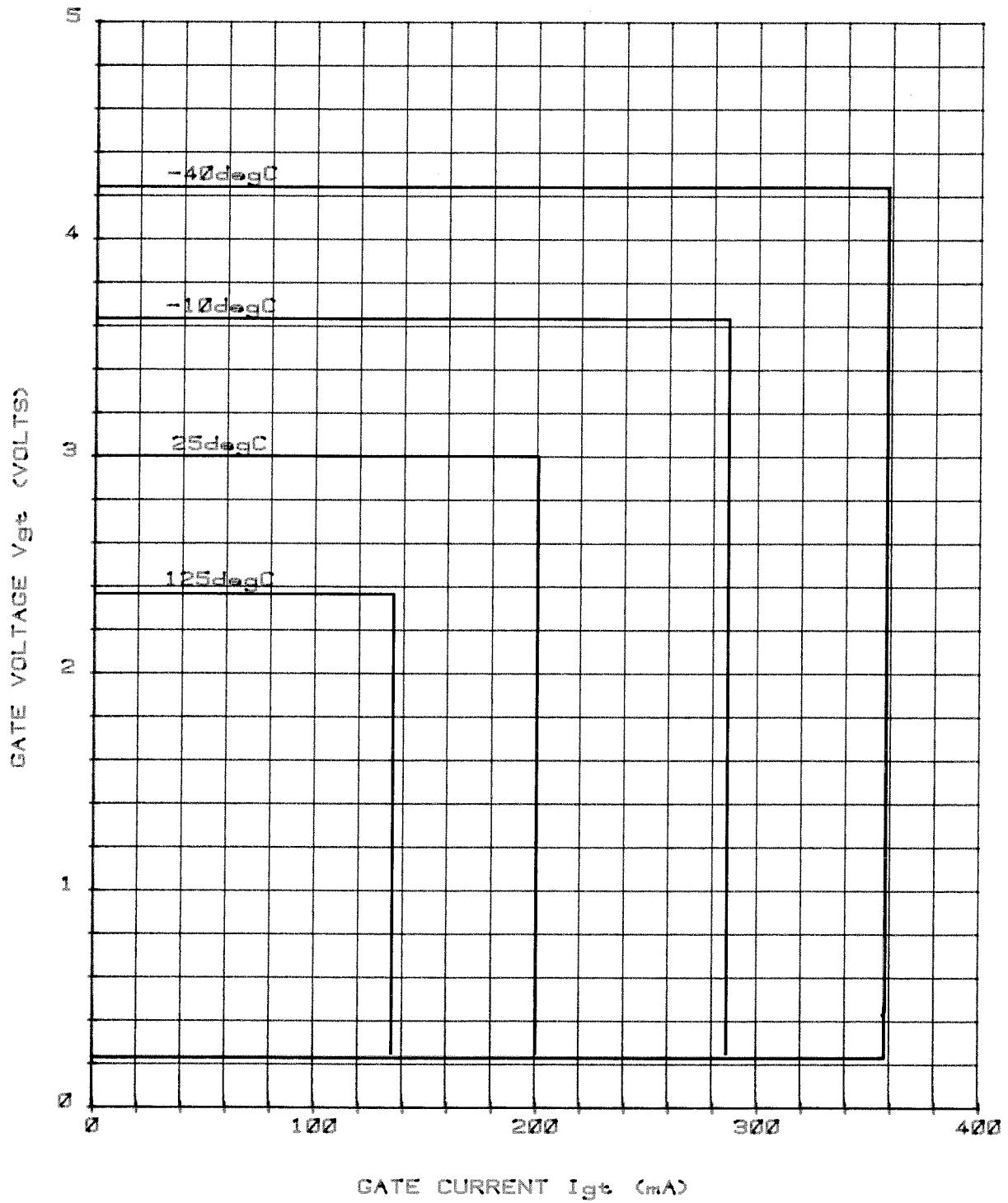


072

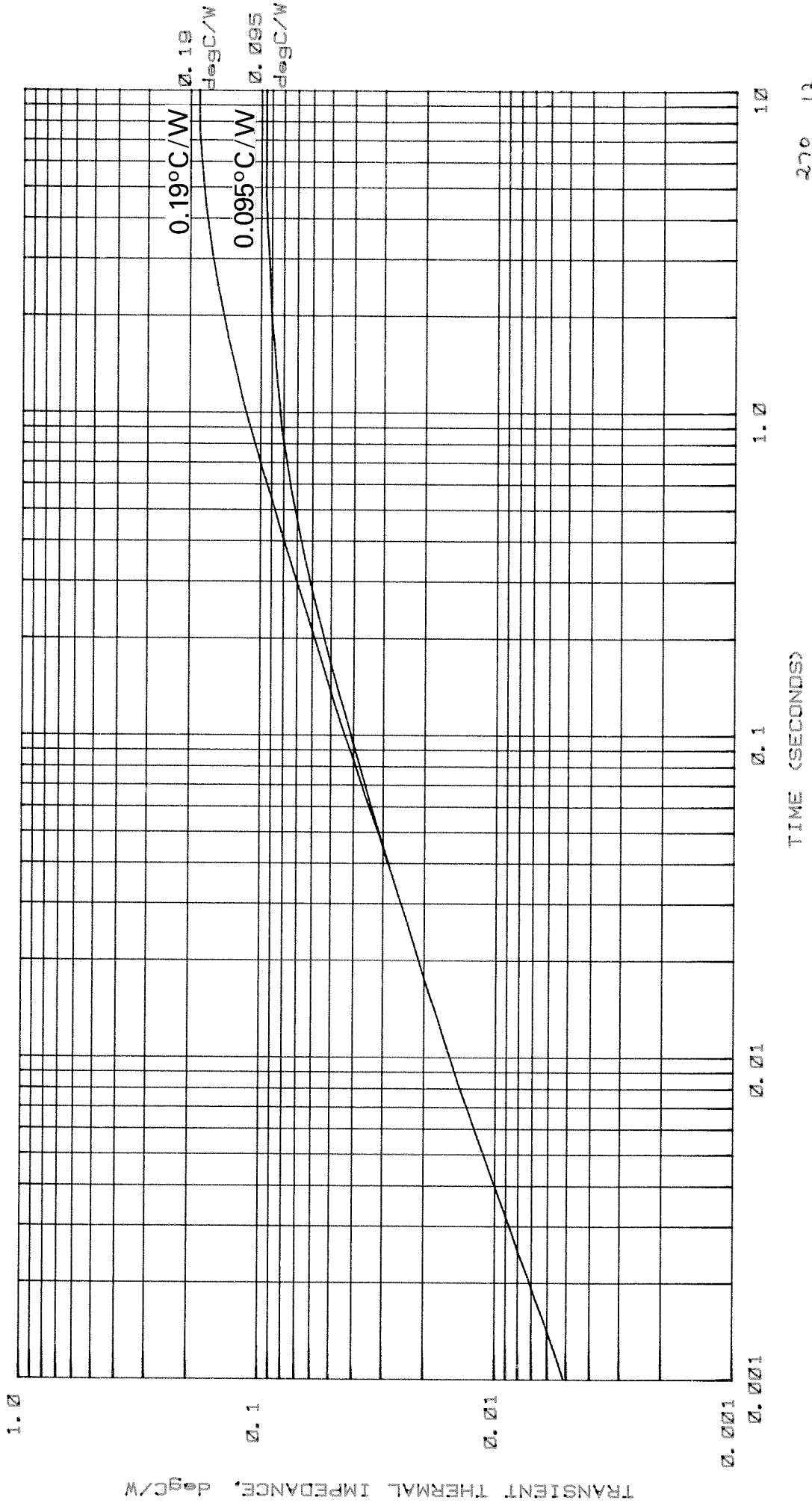


# GATE TRIGGERING CHARACTERISTICS

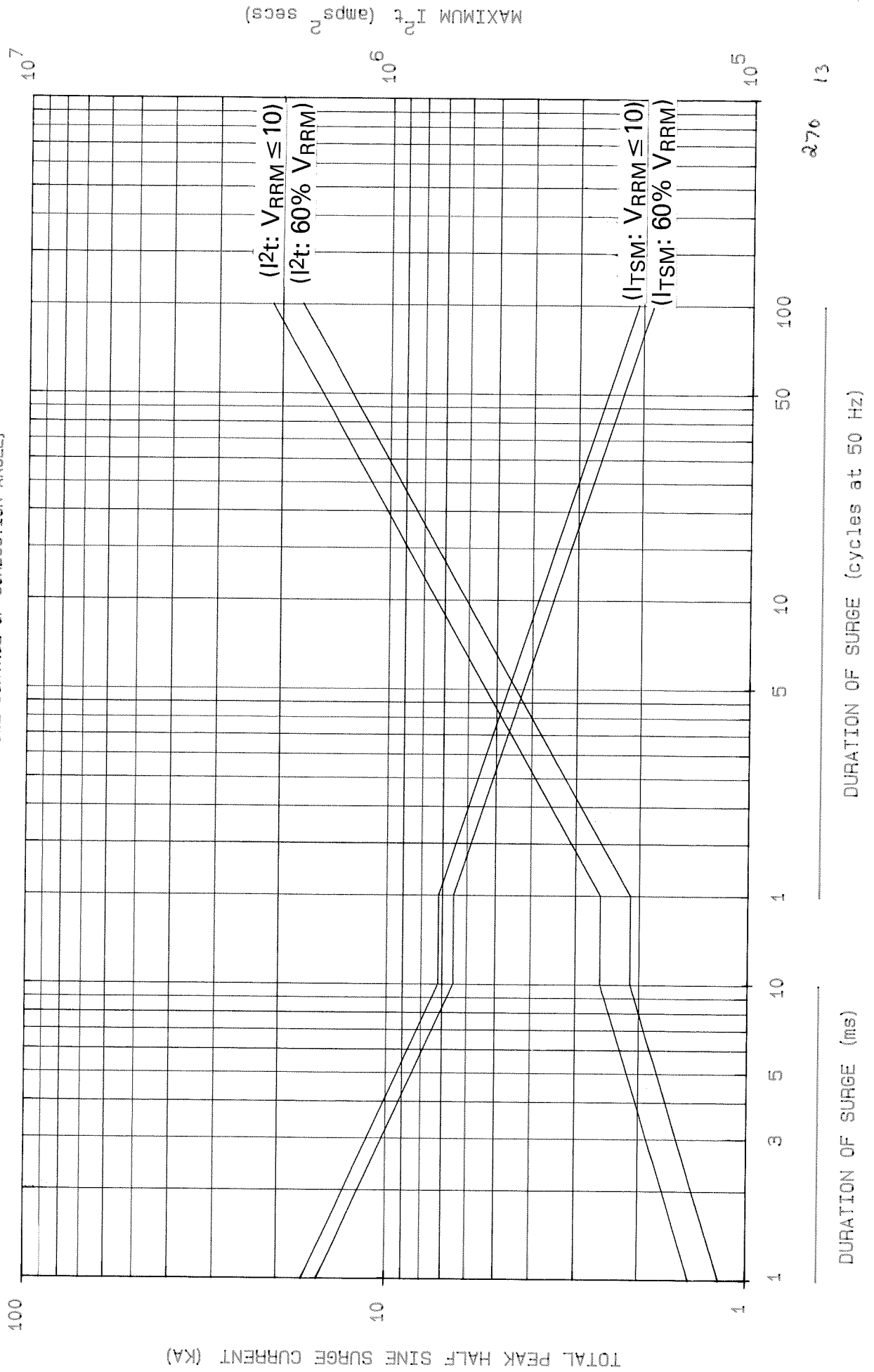
(TRIGGER POINTS OF ALL THYRISTORS LIE IN THE AREAS SHOWN)



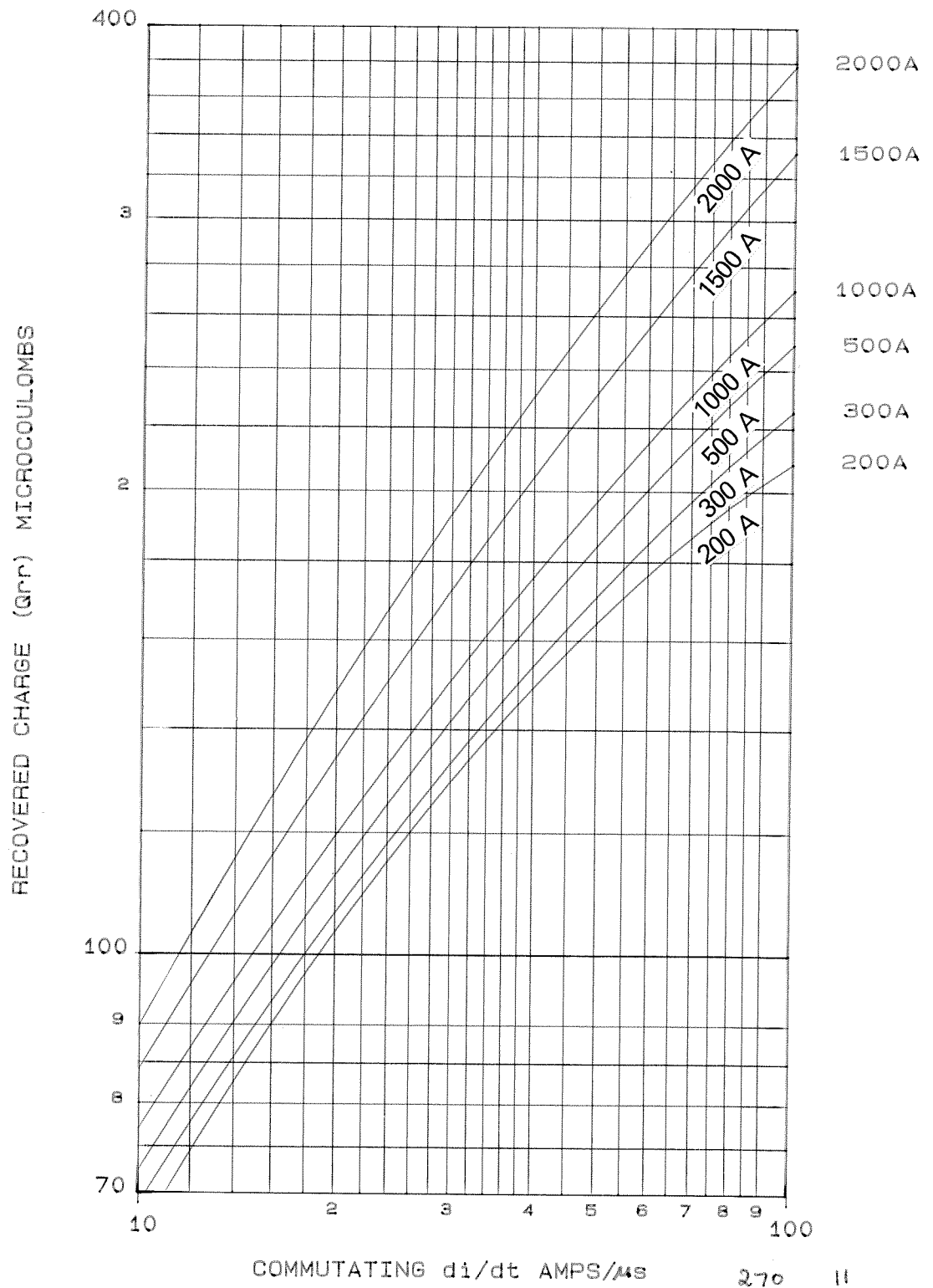
JUNCTION TO HEAT SINK TRANSIENT THERMAL IMPEDANCE



MAXIMUM NON REPETITIVE SURGE CURRENT AT INITIAL JUNCTION TEMPERATURE 125°C  
[GATE MAY TEMPORARILY LOSE CONTROL OF CONDUCTION ANGLE]

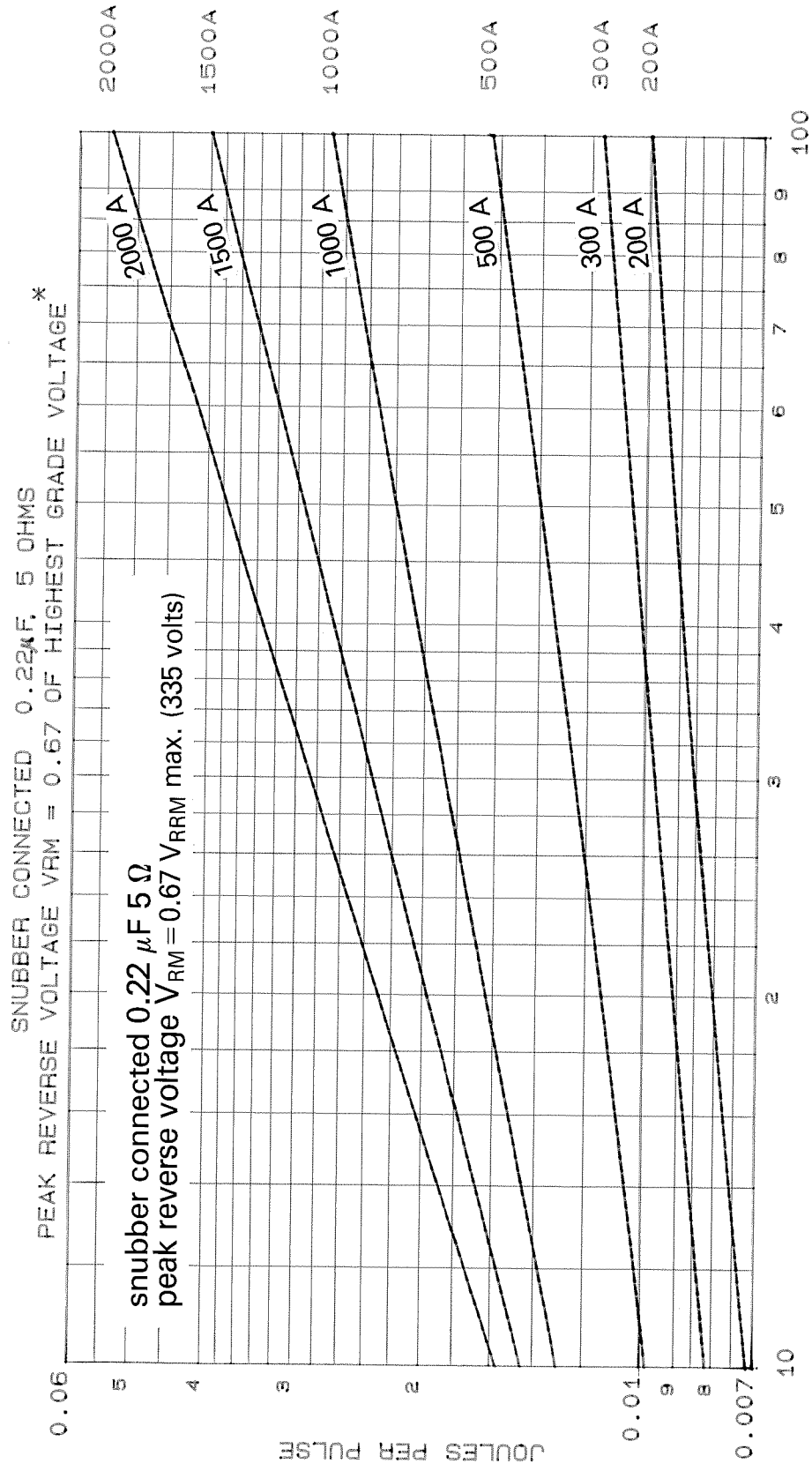


# TYPICAL RECOVERED CHARGE AT 125°C JUNCTION TEMPERATURE

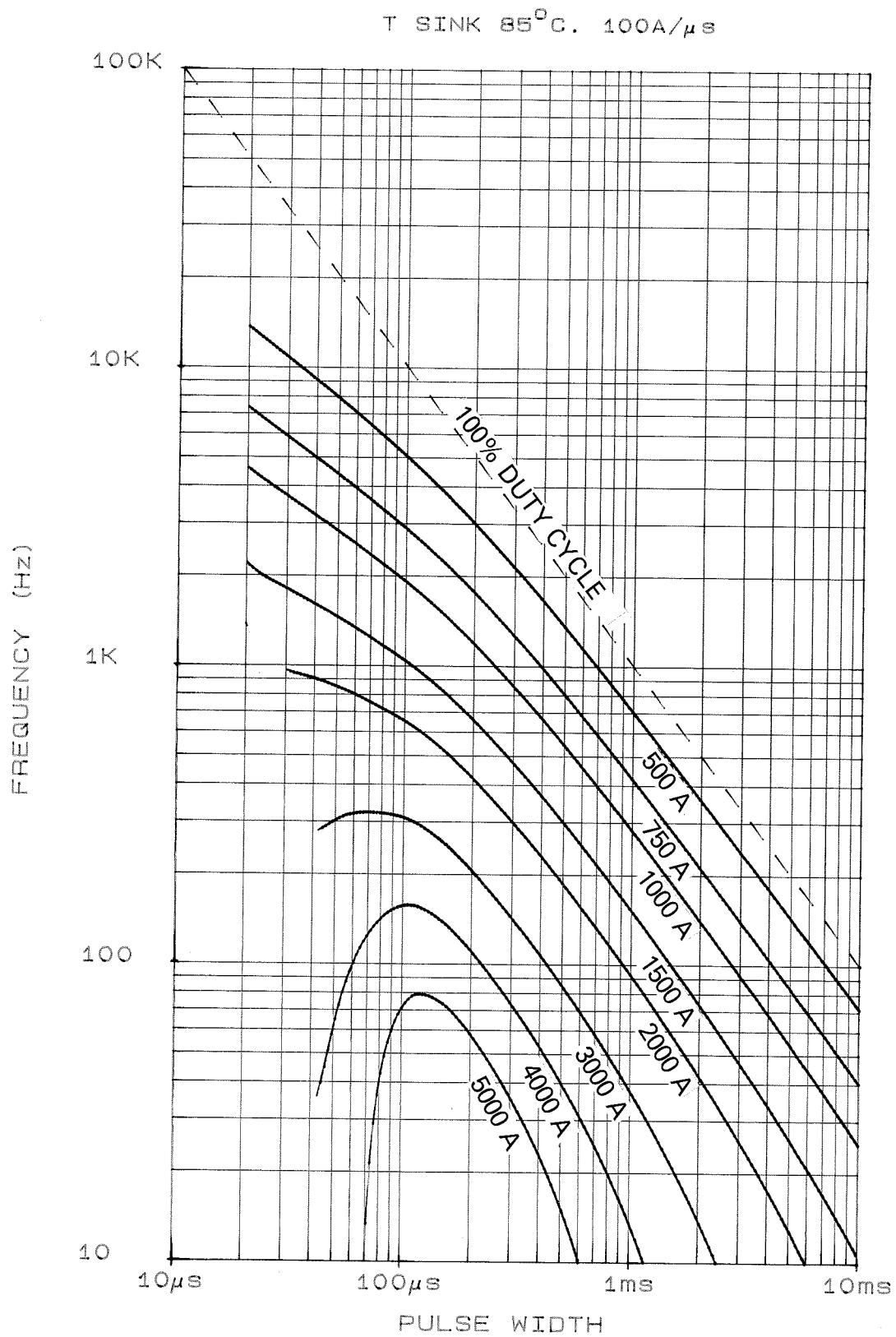


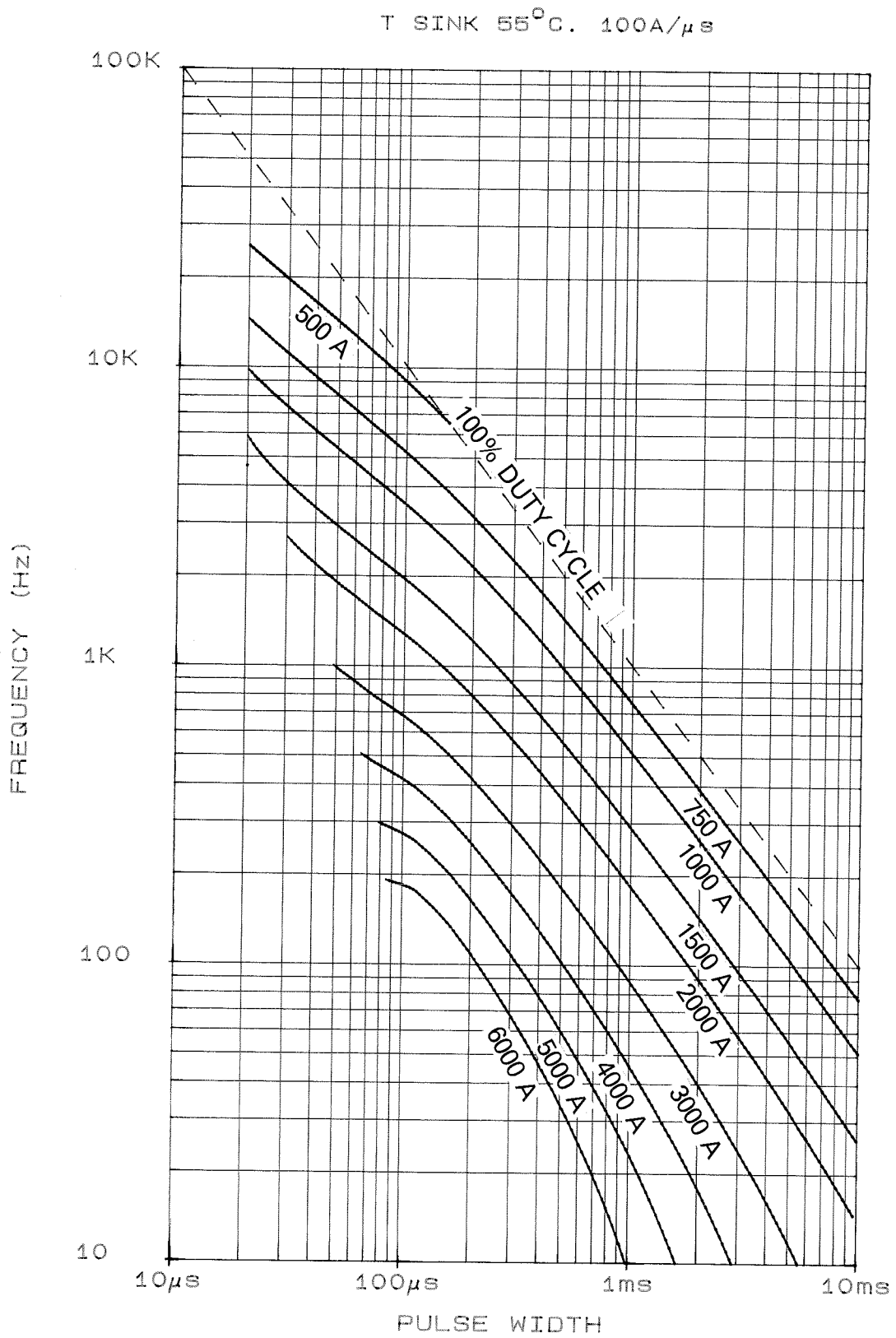
P270C F.87

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



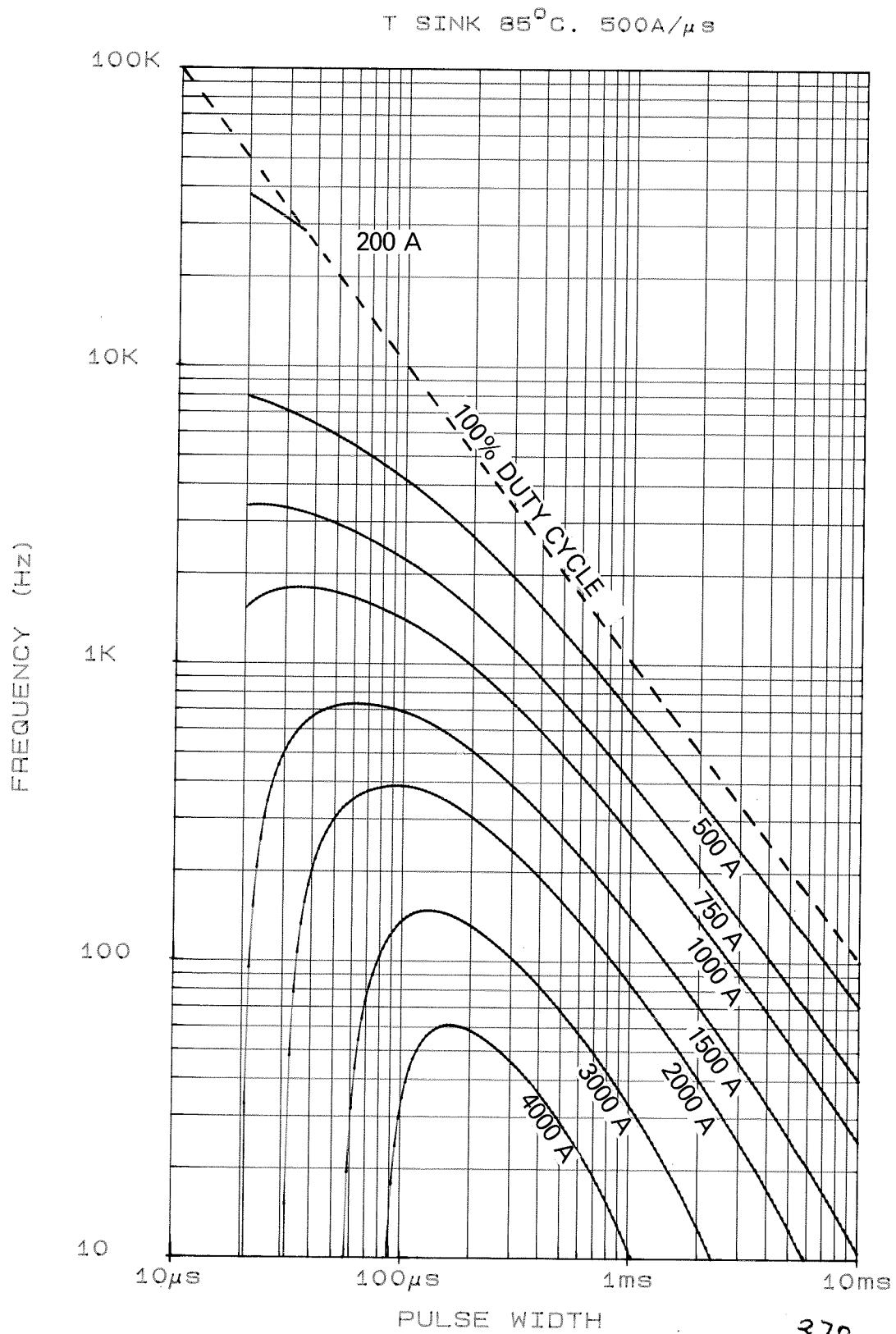
\* NOTE: ENERGY PER PULSE SHOULD BE ADJUSTED PRO RATA WITH APPLIED PEAK RECOVERY VOLTAGE



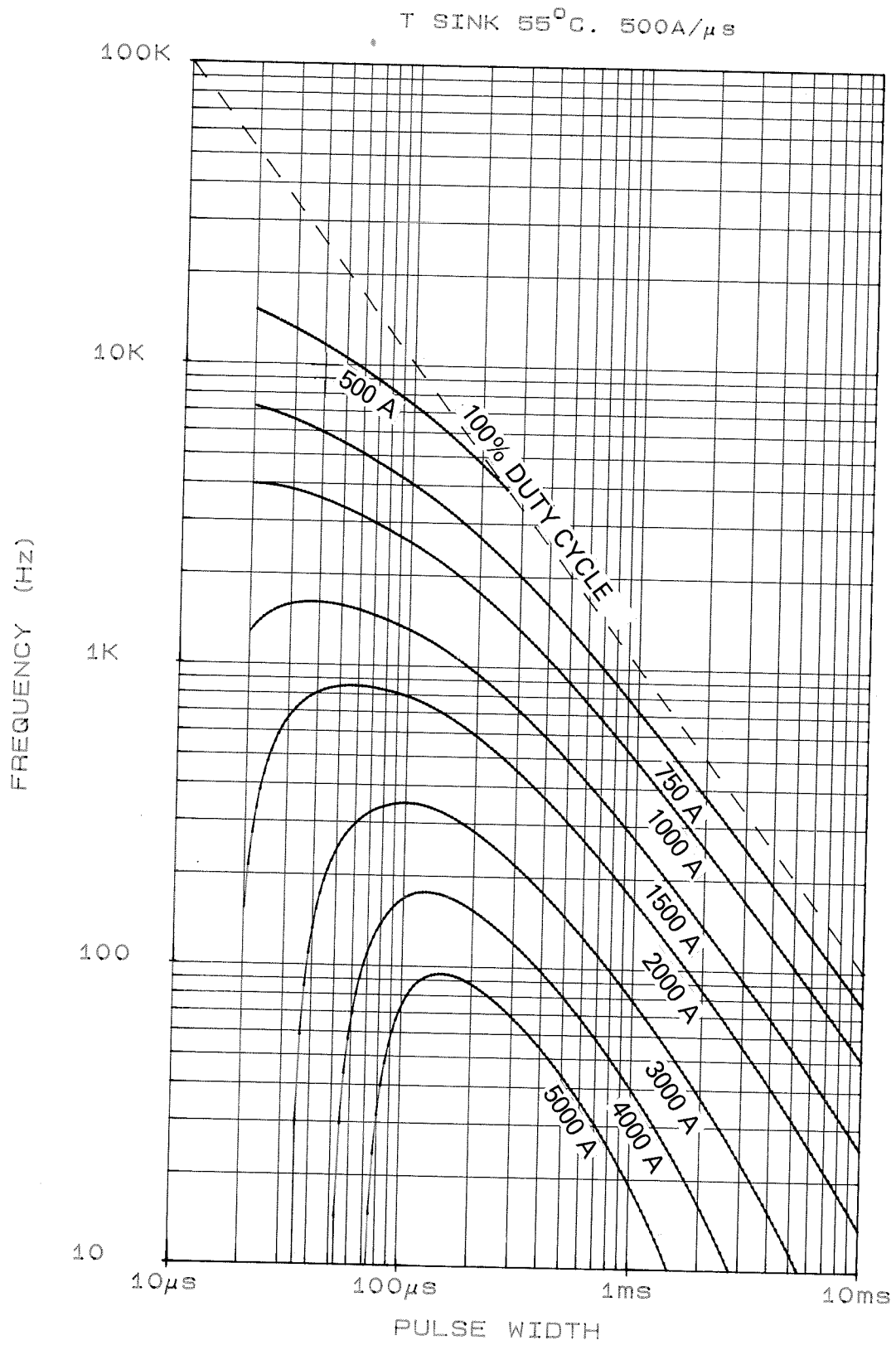


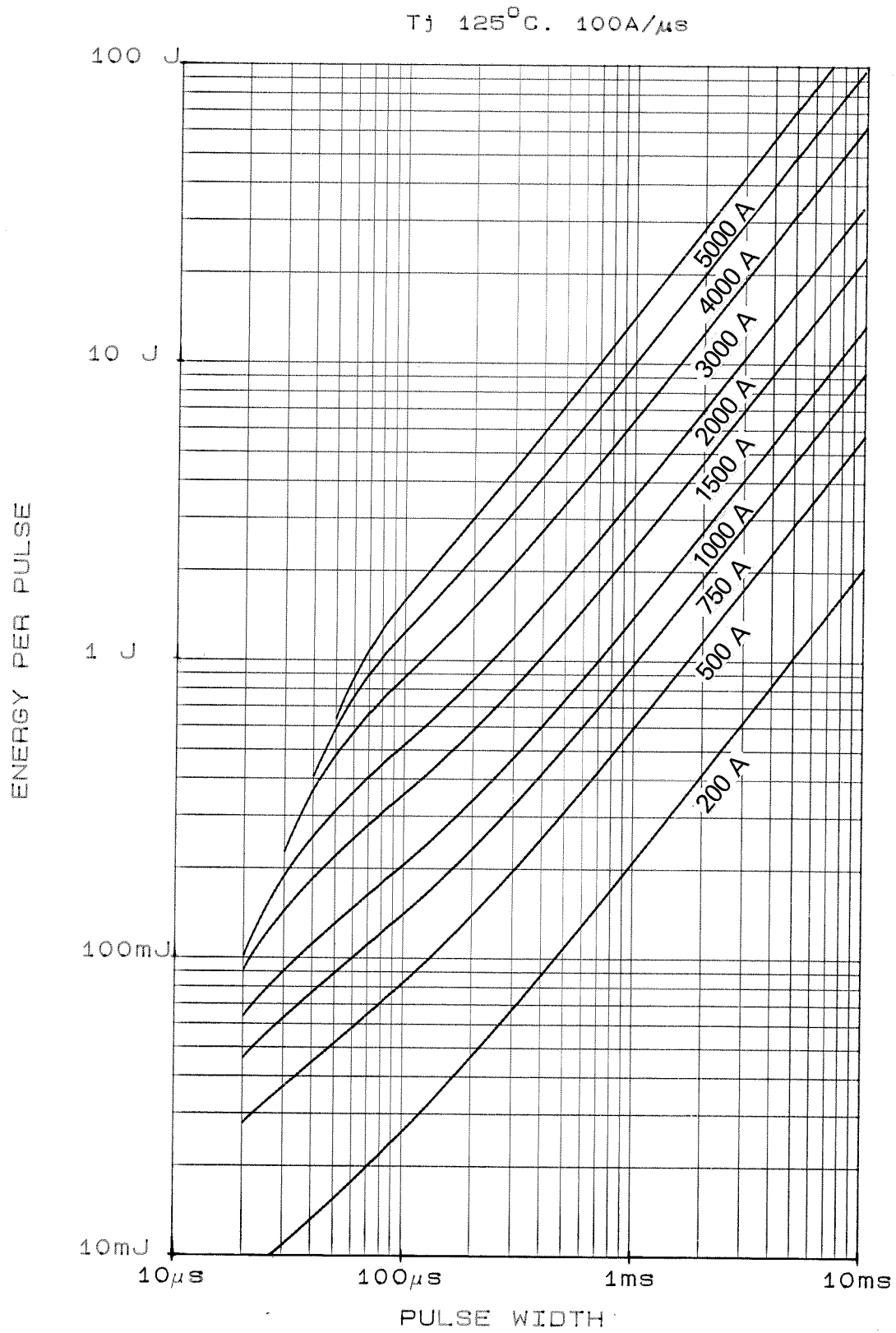
270 4

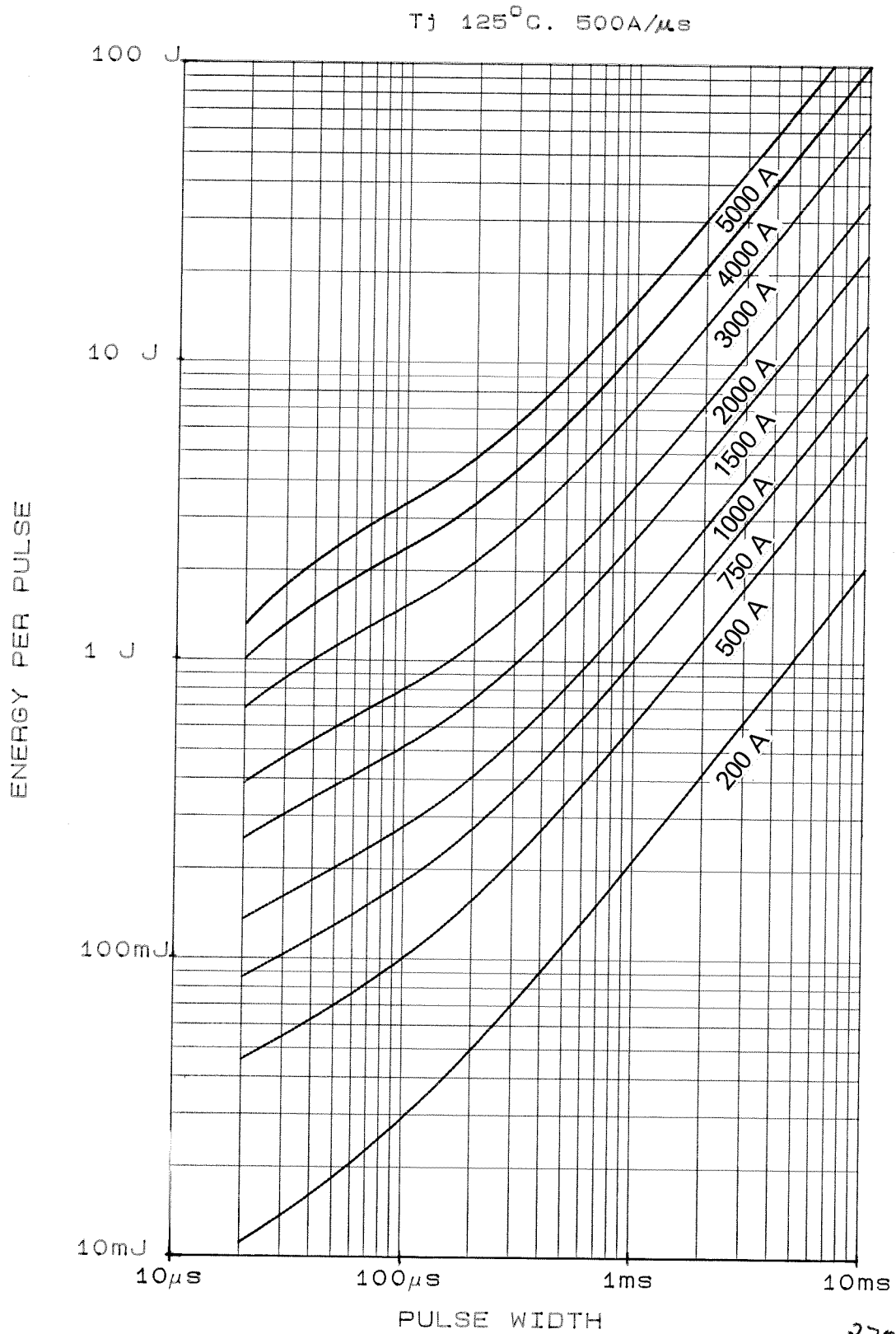
09750 Fig 1



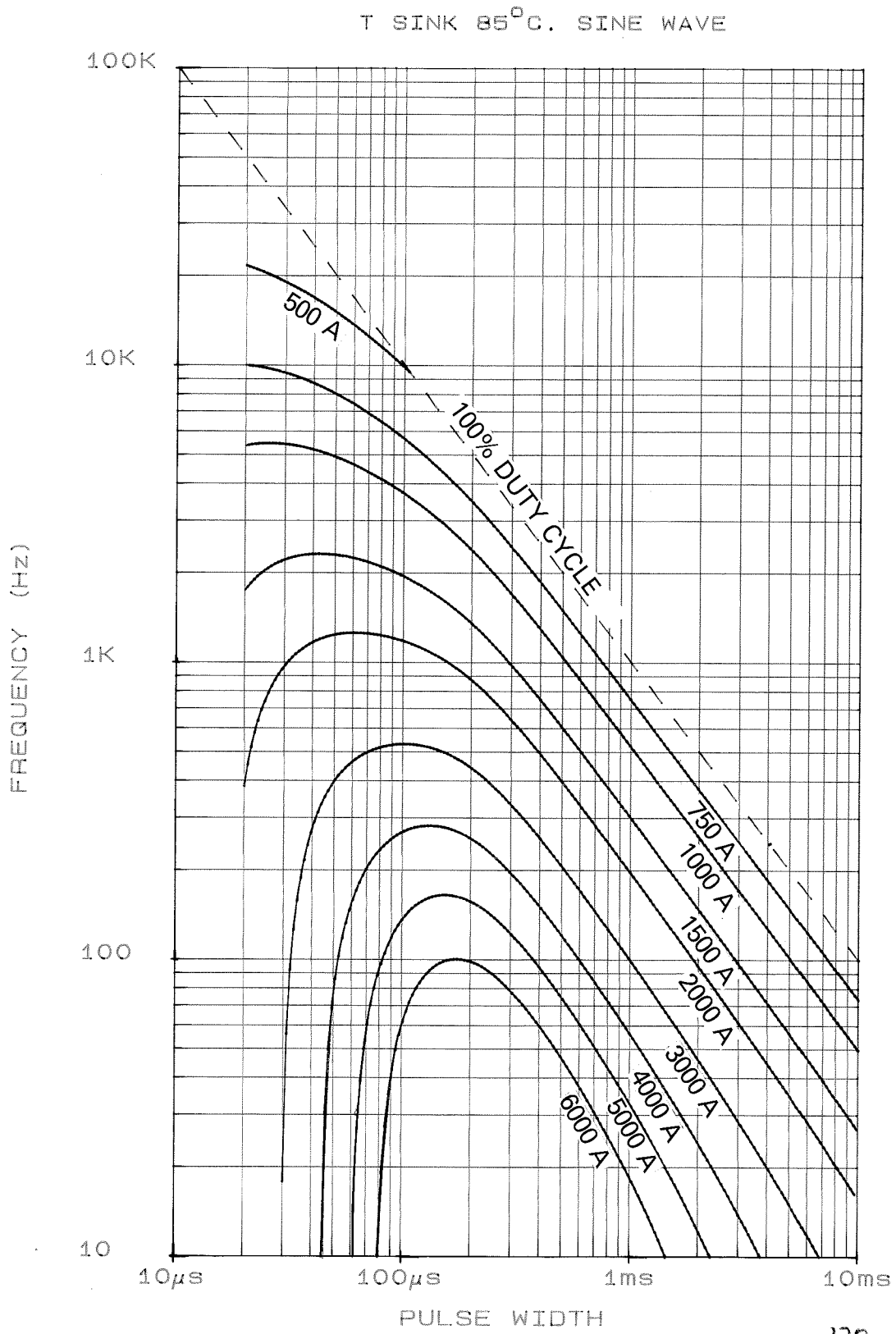
Pg 100 F53



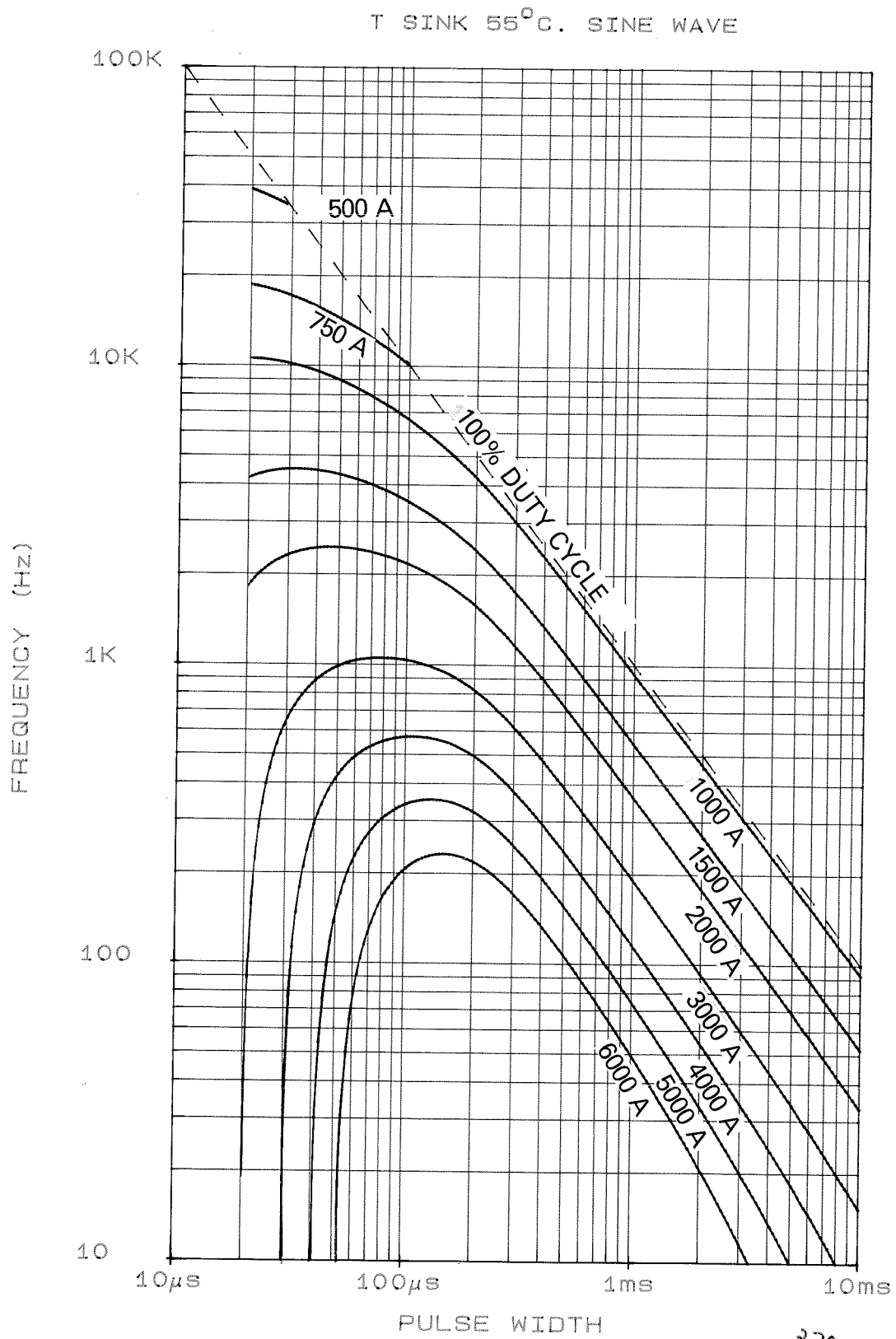




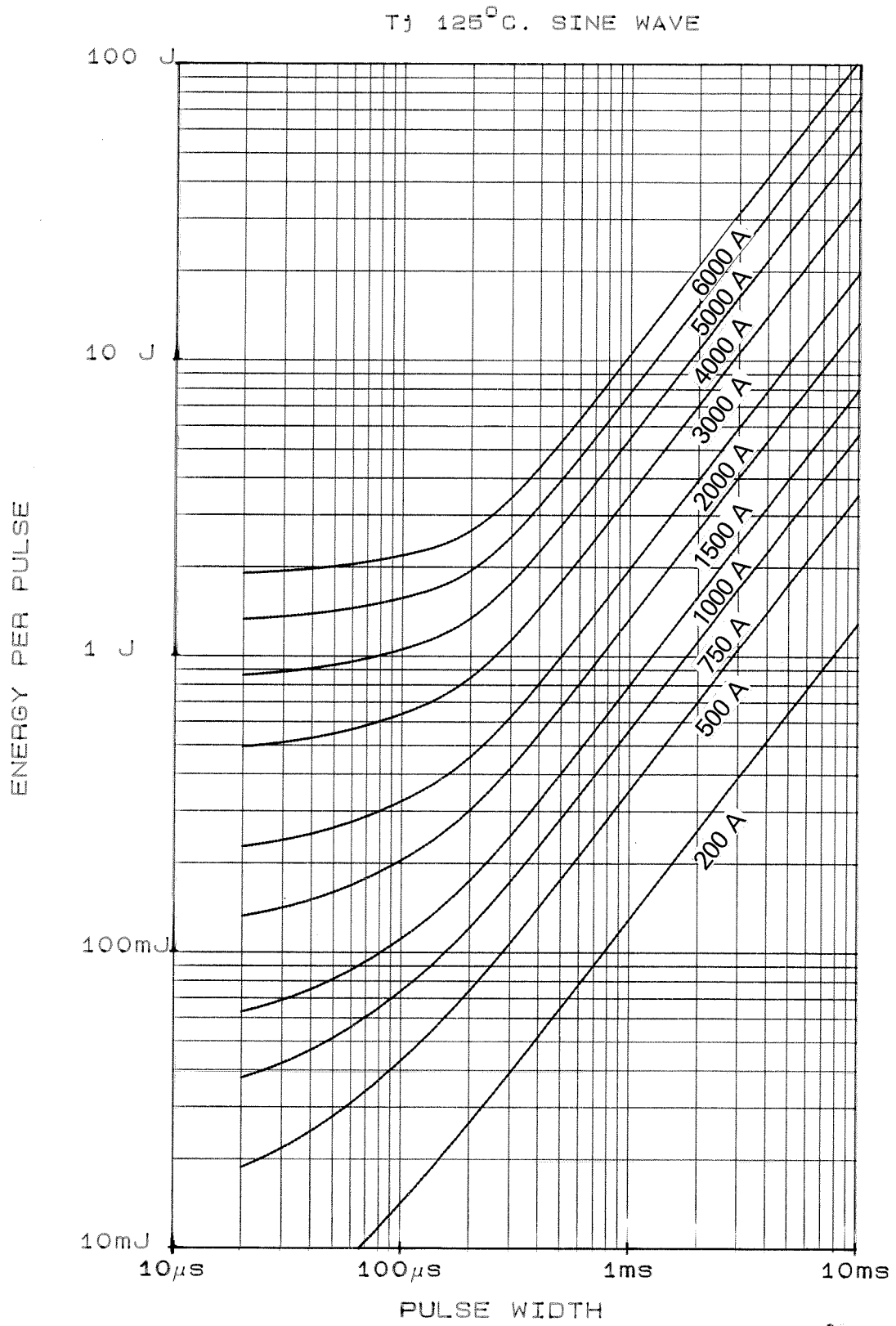
Q270 e Fig 8



Q3155 Fig 16

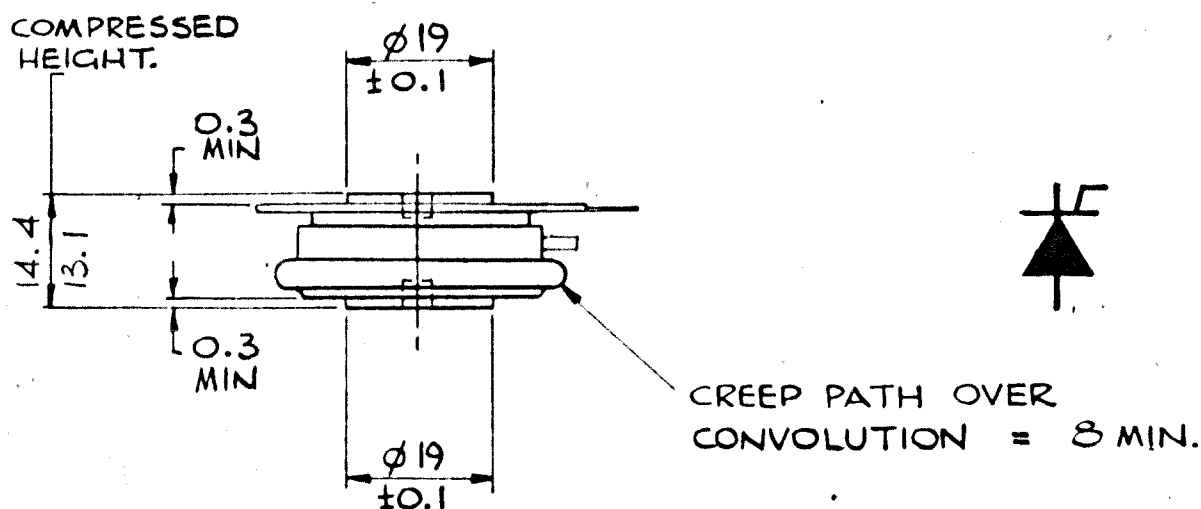
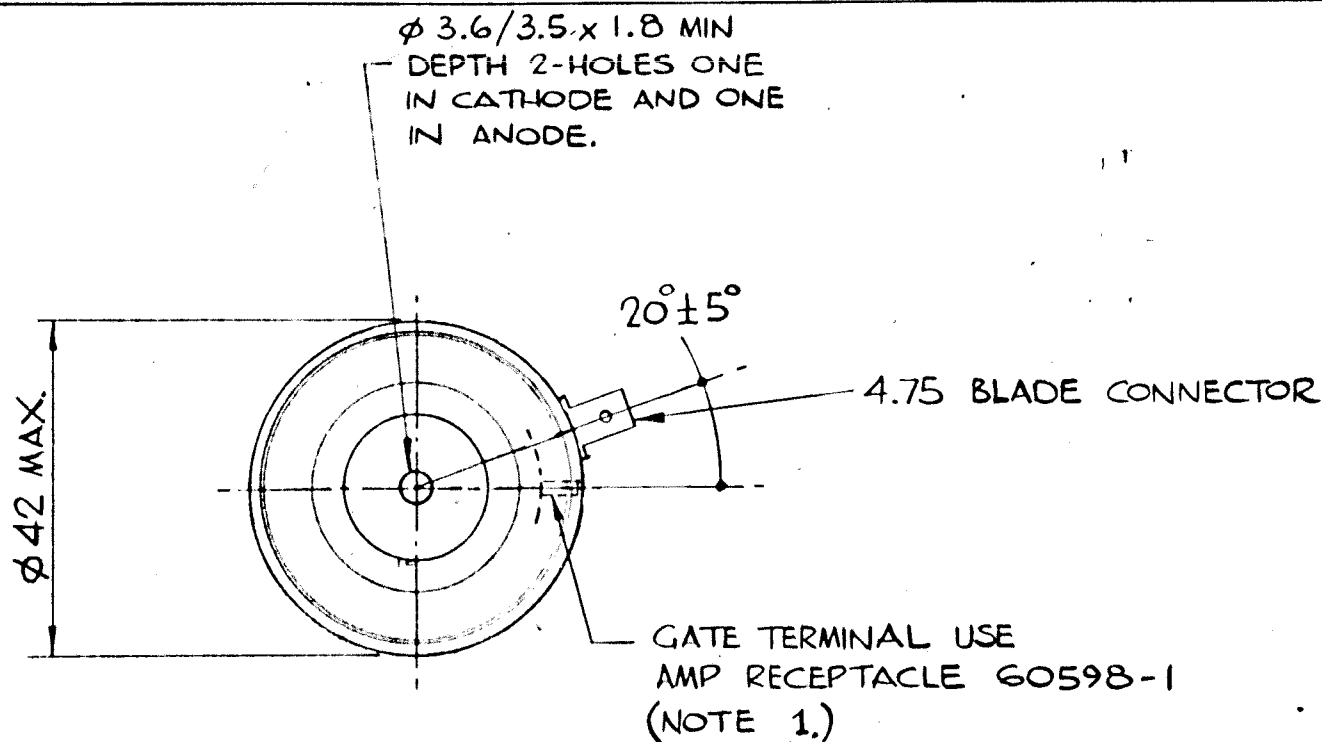


P3700 Fig 9



INTERNATIONAL OUTLINE No. TO-200AB  
WEIGHT. 70 GRAMS. - 24 -  
FINISH. NICKEL PLATE.  
DEVICE MARKING INCLUDES MONOGRAM, TYPE No., SPEC.  
No. AND POLARITY SYMBOL.  
DEVICE MOUNTING: CLAMPING FORCE TO BE APPLIED  
ON  $\frac{1}{2}$  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.  
G.A. DRG. No. 159B100H100-H110. 103B211

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



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| 1   | 9.9.76 P118                                                                                                                  |                                                                                     |  | <br><b>THIRD ANGLE PROJECTION</b>                     |
| 2   | 23.04.78<br>REDRAWN.<br>Ø19 WAS Ø29.<br>0.3 ADDED.<br>5.2/14 WAS<br>15.2/12.5.<br>LEADS ADDED. <i>BS</i>                     |                                                                                     |  | <b>DIMNS. IN MILLIMETRES</b>                                                                                                               |
| 3   | M613 14.6.78<br>LEAD COLOURS<br>CHANGED. <i>BS</i>                                                                           |                                                                                     |  | <b>DRG. No.</b><br><b>101A212</b>                                                                                                          |
| 4   | M636 7.8.78<br>LEADS DELETED <i>BS</i>                                                                                       |                                                                                     |  |                                                                                                                                            |
| 5   | 11.9.78<br>CLAMP FORCE<br>WAS 500 -<br>1200 kgf. Ø42<br>WAS Ø43<br>NOTE 1 ADDED.<br>14.35/13.08<br>WAS<br>15.2/14. <i>BS</i> |                                                                                     |  |                                                                                                                                            |
| 6   | 19.9.78<br>14.4/13.1<br>WAS<br>14.35/13.08 <i>BS</i>                                                                         |                                                                                     |  |                                                                                                                                            |
| 7   | 30.10.78 M670<br>TYPE N° ADDED <i>BS</i>                                                                                     |                                                                                     |  |                                                                                                                                            |
| 8   | 17.9.79 M773<br>550 kgf WAS<br>700 kgf. <i>BS</i>                                                                            |                                                                                     |  |                                                                                                                                            |