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PROCESSING GAIN AS A FUNCTION OF ASPECT ANGLE.(U)
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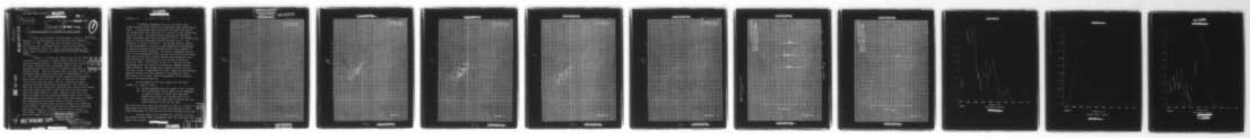

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TRACOR, INC. 1701 Guadalupe St Austin 1, Texas November [redacted] 1964

TECHNICAL NOTE, MOST Project -3

PROCESSING GAIN AS A FUNCTION OF ASPECT ANGLE.

This note describes the preliminary results of the analysis of thirteen magnetic tapes received from USNUSL on October 19, 1964. These tapes were recorded on October 7, 1964. One hundred cycle bandwidth pulses of half second duration were transmitted using both narrow and wide beam modes. The aspect angle variations are 000 deg, 010 deg, 020 deg, 030 deg, 045 deg, and 090 deg.

Figures 1 to 5 show the output (S/N) for the linear correlator as a function of input (S/N) as measured by the detector-averager process. The data shown are not corrected for energy splitting due to multipath effects since the separate arrivals were to small to resolve on the basis of relative powers. The echo arrivals were very small, having an average input signal-to-noise ratio of approximately -4 dB. For this reason the confidence in the measured input signal-to-noise ratio is also very low. This is reflected in Figures 6 and 7 which show the input (S/N) as a function of aspect angle for wide and narrow beam transmissions. One would predict that the input (S/N) would increase more sharply with increasing aspect angle from 000^{o} to 090^{o} than the slow trend shown. Since the input (S/N) is so small, Figures 6 and 7 are very likely a measure of the minimum measurable signal levels rather than depicting a true slope of input (S/N) with respect to aspect. The processing gain variations shown in Figures 1 to 5 are not a function of input (S/N), and one can have more confidence in the results. One would expect that any change in processing gain from one aspect to another would be fairly constant on the average. Figures 1 to 5 show little change in processing gain with change in aspect.

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A possible explanation for the very small input signal-to-noise ratios would be an abnormally high reverberation level. To investigate this possibility the power spectrum of the reverberation was evaluated for a section of data immediately before the echo. The power density spectrum and cumulative power distribution are shown in Figures 8 and 9. The reverberation power is clearly observable between 3.35 and 3.45 kc. The bandwidth is correct at 100 cps. The average spectral density of the reverberation relative to the background was determined by measuring slopes on the cumulative power curve (Figure 9). A value of +9 dB was obtained. To obtain a comparable measurement of the reverberation level during a period when good echoes were received the power density spectrum and cumulative power distribution were evaluated for a set of data recorded on August 20, 1964. (See Figures 10 and 11.) This set of data was analyzed and the results are reported in TRACOR document number 64-287-C. The average input signal-to-noise ratio for this set of data is approximately +6 dB. Again the reverberation spectral density is +9 dB relative to the background noise. Note that we do not have a direct measurement of the absolute level of the noise background.

In conclusion we can only explain the very small signals in a negative sense:

(1) System bandwidth does not appear to be a problem.

(2) The reverberation levels appear to be comparable to those in effect at other times when good echoes were received in the same mode of operation and at the same range, provided that the noise background level was the same.

Since only two echo cycles are available in this set of data at beam aspect it is not possible to get a good measure of beam aspect performance at the time the off axis recordings were made.

The next tapes to be processed are currently in-house and contain coarser aspect information (bow, 45°, and beam) with higher level echoes.

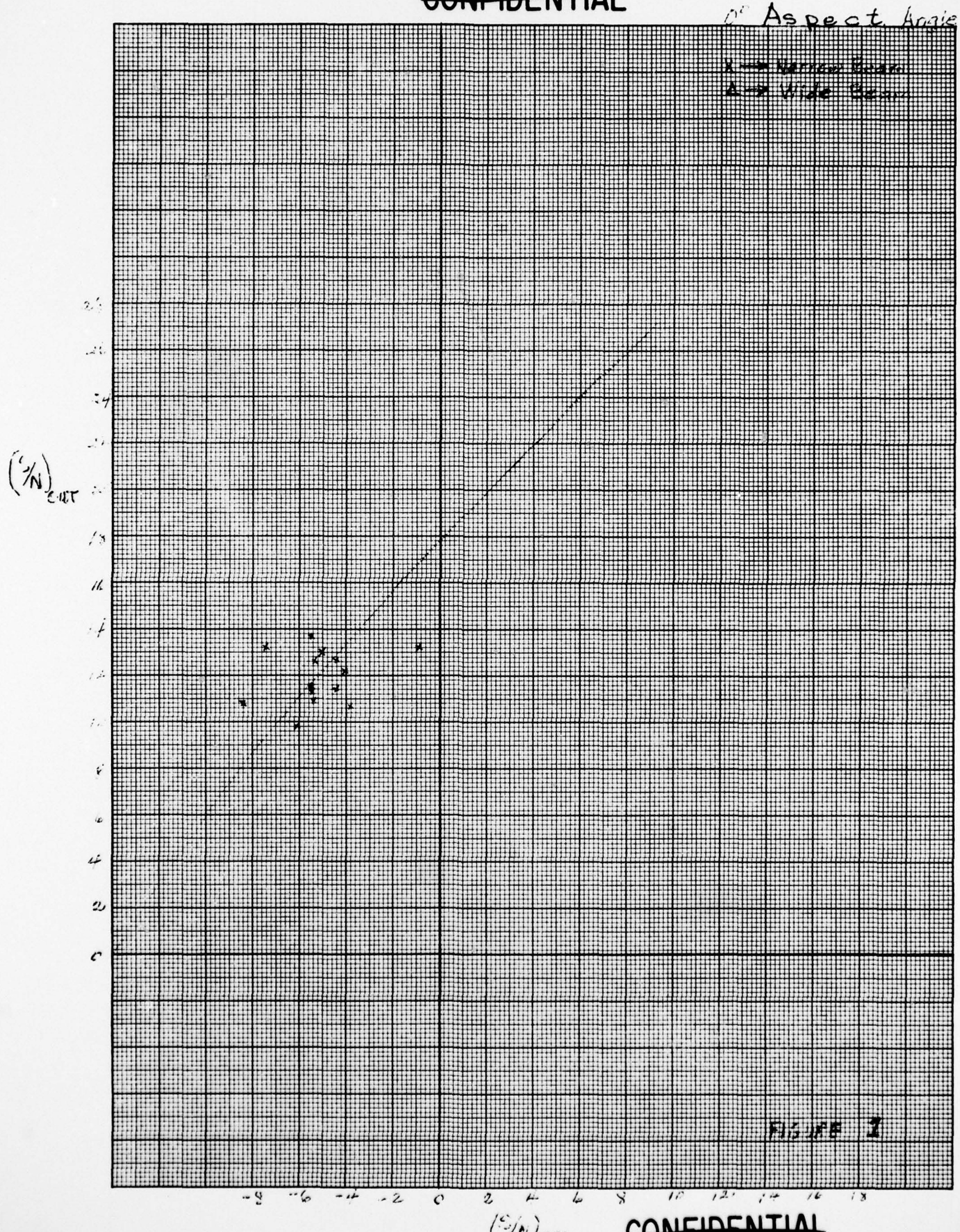
0° Aspect Angle
x → Narrow Beam
Δ → Wide Beam
$(S/N)_{OUT}$
$(S/N)_{IN}$
-8 -6 -4 -2 0 2 4 6 8 10 12 14 16 18
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28

FIGURE 1

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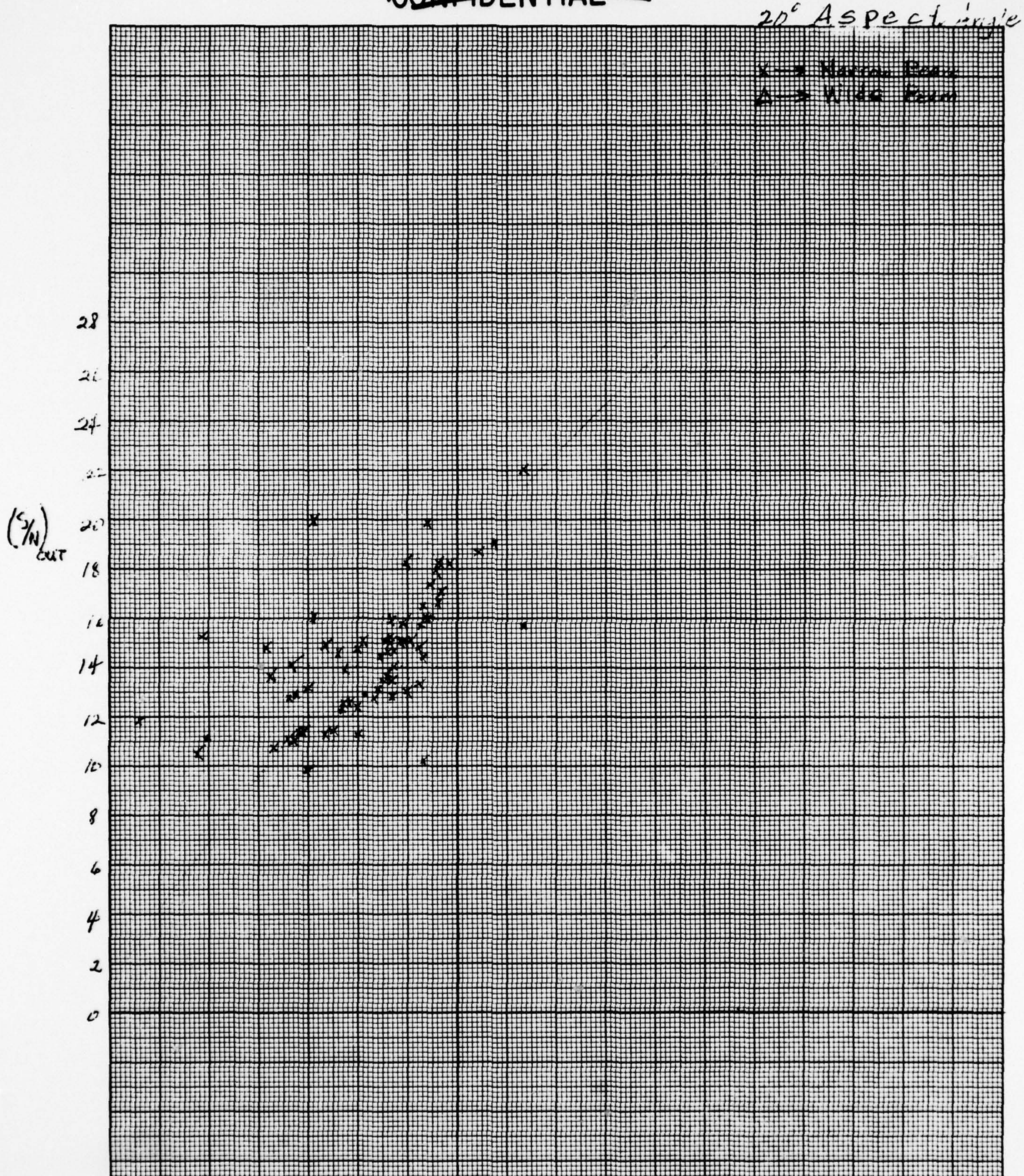

FIGURE 2

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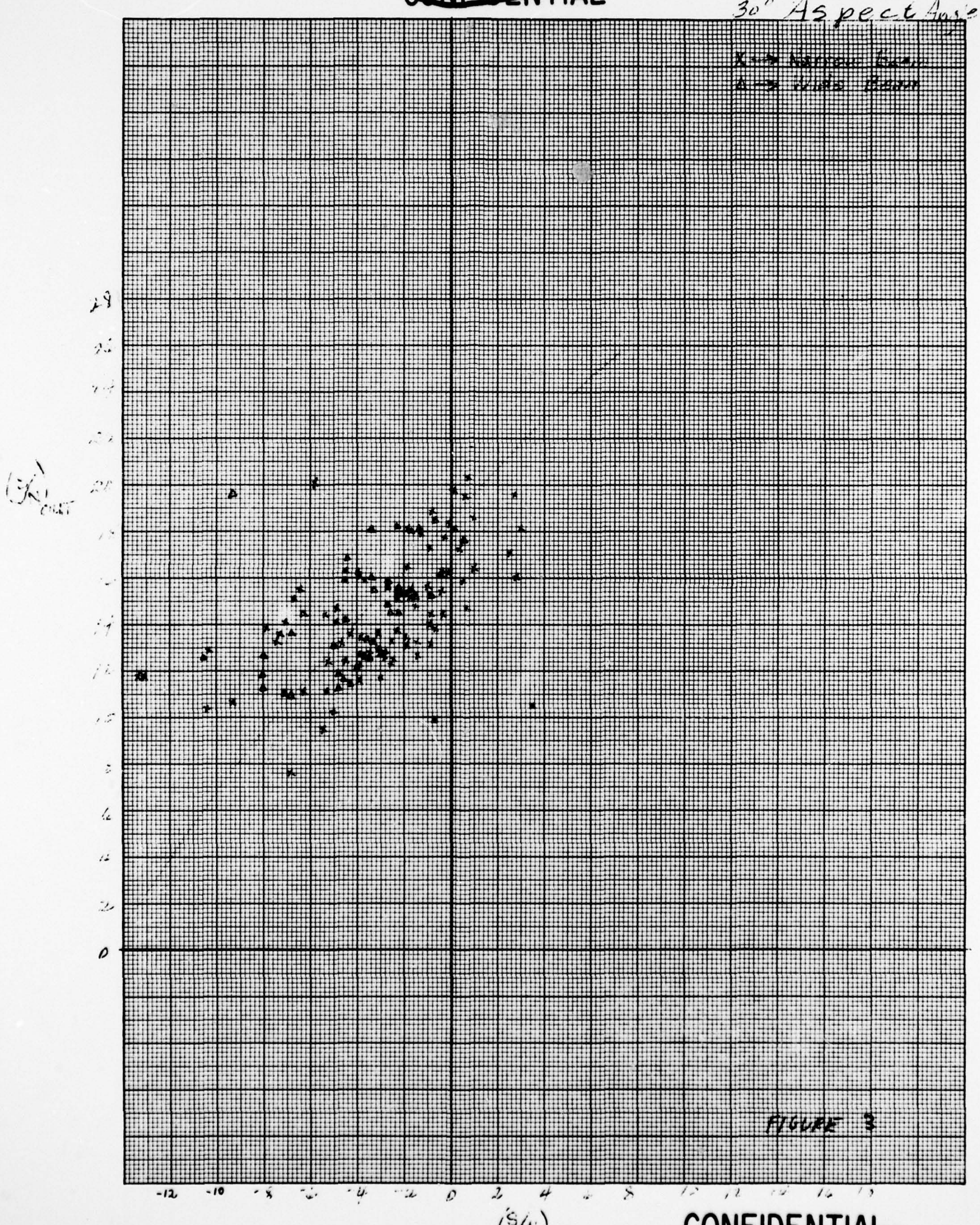

FIGURE 3

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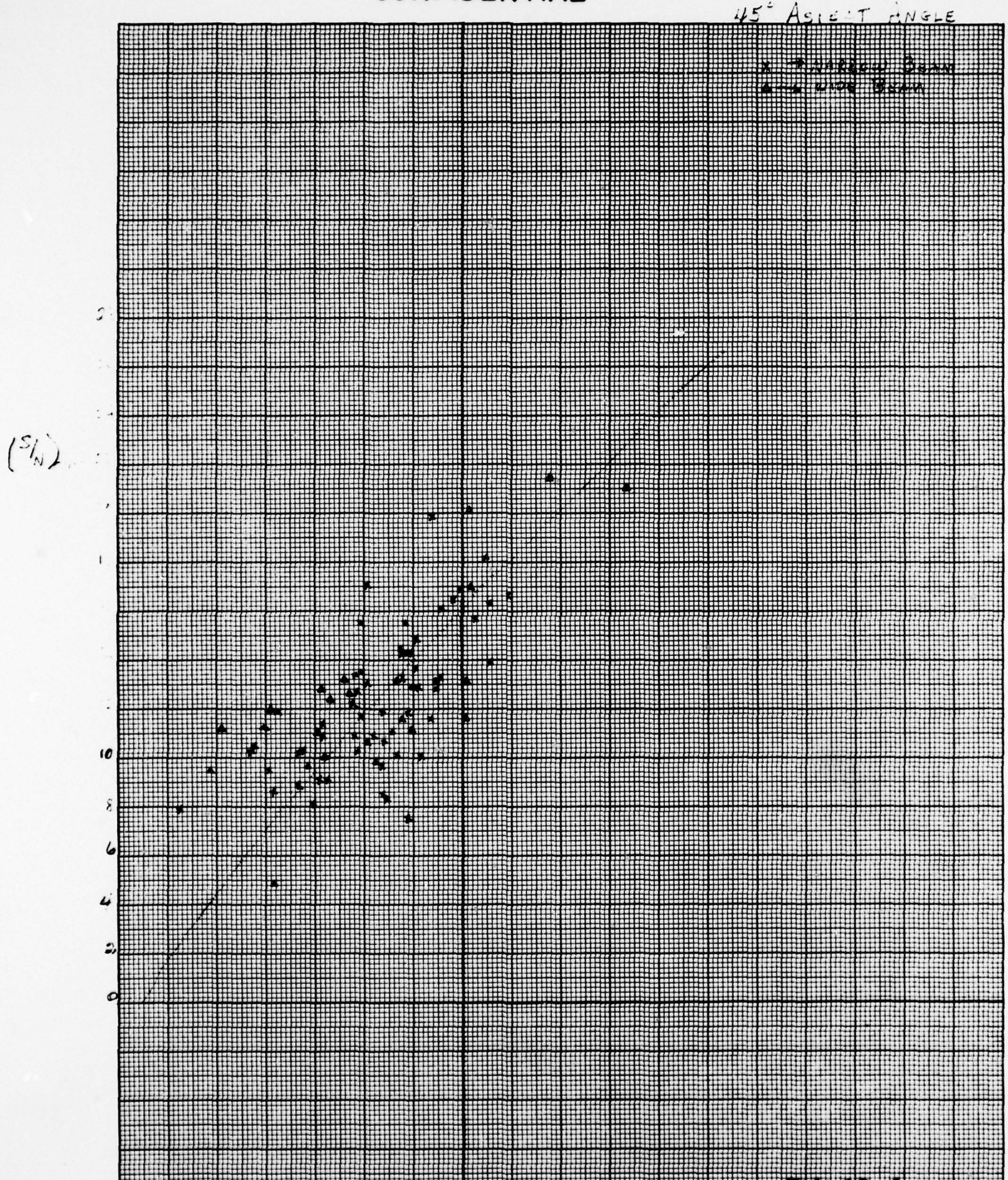

FIGURE 4

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90° Aspect Angle

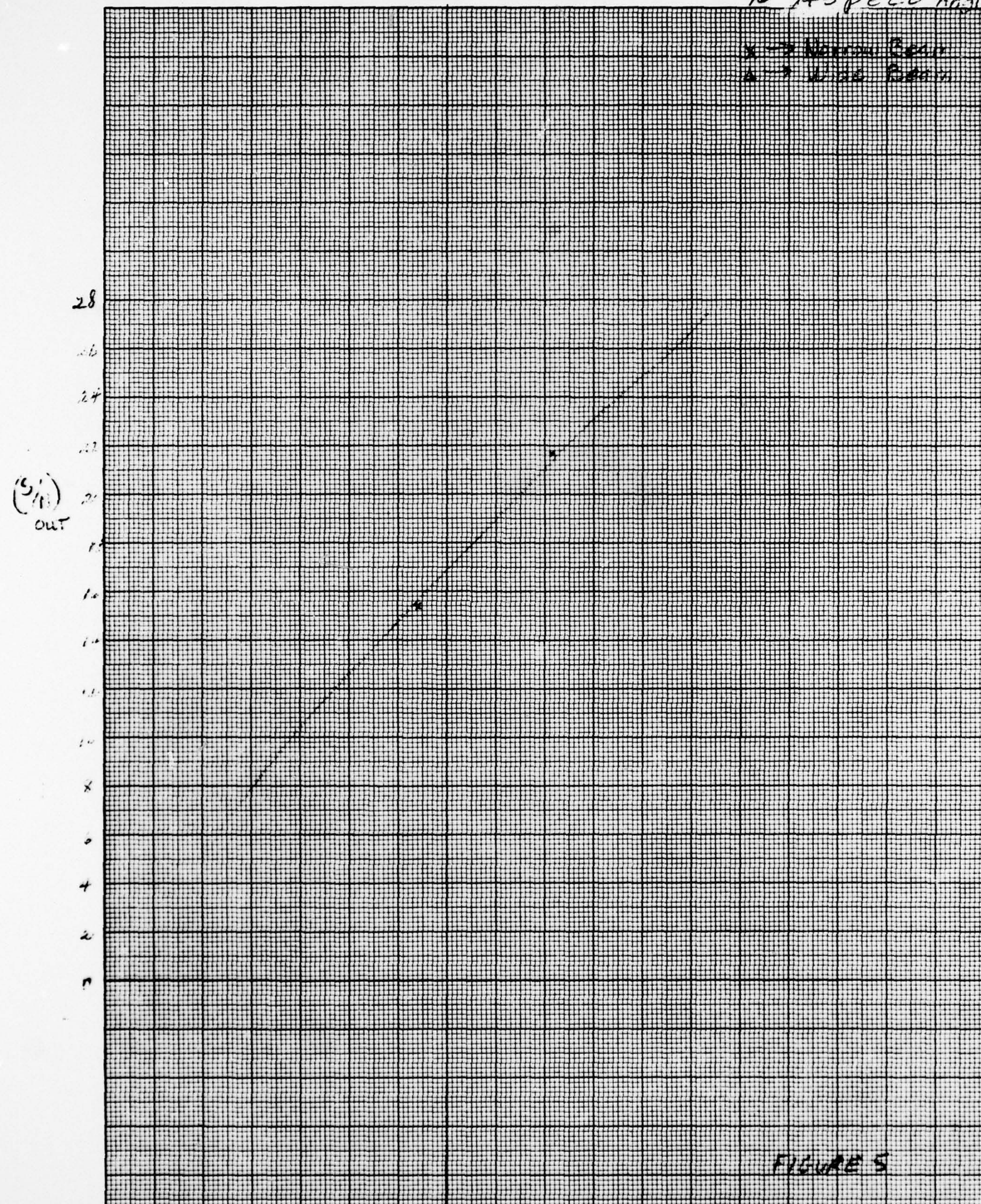

FIGURE 5

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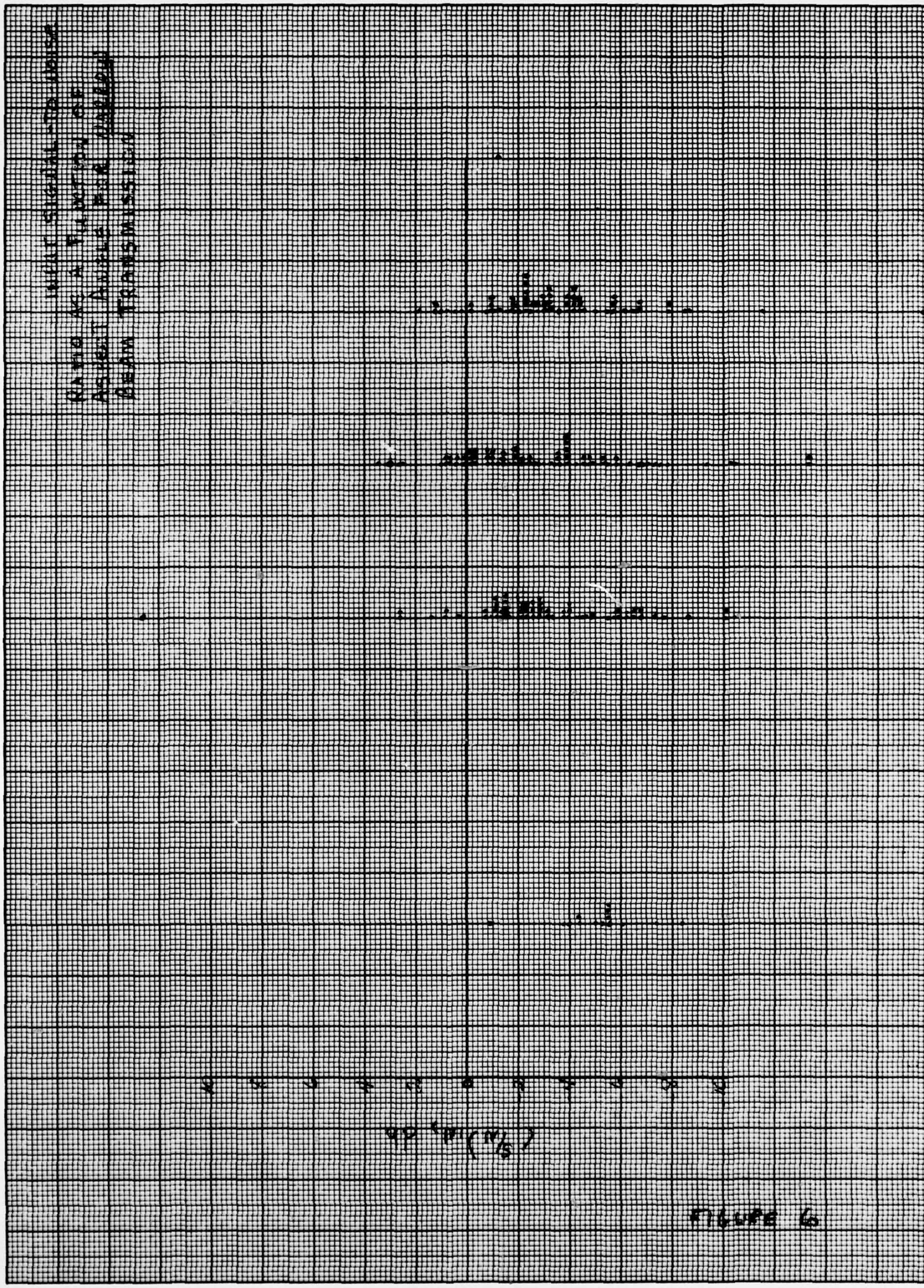

FIGURE 6

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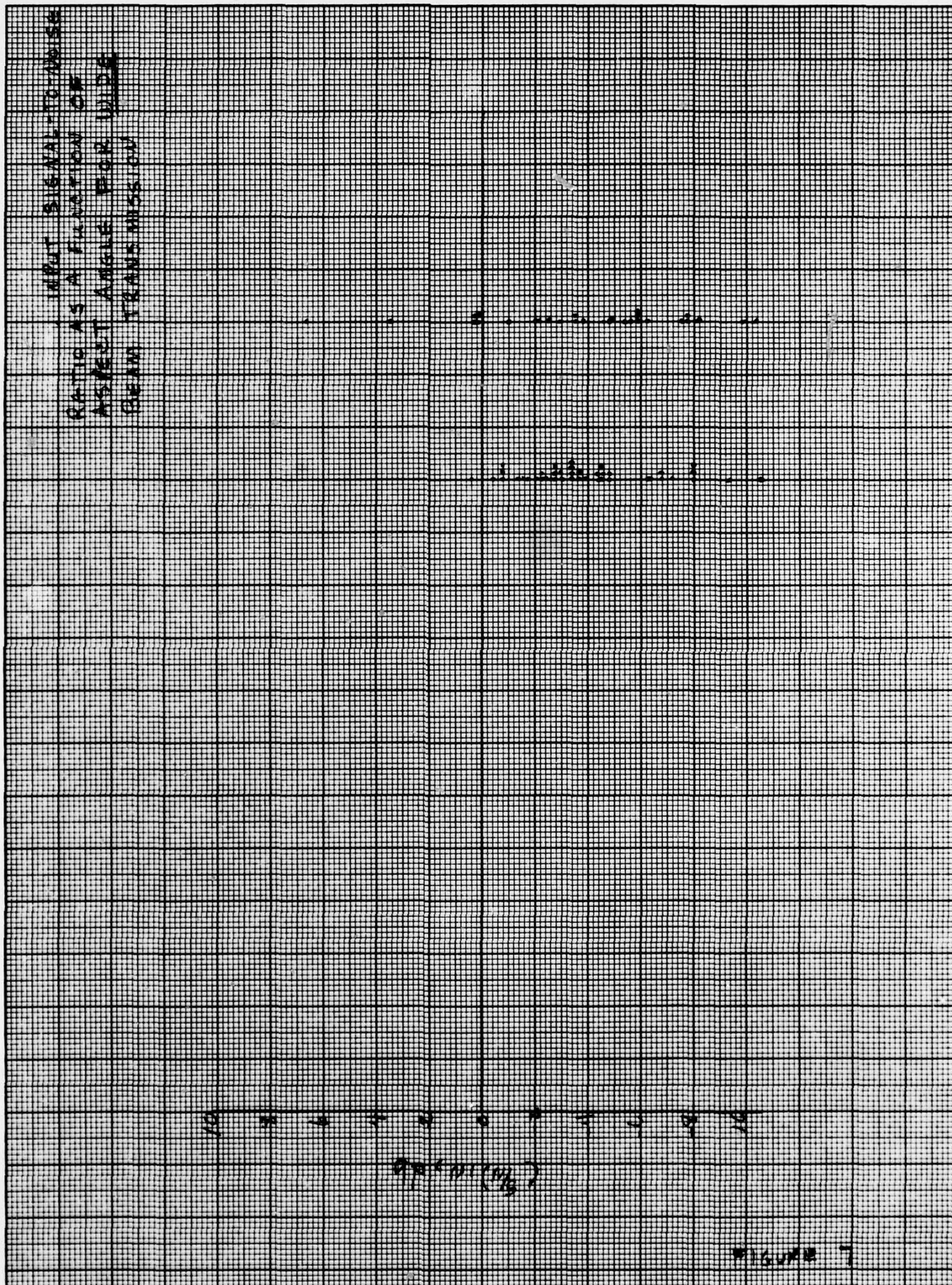

FIGURE 7

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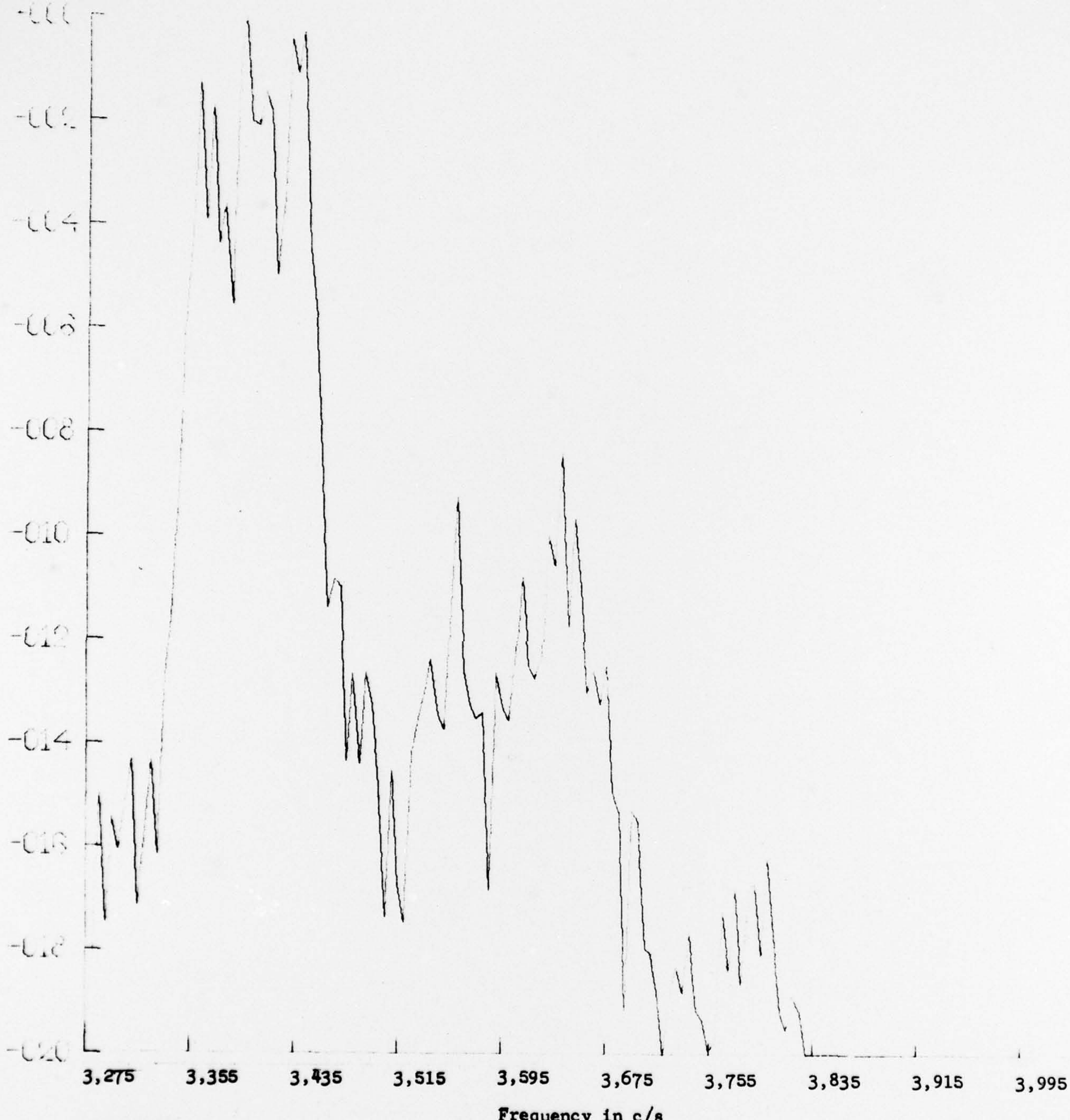

FIGURE 8

Power Density vs Frequency

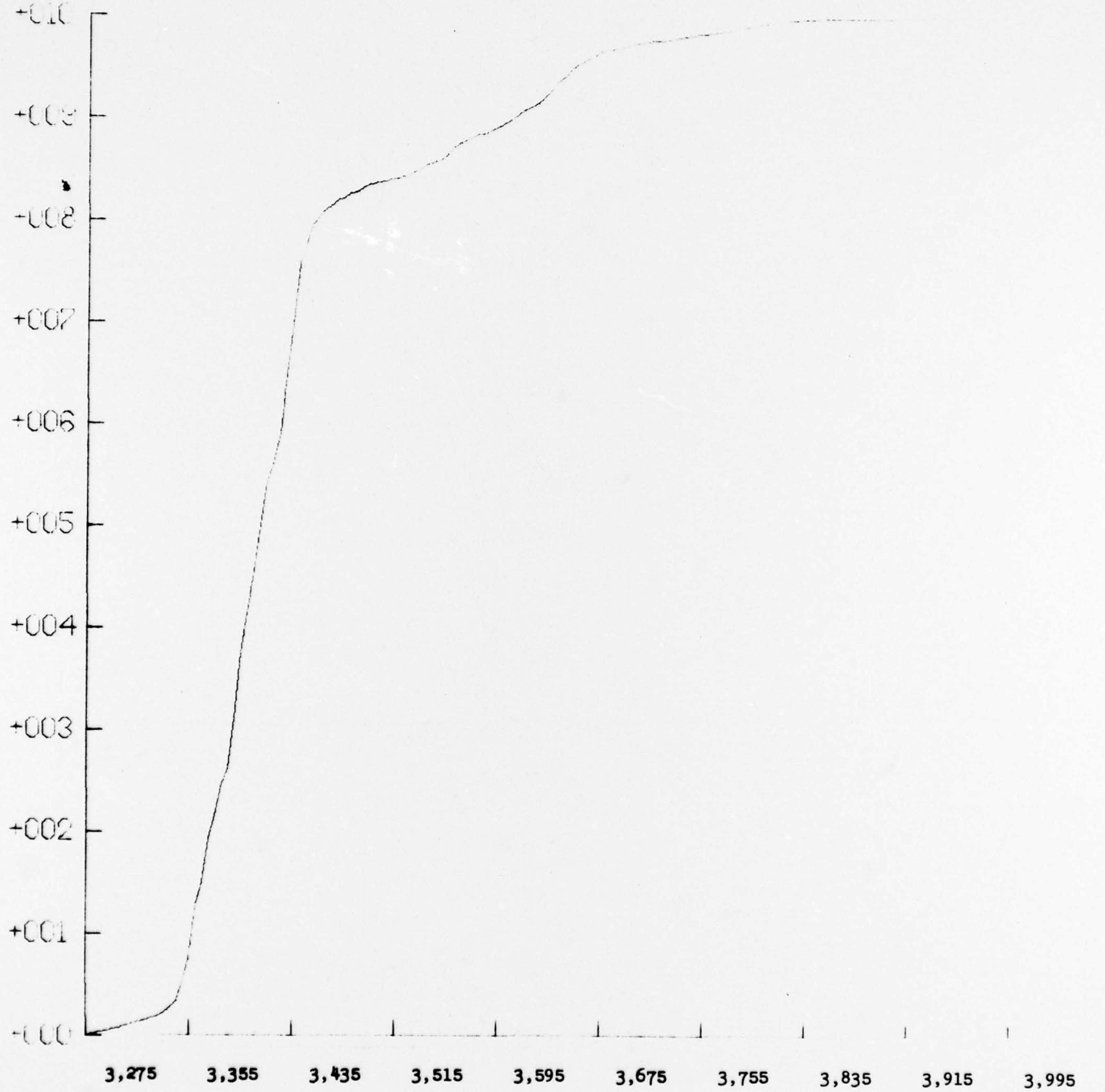

FIGURE 9

Frequency in c/s

Cumulative Power vs Frequency

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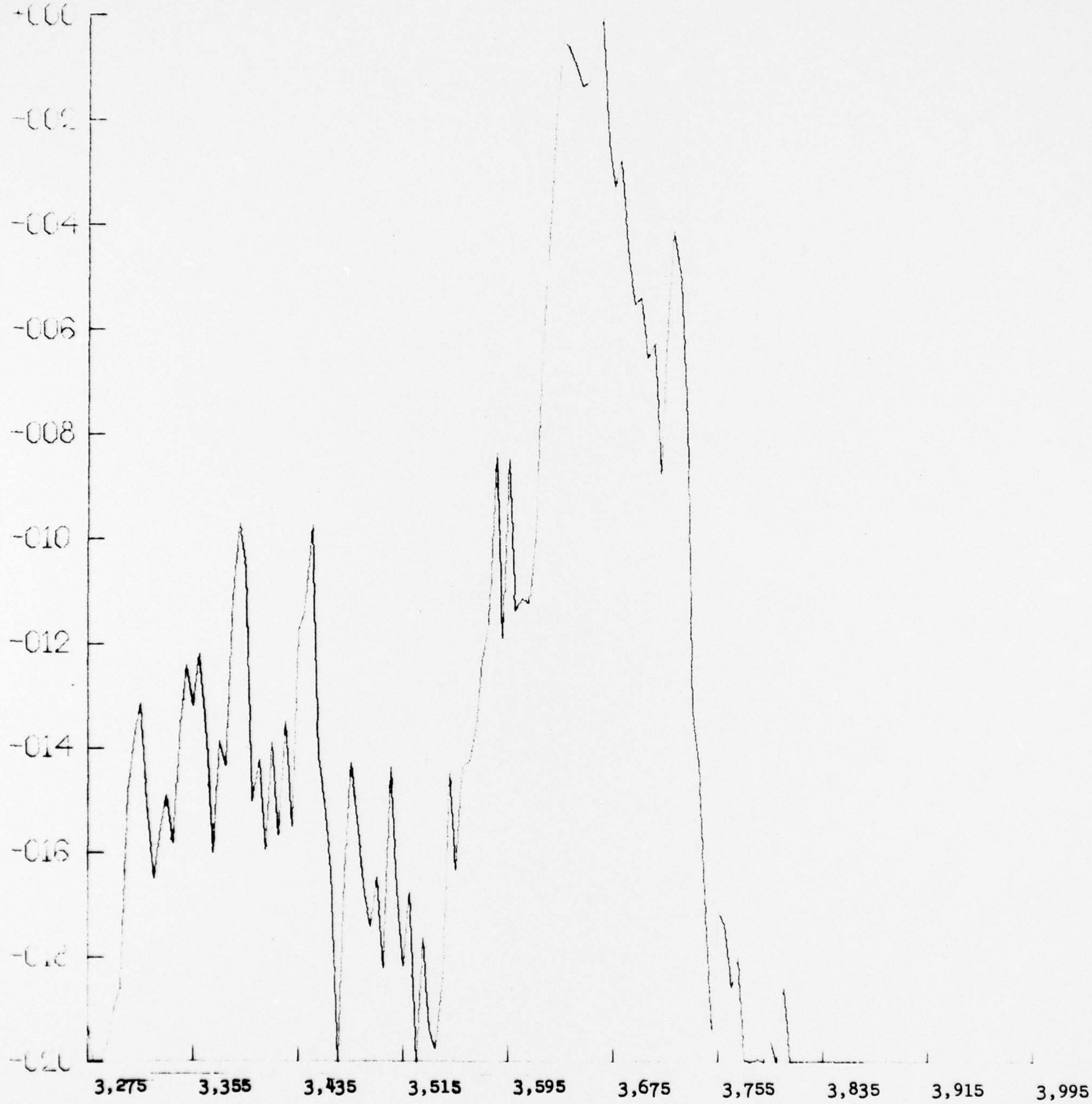

FIGURE 10

Frequency in c/s

Power Density vs Frequency

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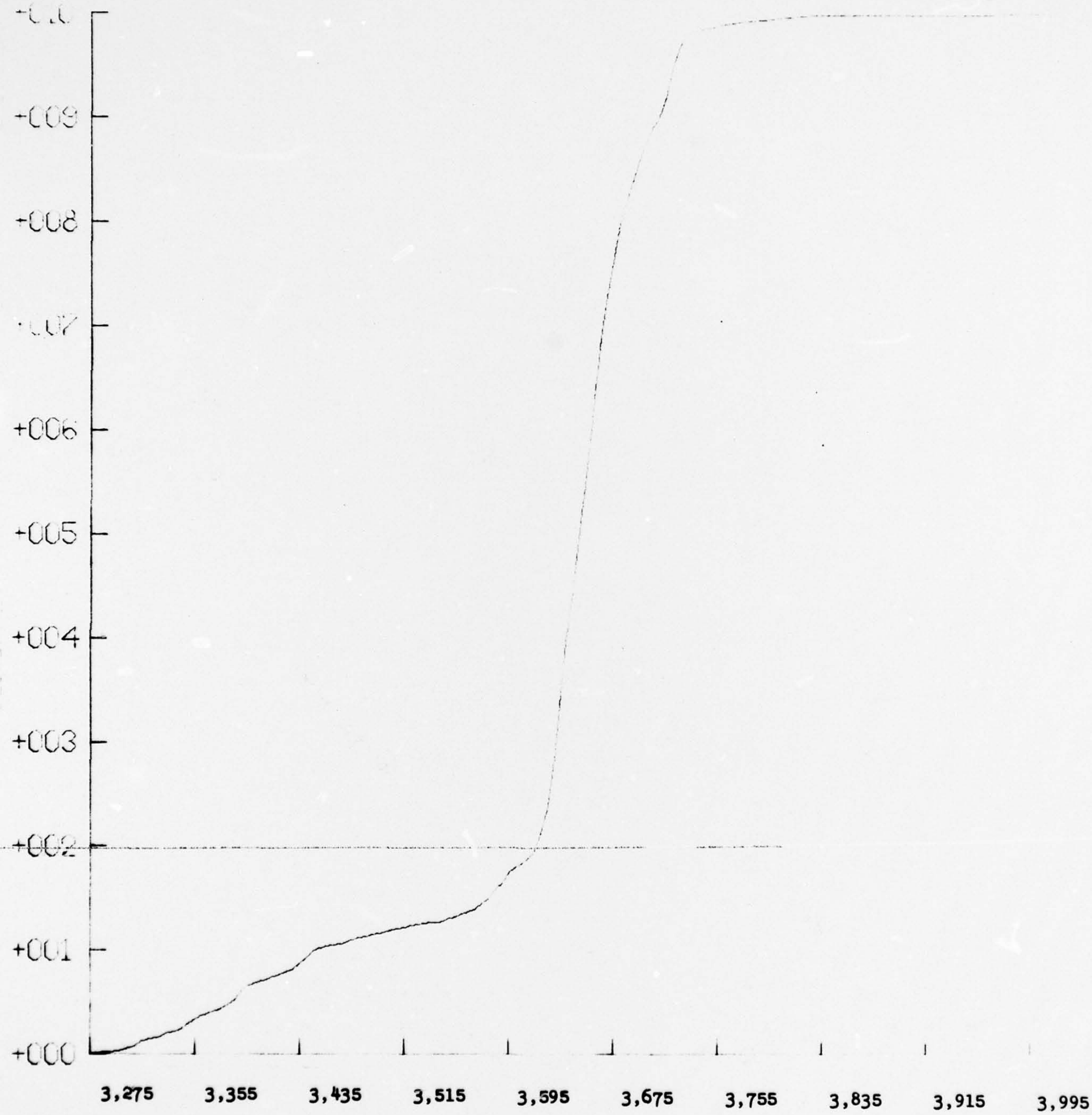

FIGURE 11

Frequency in c/s

Cumulative Power vs Frequency

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