

FILE 601

RCH & DEVELOPMENT  
WASHINGTON, D. C.

PRELIMINARY EVALUATION OF A  
TYPE LE-3 LIMPANDER AUDIO AMPLIFIER  
TECHNICAL DEVELOPMENT REPORT NO. 418

Prepared by: John Dowd  
Range Instrumentation Unit  
Measurement Facilities  
Section

Reviewed by: Walter A. Martin, Jr.  
Chief, Systems Engineering  
Section 1

Approved by:

H. U. Hermanson  
Chief, Experimentation  
Branch

J. S. Cowart Jr  
Director

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FEDERAL AVIATION AGENCY  
National Aviation Facilities Experimental Center  
Atlantic City, New Jersey

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National Aviation Facilities Experimental Center  
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Bureau of Research and Development  
Federal Aviation Agency  
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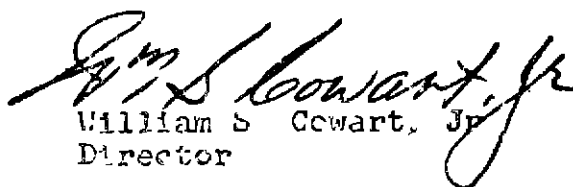
Subject: Final Report on Task Assignment No. 59-739,  
Title: 'Preliminary Evaluation of a Type LE-3  
'Limpander Audio Amplifier'

Dear Sir:

In February 1959 the Technical Development Center procured four (4) Audio Limiter-expanders (Limpanders) to determine their possible usefulness in the Air Traffic Control Communications System.

The final Technical Development Center Report, titled 'Preliminary Evaluation of a Type LE-3 Limpander Audio Amplifier' is herewith enclosed.

Sincerely,

  
William S. Stewart, Jr.  
Director

Enclosure - 1

Copies to:

Director (1 Copy)  
Development Division (5 Copies)  
Operations Analysis Division (2 Copies)  
Systems Analysis Division (2 Copies)

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### ABSTRACT

A preliminary evaluation was made of a commercially available audio limiter (trade name LE-3 Limpander). Tests of frequency range, limiting range, frequency distortion, and limiting distortion were made. Since time did not permit full operational tests of the amplifier, further and more extensive tests are recommended.

## PURPOSE

The purpose of this evaluation was in keeping with the policy of staying abreast of new developments in the electronic arts and to determine their possible usage in air traffic control systems.

## SUMMARY

This report covers the evaluation of an audio amplifier limiter, commercially known as a Type LE-3 Limpander, to determine its possible applications in air traffic air/ground communication systems. The unique feature of this equipment is its fast action which gives emphasis to usually soft consonant tones and limits usually hard vowel tones. The specifications of the manufacturer for low distortion limiting and consonant amplification for high readability were evaluated.

## INTRODUCTION

In February of 1959, the Technical Development Center procured four automatic audio-control amplifiers (trade name "Limpander" Type LE-3) to determine if these devices could be applied in the air traffic control communications system. The following are the specifications as taken from the manufacturer's literature:

1. Rack model 3 1/2 inches long.
2. 50-db low distortion limiting.
3. 50-microsecond attack time.
4. 25-millisecond release time.
5. Input impedance 50/250/600 ohms.
6. Input level - microphone (.1 volt maximum).
7. Output impedance 5000/600 ohms.
8. Output level plus 20 decibels (db) (600 ohms).
9. Frequency range - voice.
10. Input indicator volume unit (VU) meter.
11. Transformer input - 70-cycle low-frequency response.
12. Tubes:
  - (1) 6AT6
  - (3) 6BC8
  - (1) 6C4
  - (1) 5Y3
  - (1) 6B2

The manufacturer also stated that, because of the built-in fast attack and release time, the equipment would amplify consonants to a comparable volume with vowels making speech reproduction very much more readable as well as increasing the average power output. Possible uses considered were:

1. Line Amplifier: As an amplifier at either one or both ends of a telephone line used for remote control of communication equipment.
  2. Modulator Preamplifier: As an amplifier whose output would remain relatively constant even under sudden bursts. This device would prevent over-modulation and make it possible to increase the average modulation percentage of a transmitter.
  3. Speaker Amplifier: Used immediately before speakers in control rooms, its consonant amplification would increase intelligibility and its squelch circuit would reduce noise. Also, the fixed audio level might tend to keep strong signals from blasting while at the same time allowing full amplification of weak signals.
- Recorder Preamplifier: At air traffic communication stations, tape recordings sometimes are used to send continuous weather reports. It was believed a tape made with the Limpander used as a recorder preamplifier would provide an improvement in the quality of the message since a constant amplitude output would be obtained from the recorder plus the advantage of consonant amplification.

## DISCUSSION

Tests were made to determine the gain and frequency characteristics of each of the four amplifiers. A Hewlett-Packard 650 audio test oscillator was connected to the 600-ohm input of the Limpander and a Hewlett-Packard 410B db meter connected to the 600-ohm output. A Tektronix 549 oscilloscope was connected to the output to note any waveform distortion. Gain curves were made at 1,000 cycles. The only control on the Limpander was a level control which for a maximum input signal of .1 volt, should be set to bring the VU meter on the Limpander to 0. Figure 1 shows the frequency response curves of the four Limpanders tested. Figure 2 depicts the gain curves for the same units. These curves were derived with the VU meter of the Limpander set at 0. The distortions noted during these tests were negligible. Figure 3 is a graph of the signal-to-noise ratio for a typical Limpander.



Arrangements were made to test the Limpander in the air traffic communication station at the Weir Cook Airport. A Limpander was installed at one of the two control consoles as a speaker amplifier for the incoming signals from the UHF receiver site. When first installed, the operators' reaction was unfavorable. The squelch action of the Limpander and absence of background noise led to the belief that at times their UHF communications were not operating.

For comparison purposes, the operators moved to another console without the Limpander and the results obtained were favorable to the use of the Limpander. The Limpander was found to have less background noise, less fatigue for the operators, and adequate volume.

No tests were undertaken to evaluate the Limpander as a telephone line amplifier or as a source for modulating a transmitter. Some tests were run with the weather tape recorder but were not sufficient to draw conclusions.

## CONCLUSIONS

The limited evaluation of the Limpander resulted in the following conclusions.

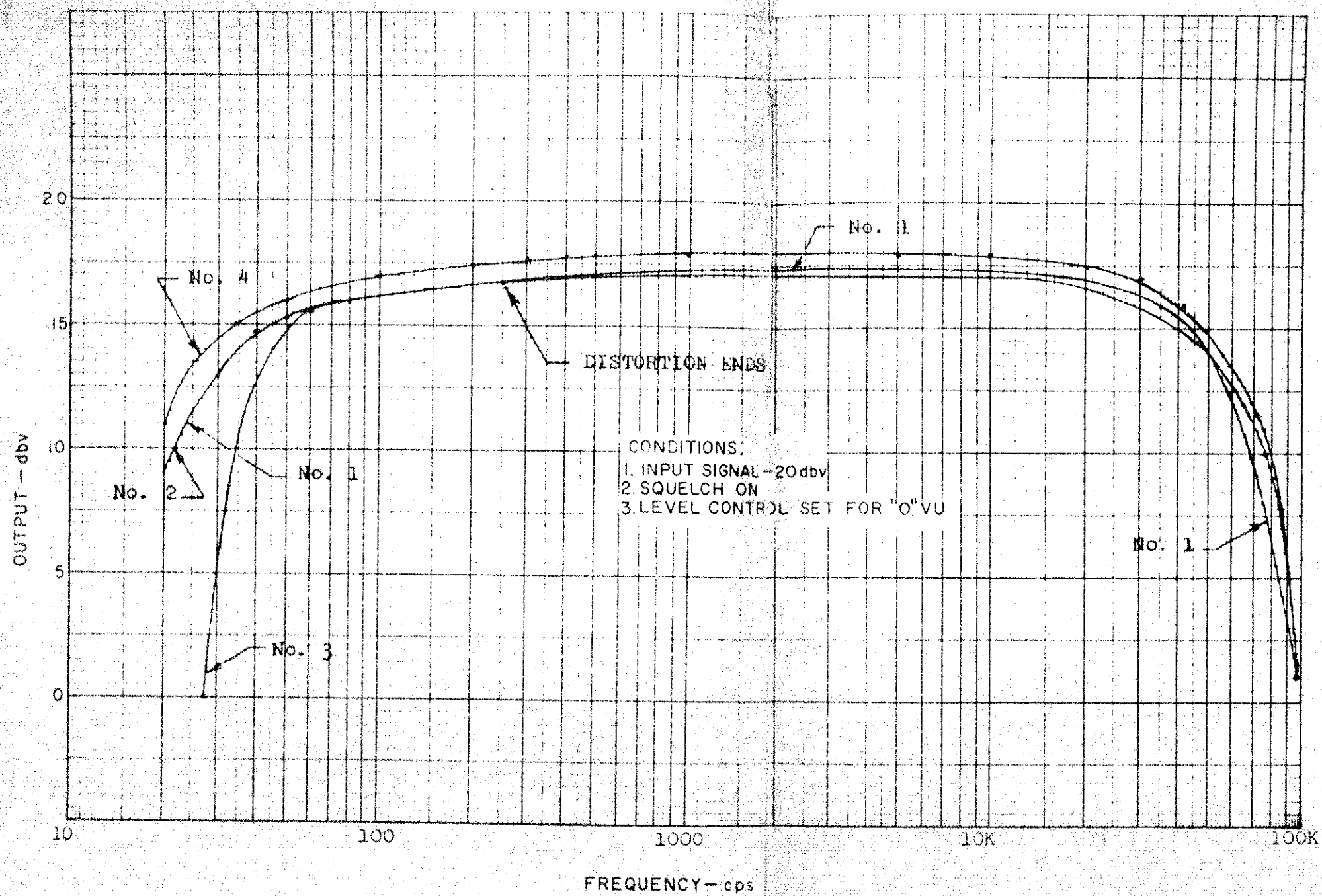
1. The Limpander reduced background noise when used as a speaker amplifier. Subjective opinion indicated that readability was increased due to the action of the Limpander in increasing the volume of consonant tones and limiting the volume of vowel tones. The operators felt that fatigue was reduced.

2. The Limpander was found to be a useful device.

## RECOMMENDATIONS

It is recommended that the capabilities of the Limpander be further evaluated to determine its usefulness as:

1. A line amplifier,
2. A modulator or exciter, and
3. A preamplifier for tape recorders used in the continuous broadcasting of weather information.

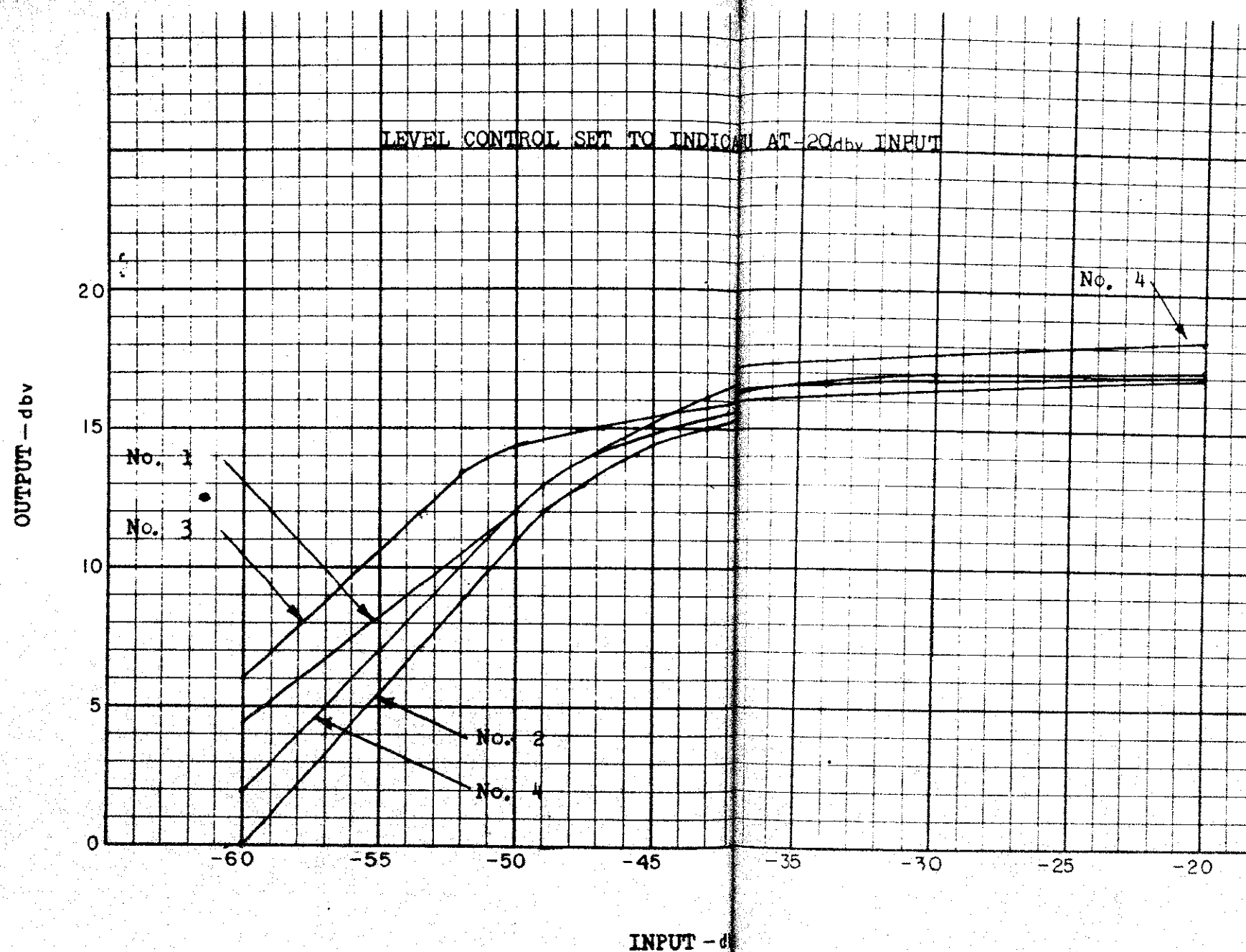


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COMPARISON OF FREQUENCY  
 RESPONSE CURVES OF  
 FOUR LIMPANDERS

Task No. 59-739

FIG. 1

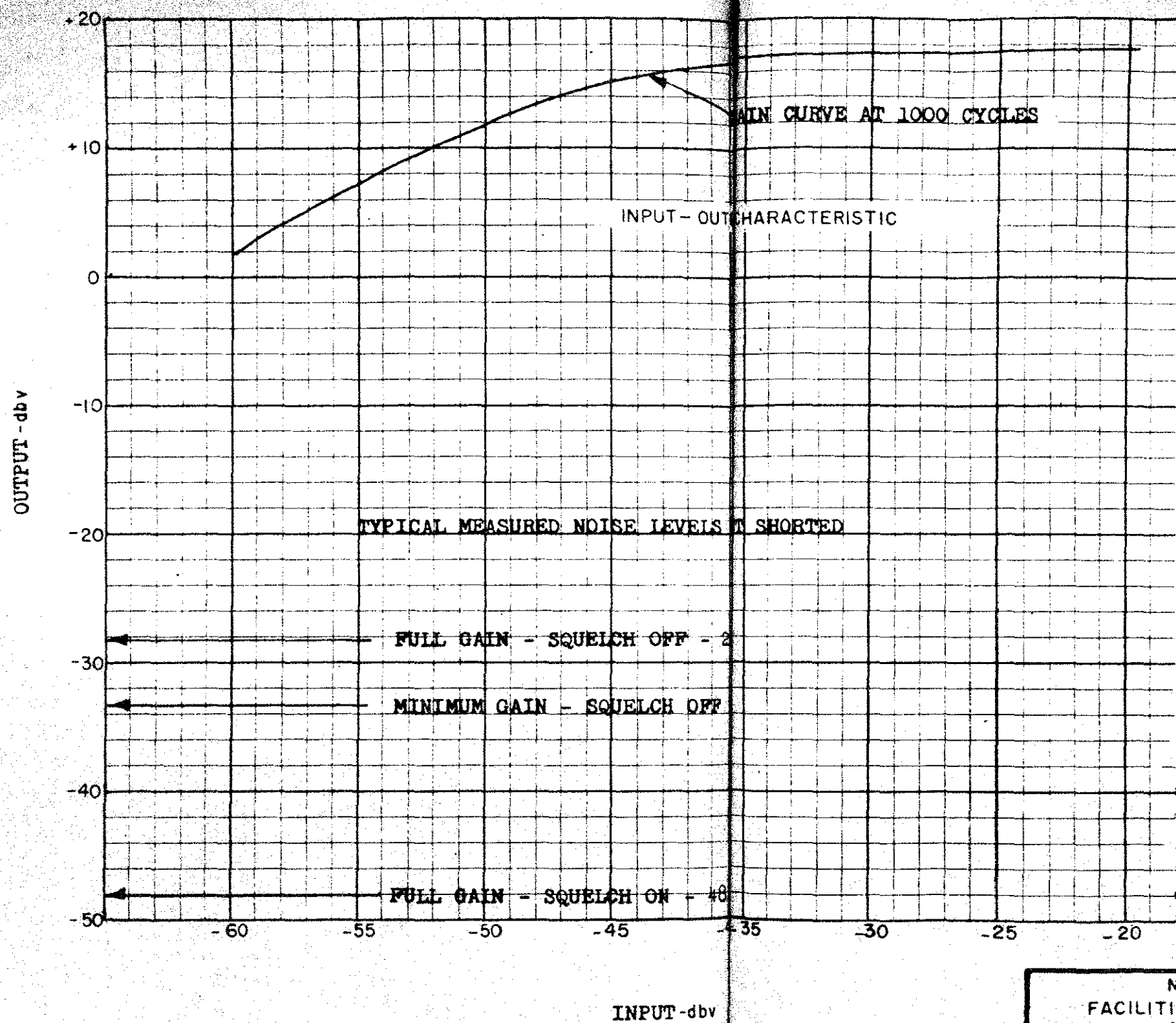


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GRAPH SHOWING  
GAIN CURVES OF  
FOUR LIMPANDERS

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FIG. 2



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**CHART SHOWING NOISE  
LEVELS AND INPUT-OUTPUT  
GAIN CHARACTERISTIC**

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**FIG. 3**