

## Hypoacusis detector for evaluation of scholars in field

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**Abstract.** Hypoacusis on scholars has become not only a problem but also an indicator when attention disorders or misunderstood instructions from teachers are observed. A primary detection of hypoacusis, in particular in speech range, can help scholars, parents and teachers to improve or correct the learning process. A hypoacusis detector has been developed to be applied in field. This device is based on the generation of three tones and three sound level pressures in the speech range. Both the laboratory evaluation and a case of study results are reported in this document.

### Keywords:

Hypoacusis, Hearing Loss, Attention disorders, Audiometry.

### I. INTRODUCTION

According to data from the Institute for Human Communication in Mexico, there are 22,224 people with hearing disorders. From this number, it is reported that 22.4% people suffer hypoacusis. However, the real magnitude of this disorder in Mexico is unknown because neither strategies nor interest have been implemented to attend it [1].

Audiometric tests in field have been rarely applied on scholars of public and private schools for elementary education in Mexico, until some problems of attention or misunderstood information expressed by teachers have emerged. In some cases, these disorders have been misinterpreted and considered as low linguistic stimulation, mental disorders or hyperactivity. It is reported that problems appear when some kind of hypoacusis between 30 to 50 dB is present [2, 3].

Generally, kids with hypoacusis do not express hearing problems, specifically when those problems are slight. Because they do not perceive their hearing loss, information can be lost and the message sense can be misunderstood. More else, a scholar can be ignored in class and some other problems may appear in their academic performance.

Other factors like distance between pupil and teacher, reverberation, background noise in the classroom, and voice echo, enhance the problem of hypoacusis.

Hearing loss has been demonstrated to be a primary factor that induces disorders in psychological and social performance of the scholars. For this reason, a primary detection of hypoacusis is a good proposal for early diagnoses. If hypoacusis is detected using the device developed, a complete audiometric study would be needed.

A hypoacusis detector has been developed and it is reported in this document. The device is based on the generation of 300, 1000, and 3000 Hz frequencies of sinusoidal signal and allows the application of 30, 40, and 50 dB of sound pressure levels (SPL).

### II. METHOD AND MATERIALS

Monitor devices, like audible toys or the observation of reactions to sound stimulations without previous warnings, have resulted of great value for the detection of hypoacusis in kids [1].

In this work, a small tool to detect hypoacusis has been developed. This device is intended to be used in classroom, to be hidden by the teacher, portable, battery supplied, and easy to change the controls.

Basically, the tool is formed by a pure tone generator with frequencies and SPL given above. This tool can be applied on a distance of 70 cm or less. It is variable in steps for both frequency and SPL given by using two arrangements of three-pushbutton switches, to know without see, the chosen combination. SPL can be changed from 50 to 70 dB with increments of 10dB.

The signal generator was developed by using the integrated circuit ICL8038, a sinusoidal signal generator whose frequencies can be changed from 0.01Hz to 300 kHz modifying just a resistor. This device can be adjusted for

harmonic distortion and symmetry parameters. For the power output, the integrated circuit labeled TDA2003 was used. The complete circuit is shown in figure 1. [4]

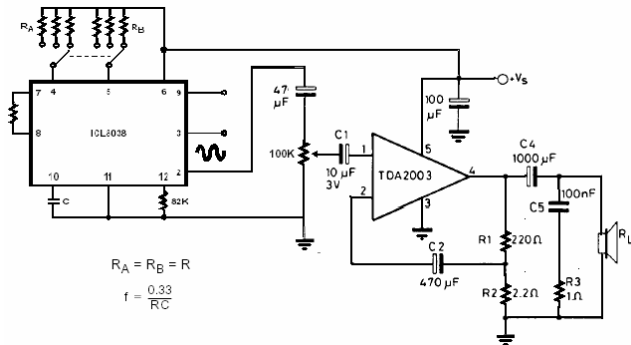


Figure 1. Schematic of the pure tones generator.

### III. CHARACTERIZATION

Evaluation of the hypoacusis detector was performed in an anechoic chamber. The detector was placed in front of a microphone for measurements (B&K, model 4165, USA). Figure 2 shows the arrangement that includes an extension rod and tripod mounting support.



Figure 2. Hypoacusis detector - microphone arrangement for characterization.

Both hypoacusis detector and microphone were aligned considering 0.7 m apart each other and 0.93 m height from the floor of the anechoic chamber.

A spectrum analyzer (B&K, model 2034, USA) was used for the test. It is based on the Fast Fourier Transform (Figure 3). The measurement system was calibrated using a 94.3 dB and 1000Hz tone.



Figure 3. Measurement System based on FFT

Three parameters were measured for the characterization: sound pressure level, current supply and signal frequency. The current supply was measured simultaneously with the sound pressure level using a multimeter (Fluke, model 75A, USA).

### IV. RESULTS

Results of characterization are shown in figures 4, 5 and 6.

Measures were made during 8 hours. It can be seen instability in the results, especially in frequency that presented a displacement of 16%. Even though, the device was considered useful under this condition. The circuit has been modified to reduce this deviation. Sound Pressure Level was practically maintained without changes until battery was totally discharged. Current supply was 45 mA average.

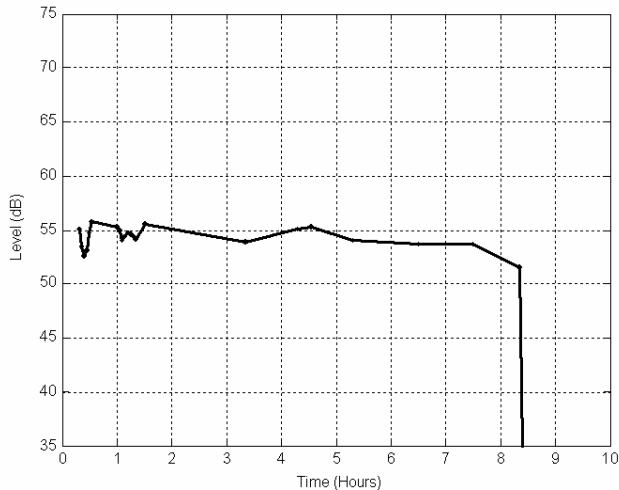


Figure 4. Sound Pressure Level vs time

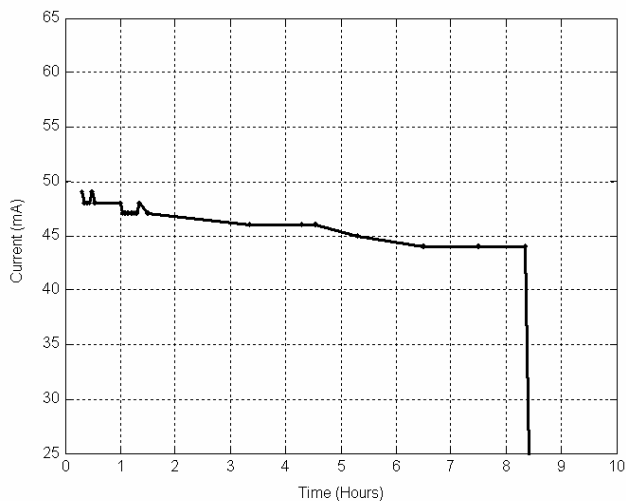


Figure 5. Current supply vs time

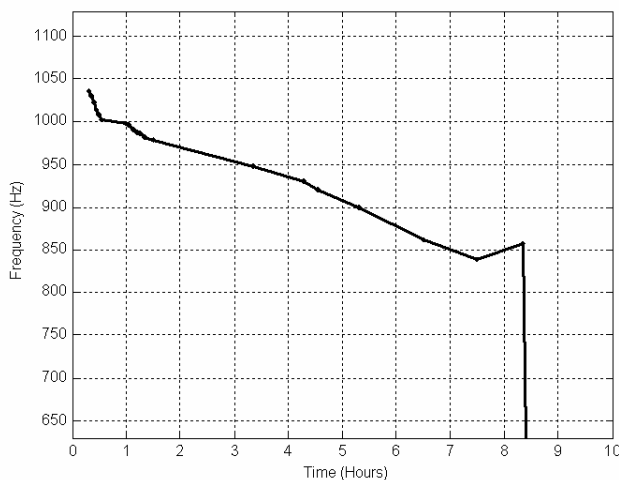


Figure 6. Signal frequency vs time

## V. CASE OF STUDY.

The device was submitted to 25 scholars from a private elementary school, distributed in 22 for control and 3 experimental. Control means that no apparent attention disorder neither low academic performance was observed. Three experimental means that some problems were observed. Measurements were made under 20dB of background noise and in a separate room. Device was managed by the scholars and an experimental protocol was followed.

The results of this study were that all the scholars could hear the sound under the different sound level pressures and frequencies.

## VI. CONCLUSIONS

A hypoacusis detector has been developed. This device is as a novel proposal to close a primary audio evaluation to scholars, especially having problems in their academic performance.

The solution was simple but complemented with the protocol of application customized for kids, really promises to help in detecting early hypoacusis problems in field.

New cases of study will be submitted and some physical modifications will be performed to the device trying to make it more attractive to the scholars. Intelligibility evaluation will be included.

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