



# All About FM



## Introduction.

Understanding speech in the classroom environment can be difficult for all students, but for a child with a hearing loss it is even more challenging. In this booklet we discuss three common obstacles to the understanding of speech: noise, distance and reverberation. We explain how they occur and how they interfere with a student's ability to understand the teacher. We then offer an effective tool for improving the classroom environment – FM technology.

## The Need for FM Systems.

A typical classroom scenario: The teacher asks a question about last night's homework, and wanting to encourage participation from those who rarely raise their hand, she decides to call on Johnny: "Johnny, can you answer that question?" Johnny looks up with surprise and embarrassment. He wasn't even aware that she had just asked a question.

If the teacher had not called Johnny's name, his apparent lack of attentiveness may have continued to go unnoticed. This scenario is typical for children with a hearing loss, and unfortunately, at first impression, the student may be viewed as apathetic or not understanding the material.



*If a student is unable to clearly hear the teacher, participation in classroom discussion may be next to impossible.*

# Obstacle 1: Noise.

Children with hearing loss, however mild, generally remain silent about their inability to understand the teacher because they, like Johnny, may not even be aware that they have missed a question or other directions. Or they pretend to understand, until the teacher or a family member begins to take notice. Once the child has been identified as having a hearing loss, immediate steps must be taken to provide him/her the optimal listening conditions for clear speech understanding. Improving the listening environment will help the student become more confident to participate, and will enhance the overall learning process in the classroom. Classrooms, by nature, are

often poor acoustical environments for students with a hearing loss. Distance between teacher and student, combined with background noise from street traffic, feet shuffling, desks and chairs being moved, and other students talking, make speech intelligibility extremely challenging. Hearing aids not only amplify the speaker's voice, but also all other background sounds. Thus, hearing aids alone cannot help make the speaker's voice any clearer. To improve speech understanding, amplification must provide more than increased volume, it must overcome the three obstacles presented by the listening environment: noise, distance and reverberation.

A student's first obstacle to the understanding of speech is the background noise in the classroom. All of us have experienced the frustration of trying to hear the television or radio while others are talking. For students in the classroom though, noise is more than just an annoyance. It causes a general breakdown of communication, which can result in academic failure from missed directions and information given by the teacher. Noise is often an uncontrollable factor and can emanate from both inside and outside the room. Street traffic, playground noise, feet shuffling, desks and chairs moving, fans, and heaters are all contributors to poor speech understanding.

A number of studies have measured the intensity of back-

ground noise in classrooms. These studies show that a typical classroom has a noise level of approximately 60 decibels (dB) – equivalent to the level of noisy typewriters in an office. In order for the student with a hearing loss to receive the teacher's voice, the signal (teacher's voice) should be 15 to 20 dB higher than the background noise. This is what audiologists refer to as a 15 to 20 dB signal-to-noise ratio. A signal-to-noise ratio is determined by measuring the intensity of the signal and the background noise found in the classroom. The difference between these figures represents the signal-to-noise ratio. In a normal setting, the teacher's voice measures - approximately 65 dB, and the background noise approximately 60 dB. This leaves us with a signal-to-noise ratio of only 5 dB ( $65 \text{ dB} - 60 \text{ dB} = 5 \text{ dB}$ ). Since a 15 to 20 dB signal-to-noise ratio is -desirable, the average classroom with a 5 dB signal-to-noise ratio is clearly inadequate for the student with a hearing loss.



*A girl using an FM-system*



*Students with hearing loss have greater difficulty discriminating between competing background noise and the teacher's voice.*

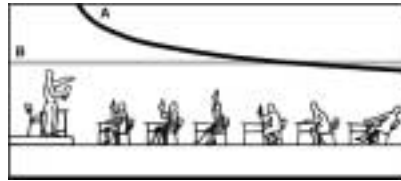
## Obstacle 2: Distance.

The second obstacle to the understanding of speech is the distance between student and teacher.

You can experiment with the effect of distance on speech understanding by standing three feet away from your listener as you speak at a normal volume. Now step back another three feet, and continue to double the distance, while maintaining the same voice level. Soon you will find that your listener will no longer be able to understand what you are saying, particularly if you are in a noisy listening environment. This is exactly the problem students face when they sit at a distance from the teacher.



*Sitting close to the teacher is an effective, though impractical method of decreasing the sound distance between teacher and student.*



*A = Teacher's voice    B = Background noise  
Increasing the distance between teacher and student reduces speech understanding.*

In a classroom setting the teacher is an average of 6 to 12 feet from students in the front row. Let's say, that at 6 feet from the students the teacher's voice is measured at 65 dB and the background noise measures 60 dB. Now let's say the students move to the third or fourth row, another 6 feet away. The teacher's voice is now being heard at 59 dB (the rule is that doubling the distance yields a 6 dB decrease in the sound level), so now the background noise is actually 1 dB louder than the teacher's voice! The teacher's voice has in fact been drowned by the background noise because of the increase of distance. For all students, but especially for those with a hearing loss, this situation is clearly not optimal. Positioning a student with a hearing loss directly next to the teacher would help, but this type of restricted seating is neither practical nor advised.

## Obstacle 3: Reverberation.

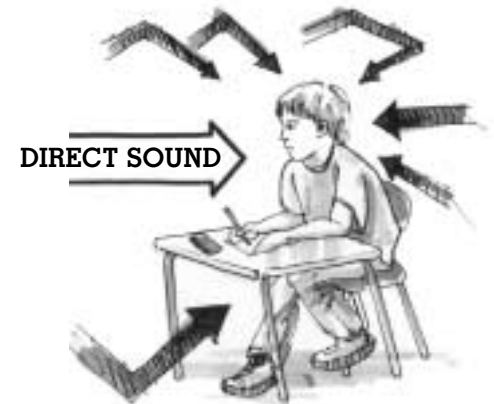
Posing yet another obstacle to speech understanding is reverberation (also referred to as echo) – sound which travels from the speaker by reflection from surfaces in a room. All rooms reverberate sounds, some more than others depending on construction and furnishings.

For example, hard walls, high ceilings, glass windows, and uncarpeted floors, common to many classrooms, reverberate sounds much more than carpeted floors and acoustically treated walls and ceilings. Reverberation is generally unnoticed among listeners with normal hearing.

Reverberation is measured in time – the time it takes for a sound to decrease in intensity by 60 dB (e.g. from 60 to 0 dB). This should be no higher than 0.3 to 0.4 seconds for persons with hearing losses. However, studies performed in classrooms illustrate that actual reverberation average 0.8 seconds in a normal classroom, which is twice that recommended. This makes it even harder to hear the teacher (Ross, 1992).

Improving classroom listening conditions with acoustically treated walls, floors, and ceilings is an effective, though

somewhat impractical and expensive way to control the acoustical effects and reverberation in the classroom.



*Reverberation of both the teacher's voice and background noise further confuse speech understanding.*

# The Solution.

As illustrated, all listening environments present challenges for persons with hearing losses. But every effect of the environment can be overcome simply by reducing the distance between the speaker and the listener. The Phonic Ear FM-system provides a solution without seating restriction or costly construction modifications to the classroom.

With the help of a Phonic Ear FM-system, the distance between the teacher and students (no matter where they're sitting in the classroom) becomes effectively no more than six inches. An FM-system provides a direct transmission from the teacher-worn transmitter with microphone to the student-worn receiver. Since the teacher's mouth is always only six inches away from the microphone worn below the chin, physical



*This girl uses her FM-system.*

distance is no longer an issue. Moreover, the FM-system is wireless so the teacher can move freely around the room and turn to face the blackboard while effortlessly maintaining the level of his/her voice to the student.

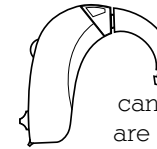
This direct transmission of the teacher's voice to the students' ears overcomes the problem of distance, therefore combating the effects of background noise and reverberation.

For many years teachers, speech pathologists, parents and audiologists have utilized Phonic Ear FM-systems to assist students in all learning environments. In special classrooms and mainstream programs, from preschool through college, Phonic Ear FM-systems provide the acoustic environment necessary for good speech understanding. And while no FM-system can eliminate background noise or reverberation, it can control their effects, while simultaneously providing high-quality amplification of the teacher's voice to any number of students.

# The FM-System.

## Direct Audio Input

Students receive the FM signal directly through their hearing aids. The two ways this direct connection can be accomplished are discussed below.



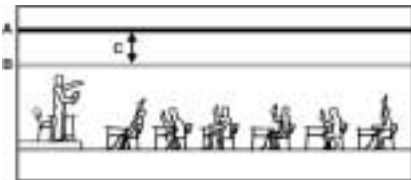
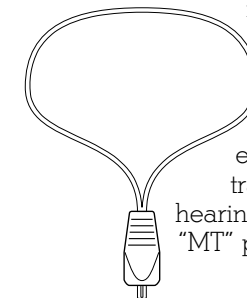
## Audio Plug & Cord

A personal FM-system may be connected directly to a student's hearing aids with use of an audio plug and cord. Both plugs and cords are available in a variety of sizes and lengths, and provide excellent sound quality.



## Neck Loop

A neck loop may also be used to transfer the FM signal to the hearing aids. The neck loop may be worn beneath clothing, and is connected by a cord to the receiver. To receive the FM transmission, set the hearing aids in the "T" or "MT" position.

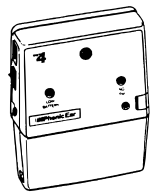


- A = Teacher's voice through Phonic Ear FM-system
- B = Background noise
- C = 15-20 dB signal to noise ratio

*Sitting in any row of the classroom, the student can hear the teacher's voice through the Phonic Ear FM-system as clearly as being right next to her.*

# Trouble Shooting.

## Receiver



This unit picks up the FM signals from the person who speaks into the transmitter and transfers the signal to the hearing aids.

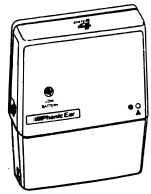
## Problem:

No sound from receiver.

## Solution

- Check that the cords are properly connected and not broken.
- Turn up volume controls.
- Replace batteries.

## Transmitter with a microphone



When someone speaks into the microphone, the sound signal is transmitted from the transmitter to the receiver.

## Problem:

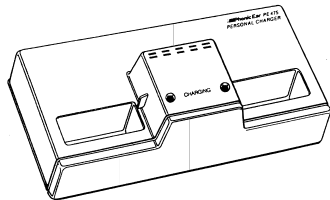
No FM reception.

## Solution

- Make sure that the microphone or antenna cord is plugged into the transmitter.
- Replace batteries in transmitter.
- Check that the cords are properly connected and not broken.
- If the FM-system uses crystals try to plug in one you know is working.

## Charger

This box can be used to store the personal FM system and charge rechargeable batteries should any be used.



*Sponsored by the Oticon Alliance for Better Hearing*