

## ***Automatic mixer***

The function of an automatic mixer is twofold:

- 1) to automatically activate microphones as needed and
- 2) to automatically adjust the system gain in a corresponding manner.

## **Summary of automatic mixer benefits**

The primary function of an automatic mixer is to keep unused microphones turned off and to instantaneously activate microphones when needed.

- Using an automatic mixer will:
  - Improve gain before feedback
  - Reduce audio degradation caused by superfluous open microphones
  - Control the build-up of background noise
- Keeping the number of open microphones to a minimum always improves overall audio and quality
- The additional control circuitry on automatic mixers provide a variety of additional functions like:
  - Audio privacy switches
  - Chairperson control of all microphones
  - Illuminated indicators of microphone status
  - Automatic video camera selection based on microphone activation

## **Level vs. Gain**

Level refers to the sound-pressure level or the audio signal voltage in the system at a given moment.

Gain refers to amount of amplification in a signal path between the input and the output

## **Gain Structure**

Setting gain structure in a sound system concerns the proper calibration of signal levels between devices in the audio chain to achieve good signal-to-noise ratio and adequate headroom.

Since all the “devices” are within the same automatic mixer, headroom is not a concern. The Unity method will be applied. It simply means that every component after the mixer should produce an output voltage equal to the voltage at its input.

## **Acoustic Echo Cancellation**

It is designed to reduce the complex echoes which result from loudspeaker-to-microphone leakage.

An AEC monitors the incoming audio signal from remote sites, and compares it to the signal that is about to be transmitted. If the echo canceller detects the presence of the

incoming audio in the outgoing signal, it attempts to remove it electronically from the outgoing signal.

Acoustic echo cancellers are commonly mistaken to be capable of removing the hollow sound associated with a room that is too reflective; no electronic device can do that. In fact, excess reflected sound makes it more difficult for the echo canceller to work properly, and reduces the degree to which it can reduce transmission echo.

Acoustic echo cancellers take time (1/10 of a second or more) to "learn" how to reduce echo in a particular room, and they have to go through this learning process whenever the path from loudspeaker to microphone changes. This might be caused by a wireless microphone user moving around the room, or microphones being turned on and off by an automatic mixer. During these "learning" periods, echoes will not be reduced.

### **Optimal signal flow for the echo cancellation process**

Microphone > Gain > AEC > NC > Mute > Filters > AGC > Mic Mixer

### **Equalization**

Selectively boosting or cutting bands of frequencies to improve the performance of a sound reinforcement system by emphasizing the frequency ranges most critical for speech.

### **What equalization cannot do:**

Make a poorly designed sound reinforcement system work satisfactorily.

Improve intelligibility problems caused by reverberation, reflections, mechanical vibration, high background noise levels, or other problems caused by the location or physical design of the room.

Improve intelligibility problems caused by the talker being too far from the microphone.

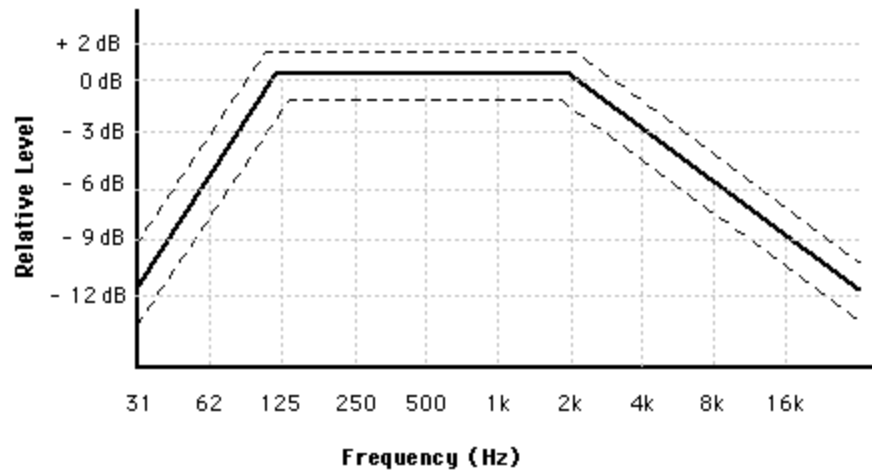
Improve the performance of sub-standard audio components in the sound reinforcement system.

Eliminate distortion or noise problems caused by mismatched audio levels between system components.

Improve echo return problems in teleconferencing systems.

### **The best equalization curve for a speech sound reinforcement system?**

See the graph below. Note that the response above 2kHz rolls off 3dB for each octave, i.e. -3dB at 4kHz; -6dB at 8kHz; -9dB at 18kHz. The response from 125Hz to 2kHz is flat with a window of  $\pm 2$ dB. Frequencies below 125Hz are rolled off to minimize rumble/boominess. This curve is based on human hearing and perception research.



**Parametric EQ:** The "problem solver." Use the parametric equalizer to correct response peaks in the sound system. Microphones and loudspeakers, in particular, introduce many irregularities into the overall frequency response. With the appropriate audio measurement device, these irregularities are easily identified and corrected by a parametric equalizer.

**Graphic EQ:** The "tone control." Use the graphic equalizer to make broad changes to the sound system's frequency response. Once the parametric equalizer has flattened the frequency response of the system, the graphic equalizer serves as a tool for subjective shaping to achieve "pleasing" sound quality.

**Crossover:** It can either separate high, mid, low frequencies (3-way) or separate high frequencies from other frequencies (2-way) to output to different speakers that specialize for that frequencies in order to improve performance.

## Dynamics processors

The term dynamics refers to the wide variations in signal levels commonly encountered in sound systems.

**Compressor/Limiter:** reducing the level of all signals about a user-defined point (the threshold), by a specified amount.

**Expander:** expanding the dynamic range of an audio signal by raising signals that pass about the threshold.

**Noise gate:** When signal level drops below the threshold, the output is turned off to preventing build-up of undesired noises.

**Automatic Gain Control (Leveler):** Compensate for difference in level between loud and soft talkers by either adds or reduces gain.

## **Delay**

Delaying the incoming audio signal to make sure the signal arrives to all speakers with difference distances at the same time.

Delay (milliseconds) =  $1000 (D \text{ (feet)} / 1130)$

The most common problems

Problems	Remedies
Feedback	Parametric Equalizer/ Automatic Mixer/ Feedback Reducer
Poor tone quality (subjective)	Graphic equalizer
Sound source too loud	Compressor/Limiter/AGC
Sound source too quite	AGC
Varying signal levels from multiple sound sources	Compressor/Limiter/AGC
Unwanted noise	Noisegate/Downward expander
Unexpected transients	Compressor/Limiter/ No overshoot Peak Limiter
Comb filtering due to open microphones	Automatic Microphone Mixer
Frequency response anomalies due to misaligned loudspeakers	Delay
Poor intelligibility	Parametric Equalizer/ Automatic Microphone Mixer
Acoustic echoes (in teleconferencing systems)	Acoustic Echo Cancellor
Distortion (due to wide dynamic range)	Compressor/Limiter

**Problems that cannot be solved by audio processing:**

- Echoes because of poor room acoustics
- Poor sound due to excess room reverberation times
- Feedback caused by operating beyond the limits of PAG
- Noise
- Distortion due to improper gain structure

**Potential Acoustic Gain (PAG)** is the calculated gain that a sound system can achieve at or just below the point of feedback.

## **Bibliography**

Biamp Technical Support Team, (2007) *Automixers*, Technical Newsletter Volume 2, Issue 3.

Hannig, K., (2005) *Optimizing Teleconference Audio system Designs*, Pro AV Magazine.

Shure educational guides and articles (2007), *Basic of Equalization and Feedback*, Shure Incorporated.

[http://shure.custhelp.com/cgi-bin/shure.cfg/php/enduser/std\\_adp.php?p\\_faqid=71](http://shure.custhelp.com/cgi-bin/shure.cfg/php/enduser/std_adp.php?p_faqid=71)

Shure educational guides and articles (2007), *Why Use Shure Automatic Mixers*, Shure Incorporated.

Sigismondi, G., (2003) *Selection and Operation of Audio Signal Processors*, Shure Incorporated.

Stuckman, T., & Marks, S., *Automatic Mixers*, Peavey Electronics.

*Automatic Mixer Application Guide*, Peavey Electronics.

*Crossovers de-mystified*, BBS Audio

*Compression*, BBS Audio

*Loudspeaker protection*, BBS Audio