

## Setting up the Acoustic Echo Canceller Reference of a XAP

### Description

Acoustic echo is generated when far end audio leaves the local room's speaker and gets picked up by the local room's microphones and transmitted back to the far end. This results in the far end hearing hear an echo of their own voice as they speak. Acoustic Echo Cancellation (AEC) is the process of canceling this acoustic echo and every mic input on the XAP is equipped with an Acoustic Echo Canceller capable of canceling this acoustic echo. Last by defining the PA Adapt and AEC Reference (PA/AEC Ref) of a microphone you are telling it what audio you want it to cancel.

### Introduction

This document discusses the PA/AEC Ref of a XAP and how to set up a proper PA/AEC Ref for microphone inputs. A brief theory of Echo Cancellation Referencing will be followed with instructions for setting up microphone PA and AEC Refs in four different applications.

- Application 1) One XAP unit and a single feed to a power amplifier.
- Application 2) Two XAP units and a single feed to a power amplifier.
- Application 3) One XAP unit, a single feed to an amplifier, and local mic reinforcement
- Application 4) One XAP unit and multiple feeds to amplifier(s), stereo speakers and ceiling speakers.

### A little Echo Cancellation Theory

Acoustic echo is generated when far end audio leaves the local room's speaker and gets picked up by the local room's microphones and transmitted back to the far end. This results in the far end hearing hear an echo of their own voice as they speak. Every microphone input on a XAP can cancel this Acoustic Echo. This is accomplished by defining the PA/AEC Ref for the microphones input. See Figure 1. By defining the PA/AEC Ref you are telling the microphone what audio you want it to cancel. Usually the output channel that connects to the local room's amplifier and speaker is mix of far end and program audio. By defining a microphone's PA Adapt and AEC Ref to this output you are telling the microphone to cancel the mix of the far end and program audio that is entering the room. If multiple XAP units are linked through the expansion bus a microphone's PA Adapt and AEC Ref can even be defined as an output channel on another XAP unit by using on of the four Expansion bus references. If a microphone is routed to the output you have told it to reference then the microphone will cancel it's own audio. Thus a microphone's PA Adapt and AEC Ref may even be defined as a Virtual Reference. Each XAP unit also has four Virtual References that provide the user with the ability to pick and choose the audio sources that the microphone will cancel.

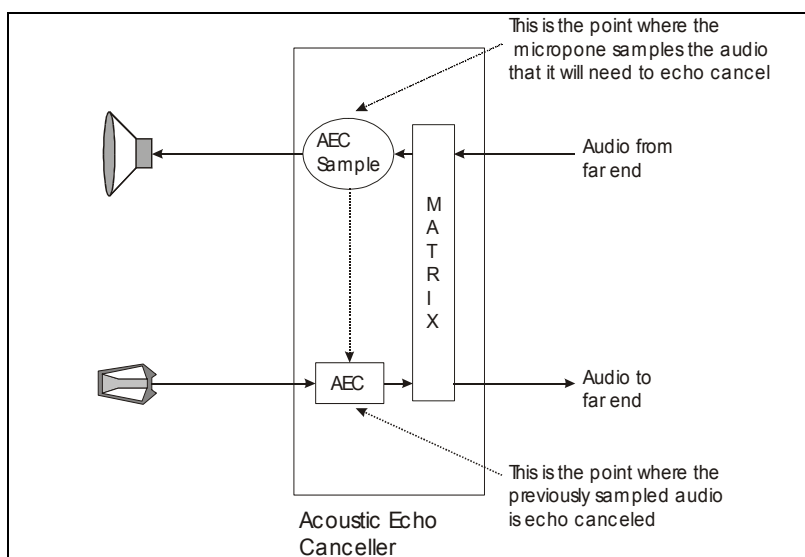


Figure 1

**Application 1)** One XAP unit and a single feed to a power amplifier. (Microphones reference an output)

The figure displays three screenshots from the ClearOne software interface:

- Top Screenshot:** A matrix routing table for 'Outputs 1 - 12'. The columns are numbered 1 through 12, and the rows are labeled 'MIC INPUT 1' through 'MIC INPUT 8' and 'FROM FAR END'. A yellow oval highlights the 'TO FAR END' column (column 9), and a green circle highlights the 'AMPLIFIER' button in the bottom right corner of the matrix.
- Middle Screenshot:** The 'Acoustic Echo Canceller - MIC INPUT 1 XAP 8' window. It shows a block diagram of the AEC process with 'ERL Meter' and 'ERLE Meter'. Below the diagram, there are controls for 'Enable Acoustic Echo Canceller (AEC)', 'Non-linear Processing (NLP)' (Aggressive, Medium, Soft, Off), and 'PA Adapt and AEC Reference' (set to 'AMPLIFIER'). At the bottom, there are three meters for 'Echo Return Loss (ERL)', 'Echo Return Loss Enhancement (ERLE)', and 'Total Echo Reduction (ERL + ERLE)'. The 'AMPLIFIER' dropdown menu is circled in red.
- Bottom Screenshot:** The 'Inputs 1-8 - XAP 800 0 (D-vice ID 0)' window. It shows a grid of controls for eight microphone inputs. The 'AEC' button for 'MIC INPUT 1' is circled in red.

**Step 1:** In the matrix route the microphones to the far end.

**Step 2:** In the matrix route the far end to the amplifier.

**Step 3:** Select the PA Adapt and AEC reference to the amplifier.

**Note:** The AEC window is opened by selecting the AEC button in the Inputs 1-8 Window.

Figure 2

**Application 2)** Two XAP units and a single feed to a power amplifier. (Unit 1's mics reference Unit 0's output)

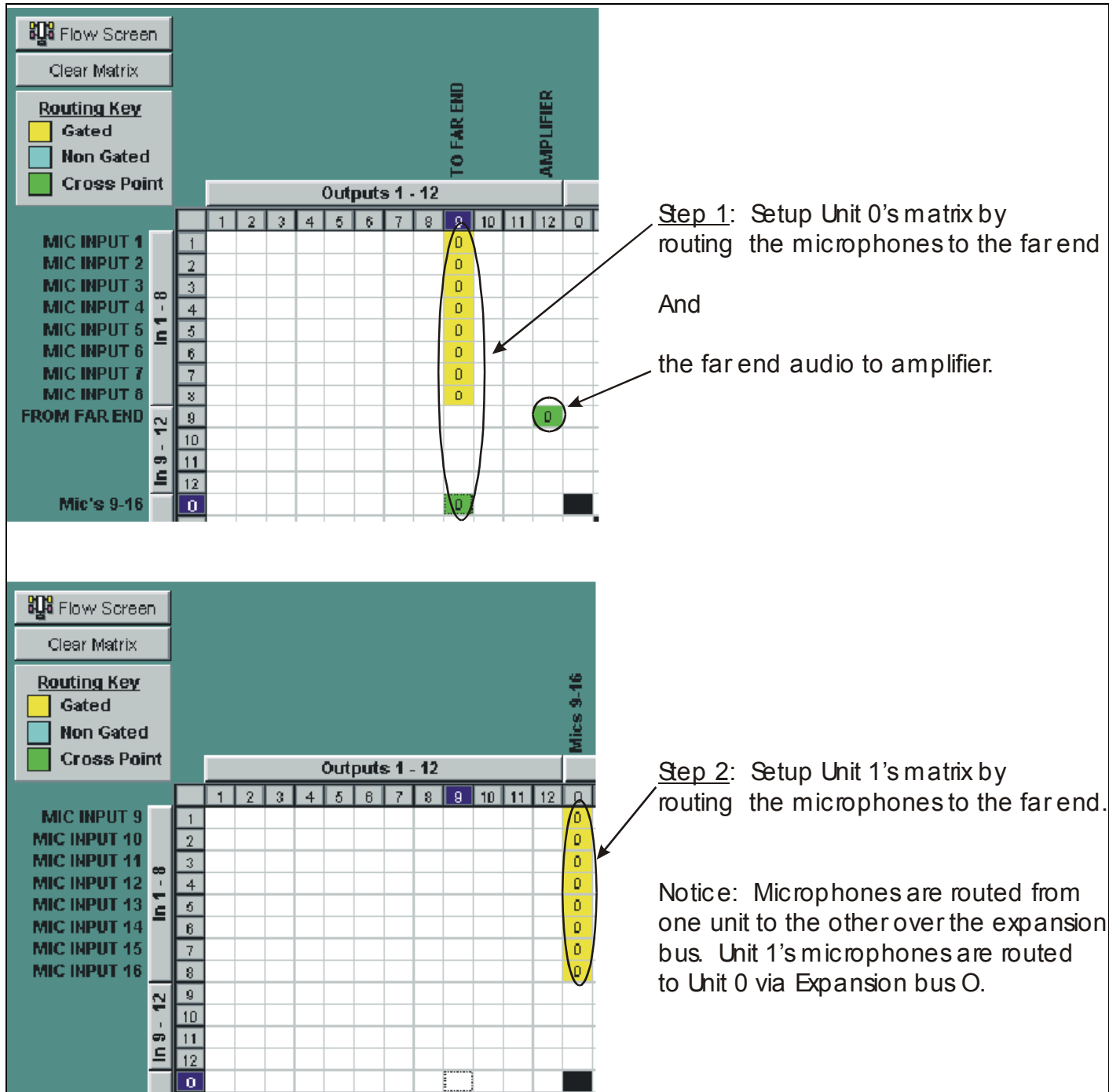
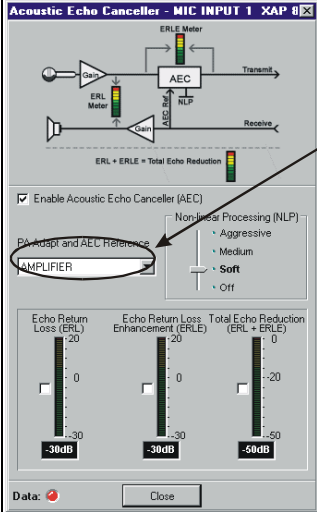


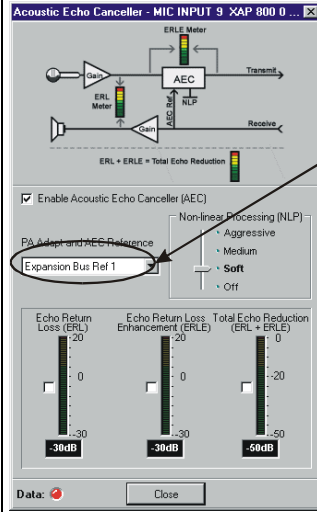
Figure 3



**Step 3: Setup Unit 0's AEC Reference**

Select the microphone's PA Adapt and AEC Reference to the output feeding the amplifier.



**Step 4: Setup Unit 1's AEC Reference by**

Selecting the microphone's PA Adapt and AEC reference as Expansion Bus Reference 1.

AND

Define Expansion Bus Reference 1 as the output feeding the amplifier.

**Note:** Microphones can echo cancel audio outputs on another unit. In this example Unit 1's microphones are echo cancelling the amplifier output of Unit 0.

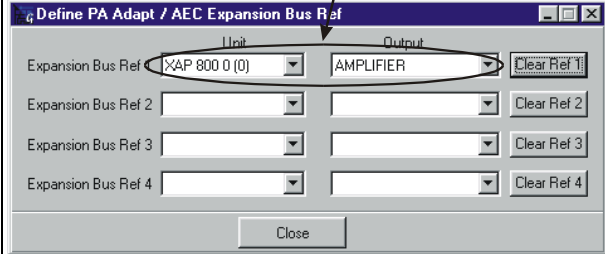


Figure 4

**Application 3)** One XAP unit, a single feed to an amplifier, and local mic reinforcement (Mics reference a virtual reference because they are locally reinforced)

**Routing Matrix (Outputs 1-12):**

Input	1	2	3	4	5	8	7	8	9	10	11	12	0
MIC INPUT 1										0			-18
MIC INPUT 2										0			-18
MIC INPUT 3										0			-18
MIC INPUT 4										0			-18
MIC INPUT 5										0			-18
MIC INPUT 6										0			-18
MIC INPUT 7										0			-18
MIC INPUT 8										0			-18
FROM FAR END												0	

**Cross Point Settings:**

Input / Output: MIC INPUT 1 \ AMPLIFIER  
 Attenuation: -18.0

**Acoustic Echo Canceller - MIC INPUT 1 XAP 800 0 ...**

Enable Acoustic Echo Canceller (AEC)    
 Non-linear Processing (NLP)    
 PA Adapt and AEC Reference: **Virtual Ref 1**

**Virtual Reference XAP 800 0 (Device ID 0)**

Input	TO FAR END	AMPLIFIER
MIC INPUT 1	0	-18
MIC INPUT 2	0	-18
MIC INPUT 3	0	-18
MIC INPUT 4	0	-18
MIC INPUT 5	0	-18
MIC INPUT 6	0	-18
MIC INPUT 7	0	-18
MIC INPUT 8	0	-18
FROM FAR END	0	0

Output Level Tracking: Virtual Ref. 1: AMPLIFIER, Virtual Ref. 2: None, Virtual Ref. 3: None, Virtual Ref. 4: None

**Step 1:** Route the microphones to the far end

**Step 2:** Route the microphones to the amplifier AND Route the far end to the amplifier.

**Note:** The microphones routed to the power amplifier have 18dB of attenuation. This prevents feedback and can be used to adjust the sound reinforcement level. Cross point attenuation is adjusted by right mouse clicking on a cross point, selecting cross point, and adjusting the level..

**Step 3:** Select the microphones PA Adapt and AEC Reference to Virtual Reference 1.

**Step 4:** Setup the Virtual Reference 1 by Routing the audio from the far end to virtual reference 1 AND setup the Output Level Tracking to track the output feeding the power amplifier output.

**Note:** The microphones DO NOT get routed to Virtual Reference 1. If they are then they will try to echo cancel their own audio.

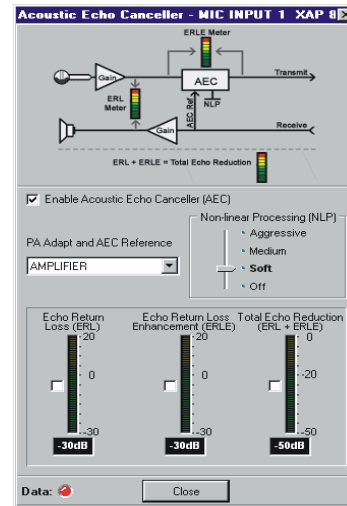
Figure 5

**Application 4)** One XAP unit and multiple feeds to amplifier(s). Stereo Speakers and Ceiling Speakers. (In example 1 the mics reference an output because the output contains all audio sources entering the room. In example two the mics reference a virtual reference because there are separate program and conferencing speakers)

Example 1: The microphone's PA Adapt and AEC Reference is the amplifier on output 12 because this output contains a mix of the far end audio *and* the program audio.

Note: The microphone's AEC is set to reference all the audio sources that enter the room.

	1	2	3	4	5	6	7	8	9	10	11	12	0
MIC INPUT 1													
MIC INPUT 2													
MIC INPUT 3													
MIC INPUT 4													
MIC INPUT 5													
MIC INPUT 6													
MIC INPUT 7													
MIC INPUT 8													
FROM FAR END													
PROGRAM LEFT													
PROGRAM RIGHT													



Example 2: The microphone's PA Adapt and AEC Reference is the Virtual Reference because there are separate outputs for the far end audio and the program audio. Setup the Virtual Reference by routing the far end audio and the program audio to Virtual Ref 1 then select output level tracking to the amplifier because this output contains the far end audio.

Note: The microphone's AEC is still set to reference all the audio sources that enter the room.

	Virtual Ref. 1	Virtual Ref. 2	Virtual Ref. 3	Virtual Ref. 4	TO FAR END	PROGRAM LEFT	PROGRAM RIGHT	AMPLIFIER
MIC INPUT 1								
MIC INPUT 2								
MIC INPUT 3								
MIC INPUT 4								
MIC INPUT 5								
MIC INPUT 6								
MIC INPUT 7								
MIC INPUT 8								
FROM FAR END								
PROGRAM LEFT								
PROGRAM RIGHT								

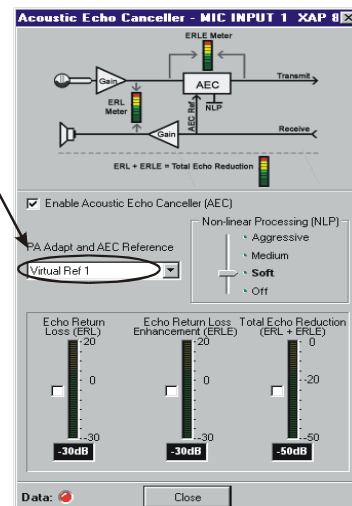


Figure 6

**Conclusion**

In every application the microphone references all the audio that enters the room except for itself. This is done by setting up a microphone's PA Adapt and AEC Reference. The PA Adapt and AEC Reference can be an Output Channel, an Expansion Bus Reference, or a Virtual Reference.

If there is no voice lift, aka local mic reinforcement, then the microphones PA Adapt and AEC reference should be an Output Channel, in particular the output connected to the speaker.

If the microphone needs to reference an output channel or a virtual reference on another unit then this is done via the Expansion bus Reference. Using one of the four Expansion Bus Reference a microphone and reference and echo cancel audio on from linked units.

If the microphone needs to be locally reinforced or if there are separate program and conference speakers in the room then the microphone use a Virtual Reference for it's PA Adapt and AEC reference. Route to the virtual reference all the audio sources that will enter the room speakers except for the local mic reinforcement.