Sage Alerting Systems
Service Bulletin #1, Audio Levels

For the Sage Digital ENDEC 3644,
Revised for version 1.1 (versions 88 and greater)

Note: In the discussion below, level always refers to peak level.

Summary

The default settings for record level and playback level are too high if the peak audio input level into the ENDEC's monitor input is greater than 0.8V. This shows as about -7dBFS on the ENDEC's Show Input Levels web page.

Users with audio settings too high can relay alerts that appear to have another alert mixed with it, or an alert that decays into unintelligibility.

This bulletin describes how to tell if your audio settings can cause this problem, and recommends changes to your settings to solve this problem.

Description

If your input levels, or the output levels resulting from the combination of the input levels, the record levels, and the playback levels, result in excessive output from the ENDEC, then quality of alerts you put on the air can be reduced, or in some cases can be unintelligible.

If the input levels are too high, the resulting output will be clipped, no matter what the playback level. If the record/playback level is too high then the output level from the ENDEC's main audio out XLR can exceed +14dB. If the output level does exceed this level, then the output can cross couple to the input, resulting in an unintelligible alert relay.

The "output appears on the input" issue only shows up if the alert is sent in the "automatic relay" mode, meaning the ENDEC starts retransmitting the alert while it is still receiving the incoming alert (this includes the EAN). In this mode, if the audio output is excessive, you will hear what appears to be a mix of two different alerts, but what you are hearing is the start of the original alert, delayed by about 20 seconds.

In cases where the input is loud enough the be clipped, and the output is >+14db, then the output appearing on the input will also be loud and distorted, which will again appear in the output 20 seconds later, resulting in an unintelligible alert if the alert is more than 20 seconds. The first 20 seconds will have degraded audio as well, depending on how often the output is greater than +14dB, and what your downstream equipment does with such a signal.

In the case where an alert is of the "timed relay" type, the audio will also be excessively loud, but won't result in a delayed copy of the audio appearing again on the input, because the ENDEC isn't sending the alert while it is still being received.

Note: The above discussion refers to the levels of the "speech" portion of the alert. While it is possible to turn up the "tones" portion of the alert (data tones and the two-tone attention signal) to +14dB, you would need to turn the tones far hotter than the default levels.

How to tell if you have this problem

All of the input levels are displayed on the ENDEC's web page, click the "tools" button, and then click "levels". You'll see a display that looks something like this:

VU levels						
	Mon In Gain	Input Average	Input Peak	Record Gain	Playback Gain	Peak XLR Output
Monitor #1	6.0 dB	Silent		-6.0 dB	-12.0 dB	
Monitor #2	0.0 dB	Silent		-6.0 dB	-12.0 dB	
Monitor #3	0.0 dB	-15.6 dBFS	-5.4 dBFS	-6.0 dB	-12.0 dB	5.8 dBu
Monitor #4	0.0 dB	-15.6 dBFS	-6.4 dBFS	-6.0 dB	-12.0 dB	4.8 dBu
Monitor #5	0.0 dB	-24.0 dBFS	-10.0 dBFS	-6.0 dB	-12.0 dB	1.2 dBu
Monitor #6	0.0 dB	Silent		-6.0 dB	-12.0 dB	

Figure 1. ENDEC Monitor Audio Level Display

The columns are:

Mon In Gain	A hardware amplifier stage on each monitor input is adjustable from 0dB to 7.5dB
Input Average	The average level of the digitized monitor input, in dBFS
Input Peak	The peak level of the digitized monitor input, in dBFS. If this entry is "clipping", then the input is too loud to digitize without loss.
Record Gain	The Record #1 Level from the ENDECSetD levels tab
Playback Gain	The Playback Level from the ENDECSetD levels tab
Peak XLR Output	The Peak output of the main XLR analog audio output, taking the input average, adding the effects of the Record and Playback Gain, converted from dBFS to dBu.

If the output peak is higher than 14dB, you will begin to hear some loopback noise. At 14 dBu, the noise is almost unnoticeable. At higher levels, the noise will affect the intelligibility of the playback.

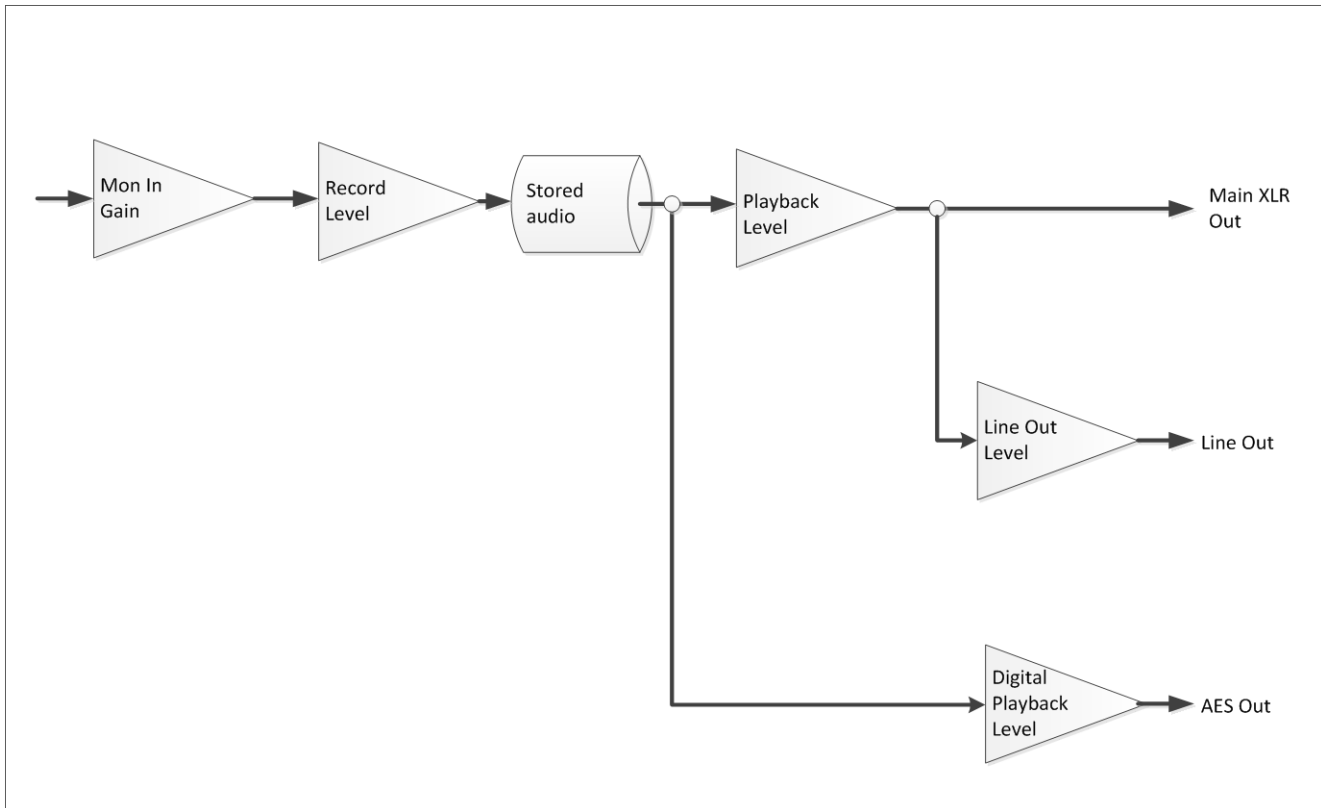Refer to the figure below for a better understanding of the ENDEC's monitor input audio path.

Figure 2. ENDEC Monitor Audio Path

By default, the audio comes into the ENDEC, is amplified in hardware by the Monitor Input Gain, and is converted to digital. Once it is in the digital domain, it is displayed as dBFS, where Full Scale is 16 bits, that is, +- 32767. This is to make it easier to compare to audio from other sources, such as audio files attached to CAP messages. Your audio might show up as -9dBFS, for example. If you raise the Monitor Input Gain 3dB, the audio will be -6dBFS.

The digital audio is then adjusted by DSP software, before it is stored (record level). Just add that setting - if your record gain is -3dB, your -6dbFS is now -9dBFS. This is what is actually recorded as a digital audio file inside the ENDEC. If you get a log file and load it into a digital audio editing program, you'll see -9 dBFS.

At playback time, the audio runs through the playback gain. If you have it set to -12db, your audio out is -15dBFS. The digital output is then converted to analog, and run through non-adjustable hardware amplifiers.

To convert from dBFS to dBu on the output, add 29.2. That gives us, in this example, 15dBu, which will show up as red, and would cause a minor loopback problem - as well as being too loud in general.

In this case, if you wanted the peak output to be +4dBu, for -9dBFS input, set record gain to -6db, and playback gain to -10dB.

For the record level, 64 is 0db, 32 is -6db. For playback, 127 is 0db, 64 is -6db, 32 is -12db.

Input Clipping

If the peak input level displays "clipping", then the input is too high. You must reduce the monitor input gain. If a setting of 0dB is still clipping, then you must reduce the output level of the audio source. If you can't adjust the receiver output, you must install an external pad.