

Overview

This document describes important technical details concerning Symphony I/O and Pro Tools' Delay Compensation function. These details are provided to respond to inquiries from advanced Symphony I/O users.

Delay Compensation

The purpose of delay compensation is to maintain the precise timing relationship between DAW tracks even when delays are introduced on some of the tracks through the insertion of software plug-ins, hardware inserts or other routing.

In order for hardware to be "delay compensation compatible", the delay through the hardware's A/D, D/A and digital I/O must be equal to the delay through the emulated Avid hardware. This way, when the delay compensation function applies sample delays to signal paths based on Avid hardware, no timing errors are introduced due to the fact that third-party hardware is in use.

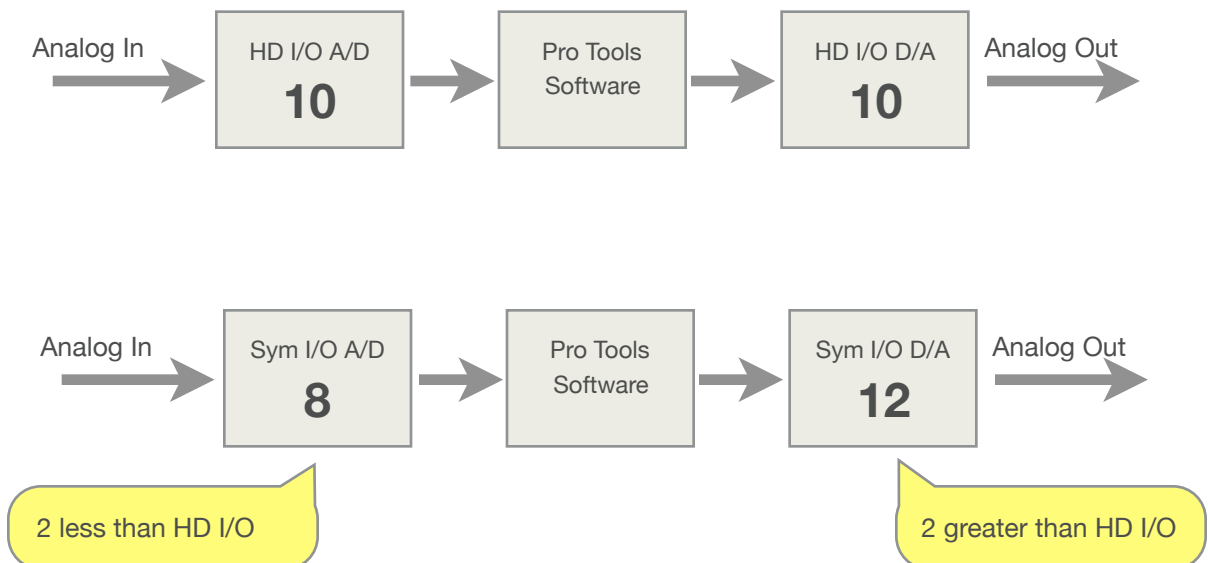
When used as an analog or digital hardware insert, Symphony I/O provides a signal path that sample accurately reproduces the delay of an HD I/O.

Symphony I/O Delay Comp Implementation

Ideally, Symphony I/O's A/D delay would be equal to the HD I/O's A/D delay and Symphony I/O's D/A delay would be equal to the HD I/O's D/A delay. This would ensure that any conceivable signal path through Symphony would have the same delay as HD I/O.

Unfortunately, this isn't the case. During the design phase of Symphony I/O, a high priority was placed on the ESS DAC chip, which has remarkable characteristics that greatly exceed other DACs. One tradeoff was that the chip's propagation delay was longer than the DAC used in the HD I/O, and couldn't be reduced without a compromise in D/A quality.

To accommodate for this, the propagation delay of Symphony I/O's A/D side was reduced by the corresponding amount, so that Symphony I/O's A/D - D/A path is equal to that of the HD I/O. This offset is shown below using theoretical delay values.



Workflows

Given this offset of Symphony I/O's A/D and D/A delay, how are various Pro Tools workflows affected?

Hardware Insert - If Symphony I/O is used as a hardware insert, it provides a signal path that sample accurately reproduces the delay of an HD I/O. Please see the notes below concerning a 1 sample delay bug and sub-sample delay.

Using Symphony I/O & HD I/O together - When using Symphony I/O with an HD I/O, delay through all tracks is equal IF HD I/O inputs are routed only to HD I/O outputs and Symphony I/O inputs are routed to Symphony I/O outputs. This would be the case where Pro Tools is used as a multitrack recorder with a "1 to 1" routing for each track, where mixing is done on an external hardware console.

When signal paths use a mix of HD I/O and Symphony I/O inputs and outputs, delay differences of a few samples will occur. For example, if a single snare mic were routed to both an HD I/O and Symphony I/O A/D input, the snare would be recorded to Pro Tools a few samples earlier on the Symphony I/O track. If both track were then mixed in Pro Tools to an HD I/O output, comb filtering would be heard.

The obvious workaround is to avoid sending phase sensitive signals through different interfaces - a rule of thumb that applies to any digital audio system. Don't send the snare close mic to HD I/O and the overheads to Symphony I/O.

One Sample Delay Compensation Bug

During the several years that Apogee has tested delay compensation with Apogee hardware, we've infrequently but consistently encountered a bug whereby delay compensation is off by 1 sample. We've observed this bug while using Avid hardware interfaces as well. The 1 sample error is fairly rarely encountered, and usually resolved by closing and relaunching the session.

Sub-Sample Delay Differences

While Symphony I/O's A/D - D/A propagation delay is the same as HD I/O's to the sample, there is a sub-sample difference that's difficult to measure and isn't seen in Pro Tools even at the highest magnification. This sub-sample difference is observable when performing "null" tests to verify delay compensation, but doesn't result in degradation of the audio signal at all.

It's important to note that this error is below the measurement resolution of Pro Tools and most audio measurement systems.

Verifying Delay Compensation

The following test is used to verify delay compensation with HD I/O, Symphony I/O or any other HD-compatible interface.

- 1) Open Pro Tools and configure it for use with the interface under test.
- 2) Verify that Delay Compensation is checked.
- 3) Create 4 mono audio tracks.
- 4) On tracks 1-2, create two identical square wave regions using the Audiosuite signal generator. Choose a low frequency and set level to -10 dBfs.
- 5) Route Track 1 through Bus 1 to Track 3, route Track 2 through Bus 2 to Track 4.
- 6) Record-enable tracks 3-4. See the mixer diagram below (Disregard Audio 3).
- 7) Place the cursor before the tracks 1-2 regions and initiate recording. In effect, the regions are re-recorded on tracks 3-4.
- 8) Zoom in to the sample level and verify that either a positive or negative transient lines up perfectly as shown in the
- 9) Now instantiate a hardware I/O insert point, and loop the insert send back to the insert return on the hardware rear panel.
- 10) Record tracks 1-2 onto tracks 3-4 again.
- 11) Verify that all four square waves line up. If they do, this indicates that even when the hardware insert is introduced into the signal path, signal preserve their timing relationship to other tracks.



