The DART® Two Step - First Record, then Restore.

Recording and restoring using 96 kHz and 24 bit audio
by Les Noise

Thank you for your continued interest in our DART PRO products.

DART PRO 24™ has been a great success for our customers this past year. As we continue to strive for the best customer satisfaction, we're happy to report on our latest user feedback. This article outlines the most effective method using 96 kHz and 24 bits recording.

We have found the most effective method of recording and restoration is an easy two step process.

Audio Professionals we've talked to agree that creating the best digital audio file for archiving is achieved by recording at 24 bits and 96 kHz. *Standard Redbook* audio from a CD format is recorded at 16 bits and 44.1 kHz stereo (two channels), which result in 10 megabytes of data storage for every minute of recording.

For example:

-A 3 minute song results in a 30 megabyte file.

A 5 minute track is 50 megabytes.
-
An album side (appx. 20 minutes) results in a 200 megabyte file.
-
The same audio recorded at 96 kHz and 24 bits, stereo, is *3.3 times* as much data.

In other words -

1 minute of recording is about 33 megabytes.

10 minutes is 330 megabytes.

An album side (appx. 20 minutes) is about 700 megabytes.

The most important thing we have learned working with 24 bit and 96 kHz sound is not to combine the two functions (recording and restoration) into a single real time process. The amount of data being recorded is far too great to restore in real time at these higher frequencies.

We understand that some audio enthusiasts are accustomed to recording and restoring in real time working at lower recording densities such as 22 kHz, 16 bits, and single channel. The data rates for this density is about 2 1/2 megabytes per minute or one

quarter the data at *CD* densities. When recording at these lower levels, the CPU, memory, and software are fast enough to record and restore in real time. In fact, 22 kHz single channel recording is quite satisfactory when working with some older recordings.

Unfortunately, recording and restoring in real time at 96 kHz and 24 bits doesn't work. Even the latest PCs are not fast enough to process the data volume that results from these higher frequencies when recording and restoring at the same time.

If it is inadvisable to record and restore at the same time, then what is the best way to process recordings? It should be done in two steps:

The first step is to record the audio data to disk.

The second step is to then do all the processing from the disk file.

It's that simple. Hence, the DART Two Step.

We also offer some additional suggestions.

<u>For long term data archiving:</u>

Record the data at 96 kHz and 24 bits two channels. Then, use this copy as the archival copy of the recording.

Keep this file as a backup on DVD along with the rest of the archived recordings. You can currently store up to 4 Giga-bytes of data on a single DVD. If you need to save storage space, use a lossless data compression format such as ZIP. It will allow you to store approximately twice as much data in the same space. It's inadvisable to use the MP3 format for archiving as it's a poor compression format for audio data. You will lose essential data during compression that is critical to the restoration algorithms.

Why record at such high frequencies?

This is what the Pros do – record at the higher densities for posterity and as insurance against possible loss of the original material.

Future audio tools will use high density recordings to produce even better sound. Therefore, if your original recordings are deteriorating, this may be the best method to capture that audio.

Finally, take the results from the audio restoration and editing, and organize and format the files for listening.

A few years ago, that meant burning a standard Redbook Audio CD with 10 to 20 tracks.

These days, the options have expanded to include digital players such as MP3 players and iPods®. The common denominator of these devices is the audio file format and the software tools used to prepare the audio file for the different devices all recognize .WAV file format. Use the results files from DART®, which are .WAV files, to make MP3 files, syncs to iPod® or the "old fashion" CD burning software. There are many different programs for CD burning, MP3 conversions and syncs, as well as importing .WAV files to the iPod®. They all work well. Most audio files using DART® will upload to an iPod® without additional software or extra effort.

In conclusion, we recommend the DART Two Step:

Step One - record the original audio to a disk file, making it the archive copy of the audio at 96 kHz frequency.

Step two; use the archive copies as the base for the audio restoration work. You don't need to work in real time mode - especially if you are using DART PRO 24™, DeCrackle, or even DeClick at the higher frequencies. These restoration programs are extremely sophisticated DSP algorithms that can use extensive CPU power, even when using the fastest CPUs.

We hope this article helps you to achieve the highest quality results in your audio restoration work.

As always, we at DART believe old sounds are the best sounds.

Les Noise, Chief Audio Officer

FAQ:

Can I record audio at 96 kHz and 24 bits with any sound card?

No. You will need a sound card that supports higher frequencies. Most PC systems today come with a 44 kHz, 16 bit sound card that's of reasonably quality. There are some PC systems designed with high end audio in mind and come installed with a 96 kHz sound card. In most cases, you'll need to add a high frequency sound card to your system.

What if I'm using recordings from CDs? Do I need to archive at the higher frequencies?

That's not necessary. You may feel it important to maintain all archive recordings in the same format. The .WAV file format keeps track of the recording parameters, so you don't have to.

It is feasible to have mixed mode archive sound files. CD Redbook (or standard digital audio format) is done at 44.1 kHz, 16 bits, and two channels. The best way is to rip the tracks to disk as .WAV files (not MP3) and then archive those files for posterity.

For processing the audio in the case of using DART®, it's likely you're interested in restoring your recordings.

Why archive audio CDs?

This is really the subject for another article, but the long and short of it is music CDs can go bad too and do so frequently. So if you have valuable music CDs it would be a real good idea to make backup copies or better yet archive them using DVD because the media is actually more reliable than CDs.

Why do I need to record at the higher frequencies for archiving audio?

The strategy is to capture as much data as possible for each recording in the event you loose the original recording and have no other copy. Future technology may be able to use the higher densities for getting better results. In the mean time DART has made it easy to down-sample the archive copy to use lower densities for restoration with today's technologies.

Do I have to archive audio using 24 bit 96 kHz recording?

No. But you should record the audio at 16 bits and 44.1 kHz minimum. Most computer systems now have sound cards (chips) that record at these levels.

Does recording at higher densities improve the sound quality by itself or do I need to use restoration programs to improve the sound quality?

Recording at higher densities does NOT improve quality by itself especially with older recordings. It just captures more audio data. Restoration software will be needed to improve the quality of the sound. DART is the best for the restoration work.

Why try to do restoration in real time?

The ideal restoration process is to be able to make adjustments to the restoration controls and hear the results while changing the controls. This works when using lower frequency recordings (22 kHz). But for higher frequency recordings (96kHz) it does not work because the computer systems are not nearly fast enough.

Does it make any difference if restoration is being done directly from the sound card or from a disk file?

It makes no difference to the restoration programs. But the results could be drastically different if trying to do restoration directly from the sound card. This is a method that

forces processing in real time and will result in poor results at the higher frequencies since computer systems are not fast enough to keep up with the incoming data rates.

If restoration can't be done in real time, then what should be done?

DART® has **processing options** which allow you to sample small parts of the audio with a restoration tool that tests different settings before trying to process the entire recording. But this requires processing from a disk file. So first record to a disk file and then use DART in-line mode for sampling short segments with different restoration settings.

This greatly speeds up the restoration process by not having to wait to restore the entire recording between each test. Real time processing can be tried, but if the results are poor, switch to in-line processing. In-line processing does not limit the restoration tools to run in the same time period as what it takes to play the music. The programs can run as long as needed before playing back the results.

Should restoration always be done using higher density recordings?

When working with older recordings, (*78 RPM*), we've found the best results are achieved when converting these recordings to frequencies matching those of the originals. This may mean down sampling to 22 kHz. We strongly recommend this procedure if your results are disappointing using higher frequencies.

In some cases, over sampling a troubled recording can actually make the recording worse and therefore more difficult to restore. This is a common problem. Even though you have captured the audio data at the higher frequencies, it may cause problems with the restoration programs. Not to worry. When using DART®, it's easy to down sample the recording from the highest frequencies to any lower frequency before applying any of the restoration functions.

