

## Digital Mixing Desk

---

The **Digital Mixing Desk** is for mixing Audio files in the same manner as you would with an analogue 4 or 16 track mixer. Mixing files can be done on any waveform editor, whilst this is fine for mixing a few short files together it is woefully inadequate for mixing several large files, where each minor adjustment requires manual mixing each file again, this is incredibly tedious.

The **Digital Mixing Desk** was designed as a fast, effective solution to this problem, allowing infinite fine tuning until the desired mix is achieved.

The **Digital Mixing Desk** will work on any Windows 95 system with a sound card.

### **Introduction.**

[Over View](#)

[Getting started](#)

### **Mixing Desk basic operation.**

[Add a New Track](#)

[Remove a Track](#)

[Mix the Tracks](#)

[File Menu Commands](#)

[Characteristics Menu Commands](#)

[Options Menu Commands](#)

[The Master Track](#)

### **Other things to do with the Digital Mixing Desk.**

[Creating Surround Sound Effects](#)

[Appending Tracks](#)

[Alignment](#)

[The Master Track](#)

### **Performance Matters.**

[Maximising Sound Quality](#)

[How do I increase the Performance on my system](#)

## Over View

A lot of effort has gone in to making the interface as intuitive and flexible as possible, so don't be fooled in to thinking 'It's too easy to learn so it can't be any good', that was our aim; **minimal learning curve, maximum power.**

The emphasis throughout is on maximum quality, both in sound quality and code quality. The Mixes produced are superior to those that can be achieved on most of our competitors software.

### The main features:

=====

The **Digital Mixing Desk** can be used in **Real Time** like a conventional Mixing Desk.

Loading a Track is very fast as all you are doing is providing a pointer to it. No intermediate file is created prior to Mixing, the data is just streamed from it's source when it is needed. For this reason the data should be located on your hard drive.

16 bit, 8 bit, stereo and mono files can all be mixed together, but they must all be of the same **Sampling Frequency.**

Left and right channels are mixed independently.

A **Delay** unit is available for each track.

If the tracks are slightly out of sync, they can be delayed to realign them, no expensive equipment required. Delays and simple surround effects can be quickly generated, by adding multiple copies of the same track and by adjusting the delays and amplitude of each.

Harmonic **Enhancements** and **EQ**'ing can be applied to each track.

All processing is done to 32 bit accuracy.

You can perform re-**Dithering** to maintain the maximum Dynamic Range of the signal.

The mixed file can be saved. The mixer settings can also be saved for re-mixing at a later date.

If 15 tracks aren't enough, then the mixing session can be split to create intermediate files which can be further mixed.

Multiple copies of the Mixing Desk can be active.

### Note.

The only restriction is that all tracks to be mixed must be PCM formatted \*.WAV files of the same **Sampling Frequency.**

If you need to mix a file with a different Sampling Frequency then you must equalise all the formats first, the **GCT Audio File Converter** will do this for you, it also provides anti-aliasing and filtering.

[Getting started](#)

## Getting started

The **Digital Mixing Desk** can support a maximum of 15 track bars (15 channels if all mono, 30 channels if all stereo), when in use the Mixing Desk will look something like a normal analogue mixing desk, with each track having its own volume sliders, a delay setting, looping option, filtering and Enhance effect.

The majority of the controls are visible on screen all the time.

You will notice a **Master** track bar on the right of the screen, this behaves similarly to an individual track bar, but scales the amplitude of the entire group of tracks.

### Let's Add a Track.

---

Click the **Add Track** button, a standard Open dialog will appear, select a \*.wav file you have available, a Track bar will now appear (Track 1). Please use a mono track.

This Track bar looks very similar to what you would find on a normal Mixing Desk.

Click the **Solo** button, the raw track will play. Pull the volume slider up and down to adjust the volume. This is just playing the original track, and adjusting the volume of the soundcard. Only when Mixing is activated do we physically alter the data sent to the Sound Card.

### Track bar controls.

---

With the cursor over a Track, it's format and length are visible in the Information panel at the bottom of the screen. If the track is a mono file one volume slider will be present, if stereo then two.

The panel to the right of the information panel indicates the format of the destination file, the default is 16 bit mono. This can be changed from the Characteristics menu.

The **Volume sliders** allow each track to have independent volume control.

The **Gang** button effectively ties the stereo volume sliders together so they track each other.

The **Delay** allows the start of each track to be delayed, this can be used for track alignment, to run a sequence of tracks together, to create echo effects etc.

The **Loop** button enables the track to be looped continuously, or a specified number of times. Whilst over a Track right click the mouse to bring up the Loop menu. The default mode is continuous looping.

The **Mute** button allows the track to be muted without effecting the volume sliders.

The **Solo** button allows the track to be played on its own, this behaves differently depending whether mixing is taking place or not. Mixing Off - the raw unaltered file is played; Mixing On - the track is played with the settings as defined by the Track panel details, all the other tracks being kept in sync.

The **EQ** button switches in the Equalisation.

The **Enhance** button applies harmonic enhancement to the track.

**Note.** These functions are computationally intensive.

### Real Time Mixing.

---

This is the default mode, the Mixer behaves like a conventional Mixing Desk.

Click the **Mix Tracks** button. Now we are mixing, all the feature on the track bar can now be activated.

Push the volume slider up to +10dB, this may cause the output to clip. You can correct this either by reducing the volume on this track alone, or you can reduce the gain on the **Master** track bar. Bring the gain back to 0dB.

**Note.** Internally a Track's data never clips even with too much gain and EQ. Clipping is only caused when the data must be quantised. In the above example +10dB gain could overload the 16 bit range, however since we are using 32 bits we have plenty of headroom to spare.

Click the **Enhance** button, in and out listening to the difference, it sounds louder due to increased harmonic content.

Similarly, you can dial in some **EQ** parameters and switch in and out the EQ function.

To investigate the **Delay** function we need to add another track.

Click **Add Track** button again, and Open the same track again. Track 1 and Track 2 are identical.

Select Characteristics|Stereo, the mono track bars will now become stereo pairs.

Adjust the left/right volume controls, of each track

	Left	Right
Track1	0dB	-120dB
Track2	-120dB	0dB

Click the **Mix Tracks** button.

Clicking **Solo** on track 1, will play to the Left only, and **Solo** on track 2, will play to the Right only, this is how you have set up the track bars.

Now with both tracks active, type 0.1 in the delay of track 2 (100 milliseconds). The effect is significant.

**Remember.**

**The Volume, Delay, EQ and Enhance can all be adjusted in Real time. They are available on each and every track, so each track can be individually tweaked until you have the effect you require.**

**Note.**

If your system will not run in **Real Time** mode without 'stuttering' increase the **Input Block Size**, (**Options|Input Block Size**) this helps reduce the disk overheads.

**Off Line Mixing.**

-----  
In the Off Line mode the mixing isn't done in 'real time', you set the track volumes independently then mix the file. This isn't as big a problem as it first appears since the option to create a test file is the default mode, that is you only mix a small section together, once you're satisfied with your set-up, you then do a full mix.

**Well**, that's basically it.

A fast, powerful mixing tool, with delay lines, EQ, and Enhancing features.

If you are mixing with high sampling rates (>32kHz) then **Dithering**, (**Characteristics|Dithering**) can be used to extend the Dynamic Range.

Dithering

**Note.**

All tracks to be mixed must be of the same **Sampling Frequency**.

If you need to mix a file with a different Sampling Frequency then you must equalise all the formats first, the **GCT Audio File Converter** will do this for you, it also provides anti-aliasing and filtering.

**GCT Audio Wave Editor** provides a tool for splitting a Stereo file in to independent mono left and right files, this gives you more control of the mixing process.

[Add a New Track](#)

[Mix the Tracks](#)

[Remove a Track](#)

**a test file**

Select Test File from Options menu

**full mix**

Deselect Test File from Options menu

## Add a New Track

This creates a Track bar, and assigns the specified file to it.

**EQ** - Equalisation, two bands each with 1.5 octave bandwidth.  
- Gain adjustment limited to +/- 20dB.

**Enhance** - Enhances the track by adding more harmonics.

**Volume Sliders** - control the Track volume Left and Right, scaled in decibels.

**Gang** - ties the volume sliders together so they track each other.

**Delay** - track offset, to allow alignment of files.

**Loop** - enables track to be looped.

**Mute** - mutes the track.

**Solo** - plays only this track.

With the cursor over a Track, it's format and length are visible in the Information panel at the bottom of the screen.

### **Note.**

The EQ and Enhance functions are computationally intensive.

When playing the raw track, if your Sound card doesn't support independent left/right volume control (most don't), then the volume played will default to that of the left channel, if the volume setting is initially zero then the right channel volume is selected.

[Mix the Tracks](#)

[Remove a Track](#)

[Getting started](#)



## Remove a Track

Remove the specified Track from the Mixing Desk.

[Add a New Track](#)

[Mix the Tracks](#)

## Mix the Tracks

Mixes the tracks as specified by the Track bar settings.

The **Master Track** to the right of the screen provides a global gain adjustment to the mixed tracks.

In the **Real Time** mode the Mixer behave like a conventional Mixing Desk.

In the **Off Line** mode the mixing isn't done in 'real time', you set the track volumes independently then mix the file. This isn't as big a problem as it first appears since the option to create [a test file](#) is the default mode, that is you only mix a small section together, once you're satisfied with your set-up, you then do a [full mix](#).

The results of the Mixing is written to your Hard Disk.

If your system is not fast enough to run the mixing in Real Time, ie you get excessive dropout the file written to the Hard Disk will still be correct.

All tracks to be mixed must be of the same **Sampling Frequency**.

[Add a New Track](#)

[Remove a Track](#)

**a test file**

Select Test File from Options menu

**full mix**

Deselect Test File from Options menu

## File Menu Commands

### **Add a Track.**

This creates a Track bar, and assigns the specified file to it.

### **Save As.**

Saves the mixed file.

### **Open Mixer Settings.**

Clear the mixer set-up and Load the selected mixer settings.

### **Save Mixer Settings.**

Saves the mixer settings, for this session.

If you move the Track data off your computer on to a backup medium, then place the associated \*.DMD files in the same directory.

The original location of each track is stored in the \*.DMD file, but if the Tracks are no longer there the computer will look in the same directory as the \*.DMD file.

### **Close all Tracks.**

Closes all the tracks you have been working with. To remove a single track use the 'Remove Track' button.

### **Exit.**

Closes the all the tracks you have been working with and quits the Mixing Desk.

[Characteristics Menu Commands](#)

[Options Menu Commands](#)

## Characteristics Menu Commands

### **Stereo.**

Create a Stereo file.

### **Mono.**

Create a Mono file. **Default.**

### **16 Bit.**

Create a 16 Bit file. **Default.**

### **8 Bit.**

Create an 8 Bit file.

### **Dithering.**

Apply re-dithering to the output file.

Dithering

File Menu Commands

Options Menu Commands

## Options Menu Commands

### **Test File.**

Create a Test File, otherwise do a Full mix.

### **Set the Test Time.**

Defines the length of the Test file.

**Note** These two functions only effect the **Off Line** mixing mode.

### **Delayed Test File.**

Create a Delayed Test File.

Lets you test a mixed section starting ss.mmm seconds in to the file.

### **Set the Delay Test Time.**

Set the start point for the Test file, ss.mmm seconds in to the file.

For example, the files may be 5 minutes long, and you want to test the mixing at 2 minutes without mixing the whole lot. Also useful for testing the overlap section when running one file into another.

### **Block Size.**

This determines the amount of information read from the disk, it also sets the response time of actions applied to the mixer, default of **1/4 second**.

**Note.** The greater the Block Size the less time is wasted on disk-head movement.

**If your system will not run in Real Time mode without 'stuttering' increase the block size.**

### **VU Meter.**

This provides a visual representation of the peak value in the Mix, it is inactive while just playing the files.

In the **Real Time** mode it provides a measure of the peak within each Mixed Block.

In the **Off Line** mode it provides a measure of the peak within the Mixed section.

**Note.** The Mixer clips at 0dB (when the red block is highlighted).

[File Menu Commands](#)

[Characteristics Menu Commands](#)

## The Master Track

The **Master Track** behaves like any of the other Tracks.  
Hitting the **Play** button just plays the Mixed track if one has been created.

The **Echo** button provides a means of adding echo to the grouped tracks.  
This tool can be used to create Delay, Echoing and Reverb - type effects.

The **Delay** parameters.

**Delay:** This is the time between each echo.

Setting a Delay of 50 - 100 milliseconds creates a doubling effect, this can be used to thicken the sound.

With Delay settings of greater than 100 milliseconds, each echo can now be heard as separate to the input.

**Gain:** This sets the amplitude of the initial Echo.

**Bandwidth:** This sets the cutoff frequency for the the Delayed signal, so a real echo can more faithfully be simulated. In a real Echo the higher frequencies are absorbed by the surroundings.

The **Regeneration Gain:** This sets the Gain of each successive echo.

Each Echo will be a percentage of the previous one.

Setting a Regeneration Gain of 0 produces no echo at all, just the primary Delay.

Setting a Regeneration Gain of 100 produces an echo that never dies away.

By Setting a short Delay, high Gain and Regeneration Gain, and maximum Bandwidth, some interesting effects can be produced.



## Creating Surround Sound Effects

### **Example 1.**

Add a Mono \*.wav file.

Add the same track again. Two track bars will now be visible.

Adjust the volume controls. Trk1 (-3dB) and Trk2 (-10dB).

Set the delay of Track 2, to 0.1 seconds.

Mix the tracks.

In the Real Time Mode, you can compare the mixed track against the original by simply depressing the **Mute** button on Track 2 thus removing it from the mix.

### **Example 2.**

Set Characteristics|Stereo. Stereo volume controls will appear.

Adjust the left/right volume controls, of each track.

Trk1 (-3dB, -10dB) - Trk2 (-10dB, -3dB).

Mix the tracks.

### **Note.**

The Delay, Volumes and Effects can all be adjusted in Real time, so they can be tweaked until you have the effect you are after.

## Appending Tracks

Add two Mono \*.wav files. Two track bars will be visible.  
Set Characteristics|Mono. A single volume control will be available.  
Set then volume control of both tracks to 0dB.

Set the delay of Track 2, to the length of Track 1.  
With the cursor over Track 1, it's length is visible in the information panel at the bottom of the screen.

Mix the tracks.

To run the files together even more smoothly, reduce the delay of Track 2 slightly as required, and mix again.

### **Testing the mixing of the crossover section.**

With Options|Test file set.  
Set Options|Set Test Time. to approx. 20 seconds.  
Set Options|Delayed Test.  
Set Options|Set Delay Time. to approx. 10 seconds before the merge point.

Mix the tracks.

The delay of Track 2 can be quickly adjusted, and a Test file re-mixed to achieve the required effect.

## Alignment

If you need **precision alignment** between the tracks create a Stereo mix so the offset can be accurately measured.

Trk1 Volumes (0dB, -120dB).

Trk2 Volumes (-120dB, 0dB).

Align the tracks by adjusting the delays of the tracks, mix the tracks and save the output file. Open this file with a suitable Waveform editor such as **GCT Audio Wave Editor** and precisely measure the offset between the left and right channels. Add this offset to the appropriate track's delay and precision alignment will be achieved.

**Stereo mix**

Select Stereo from Characteristics menu

## Maximising Sound Quality

We recommend you use the **Digital Mixing Desk** as the final mixing tool as this will allow full control of the resultant output file. All the internal processing is done to the highest quality, the resolution is only reduced in the final quantisation process when some of the information must be discarded. If the Sampling frequency is >32kHz, it is recommended that you enable the **Dithering** function Characteristics\Dithering so you retain as wide a Dynamic Range as possible.

Always use 16 bit data, and as high a sampling rate as possible.  
If the destination media is CD then use a 44100Hz sampling rate.

### **Mixing Audio and Midi files.**

Normally when you mix Audio and Midi files together it is the Sound Card which is doing the mixing, the results of which can vary significantly. If however you record the output of a Midi file in to a \*.WAV file (using Digital loopback if possible) then mix it to the Audio files using the **Digital Mixing Desk** far superior results can be achieved.

### **Digitising Signals.**

In general, do not use your sound card to record an analogue input, your computer is a very noisy environment. Performance figures for sound cards are usually measured in a clean environments so take the specifications with a pinch of salt.

If you must digitise using the sound card then record the original to tape, then digitise it. Whilst recording you must try and minimise the controllable sources of computer noise. Here are some suggestions; leave the computer idle (doing nothing but recording), reduce the screen to a flat neutral colour, if your software has fancy VU bars bouncing up and down turn them off (they turn the Red and Green video guns hard on and off, and can add lots of noise to the input signal), it all helps.

If possible, record all files away from the computer, then digitise and transfer to the computer via S/PDIF. Record the Midi file to \*.WAV file by using Digital loopback (the digital data is routed back on the input for saving, without the loss of quality introduced by the D/A - A/D process), some sound cards support this feature.

### Dithering

## How do I increase the Performance on my system

The Mixing Desk places quite a lot of strain on all the components of your system (except video) . Probably the biggest bottleneck is the Hard Disk, trying to ensure that all the track data is available at the same time for mixing.

Here are some thoughts on reducing this bottleneck:.

I will assume your Hard Drive is in good condition and Defragmented regularly.

1. The Mixing process is not a CPU killer, so you don't need the latest Mega, Giga, Terra FLOP processor to run the Mixing Desk, however you do need at least one big, fast Hard Drive (the more the merrier). It is the movement of the Disk Heads and accessing the data which is the big problem.

The **Options|Block Size** reduces Head movement by reading in bigger chunks of data on each read operation, unfortunately the penalty is slower response to the track bar adjustments.

2. Increase the RAM available to Windows to cache the Disk reads.

Reduce the number of programs running, Windows can then use the spare RAM to cache reads from your Hard Drive, this can significantly reduce Disk Head movement. Alternatively increase the RAM available, buy some more.

3. The mixed data is written back to the Temp directory, if the Track Data can be brought from a separate disk would help. ie) write to disk C: with all reads from disk D:.

4. Do not try this unless you really know what you are doing (I haven't tried this).

Partition your Hard Drive in to as many partitions as your Hard Drive has Heads, (4 heads - 4 partitions). Place your data on a separate partition, now when you read the data the head movement should be minimal.

The **Equalisation** and **Enhancing** are processor intensive, the algorithms implemented are pretty much optimised so I can't help you there.

Testing has revealed that the performance on a P120 with 16MB RAM and a single WD AC31000H Hard Drive (with no fancy partitioning) is more than adequate for all but the most demanding user.

## Infinite Loops

This problem should be rarely encountered, but if it is here is what's happening.

The length of the fully mixed file is determined by the file which has the longest combined (length + delay).

An **Infinite Loop** occurs when this file is selected for **looping** as it is impossible to determine when this file has to stop.

This combined longest file isn't always the longest physical file.

For Example.

	(Length)	(Delay)	(Delay + Length).
Track 1 Introduction	30 sec.	0 sec	30 sec.
Track 2 Drum pattern	10 sec.	30 sec	40 sec. Loop.

Looping the Drum pattern after the Introduction would cause an Infinite Loop, as we would have no idea when to stop looping.

In the Off Line mode this is prevented from occurring, however it will still occur in the Real Time mode, if left unchecked you will create an enormous output file on your disk.

In the Off Line mode, there are two ways to create the Drum loop after the Introduction.

1) Limit the number of Loops a track can do, specify it instead of using continuous looping.

2) Add a dummy Track 3 of length 45 seconds, delay 30 second setting the volume to zero. This Track is now flagged as the longest file; as below..

	(Length)	(Delay)	(Delay + Length).
Track 1 Introduction	30 sec.	0 sec	30 sec.
Track 2 Drum pattern	10 sec.	30 sec	40 sec. Loop.
Track 3 Dummy track	45 sec.	20 sec	65 sec.

Here the Drum pattern will loop 3.5 times, from 30 ---> 65 seconds.

## Looping

The **looping option** allows the track to be looped continuously, or a specified number of times. Whilst over a Track right click the mouse to bring up the Loop menu. The default mode is continuous looping.



## Dithering

This function is accessible through the **Characteristics** menu.

**Dithering** is a mathematical technique used prior to quantisation in order to reduce signal distortion from correlated error components, in doing so, a small amount of noise is added to the final signal. With the application of a Noise-shaping filter the perceived degradation caused by the quantisation is reduced by concentrating the noise power at the higher frequencies where the ear is less sensitive.

### What ?

Let's run that by you again.

Noise is added to the signal in such a way that it sounds better, even though slightly more noise is present. The additional noise is shaped so that it is shifted to where ear is less sensitive.

### How much Noise is added ?

Less than 2 LSB's of noise is added, the exact amount depends on which frequency component of the noise you look at.

### Using Dithering.

Dithering should be used on signals sampled at >32kHz since the added noise is moved to the top half of the frequency spectrum, for  $F_s = 32\text{kHz}$  the noise is increased between  $\sim 8 - 16\text{kHz}$  ( $F_s/4 - F_s/2$ ). Since the Ear is most sensitive at lower frequencies, the higher the sampling rate the better the results.

We don't restrict the frequencies at which dithering can be used, as long as you understand the consequences you can make the decision of when, and when not to use dithering for yourself.

You shouldn't really use dithering with 8 bit signals as the addition of  $\sim 2$  LSB's of noise is significant on an 8 bit signal.

However, the 8 bit mode is useful in testing the effect dithering has if you consider the 8 bit signal to be a 16 bit signal but 48dB down. Whilst in the 8 bit mode reduce the signal level by 20dB (effectively a 16 bit signal down 68dB), so the output range is reduced by 10x from (+/-127 down to +/- 12). Switch in and out the Dithering whilst mixing in real time and listen to the difference.

## Stuttering

If your system will not run in **Real Time** mode without 'stuttering' increase the **Input Block Size**, (**Options|Input Block Size**) this helps reduce the disk overheads.

### **Note.**

The greater the Block Size the less time is wasted on disk-head movement by reading in bigger chunks of data on each read operation, unfortunately the penalty is slower response to the track bar adjustments.

How do I increase the Performance on my system

## Enhancing

This provides harmonic enhancement by adding extra harmonics to the original sound. This is achieved through a non-linear process which sonically tends to give most emphasis to the lower frequencies, where the additional harmonics occur in the 300-4000Hz region; ie. where our hearing is most sensitive.

## Equalising

A two band equaliser is available, each with adjustable centre frequency and gain and a 1.5 octave bandwidth.

Frequency is limited to 0 ---> (Sampling Frequency/2).

Gain is limited to +/- 20dB, settings above this will be set to +/-20dB.



