

Sound Mixer Tutorials

Sound mixers (AKA *sound desks*, *sound consoles* or *sound boards*) are amongst the most common type of equipment in the world of audio production. Every sound operator must know what a sound mixer is and how to use it. The tutorials below cover the general layout and functions of sound mixing devices.

Sound Mixers: Overview

A *sound mixer* is a device which takes two or more audio signals, mixes them together and provides one or more output signals. The diagram on the right shows a simple mixer with six inputs and two outputs.

As well as combining signals, mixers allow you to adjust levels, enhance sound with equalization and effects, create monitor feeds, record various mixes, etc.

Mixers come in a wide variety of sizes and designs, from small portable units to massive studio consoles. The term *mixer* can refer to any type of sound mixer; the terms *sound desk* and *sound console* refer to mixers which sit on a desk surface as in a studio setting.

Sound mixers can look very intimidating to the newbie because they have so many buttons and other controls. However, once you understand how they work you realise that many of these controls are duplicated and it's not as difficult as it first seems.

Applications

Some of the most common uses for sound mixers include:

- Music studios and live performances: Combining different instruments into a stereo master mix and additional monitoring mixes.
- Television studios: Combining sound from microphones, tape machines and other sources.
- Field shoots: Combining multiple microphones into 2 or 4 channels for easier recording.

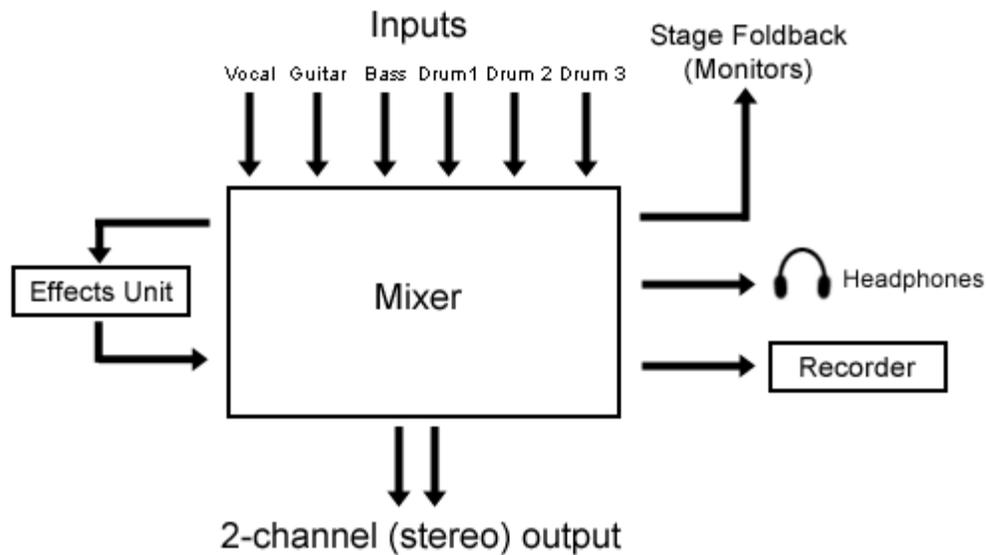
Channels

Mixers are frequently described by the number of channels they have. For example, a "12-channel mixer" has 12 input channels, i.e. you can plug in 12 separate input sources. You might also see a specification such as "24x4x2" which means 24 input channels, 4 subgroup channels and two output channels.

More channels means more flexibility, so more channels is generally better. See [mixer channels](#) for more information .

Advanced Mixing

The diagram below shows how a mixer can provide additional outputs for monitoring, recording, etc. Even this is just scratching the surface of what advanced mixers are capable of.



Sound Mixer Channels

Each input source comes into the mixer through a channel. The more channels a mixer has, the more sources it can accept. The following examples show some common ways to describe a mixer's compliment of channels:

12-channel 12 input channels.

16x2 16 input channels, 2 output channels.

24x4x2 24 input channels, 4 subgroup channels and two output channels.

Input Channels

On most sound desks, input channels take up most of the space. All those rows of knobs are channels. Exactly what controls each channel has depends on the mixer but most mixers share common features. The list below details the controls available on a typical mixer channel.

Input Gain / Attenuation: The level of the signal as it enters the channel. In most cases this will be a pot (potentiometer) knob which adjusts the level. The idea is to adjust the levels of all input sources (which will be different depending on the type of source) to an ideal level for the mixer. There may also be a switch or pad which will increase or decrease the level by a set amount (e.g. mic/line switch).



Phantom Power: Turns [phantom power](#) on or off for the channel.

Equalization: Most mixers have at least two EQ controls (high and low frequencies). Good mixers have more advanced controls, in particular, [parametric equalization](#). See also: [Audio equalization](#).

Auxiliary Channels: Sometimes called *aux channels* for short, auxiliary channels are a way to send a "copy" of the channel signal somewhere else. There are many reasons to do this, most commonly to provide separate monitor feeds or to add effects ([reverb](#) etc).

Pan & Assignment: Each channel can be panned left or right on the master mix. Advanced mixers also allow the channel to be "assigned" in various ways, e.g. sent directly to the main mix or sent only to a particular subgroup.

Solo / Mute / PFL: These switches control how the channel is monitored. They do not affect the actual output of the channel.

Channel On / Off: Turns the entire channel on or off.

Slider: The level of the channel signal as it leaves the channel and heads to the next stage (subgroup or master mix).

Subgroup Channels

Larger sound desks usually have a set of *subgroups*, which provide a way to sub-mix groups of channels before they are sent to the main output mix. For example, you might have 10 input channels for the drum mics which are assigned to 2 subgroup channels, which in turn are assigned to the master mix. This way you only need to adjust the two subgroup sliders to adjust the level of the entire drum kit.

Sound Mixers: Channel Inputs

The first point of each channel's pathway is the input socket, where the sound source plugs into the mixer. It is important to note what type of input sockets are available — the most common types are *XLR*, *6.5mm Jack* and *RCA*. Input sockets are usually located either on the rear panel of the mixer or on the top above each channel.

Type:

XLR

6.5mm (1/4") Jack

RC

Plug:



Input Socket:



There are no hard-and-fast rules about what type of equipment uses each type of connector, but here are some general guidelines:

- XLR** Microphones and some audio devices. Usually [balanced audio](#), but XLRs can also accommodate [unbalanced signals](#).
- 6.5mm Jack** Musical instruments such as electric guitars, as well as various audio devices. Mono jacks are unbalanced, stereo jacks can be either unbalanced stereo or balanced mono.
- RCA** Musical devices such as disk players, [effects units](#), etc.

Note: For more information see [Audio Connections](#).

Input Levels

The *level* of an audio signal refers to the voltage level of the signal. Signals can be divided into three categories: *Mic-level* (low), *line-level* (a bit higher) and *loudspeaker-level* (very high). Microphones produce a mic-level signal, whereas most audio devices such as disc players produce a line-level signal. Loudspeaker-level signals are produced by amplifiers and are only appropriate for plugging into a speaker — never plug a loudspeaker-level signal into anything else.

Sound mixers must be able to accommodate both mic-level and line-level signals. In some cases there are two separate inputs for each channel and you select the appropriate one. It is also common to include some sort of switch to select between inputs and/or signal levels.

Input Sockets and Controls

The example on the right shows the input connections on a typical mixer. This mixer has two input sockets — an XLR for mic-level inputs and a 6.5mm jack for line-level inputs. It also has a *pad* button which reduces the input level (gain) by 20dB. This is useful when you have a line-level source that you want to plug into the mic input.



Some mixers also offer RCA inputs or digital audio inputs for each channel. Some mixers provide different sockets for different channels, for example, XLR for the first 6 channels and RCA for the remainder.

Input Gain

When a signal enters the mixer, one of the first controls is the input gain. This is a knob which adjusts the signal level before it continues to the main parts of the channel. The input gain is usually set once when the source is plugged in and left at the same level — any volume adjustments are made by the channel fader rather than the gain control.

Set the gain control so that when the fader is at 0dB the signal is peaking around 0dB on the [VU meters](#).

Other Controls and Considerations

Phasing: Some equipment and cables are wired with different phasing, that is, the wires in the cable which carry the signal are arranged differently. This will kill any sound from that source. To fix this problem, some mixers have a *phase* selector which will change the phasing at the input stage.

Phantom Power: Some mixers have the option to provide a small voltage back up the input cable to power a microphone or other device.

Sound Mixers: Channel Equalization

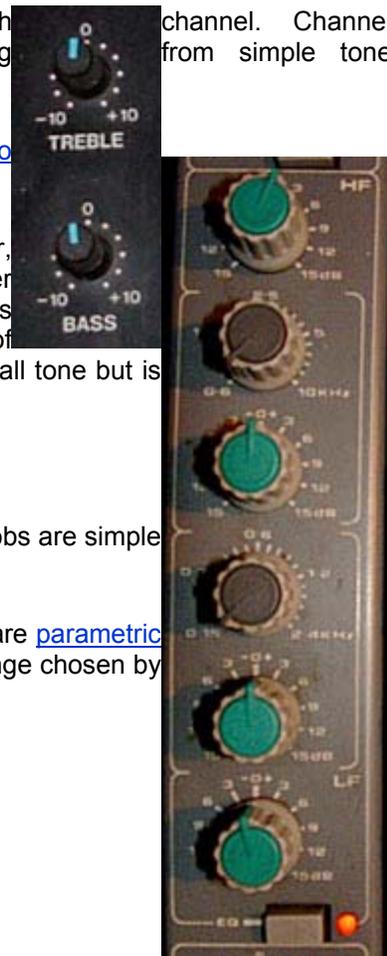
Most mixers have some of sort equalization controls for each channel. Channel equalizers use knobs (rather than sliders), and can be anything from simple tone controls to multiple parametric controls.

Note: For more general information about equalization see [Audio Equalizers](#).

The first example on the right is a simple 2-way equalizer, sometimes referred to as bass/treble or low/high. The upper knob adjusts high frequencies (treble) and the lower knob adjusts low frequencies (bass). This is a fairly coarse type of equalization, suitable for making rough adjustments to the overall tone but is not much use for fine control.

This next example is a 4-way equalizer. The top and bottom knobs are simple high and low frequency adjustments (HF and LF).

The middle controls consist of two pairs of knobs. These pairs are [parametric equalizers](#) — each pair works together to adjust a frequency range chosen by



the operator. The brown knob selects the frequency range to adjust and the green knob makes the adjustment.

The top pair works in the high-mid frequency range (0.6KHz to 10KHz), the lower pair works in the low-mid range (0.15 to 2.4KHz).

The "EQ" button below the controls turns the equalization on and off for this channel. This lets you easily compare the treated and untreated sound.

It is common for mixers with parametric equalizers to combine each pair of knobs into a single 2-stage knob with one on top of the other. This saves space which is always a bonus for mixing consoles.

Notes About Channel Equalization

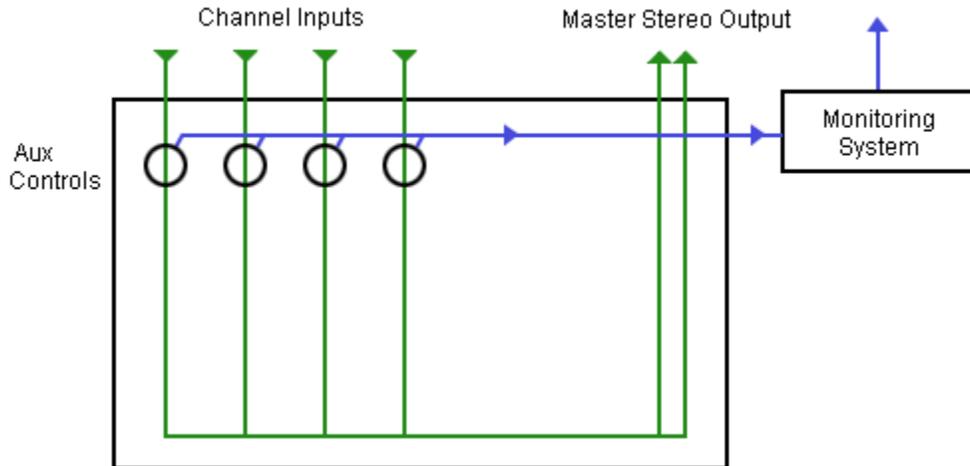
If the mixer provides good parametric equalization you will usually find that these controls are more than adequate for equalizing individual sources. If the mixer is limited to very simple equalization, you may want to use external equalizers. For example, you could add a graphic equalizer to a channel using the *insert* feature.

In many situations you will use additional equalization outside the mixer. In live sound situations, for example, you will probably have at least one stereo graphic equalizer on the master output.

Sound Mixers: Auxiliary Channels

Most sound desks include one or more *auxiliary channels* (often referred to as *aux channels* for short). This feature allows you to send a secondary feed of an [input channel's](#) audio signal to another destination, independent of the channel's main output.

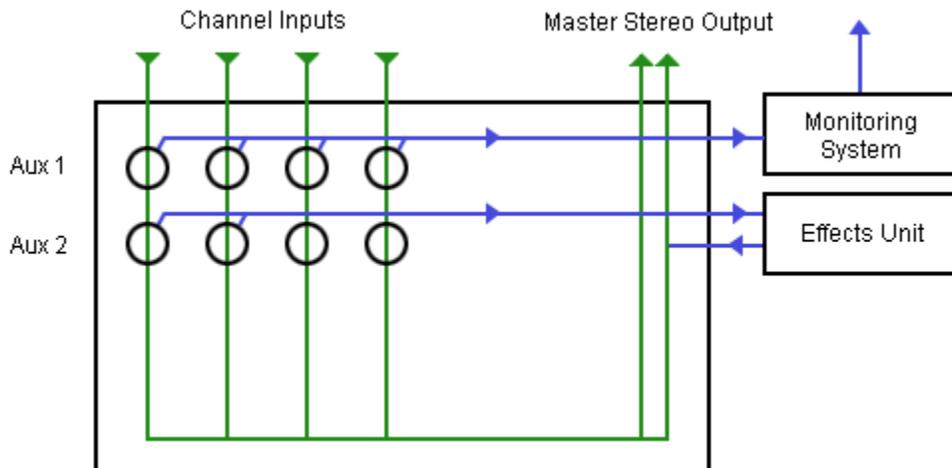
The example below shows a four-channel mixer, with the main signal paths shown in green. Each input channel includes an auxiliary channel control knob — this adjusts the level of the signal sent to the auxiliary output (shown in blue). The auxiliary output is the sum of the signals sent from each channel. If a particular channel's auxiliary knob is turned right down, that channel is not contributing to the auxiliary channel.



In the example above, the auxiliary output is sent to a monitoring system. This enables a monitor feed which is different to the main output, which can be very useful. There are many other applications for auxiliary channels, including:

- Multiple separate monitor feeds.
- Incorporating effects.
- Recording different mixes.

Mixers are not limited to a single auxiliary channel, in fact it is common to have up to four or more. The following example has two auxiliary channels — "Aux 1" is used for a monitor and "Aux 2" is used for an effects unit.



Note that the monitor channel (Aux 1) is "one way", i.e. the channel is sent away from the mixer and doesn't come back. However the Aux 2 channel leaves the mixer via the *aux send* output, goes through the effects unit, then comes back into the mixer via the *aux return* input. It is then mixed into the master stereo [bus](#).

Pre / Post Fader

The auxiliary output from each channel can be either *pre-fader* or *post-fader*.

A *pre-fader* output is independent of the channel fader, i.e. the auxiliary output stays the same level whatever the fader is set to.

A *post-fader* output is dependent on the fader level. If you turn the fader down the auxiliary output goes down as well.

Many mixers allow you to choose which method to use with a selector button. The example pictured right shows a mixer channel with four auxiliary channels and two pre/post selectors. Each selector applies to the two channels above it, so for example, the button in the middle makes both Aux 1 and Aux 2 either pre-fader or post-fader.



Sound Mixers: Channel Assigning & Panning

One of the last sets of controls on each [channel](#), usually just before the fader, is the *channel assign and pan*.

Pan

Almost all stereo mixers allow you to assign the amount of panning. This is a knob which goes from full left to full right. This is where the channel signal appears on the master mix (or across two [subgroups](#) if this is how the channel is assigned). If the knob is turned fully left, the channel audio will only come through the left speaker in the final mix. Turn the knob right to place the channel on the right side of the mix.



Assign

This option may be absent on smaller mixers but is quite important on large consoles. The assign buttons determine where the channel signal is sent.

In many situations the signal is simply sent to the main master output. In small mixers with no assign controls this happens automatically.

However you may not want a channel to be fed directly into the main mix. The most common alternative is to send the channel to a subgroup first. For example, you could send all the drum microphones to their own dedicated subgroup which is then sent to the main mix. This way, you can adjust the overall level of all the drums by adjusting the subgroup level.

In the example pictured right, the options are:

- **Mix:** The channel goes straight to the main stereo mix
- **1-2:** The channel goes to subgroup 1 and/or 2. If the pan control is set fully left the channel goes only to subgroup 1, if the pan is set fully right the channel goes only to subgroup 2.



- If the pan is centered the channel goes to subgroups 1 and 2 equally.
- **3-4:** The channel goes to subgroups 3 and/or 4, with the same conditions as above.

For stereo applications it is common to use subgroups in pairs to maintain stereo separation. For example, it is preferable to use two subgroups for the drums so you can pan the toms and cymbals from left to right.

You can assign the channel to any combination of the available options.

In some cases you may not want the channel to go to the main mix at all. For example, you may have a channel set up for communicating with the stage via an [aux channel](#). In this case you don't assign the channel anywhere.

Sound Mixers: PFL

PFL means *Pre-Fade Listen*. Its function is to do exactly that — listen to the channel's audio at a point before the fader takes effect. The PFL button is usually located just above the channel fader. In the example on the right, it's the red button (the red LED lights when PFL is engaged).

Note: PFL is often pronounced "piffel".

When you press the PFL button, the main monitor output will stop monitoring anything else and the only audio will be the selected PFL channel(s). This does not affect the main output mix — just the sound you hear on the monitor [bus](#). Note that all selected PFL channels will be monitored, so you can press as many PFL buttons as you like.

PFL also takes over the mixer's [VU meters](#).

PFL is useful when setting the initial [input gain](#) of a channel, as it reflects the pre-fade level.



PFL vs Solo

PFL is similar to the solo button. There are two differences:

1. PFL is pre-fader, solo is post-fader (i.e. the fader affects the solo level).
2. PFL does not affect the master output, soloing a channel does (by muting all other channels).

Sound Mixers: Channel Faders

Each channel has its own fader (slider) to adjust the volume of the channel's signal before it is sent to the next stage (subgroup or master mix).

A slider is a *potentiometer*, or *variable resistor*. This is a simple control which varies the amount of resistance and therefore the signal level. If you are able to look into the inside of your console you will see exactly how simple a fader is.

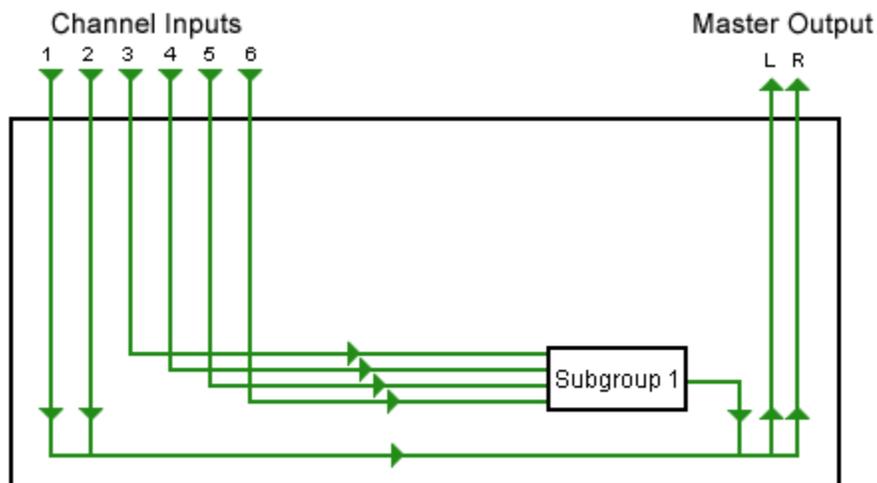
As a rule it is desirable to run the fader around the 0dB mark for optimum sound quality, although this will obviously vary a lot.



Remember that there are two ways to adjust a channel's level: The [input gain](#) and the output fader. Make sure the input gain provides a strong signal level to the channel without clipping and leave it at that level — use the fader for ongoing adjustments.

Sound Mixers: Subgroups

Subgroups are a way to "pre-mix" a number of channels on a sound console before sending them to the master output mix. In the following diagram, channels 1 and 2 are assigned directly to the master output [bus](#). Channels 3,4,5 and 6 are assigned to subgroup 1, which in turn is assigned to the master output.



Subgroups have many uses and advantages, the most obvious being that you can pre-mix (sub-mix) groups of inputs.

For example, if you have six backing vocalists you can set up a good mix just for them, balancing each voice to get a nice overall effect. If you then send all six channels to one subgroup, you can adjust all backing vocals with a single subgroup slider while still maintaining the balance between the individual voices.

Note that if your mixing console's subgroups are mono, you will need to use them in pairs to maintain a stereo effect. For each pair, one subgroup is the left channel and the other is right.

Each channel can be panned across the two subgroups, while the subgroups are panned completely left and right into the master output bus.

Sound Mixers: Outputs

The main output from most mixing devices is a stereo output, using two output sockets which should be fairly obvious and easy to locate. The connectors are usually 3-pin XLRs on larger consoles, but can also be 6.5mm TR sockets or RCA sockets.

The level of the output signal is monitored on the mixer's [VU meters](#). The ideal is for the level to peak at around 0dB or just below. However you should note that the dB scale is relative and 0dB on one mixer may not be the same as 0dB on another mixer or audio device. For this reason it is important to understand how each device in the audio chain is referenced, otherwise you may find that your output signal is unexpectedly high or low when it reaches the next point in the chain.

In professional circles, the nominal level of 0dB is considered to be +4 dBu. Consumer-level equipment tends to use -10 dBV.

The best way to check the levels of different equipment is to use [audio test tone](#). Send 0dB tone from the desk and measure it at the next point in the chain.

Many mixers often include a number of additional outputs, including:

Monitor Feed: A dedicated monitor feed which can be adjusted independently of the master output.

Headphones: The headphone output may be the same as the monitor feed, or you may be able to select separate sources to listen to.

Auxiliary Sends: The output(s) of the mixer's auxiliary channels.

Subgroup Outputs: Some consoles have the option to output each subgroup independently.

Communication Channels: Some consoles have additional output channels available for communicating with the stage, recording booths, etc.