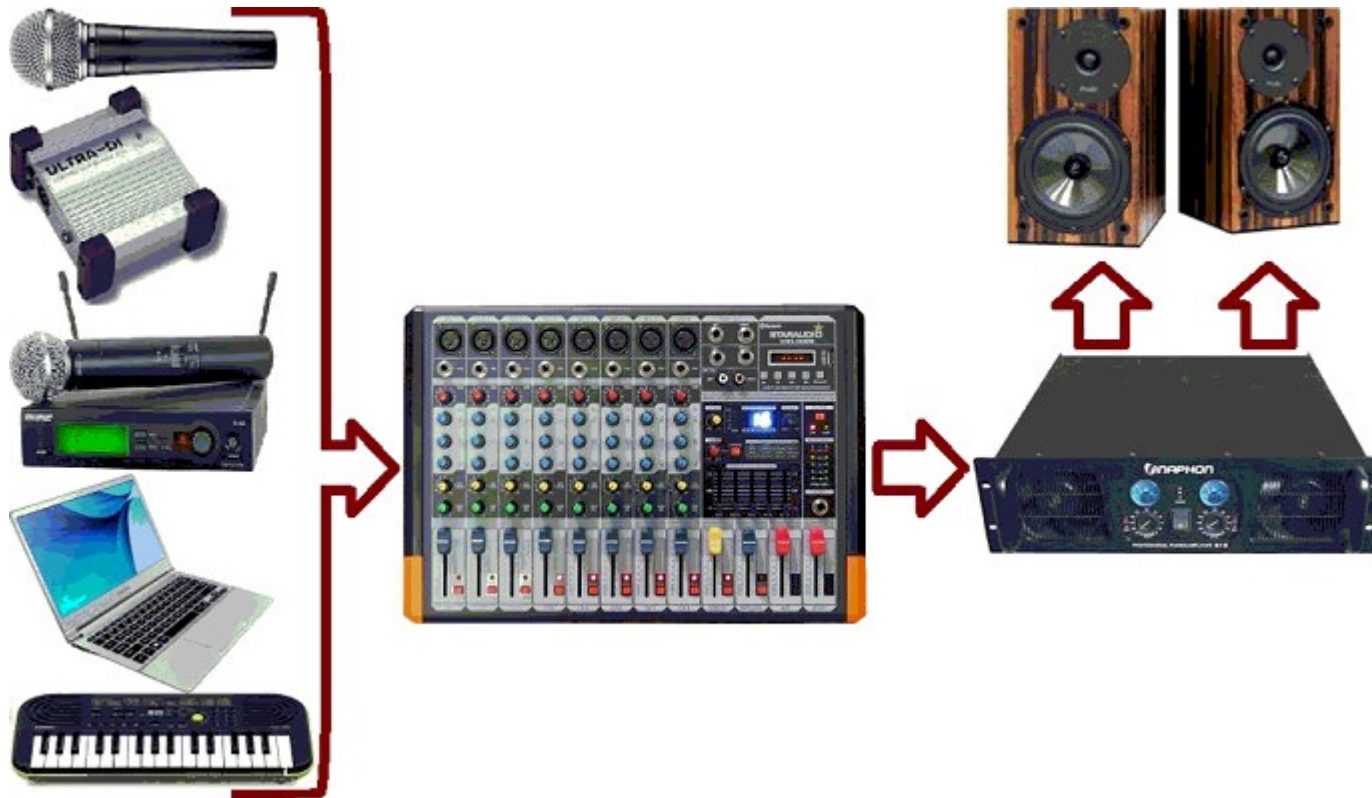




Sound System Overview

† Church Audio †



The principal purpose of a Sound System

A Sound System, originally called a P.A. (Public Address System) uses a Mixer to balance the volumes of all the Microphones and Musical Instruments connected to it. Each Microphone and each Instrument should have its own Input Channel on the Mixer so that we can control each volume individually. All inputs are then 'mixed' together and make their way to the Output Channels which we connect to Amplifiers. An Amplifier is needed to make the signal strong enough to vibrate Loudspeakers. The Amplifier may be separate, or inside the Loudspeaker cabinet. Multiple Loudspeaker cabinets will be placed around the listening area, as many as required to ensure everyone can hear properly. We call this 'Sound Reinforcement'.

The output from a mixer is usually configured around two channels, Left and Right. When working 'Live' we may use these to send the sound to the left half and the right half of a church. If the church is large then two Loudspeaker cabinets may not be enough, and additional Loudspeakers will be added.



Some extra work on the side (Auxiliaries)

As well as mixing all the Input Channels and sending the result to the Outputs (main Loudspeakers), we usually have other tasks as well.

For example, we typically send sound to the wedge-shaped loudspeakers on the floor (Floor Monitors) so that the music team can hear themselves, and each other. This is called “fold-back” because we are folding the performer’s sound back to the performers.

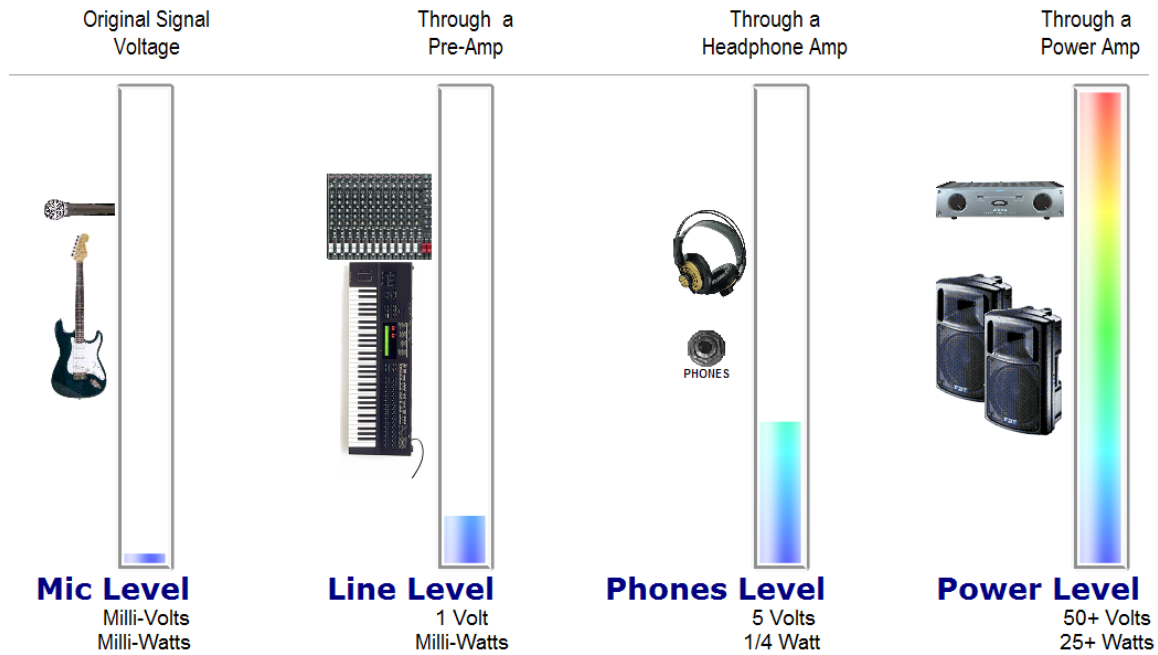
Another task may be to send a channel through a Sound Effect Unit such as a Compressor or Reverb to improve a sound.

You may wish to connect a Sound Recording Device, to record the Service, or a Music Player of some kind to play background music.

Computers, Laptops and Cell-phones are increasingly being connected for these purposes.



AUXILIARIES



Electrical Levels

Microphones and Musical Instruments generate a very small voltage (millivolts... thousandths of a volt). We call this voltage **Mic Level** (Microphone Level).

The first thing we do at the Mixer is to boost these levels (using the **Gain** knob, which is called a Pre-Amplifier) so all Inputs are amplified to approximately one volt We call this new voltage **Line Level**.

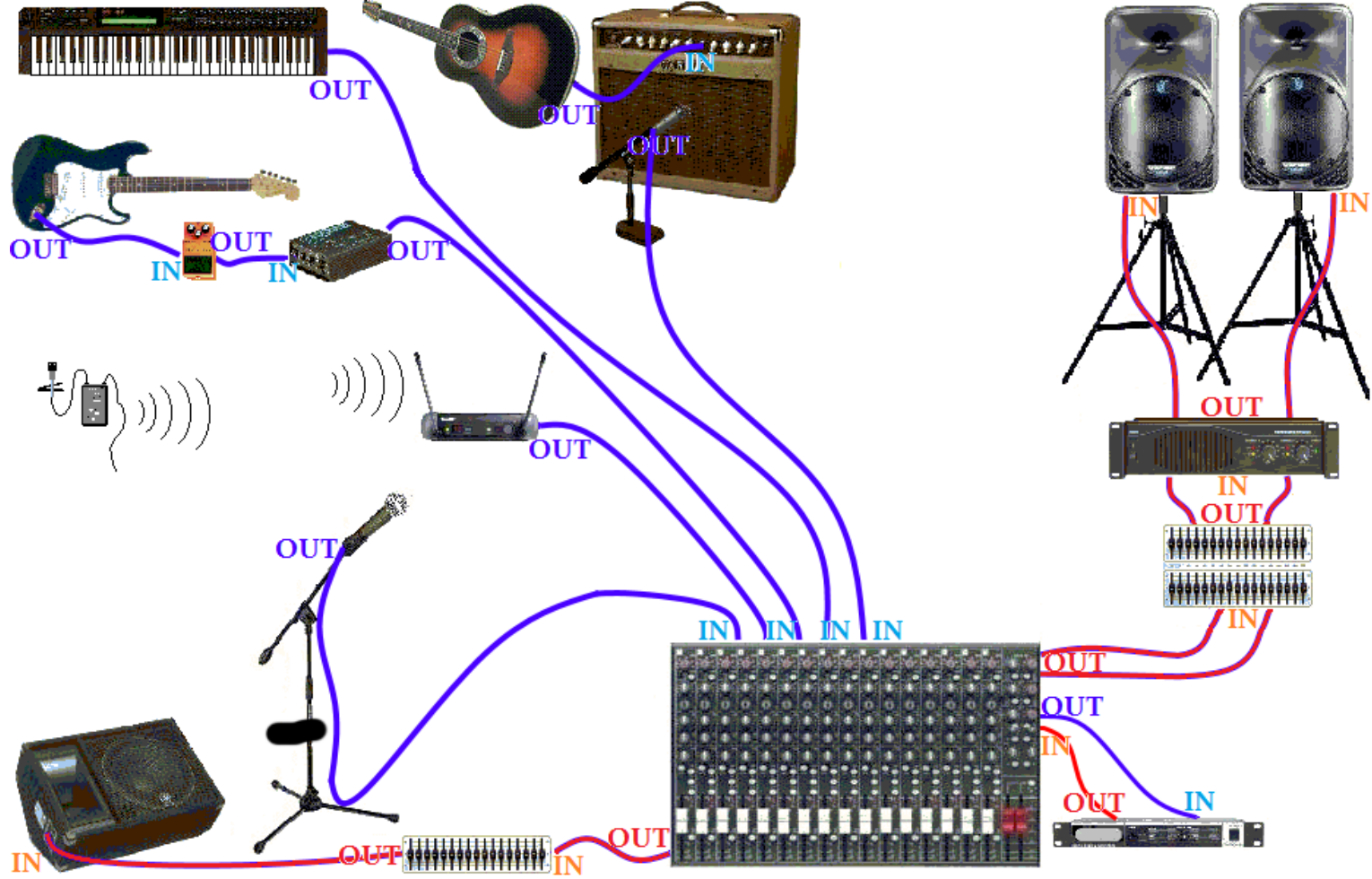
Everything is then done in Line Level.

The electrical output from a Mixer is Line Level. This is not powerful enough to make a loudspeaker cone move.

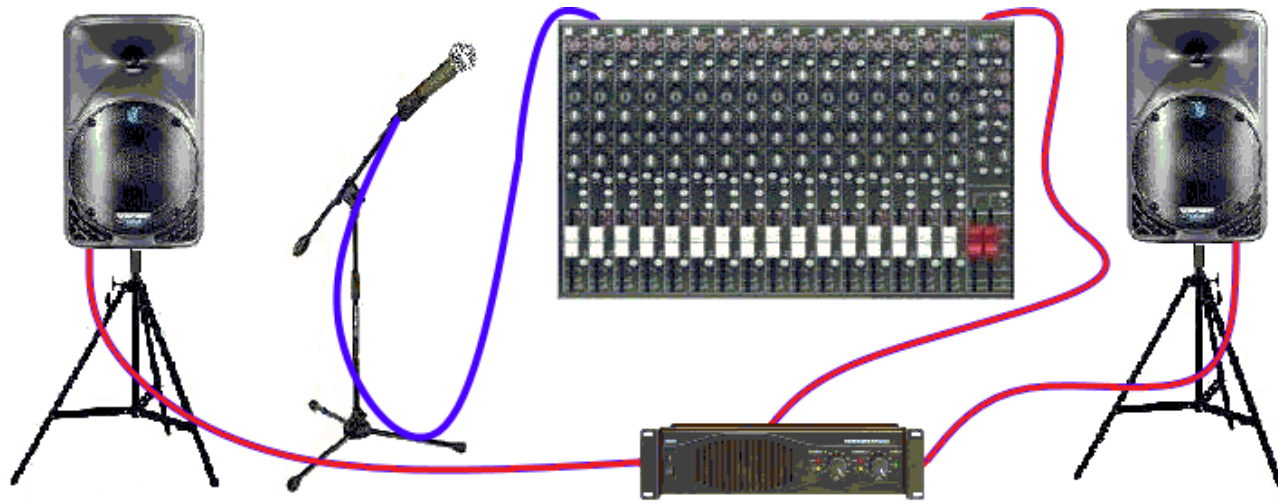
Whenever you see a Headphone connector with the word '*Phones*', it will be associated with a small Amplifier that raises the Line Level to **Phones Level**. Phones level is a bit stronger than Line Level, and is the correct strength to vibrate the small loudspeakers inside the headphones.

A stronger Amplifier (Power Amplifier) is required to raise the Line level to **Power Level** to operate Loudspeakers. Only a Loudspeaker Cabinet may be connected to the output of a Power Amplifier because of the high voltage and high amperage being generated. If you connect any other audio device to the output of a Power Amplifier, it will give off an unpleasant burning odour just before it explodes.

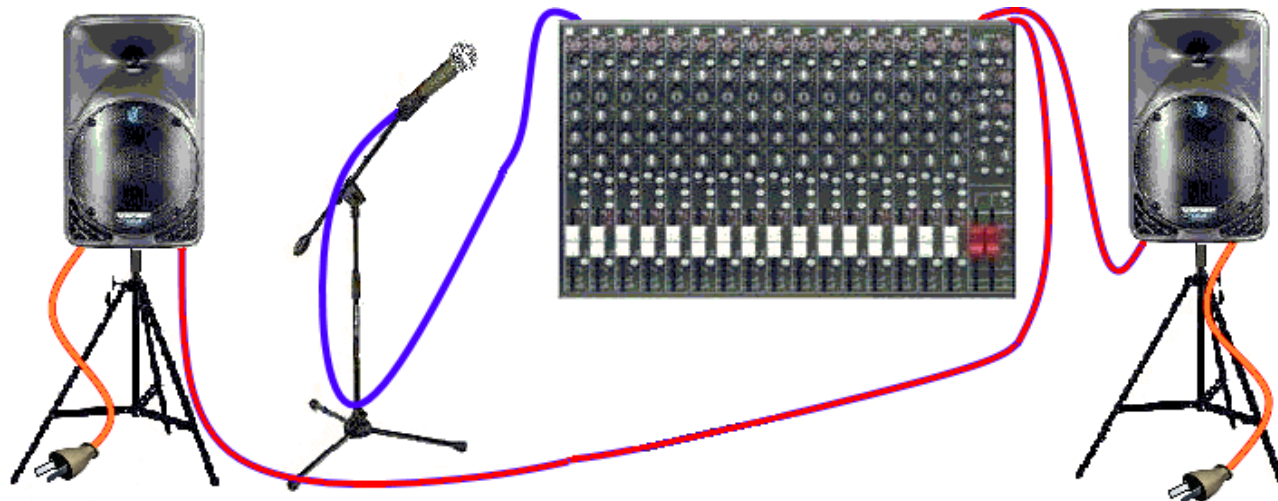
Connecting a Sound System



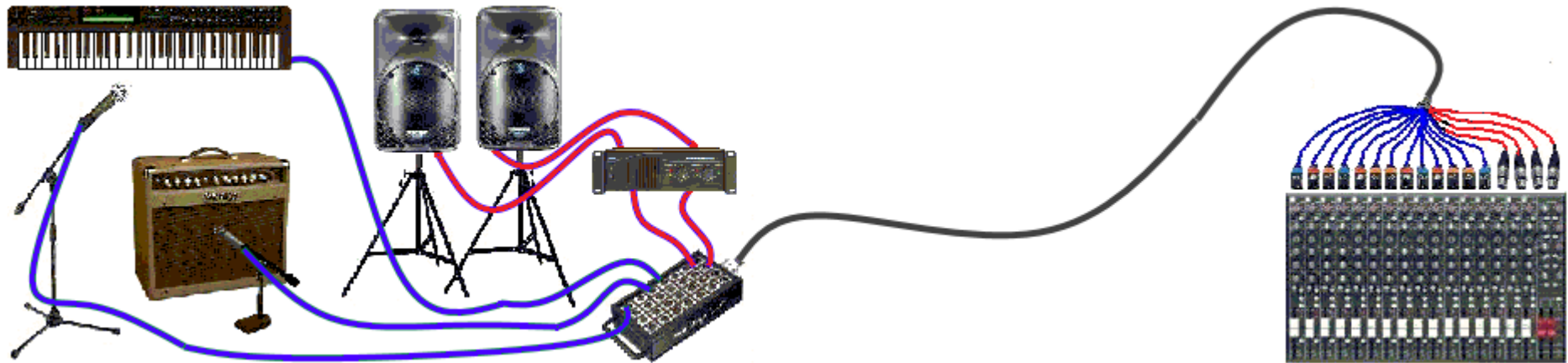
We call our connections **Outputs** or **Inputs**. Outputs connect to Inputs. The signal leaves the output of one device and enters the input of the next device.



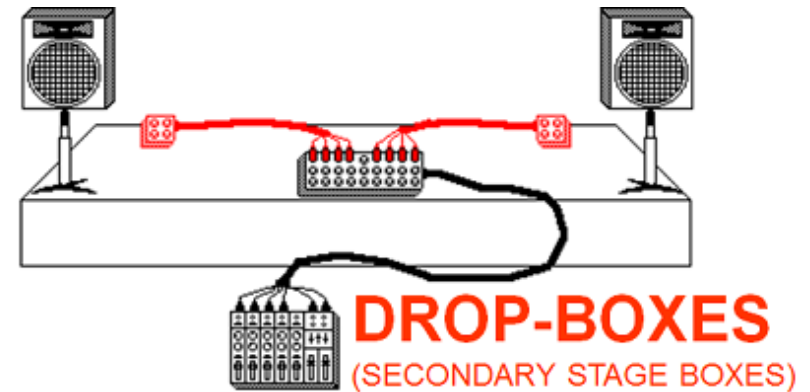
Microphones and Musical Instruments connect to the Input Channels on the Mixer, and the Output Channels go to the Loudspeakers via the Power Amplifier.



Many Loudspeaker Cabinets today have their Power Amplifiers already inside them. This is easy to see because they will have power cord attachments on the Cabinet. In this case you just connect the Mixer directly to the Cabinet.

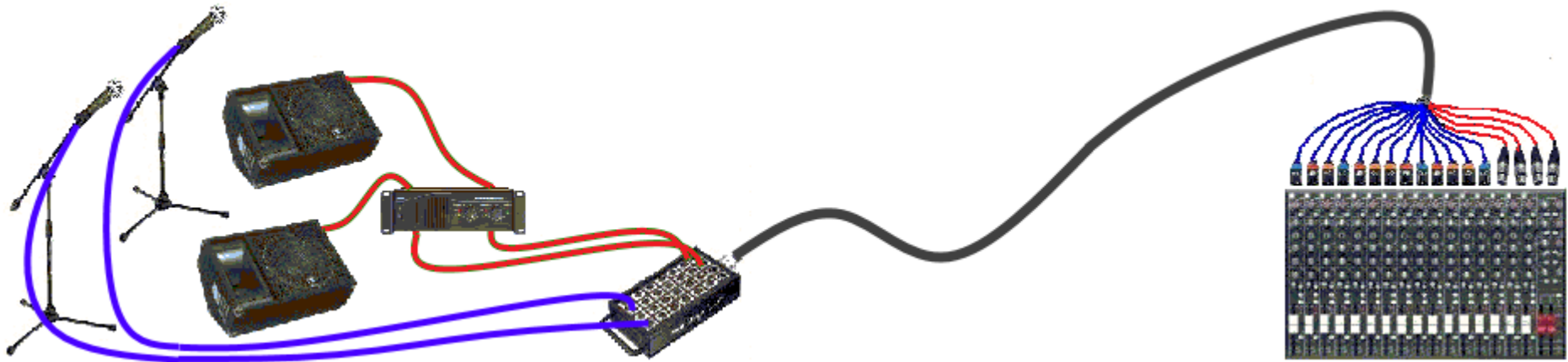


The Stage area is often quite some distance from the Mixer, further than the length of a microphone cable. We manage this by putting in extension cables.



Simple extensions use a multi-core cable with connectors (affectionately known as a **Snake**). A little more advanced has a box at the stage end (a **Stage Box**).

Sometimes we have a large number of microphone cables on the ground (hazardous). It can be tidier to add smaller short Stage Boxes, called **Drop Boxes**.



Floor Monitors (Monitors) (Wedges) are wedge-shaped Loudspeaker cabinets designed to sit on the floor in front of musicians and singers. They need these to perform properly. This is the **Fold-back** system. As with all Loudspeaker cabinets they may require a separate Power Amplifier, or there may be a Power Amplifier already inside (in which case it will have a power cable).



If **In-Ear Monitors (IEM)** are in use by the music team, then there will be no need for Floor Monitors. You will be able to create a better sound because there will be no off-stage noise from Floor monitors which always mixes with your Front-of-House sound.

With In-Ear Monitors each musician/singer wears a radio pack on their belt, and two earplugs. These are Radio Receivers and receive the transmission from the Transmitter box connected to the Mixer.

The IEM Transmitter box is connected to the output where you would have connected the Floor Monitors.



Some Microphones are cordless. These are **Radio Microphones** and allow a Singer or Speaker to have complete freedom of movement.

They come in the form of a **handheld** microphone, or a transmitter pack attached to the belt with a clip-on microphone (**Lavaliere**) that is attached to the persons collar.

These microphones are radio transmitters. We need to connect a radio receiver of identical frequency to each particular microphone to an Input Channel on the Mixer, just as we would if it was connected by a cable.



We often use **Laptops** for playing music, and perhaps for recording the Service. One problem with laptops is that their electrical earthing (grounding) system is practically non-existent. This means you may get a hum or other noise sound when you connect it to a Mixer. You may need to “earth” the chassis of the Laptop or go through a D.I. Box to resolve this. If you use a Laptop or Cellphone to play background music be sure that the volume is up high on the Player, this keeps the background noise to a minimum when connected to a Mixer.



On / Off Procedure

Avoid damaging the Loud-speakers

Electronic Devices often cause an electronic discharge (a boom or a click) when they are turned off, and some even when they are turned on. Power Amplifiers will amplify each click, and this surge (spike) of electricity can easily damage loudspeaker cones.

To avoid this, we have an order in which we switch on and switch off the devices in a Sound system. Firstly, we switch on the mixer and all other devices attached, and then we turn on the Power Amplifier last.

When we shut down we switch off the Power Amplifier first, and then all the other devices.



Lower the Fader



Lower the Fader

Whenever you disconnect a guitar etc or you need to switch Phantom Power on or off, you should lower the Main L-R faders on the Mixer, as this also causes an electrical spike.



How many Watts do I need?

For **Floor Monitors** involving quiet indoor work 50w to 100w will power things. If the music is loud, or the crowd noise is loud, you will need 100w minimum. For outdoor Services on an open stage you eventually need to be running 150w to 200w (the sound on an outdoor stage disperses quickly). For very big spread-out stages you could even need 300w.

The **Front-of-House** (FOH) will depend on how far you have to project the sound.

The international rule of thumb regarding concerts is...

1 watt per person.

100w will allow 100 people to hear speech loud and clear.

If loud music is involved, or there is a younger congregation, then you will require much more.



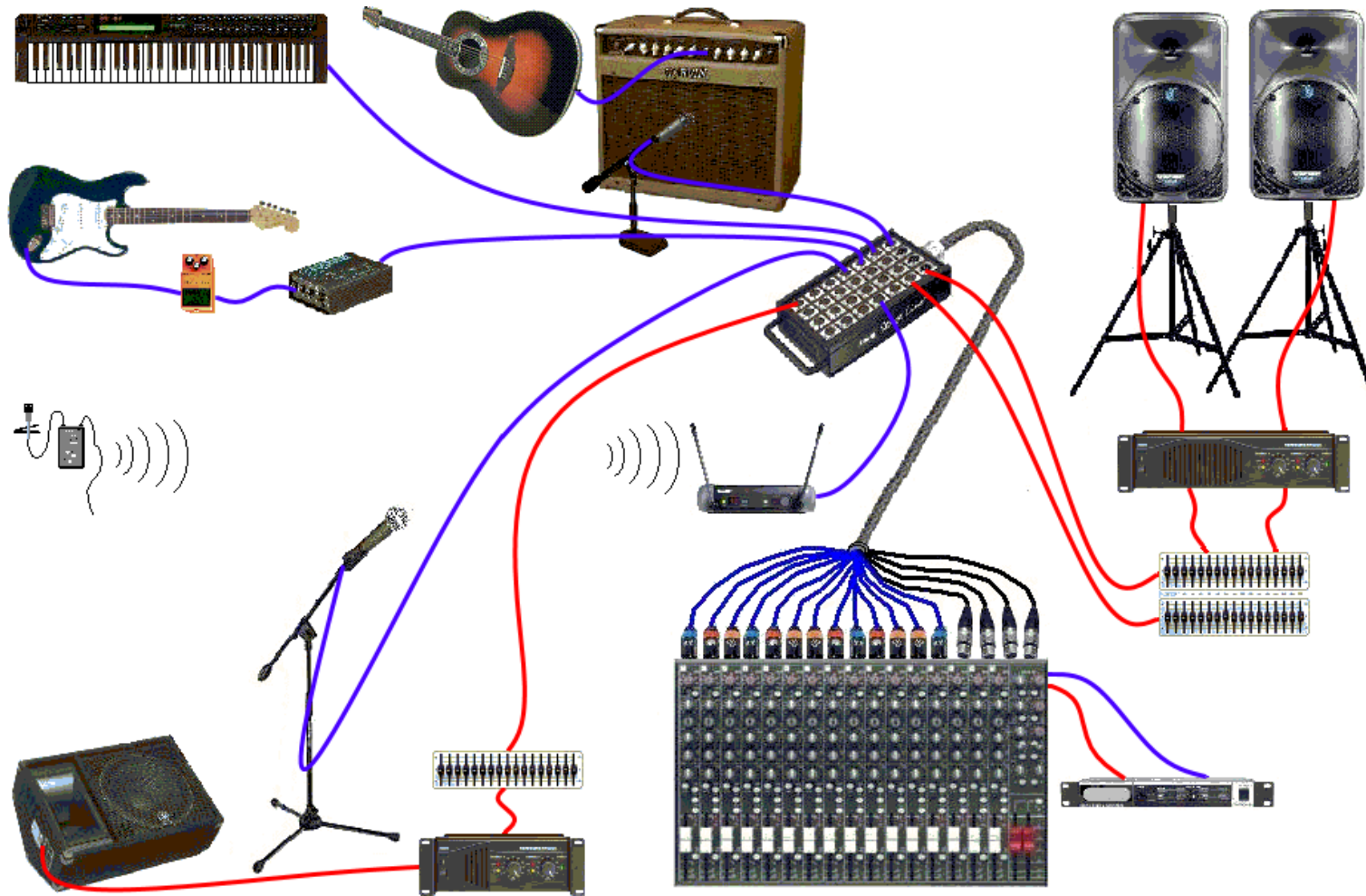
Sound Volume is measured in Decibels (dB).

For "Live Sound" we use a Sound Pressure Level (SPL) Meter. This measures the dB of Air pressure.

*If you speak so quietly that only half of the words are audible, then you are speaking at what we call the **Threshold of Hearing** (this is around **30dB**). **Normal conversation** is around **60dB**. The **Threshold of Pain** (so loud it starts hurting) is around **120dB**.*

How loud should music be? You sing at a louder volume than you speak. You need the music to be at least as loud as your singing voice (or you won't sing).

How loud is too loud? If you have to shout at someone standing right beside you... it's too loud!



If you hear annoying background noises (buzzing or humming) in your Sound System when everything is quiet, you need to unplug one item at a time (or mute the channels) until the noise disappears. That is how you find the guilty party. It may be an audio device, or it may be a damaged cable (try swapping cables to confirm if it is the cable or the device).

We search out most of our noise problems by the process of elimination. Replace something, change something, disconnect something until the noise disappears.

CREDITS

This material is offered freely to the Christian Churches; downloadable at Pietango.com

Text: *Original, by the Author, a Christian Recording Engineer.*

Images: *Designed by the Author. Some photographs were sourced from the Internet, then re-worked.*

Ever since the creation of the world, God's invisible attributes and divine nature have been evident. They are clearly understood through his workmanship, and all the wonderful things that he has made. Therefore, those who fail to believe and trust in him are without excuse, or defence. **Romans 1:20**

All of us have sinned and fallen short of God's glory, but God treats us much better than we deserve.

Because of Christ Jesus, he freely accepts us and sets us free from our sins. God sent Christ to be our sacrifice. Christ offered his life's blood, so that by faith in him we could come to God. **Romans 3:23**

If you declare with your mouth, "Jesus is lord," and believe in your heart that God raised him from the dead, you will be saved. For it is with your heart that you believe and are justified, and it is with your mouth that you profess your faith and are saved. **Romans 10:9**

For the Scripture (*Isaiah 28:16*) says, "Whoever believes in Him will not be disappointed." **Romans 10:11**

These things have been written so that you may believe that Jesus is the Christ, the son of God; and that by believing, and relying on him, you may have new life in his name. **John 20:31**