

Audio/Visual Training Manual



Audio/Visual Training Manual

- Sound, Recording, Light, and Video Training -

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This Audio Visual System Training Manual was developed to aid Christian church leaders and their A/V ministry teams in learning more about Sound, Lighting, and Video so that they are better equipped to serve God, their church, and their community through media-incorporated services and productions.

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1. Introduction

This document is a training manual for members of a Church Audio/Visual (A/V) Ministry Team. It is intended to provide an overview of basic concepts (with a fair amount of detail) concerning the operations of sound, lighting, and video equipment that may be found in today's contemporary Church services.

It is my desire to see pastors and other church leaders sufficiently educated concerning the applications and operations of sound and light systems in order to be able to properly lead the volunteer team and minimize unnecessary technology interruptions and distractions due to avoidable mishaps.

Additionally, another objective of this manual is to describe the goals of a Church A/V Team and to outline the scope of the team's work; both physical and spiritual.

If you are a pastor and wanting to start an A/V systems ministry team, consider this

- If you don't learn about A/V systems, you will be at the mercy of those who think they know what they are doing.
- Your ability to understand the operations of A/V systems will enhance your leadership abilities within your church.
- Your ability to understand A/V systems will protect you from being taken advantage of by deceitful business tactics used by many sound system companies.
- Your ability to understand A/V systems will minimize costs of purchases because you won't be sold anything you know you don't need. Otherwise, you are at the mercy of the company offering the service and consultation.
- It seems everyone who has operated a cd player feels they have the experience to operate a sound system...and are wrong.
- Multiple hands controlling your system will destroy it. The team must be exclusive.
- Every one will blame your sound team for everything.
- Most problems are caused by those using the system, not those who are trained to run it.
- The preachers, singers, and musicians must be taught "stage discipline" or your sound team will have to walk in an overabundance of grace
- The members of your sound team will need your constant encouragement and support. It can be a very frustrating and thankless job.



If you are, or want to be, part of a Church A/V systems ministry team, you should consider this:

- You will always be blamed by the listeners for any tech distraction even when most of them are caused by the users
- Singers and musicians may expect you to instantly fix any situation they define as a problem even when they are the cause
- You may see the "harsh" side of people due to the nature of the stress zone you are working in
- You will have to walk in grace and forgiveness often with all who need your services
- You will have to kindly keep curious fingers away from what you do
- You will be a vital part of the worship team
- You will be a vital part of the service
- You cannot hide behind the sound board, you are a Christian still in need of a Savior long before you are a minister. If you feel the need for personal ministry, someone else can push the buttons. There is nothing more obvious than a secular minded sound person on an A/V ministry team. The attitude will follow quickly
- You MUST keep a positive attitude, respond to everything with patience, and LOOK HAPPY!!!

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Direction of Signal

(Sound Signal starts at the top, progresses through equipment, ends at bottom)

ELECTRICAL SIGNAL SOURCE (Tape, CD, Record, or Electronic Instruments)		ACOUSTIC SIGNAL SOURCE (Voices or Acoustic Instruments)
DIRECT/PICKUP/TRIGGER (Direct Electrical Interface to Sound System)		VOCAL or INSTRUMENT MIC (Conversion of Acoustical Energy to Electrical Energy)
	MIXER (Electrical device used to blend the sound from several sources)	
70 volt Systems (Nursery, Bathroom, Office) CYCLE STOPS	EFFECTS (Electrical Manipulation of the Audio Signal)	Recording System, CYCLE STOPS



MONITOR SYSTEMS EQUALIZER (Tonal control of the sound in monitor speakers)	HOUSE MAIN SYSTEMS COMPRESSION – EQUALIZER CROSSOVER (Tonal control of the sound in main speakers)
MONITOR POWER AMPS (Electrical device to amplify or multiply the power of the sound)	MAIN POWER AMPS (Electrical device to amplify or multiply the power of the sound)
MONITOR SPEAKERS (Conversion of Electrical Energy back into Acoustical Energy)	HOUSE MAIN SPEAKERS (Conversion of Electrical Energy back into Acoustical Energy)
PROPAGATION (Affect of Building, Air, and Audience on Sound)	PROPAGATION (Affect of Building, Air, and Audience on Sound)
PERFORMERS	AUDIENCE (ears) (Appreciation of the Program)

Problems occur when the process recycles (frequencies leave speakers and are sent back through mics) and when the process reverses (lines crossed).

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2. Definition of Terms

Sound/Signal Source

Person speaking, singer, musical instrument, or a sound recording (these will be referred to as the "performer")

Microphone (Mic)

Converts audible sound energy (moving air) into electrical energy (voltage)

Mixer

Blends the electrical signals from several sound sources

Effects Processor

Adds special effects such as reverb, echo, or delay to the sound

Equalizer

Controls the tonal quality of the sound

Graphic Equalizer

Controls the dynamics of the frequency signals using individual frequency channel controls. It consists of a bank of sliders for boosting and cutting different bands (or frequency ranges) of sound. The number and width of filters depends on application.

Parametric Equalizer

An electronic multi-band variable equalizer used in sound recording and live sound reinforcement. Parametric equalizers allow audio engineers to control the three primary parameters of an internal band-pass filter which are amplitude, center frequency and bandwidth. Bandwidth is typically labeled "Q" on the unit, which stands for Q factor. The amplitude of each band can be controlled, and the center frequency can be shifted, and widened or narrowed.

Crossover:

A class of electronic filter that splits the audio signal into separate frequency bands that can be separately routed to loudspeakers optimized for those bands.

Compressor:

A process that reduces the dynamic range of an audio signal, that is, narrows the difference between high and low audio levels or volumes.

Limiter:

A circuit that allows signals below a specified input power to pass unaffected while attenuating the peaks of stronger signals that exceed this input power.

Power Amplifier

Increases the electrical power of a sound signal

Speaker (Cabinet)

Converts electrical signals into sound energy (moving air)

High-Z signal (High Impedance):

Unbalanced signal made by using a two wire system (Hot and ground) that begins to dissipate after approximately 20 ft. The high-z signal cables are usually used for instrument cables and speaker cables. Speaker cables are unshielded and thicker gauged because they are amplified. Instrument cables are shielded and usually a smaller gauge.

Low-Z signal (Low Impedance):

Balanced signal made by using a three wire system (hot, neutral, and ground) that can run for very long lengths without signal interruption. Low-z cables are always shielded and are used for mic line and mixer sends. Low-z cables are also known as stereo cables and XLR cables.

Shield:

Insulated wrapping around the cluster of wires within a cable that prevents electric sounds from entering the signals being sent through the sound system. The shield normally consists of an aluminum or aluminum alloy wrapping around the cluster of wires.

Direct Box:

A device that converts a high-z signal into a low-z signal. It usually consists of a mono input, a mono output (to personal amp) and an XLR output (to sound board). Some come with their own phantom power.

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Phantom Power:

A boost of power, usually originating from the mixer, that allows for power to be sent to the input device instead of having to use batteries to get the power needed to operate the device. Examples of devices that require phantom power are condenser mics and certain wireless mics.

Pre-amp

Small amount of amplification used to allow a weak signal to travel a long distance on a low-z cable. Frequently used for mic lines. Most mixers have internal preamps for each XLR channel.

TRS Cable

A quarter inch jack with two rings instead of one. TRS use low-z cables and are short for Tip – Ring – Sleeve. They are commonly known as “stereo cables.”

TS Cable

A quarter inch jack with one ring. TS use high-z cables and are short for Tip – Sleeve. They are commonly known as “mono cables” or “phono jacks.”

XLR Cables

A low-z cable that is typically used for sending voice or light signals to (and from) the stage to the mixers and vice versa. They typically consist of a male and female end with 3 prongs on the male end and 3 receivers on the female end. XLR stands for Ground (X), Left, and Right.

Neutrik Speakon Cables

A relatively new form of jack that can be used in both mono and stereo applications that allows for a much stronger and supportive connection to speakers from amplifiers. They have a double locking mechanism that ensures a good, secure connection.

Snake

Cable consisting of bundled cables for the purposes of sending and receiving low-z signals from the sound source area to the mixer

Propagation

Moving of sound through air, affected by building acoustics, audience, surfaces of floor, walls, and ceiling, air temperature, and humidity

Audience

People who are expected to hear the program

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3. Goals for Sound Systems

- To be out of sight and out of mind (A perfect sound system should not be noticed by the audience)
- To **create and rehearse** protocols for typical scenarios as well as reactions to unplanned changes in service order/equipment operative status that allow the team to function as fluidly and as constantly as possible.
- To allow the speaker or performer to feel comfortable
- To provide the right tonal quality different events and occurrences
- To sound as clean and clear as possible
- To help people to hear portions of speech/music that are naturally quiet
- To help people in the back of the room hear (even volume throughout the audience, not too loud in the front, not too quiet in the back)
- To make sound louder for artistic reasons (i.e. greater impact)
- To allow someone to communicate with a large group of people without having to YELL!
- To have every sound source reproduced at the volume that is appropriate for that sound (blend)
- To be able to record the program so that cassette, CD, or video copies can be made
- To make the program or event available in other rooms (nursery, cry room, overflow room, office, bathroom, etc.)
- To enable those with hearing difficulties to hear and/or see the program
- **Equipment Security**
 - “Many hands make for little work” ... but also a lot of stuff missing or damaged
 - The requirement for the A/V team to be an exclusive team is important. People, especially people of the church, often see no harm in touching what is not theirs. I strongly suggest that you make it part of your documented policy that no one touches in any way any component involving technology unless part of the trained and approved team for that tech component. Camera operators have no business touching the sound system. The person trained to operate the sound system mixer has no business messing with the light systems UNLESS that person has been trained, approved, and accepted responsibility of the system.
 - This is very important to understand and more important to apply or your gear will wear prematurely, fail unexplainably, and disappear quickly.

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4. Responsibilities of the A/V Team

Before You Enlist

- Be absolutely sure that this is a service you want to offer to your church. Remember that you've VOLUNTEERED to do this.
- Get the training you need. Look for training opportunities (like this A/V Training Manual and A/V classes). Talk to other people experienced A/V techs. Watch other A/V techs work (not just in Churches, but other places like concerts).
- Do not assume any presumptions you have concerning sound systems are worth much. BE TEACHABLE! Sound systems are a huge investment and should not be played or experimented with.

Before the Service

- Prepare yourself before each service to do everything with excellence.
- Be EARLY – no one can begin to really do anything of value until the system is turned on and running. No one should be touching the system except those who run it. Performers are NOT A/V techs
- LOOK HAPPY!!!
- Determine any special needs of the performers/program and be prepared well before the program starts (i.e. additional mics, monitor speakers, connection of music instruments, cassette tapes, CDs, Video tape, etc.).
- Set-up and check-out the sound system before the performance, check every mic, check every instrument, listen to monitor levels, queue every tape. And do it every time!
- Obtain an agenda of what is to happen and when so you can be prepared (ask questions if the agenda is not clear - the A/V Techs don't need surprises!).
- Instruct performers on the proper use of microphones.
- Run a sound check with the performers to set levels, tonal quality, and adjust monitor mix for performers.

During the Service

- Be a servant - you are there to serve, not to be served. LOOK HAPPY!!!
- Be humble - people love to point blame at an arrogant sound man. LOOK HAPPY!!!
- NEVER add to the frustration of the Pastor or any performer before or during the service or program - your job is to SERVE!
- Take notes during the service of things that need to be addressed before the next service. Adjust (or fix) what you can, do the best you can do to cope with the rest. Now is not the time to correct anyone and, with the pressure of the service, it will not come out with grace (nor will it be accepted with it).
- Work as a TEAM. Support, help, and encourage each other. Give and accept CONSTRUCTIVE criticism gracefully. The A/V Ministry is NOT a place for EGO.
- The Sound Technician is to serve the performer or speaker. Help the performer to be as comfortable as possible so that they can concentrate on the message they are delivering and not be distracted by the sound system or Sound Technician.
- The Sound Technician is to serve the audience. Ensure that the audience can hear the performance as well as possible.
- Check for feedback and adjust equalization if necessary.
- Cooperate with the performers to meet their needs, help them feel at ease, and give them confidence that they will sound good.
- NEVER antagonize the performers! LOOK HAPPY!!!
- Pay attention during the entire service or performance. Do not allow yourself to become distracted. Take your service seriously.
- Do NOT chat or gossip during the service or performance. Do NOT let your words or your thoughts dwell on criticism of others. Church is not the place to wallow in criticizing and blaming everyone and everything.
- Listen, Listen, Listen...and LOOK HAPPY
Listen to the program and make adjustments as needed during the program. Listen for correct volume, blend, and tonal quality.
- Watch, Watch, Watch...and LOOK HAPPY
Be prepared for unexpected changes. If someone picks up the wrong mic, make sure you are there to turn it on. If the performer moves to an area that is not lit, make sure you are there to adjust the lighting.

After the Service

- Give out a complement or word of encouragement now and then.
- Tear-down, put-away, and secure the equipment after the performance.
- Take good care of the equipment - treat it like it belongs to God (because it does)
- LOOK HAPPY

During Practice

- Realize you are part of the team ... you play a vital instrument ... INTERACT with the team
- Be PATIENT ... most volunteer musicians and singers have little understanding of how any of this works.
- Discuss noted observations during the service that must be addressed and how to properly correct them (with grace).
- LOOK HAPPY!!!

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5. Responsibilities of the Performers/Speakers

NOTE: The fact is that once the sound system is running, many of the problems that occur during the use of the sound system are caused by the performers failing to execute their responsibilities and stage disciplines. The sound team gets the blame ... but fault usually lies on the performers and their actions. It is therefore very important that performers understand and execute their responsibilities and stage disciplines with excellence.

Before the Service...LOOK HAPPY

- Get guitars and horns tuned well before warm-up starts
- Help with setting guitar and keyboard levels BEFORE warm-up starts
- Show up on time for warm-up and be in your designated position
- Position the mic at the right height for you and any others sharing the mic, but don't change the up/down angle of the mic or point it to the side (because it may pick up sound from the monitor speakers and cause feedback)
- Tell sound man if you have any problems he may be able to fix, especially monitor problems
- Tell sound man if you have any problems with your designated position
- Do NOT tap the mic to see if it is on, this DAMAGES the mic!

During the Service...LOOK HAPPY

NOTE: If there is an issue with your sound or monitor system, do the best you can. If an adjustment was made that altered your sound field, DEAL WITH IT. If you attempt to communicate with the A/V techs during the service it will ONLY make a scene. Put off your pride as an offering to God and do the best you can. You are a performer...perform. Deal with it later (with grace). It may be something that you did, it may be something someone else did, it may be a piece of faulty gear ... regardless it is not worth ruining what has been planned because you won't sound as good as you want to.

- If you are alone on a mic, try to stay a constant, consistent, never changing 4" from the mic, except for solos or speaking parts when you should usually be 1" from the mic
- Sing at a consistent volume (except where dynamics of the music require change). DON'T get closer to the mic and sing louder on songs you know well. DON'T back up and sing quieter on songs you know less well.
- When singing SOLO, control your own dynamic range and adjust your distance accordingly.
- If you are grouped on a mic with others, allow the quietest singer to be centered on the mic, louder singer(s) may be off to the side a little. If all singers on a mic are the same loudness, they should be equidistant from the mic. Stay as close to the mic as possible. If you are more than 15" from the mic, you cannot be heard.
- **DON'T move to another mic unless absolutely necessary.** The volume of every mic has been balanced for the people who normally sing on that mic. If you must move to another mic, tell the sound man (when convenient), don't get closer than 4", and don't sing louder than you normally would.
- If you are normally grouped on a mic and the other person(s) leave for one song, don't move closer to the mic than you would have been if the others were still there.
- Know where you are on the stage. Do not walk recklessly around the sound field. Learn where you're free and where you aren't.
- Do not cover your mic with your hand, sing with the mic turned sideways (or upside down), or twirl your mic

After the Service...LOOK HAPPY

- If at all possible, do not disconnect your line from your instrument or your gear until you know your channel is muted.
- Help pack equipment ...instruments should not be left out ... they should be cased unless the stage is secure
- Learn where equipment is normally placed so that you can set it at location which will probably be correct
- Position mic stands higher than normal for set-up (so the cords will be long enough later)
- Put mics on the mic stands (the type of clip indicates which type of mic to use)
- Help wrap up cords. THIS MUST BE DONE NEATLY! If the cords are not wrapped neatly, they will knot when used the next time (increasing setup time) and they will not lay flat (causing a trip hazard).
- After wrapping a cord, place it in a pile with similar cords. Group speaker cords (heavy cords with 1/4" plugs) together and group mike cords (XLR connectors) together by the color of their tie string.

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6. Front of House (FOH) Communication

It is vital that the A/V Team and the performers learn proper stage - FOH communication.

There are times when errors in the stage mix can be too distracting for the performers to properly execute their responsibilities. For example, if a monitor gets spiked, it can be painful and damaging. The performer must have a means of communicating this to the sound techs.

If the sound techs need to speak to the performers, they can use the “talkback” function (explained in Ch 7) to quickly and discretely address the situation.

If the performers need to contact the techs, however, this can be more complicated.

Remember: Any overtly physical attempt to attract the attention of the sound techs will cause a distraction. This is to be avoided. It is unnecessary and screams of pride and a lack of personal discipline and respect

- The sound techs are to be constantly monitoring the stage. If they are doing their job, they should immediately notice that something is ‘wrong’ and be looking for FOH direction from the performer.
- Eye contact directed from the performers to the sound techs should be considered as a discrete form of requested communication.
- Once that communication has been received by the sound tech, a sound tech should be standing and responding ... awaiting further discrete requests for adjustments.

NOTE: Discrete communications should be formulated and rehearsed in practice in order to properly make necessary adjustments. I recommend the simple, and discrete pointing by the performer to the source of the need (another performer), a point to the signal output (usually a monitor ... typically the monitor directly involved with the performer in need) and then a thumbs up or down as far as what the need required is. Additionally, for subtle adjustments, the thumbs up (or down) followed by a rubbing of the first two fingers communicates “small adjustment.”

NOTE: Since a sound tech team usually has less than three techs operating the system at once (many times just one), it is recommended that only one performer have the authority and responsibility to initiate the communication. If other performers need immediate adjustments, they can discretely communicate that need.

NOTE: If warm –ups are done correctly, this should not be a frequent occurrence

NOTE: Just because a performer desires a change to the mix doesn’t mean that it is practical. Having a performer responsible will allow that performer to make that decision.

- Once the adjustment has been made, the performer should break eye contact with the sound tech and continue eye contact with the congregation. This lets the tech know that the problem has been resolved

NOTE: Remember that your team should function as one. What makes the good great is the ability to function when things are not running correctly. If a performer cannot keep a positive attitude and properly execute the responsibilities of the position unless everything is catered correctly, strongly considering the removal of that performer until proper training and understanding of the role has been communicated, received, and embraced.

TO THE SPEAKER: It often seems that speakers seem to feel the right and obligation to call out the sound techs. I recommend that speakers also be taught and be held accountable to FOH procedures. I also recommend that the pastor tread softly concerning the tone of voice used when addressing the sound techs. If they are doing their job, they notice your uncomfortable stature and they are trying to find the resolution ... which might be something you have done yourself. Be patient ... try to work through it and deal with it later. Set the example of what you want from those who serve you. In the end, so goes the shepherd...

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7. Components of a Sound System - Signal Source

When it comes to sound systems, all of the sources for sound fall into one of two main categories:

- a) **Electrical signal sources**
- b) **Acoustic signal sources.**

Electrical signal sources are the sources from where the signal originates as an electrical wave generated by some form of digital or analog electrical equipment. Examples of Electrical signal sources include: recorded sound (MIDI, Computer, DVD, MP3 Player, CD, cassette tape player, etc) and electronic instruments (keyboard, electric guitar, electric drums, etc.). Many electronic signal sources cannot be heard at all without the use of a sound system.

Acoustic signal sources are those that naturally make sound that can be heard (at least to some degree) without a sound system. Examples of Acoustic sound sources include: voices (talking or singing) and acoustic instruments (pianos, acoustic guitars, strings, woodwinds, horns, drums, percussion, etc.).

Below, we will discuss the various ways to connect Electronic and Acoustic signal sources to a sound system:

- **Connecting Electronic Signal Sources**

In order to connect an Electronic sound source to a sound system, you usually just "plug it in". That is, an Electronic sound source usually outputs an electronic signal suitable for direct connection to a sound system (the mixer).

- **DVD, MP3, CD, Computer, Record, and Cassette Tape Players**

- DVD, CD, record, and cassette tape players all have "RCA jacks" on them which can be used to connect them to the sound system. Some mixers also have RCA jacks for input, but many only have XLR and 1/4" jacks. In this case, an RCA to 1/4" adapter is needed.
- Computers and MP3 players usually have 1/8" stereo jacks. In this case, an RCA to male 1/8" stereo adapter is needed. If you have enough channels on the mixer, you may connect the left and right signals from the CD, record, or cassette to two mixer channels. However, if channels are scarce or if the system is being run mono (rather than stereo), then you may use a Y-adapter to bring both signals into the same channel.
- If you are playing "Split-Track" performance tapes where the music is on one track (i.e. the right) and a rehearsal version of the singing is on the other track (i.e. the left), then you **MUST** connect to two mixer channels in order to be able play just the music for the performance.
- Most mixers only have a limited number of RCA ins and even then the channel strips are usually limited concerning the auxiliary sends and the equalization functions. The preferred method is to use the stereo channels, if possible, or use individual mono channels per side.
- If you try to connect a record player to a mixer, you should be aware that older record players put out a special signal called "Phono" which requires special equalization to make it sound normal. If your mixer does not have a "phono" input (and most don't), then you may need to make drastic changes to the tone controls (equalizer) to get the records to sound OK.

- **Electronic Instruments - Keyboard, Electric Guitar, Bass Guitar, Processors, Electric Drums, etc.**

- "Electronic" instruments such as guitars have a built in microphone or magnetic "Pickup". Keyboards output an electronic signal. These signals may be connected to a guitar or keyboard amplifier and/or the sound system mixer.
- Keyboards and electric and acoustic guitars come standard with a 1/4" mono jack (high-z).
- Some acoustic guitars come with an XLR (low-z) jack as well.
- Keyboards, processors, and drums often offer multiple outputs. Typically, outputs 1 and 2 are designated left (1) and right (2). Keyboards usually have a headphone out. This output should not be used (if at all possible) as a means of a signal source. Output 1 is typically configured to be used as the output if the signal is a mono signal. Output 2 can additionally be used to create a stereo feel (using two separate channels).
- If the distance between an electronic instrument and the mixer is much more than 25-30 feet, a direct box should be used to convert the high-z signal from the instrument into a low-z signal. If an extra out is not needed, in-line adapters are available to switch the signal while not needing the bulk of a direct box.

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- Usually, an electric guitar player and often a keyboard player will want to have their own guitar / keyboard amplifier. This serves two purposes:
 - a) the musician can hear what they are playing better with a dedicated amplifier than they can through the monitor system and
 - b) the musician may want to add special effects that are only available on the guitar / keyboard amplifier.
- If the guitar / keyboard amplifier is being used to add effects, then it a direct box cannot be used. In order to get the "sound" that the musician wants, you have to place a microphone in front of the guitar / keyboard amplifier to pick up the sound of that instrument for the "House mix". Usually a desk mike stand (6") with a Goose neck (12") works best in this application. If the amplifier has treble and bass speakers, place the microphone half way between them. If it has several full range speakers, place the mike directly in front of one speaker.
- Another way to connect electronic instruments to the sound system is via an wireless transmitter and receiver specifically designed for instrumental use (most use a different system that is incompatible with typical mono instrument cables). This is most appropriate for guitar and horn players that want freedom of movement. The instrumental wireless transmitter has a guitar cord which plugs into the instrument and the wireless receiver has another guitar cord which plugs into the mixer.
- **Running a direct box from a traditional guitar rig or amp (even when there is a low-z out on the amp) will result in a very abrasive and uncontrollable "tinny" sound coming through the mains. In other words, the sound coming from the amp will sound nothing like the sound coming from the mains. Avoid this situation.**
- A lot of readily available technology as been introduced over the last few years to help overcome the conflict between the desires for musicians to hear what they want from their amps while allowing the sound team to accurately mix their sound. This tech included the invention of effects processors that allow the musician to have whatever sound is desired while allowing the sound team to have absolute control of the signal coming to the board. These processors have integrated processing chips that, among many things, automatically converts the high-z signal to an accurate low-z signal. These processors are found in keyboards, drums, guitar systems, bass systems, and much more.
- Additionally, there has been many advances in monitor systems (and speakers) that, when combined with the new signal converters, have made it possible for musicians to let go of their amps altogether.

- **Connecting Acoustic Sound Sources**

To connect an Acoustic sound source to a sound system, you usually need to use a microphone to convert the "acoustic" sound into an "electronic signal".

Acoustic sound or "sound waves" are rapid minute variations in air pressure created by a person's voice or an acoustic instrument. A microphone is used to convert these sound waves into electrical signals suitable for input into a sound system.

- **Voices - Talking or Singing**

To get a person's voice into a sound system, you need a microphone. There are many different types of microphones that can be used depending on varying situations.

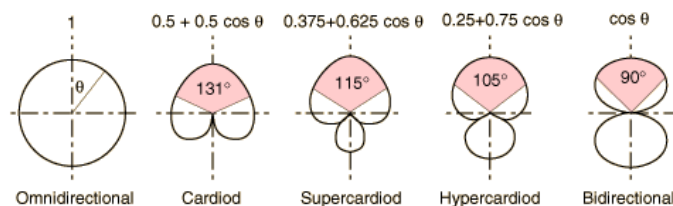
- **Wired / Wireless Microphones: (See Appendix A Microphones)**

- Microphones require a vehicle to carry the electrical sound signal from the microphone to the mixer. That vehicle is usually a cord. Cords allow for the best chance of the purity of the signal.
- There are many types of mics based upon the task. Some include:
 - Speaking
 - Vocal Lead
 - Vocal Support
 - Instrument Mic
 - Drum Mic
 - Choir Mic
 - Stage Drama

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- **Microphones are categorized by their transducer principles. The most common are:**
 - **Dynamic microphones** work via electromagnetic induction. They are robust, relatively inexpensive and resistant to moisture. This, coupled with their potentially high gain before feedback makes them ideal for on-stage use. Incidental use of phantom power does not effect the signal sent by a dynamic mic. Phantom power will, with extended use over time, heat the transducer in the mic and cause early and unnecessary wear.
 - **Condenser microphones** span the range from telephone transmitters through inexpensive karaoke microphones to high-fidelity recording microphones. They generally produce a high-quality audio signal and are now the popular choice in laboratory and studio recording applications. They operate by employing the use of capacitors in order to store an electric charge powering the transducer. A nearly constant charge is maintained on the capacitor. As the capacitance changes, the charge across the capacitor does change very slightly, but at audible frequencies it is sensibly constant. Condenser mics often require the use of phantom power.
 - **Ribbon microphones** use a thin, usually corrugated metal ribbon suspended in a magnetic field. The ribbon is electrically connected to the microphone's output, and its vibration within the magnetic field generates the electrical signal. Ribbon mics are also commonly used for recording purposes due to their quality of sound. Since they generate their own electric signal, phantom power is not needed. Unlike dynamic mics, phantom power will cause catastrophic damage to the ribbon hense destroying the mic.
- **There are many types of microphone patterns used by the different mic categories**

Below are polar graphs of some of the most common patterns used.



- **Omnidirectional** microphones hear or pick up sound from all directions equally. If improperly used, they can be associated with frequent feedback problems.
- **Unidirectional** (not shown) are microphones that "hear" or pick up only from the front blocking out everything from the side and behind. These mics offer little dynamic to the sound going through it
- **Cardioid** microphones are the most common mics used. They offer dynamic reinforcement by allowing some surround sound to be heard while prohibiting feedback. These mics require the singer to be very close in front of the mic. The patterns and range of a cardioid mic change based upon the mics but they are basically tight pattern that "magnetize" the sound directly in front of them
- **Supercardioid** and **Hypercardioid** mics allow even more dynamic presence by allowing more of a surround presence. They also allow the user to be at a more comfortable distance from the microphone.
- **Bidirectional** mics allow for two users to stand face to face and be heard. These mics are rarely used due to the discomfort of the position and the increased frequency of feedback problems
- **Pressure Zone Microphones (PZM)** (not shown) look like flat metal plates with small raised areas containing the microphone element. A PZM may be placed directly on a flat surface such as a floor or tabletop to pick up sounds from as far as 10-12 feet away. Sometimes, a shield is used to limit the sound pickup angle. Tonal quality of a PZM microphone may not be as good as other mikes, but they are useful when it is not practical to directly mike the performer.

When the cord becomes a limiter to the free movement of the performer, then a wireless microphone can be used. Wireless microphones offer freedom for its user to travel at ease

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- **There are two basic types of wireless mic systems. The first is VHF and the second is UHF.** VHF stands for Very High Frequency and UHF stands for Ultra High Frequency.
- The difference between these two types of **wireless microphones** is the region of the FM band (audio spectrum) in which each system is designed to operate.
- Both regions are reserved by law and separated from other frequency spectrums. Similarly other frequencies are designated for various radio wave transmitting devices, such as walkie-talkies or FM hearing assistance.
- VHF microphones contain a small VHF transmitter that sends a radio signal through the air to a radio receiver. The receiver is then connected to a mixer input. Placement of the radio receiver and its antenna(s) is very important. It should be close to the microphone (20 to 100 feet) and not near sources of electronic interference (i.e. CD player, effects processor, keyboard, or computers). VHF units are older and cheaper. Since they use radio frequencies, there is a much greater chance of diversity (interference) occurring.
- By choosing equipment within the VHF and UHF bands you can generally avoid interference from other types of wireless devices. In the frequency range of UHF the clarity of transmission is better than VHF because the separation from other transmission sources is better - there is also a wider spectrum to choose from. The tradeoff is that UHF generally costs a bit more than VHF.
- In particular, wireless VHF microphones operate on frequencies below approximately 300 MHz. In the U.S., most such systems operate somewhere between roughly 170 MHz and 216 MHz, with lower frequencies available for certain specialized applications.
- UHF picks up where VHF leaves off. In wireless microphones, UHF systems operate between approximately 450 MHz and 952 MHz. In the U.S., most such systems operate somewhere between roughly 524 MHz and 806 MHz, or 944 MHz and 952 MHz.
- You get what you pay for in wireless microphones! The more expensive units are called "True Diversity". That means they have two antennas to receive the signal from the microphone. The purpose of two antennas is to minimize the multi-path cancellation effect. If one antenna is receiving the signal directly from the microphone and also receiving a reflection of the same signal (i.e. off a metal object), the two signals may be out of phase and cancel each other out, causing "drop-out". However, with a second antenna (properly located), it should not be receiving the same reflected signal and therefore its signal will not be canceled out (at the same time). The receiver automatically switches to whichever antenna is receiving the strongest signal.
- If several wireless microphones are used at the same time, each must operate on a different radio frequency.
- The transmitters of most wireless systems require batteries (some operate with phantom power). These batteries should be fresh in order to send the proper signal. Battery testers will still show life left long after the sound has begun to dissipate. The rule of thumb is that no more than two weeks to a batter back ... sometimes less. For best results, REMOVE the battery.
- **Handheld Cordless Mics**
 - Handheld cordless mics consist of a mic base paired with a transmitter that sends the signal to the mixer via frequency rather than cord.
 - Handheld cordless mics are available in the same categories and styles as corded mics and vary in quality based upon the quality of the mic used paired with the quality of the wireless system operating the mic.
- **Lavaliere Microphones:**
 - A Lavaliere microphone is a small microphone that usually has a clip to attach it to the performer's clothing.
 - Lavaliere microphones provide "hands-free" operation.
 - Wireless Lavaliere microphones provide the greatest freedom of movement.
 - Lavaliere microphones usually do not sound as natural as hand held mikes and are less desirable for singing.
 - Depending on the clothing being worn, location of a Lavaliere mike is sometimes a problem. It needs to be located as high as possible and centered with the mike pointing straight up. The best location is clipped on a tie, just below the knot. If the performer is not wearing a tie or a buttoned shirt, it may be difficult to find a place to clip the mike.
 - In theatrical performances, they often hide a Lavaliere mike in the performer's hair either over one ear or above the forehead.

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- To protect the fragile connections of the wire, get the performer to wear the transmitter in a pocket or under their clothes and route the wire to the microphone through their clothes. This will also look better by minimizing the visibility of the microphone.
- **Headset Microphones/Discrete Mic Systems:**
 - Until recently, headset mics had been gaining popularity. A Headset microphone provides the "hands-free" operation of a Lavalier with superior sound quality for singing and better feedback control along with "hands-free" operation for a singer.
 - When combined with a wireless Instrument pickup, a headset mike gives a singer / instrument player complete freedom of movement.
 - There are downfalls to the headset mic. It that it can be very distracting and irritating to a persons scalp. Additionally, it can tend to mess up the speaker's/singer's hairstyle. Headset mics are also very apparent and can be a distraction to the audience
 - Discrete mics are neutral in color and wrap around the ear with the mic boomed beside the cheek. The typical discrete mics are built with very enhanced mic systems and high quality filters so the breath and rubbing sounds normally associated with lavalier and headset mics are not typically heard.
- **Acoustic Instruments - Piano, Guitar, Horn, Drum, etc.**

When mic-ing an acoustic instrument, take care to place the mics in positions and distances that can legibly pick up the instrument being played. Be sure to keep mics from facing speakers or feedback will most likely occur. Adjust the position of the instrument or player to the sound field.

- **Acoustic Guitars**
 - First, hope that the performer is using a guitar with a good quality built-in Pickup. This can be directly connected to the mixer. If the mixer is more than 25 feet away, a direct box should be used.
 - If the guitar doesn't have a pickup (or has a pickup that doesn't sound very good), use a directional microphone on a boom mike stand. Place the mike as close to the opening in the guitar as possible without being so close that the performer will hit the mike when playing the guitar.
 - Similar to electric guitars, an acoustic guitar can be used with a wireless transmitter and receiver to connect it to the sound system and allow the performer freedom of motion.
 - Many acoustic guitars require the use of batteries. As with the wireless transmitters, these batteries should be fresh in order to send the proper signal. Battery testers will still show life left long after the sound has begun to dissipate. The rule of thumb is that no more than two weeks to a batter back ... sometimes less. Also, if the guitar is left plugged in, the system is draining the batter. For best results, unplug the guitar after performing and REMOVE the battery.
- **Pianos**
 - On a Grand Piano, the lid should be opened (probably on the short stick). Piano mics (available at any full-service music store) can be placed in various locations at the discretion of the A/V team. Tonal quality can be changed by moving the mike towards lower or higher strings.
 - The use of 180 degree, cardioid, supercardioid mics placed under the piano and boomed over the string sections can provide an incredible quality sound controlled by the mixer. This method takes up a few channels. Condenser mics work best in this application but dynamic mics will work just fine.
 - For a quick fix for a small room (less than 150 people), a single, quality, dynamic mic can be placed under the piano close to the side under the strings. The high frequencies will naturally resonate around the room but the mixer being able to boost the signal will provide a pleasant sound in the mix
 - Use caution with the positioning of monitors with respect to the placement of mics to prevent feedback.
 - Many churches still love the sound of a grand piano but do not have the room or system that can accurately amplify it. Strongly consider the use of a digital piano. The advances of digital technology have allowed for digital reproduction of actually recorded pianos. The sounds are not electrical manipulations that sound like a piano, they are play-backs controlled in real-time of digitally recorded pianos. Some of these keyboards come with fully weighted ivory or wooden keys. It is strongly recommended to consider the world of digital pianos verses the bulkiness of acoustic pianos. The major differences include room for a couple of other musicians/singers and the freedom of never needing a tuning again.

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- **Drums**
 - Acoustic drum kits should be mic'd.
 - There are an abundance of drum cages available to limit the uncontrolled volume of an acoustic drums
 - Mic-ing drums is important for several reasons. Some include
 1. A drum kit that is not mic'd is LOUD. This requires that everything else be brought up to abnormal decibel levels in order to properly mix the drums with the other "noise." This can cause, among other things, the risk of unnecessary hearing loss to the whole team. It also creates an unpleasant and, often, painful environment for listeners.
 2. A drum kit that is not mic'd is UNCONTROLLED. The sound techs should have absolute control, ideally, of everything being heard. When one single piece of the mix gets too loud, others respond to it. It's a cycle that does not stop till everything is way too loud and still sounds chaotic. When this happens, it also puts the gear at risk.
 3. A drum that is not mic'd is OUT OF TIME. In rooms longer than 30 -50 feet, acoustic sounds begin to dissipate as amplified sounds continue strong. The people in the back of a 50ft room will hear the drums about a half second after they are played yet the music through the speakers is on time. The bigger the room, the worse the delay.
 - A church is never too small to mic its drums.
 - Drum kits come in many variations depending on the quality of the sound, the quality of the drums, and the size of the gear and equipment. A properly mic'd drum will use 3 to 10 or more channels.
 - A kick mic should be non-negotiable
 - Some drum mic kits come with TRIGGERS (small mics that clip onto the rim of the snare and toms). Triggers are useful when the drummer is sending each individual line into a digital brain that allows for multiple sounds OR a sub-mixer that allows the whole kit to be mixed and sent as one or two low-impedance signals to the mixer for easy controlling. Triggers are NOT preferred for high quality sets where the actual drum kit is to be amplified.
 - If a high quality kit is to be amplified, condenser drum mics are preferred. These mics are placed above the kit in several positions to pick up the sound of the kit itself. A kick mic is also employed.
 - Some small rooms (and budgets) can get a full sound from just a kick mic and two well positioned condenser mics.
- **Horns**
 - Thanks to the progression of technology, there are now special wireless mics made just for horns available at any well-equipped music store. There are different types of horn mics for the different types of horn.
 - A good quality lavalier mic attached to the inside of the end of the horn will also work well. (use a piece of felt to keep from scratching the horn)
 - A condenser mic that has a 180 degree pattern can be a great option for situations where there are more instruments than mics.
 - A quality microphone on a straight, gooseneck, or boom mike stand can also be used as to get a horn's signal into the house.

Before we complete the discussion of sound sources, there are some related areas we should review and discuss:

- **Phantom Power:**
 - Some microphones contain circuitry that requires power to make the microphone operate. Condenser microphones are one example. Some mixers provide "Phantom Power" for this purpose. Phantom Power is usually 9 to 48 VDC.
 - If the mixer has Phantom Power, it usually has a switch to turn it on or off. Sometimes there is a switch for each channel and sometimes the switch applies Phantom Power to 4 or 8 channels at a time. Be sure the Phantom Power switch is turned off if you are not using microphones that need it. Try not to leave Phantom Power turned on to a mixer channel connected to a Direct Box or to a microphone that has an On/Off switch - it may cause problems. Additionally try not to turn phantom power switches on or off when the amps are on, this can cause loud pops which can damage components of the sound system.
- **Microphone Proximity Effect:**
 - Directional mikes always have a "proximity effect". When a person is in close proximity to the microphone (2" or less), there is a dramatic increase in the low frequency (bass) response.

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- The proximity effect can be used to advantage by constantly staying close to the mike (less than 2") for a more POWERFUL sounding voice.
- Occasionally getting close for effect adds variety.
- **Miking Techniques:**
 - As mentioned above, the distance the sound source is from the microphone is very important. For singing and speaking, 1" to 4" is the optimum distance. A check for the singers is to hold the mic at the base of the filter and extend their thumb pointing to their face. If the mic is the right distance, their thumb will touch their bottom lip.
 - Equally important to distance is the angle of the microphone. When using a hand held microphone, it should be angled with the direction of the signal (perpendicular) as if the invisible waves were passing through it. Singers often hold their mics in a vertical position so the vocals pass over the top of the mic. This causes a loss of dynamics resulting in a weak signal and hence a weak sound. This also causes all of the components of the sound system to work harder to create a full sound from the weak signal. Setting the sound system with this "vertical" mic mentality will result in the frequent occurrence of excessive breath noises and "P-popping".
- **Mic Stands:**

When a hand held mike or a lavalier is not appropriate, then a mic stand is probably the best solution. Again, the proper choice of mic stands can make a big difference:

 - Straight stand - usually suitable for a speaker or singer or a group of people.
 - Boom stand - helps get the mic closer to a person playing a piano, keyboard, guitar or other instrument.
 - Gooseneck stand - often useful to get a mic close to an acoustic instrument.
 - Low profile stand – useful for mic-ing amps on the floor
 - Hanging mikes - sometimes the best way to mike a choir is to hang microphones above and in front of them.
 - Podium - often a lectern or podium has a gooseneck microphone built in.
- **Connecting Cords**

It is important to understand the different types of cords that are used to make the connections between the various parts of a sound system. All cords used to connect inputs to a sound system or to connect the various parts of the sound system together **MUST** be shielded cable in order to prevent the system from picking up hum and noise. The only exception to this is the connection between the amplifier and the speakers which does NOT need to be shielded.

The cords used to connect sound sources to a mixer fall into one of two categories:

 - **High-Z (Unbalanced)**
 - The term "unbalanced" refers to a two-conductor cord where one conductor is a grounded shield and the other conductor carries the sound signal. However, the sound signal must also return via the shield. The connection is referred to as "unbalanced" because one conductor is grounded and the other is not.
 - Unbalanced cords may use RCA jacks, or 1/4" plugs.
 - Unbalanced connections generally should not be used for distances much greater than about 25'. At greater distances, an unbalanced cord picks up too much electronic "hum" and noise. Although the shield protects the inner conductor from picking up hum and noise, since the sound signal must return via the shield, it is affected by the hum and noise picked up by the shield.
 - **Low-Z (Balanced)**
 - The term "Balanced" refers to a three-conductor cord where the outer conductor is a grounded shield and two inner conductors carry the sound signal. The connection is referred to as "balanced" because the two inner conductors that carry the sound signal are "balanced" at the same voltage level.
 - Balanced cords can carry sound signals much further than unbalanced cords, typically several hundred feet. Balanced cords are not nearly as susceptible to picking up hum or noise because the sound signal only goes through the inner two conductors and never uses the shield. Therefore hum and noise picked up by the shield is simply grounded.
 - **Using a snake (See Appendix B)**
 - The use of a snake is required if the placement of the mixer is off stage.
 - Snakes allow for signals sent and received.
 - See Appendix B for some examples of snakes

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- Snakes can be ordered in any size and in mostly any configuration.
- Snakes can be used in bundles (recommended)

NOTE: It is recommended to configure the snake with more channels than you need. It makes room to plug in future members of the team AND makes mixing guests easier. Remember, once you set the levels of a channel, only the person who used the channel should use it from that point on. Any movement will mess up the total mix as it has been set. The attempt to recover it will be difficult and most likely, impossible.

NOTE: It is recommended to order split your need for lines into two snakes. This way, you have the appropriate number of signals being sent to the board while you are allowing multiple lines for return. This way, the components can be placed off stage instead of in the sound booth and will be better protected from accidental or incidental adjustments that will mess up the mix.

- Snakes are usually configured in groups of 4.
- Quality snakes consist of shielded individual lines inside of a shielded bundle. Poor quality snakes skip on the shielded bundle.
- The only time a snake should not be used is when the mixer can be reached directly by the 20ft cords used by the performers AND do not clutter the stage.
- Snakes provided extra safety
- Snakes should be hung in the air for permanent installations
- Snakes should be run along the corners for mobile installations

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8. Components of a Sound System – Mixer

- A **mixer** (AKA *Sound Board*) is an electronic device which combines the electrical sound signals from microphones, instruments, Tape, CD, etc.
- With the mixer, you can adjust the volume and tonal quality of each input source to achieve a harmonious and pleasing blend ("mix") of all the sound sources.



NOTE: When choosing a mixer, there are many different mixers made to handle different situations. Search thoroughly before you choose the mixer that will best benefit your situation. See Appendix C (Mixers)

Remember that you get what you pay for!

NOTE: One of the most important features of a mixer is not found as a control on the mixer and cannot be altered. It is called "crosstalk." It is a *specification*, much more important than a control. Crosstalk is any phenomenon by which a signal transmitted on one circuit or channel of a transmission system creates an undesired effect in another circuit or channel. In other words, it's like the bleeding of sound from channel to channel. That sound is not necessarily a copy of the signal but more like an aftershock of the signal. It causes poor clarity of the channel signal and can result in hums and buzzes that can't be traced to a single source. Electricity makes its own noise. If that noise is not filtered, you have an uncontrolled noise being amplified through your sound system! Concerning mixers specs, crosstalk control is the level of control the mixer has on preventing the "bleeding" of signals between channels. Low quality mixers have little, if any, crosstalk filtering. High quality mixers state the exact spec of the crosstalk filter.

- The output of the mixer goes through the compressor (optional), the digital delay (only for large distributed speaker systems), the graphic equalizer (or parametric equalizer), the cross-over (only for 2-way or 3-way speaker systems), to the amplifier(s), and then to the speaker(s). If you are using a stereo speaker system, all the equipment is doubled!
- Most mixers provide separate controls for the main speakers and one or more sets of monitor speakers. Each set of monitor speakers also needs a compressor (optional), graphic equalizer, amplifier, and speaker(s). Sometimes, a separate mixer is used for the monitor mixes.
- Usually, the mixer provides the ability to connect effects processors to add reverb, echo, delay, etc. to the sound.
- It is very desirable that the house mixer and sound technician be located somewhere near the middle rear of the audience area so that the sound technician will hear the same sound the audience hears (but not block the view of the audience). It is best if the mixer is located on the main floor with the audience, but sometimes it is necessary to locate it in a balcony. The house mixer should not be located in another room or behind a glass wall.
- If a separate mixer is used for the monitor mixes, it should be located to one side of the stage where the monitor mix technician can have eye contact with all the performers (yet not be seen by the audience).
- The microphones are connected to the mixer either directly via mic cords or through a "snake" if the mixer is too far from the mics.
- Instruments (guitars & keyboards) are connected to the mixer through a special adapter called a "direct box" (used to convert high-z signals to low-z signals in order to send signals to the mixer via XLR microphone connections).
- A "snake" is a multi-conductor cable normally placed in the stage area that sends and receives signals (number varies, usually in clusters of 4 (ie, 12, 16, 24, etc)) to and from the mixer. A snake usually consists of sends and returns, both balanced. The sends are typically XLR's and the returns typically vary between XLR's and TRS's. However, snakes can be ordered or made in any format wanted by the A/V team.
- If a separate monitor mixer is used, the snake must have splitters on each channel to feed both the Monitor Mixer and the House Mixer.
- A mixer usually handles 8, 16, 24, 32, 40, or 48 channels or inputs. A "Channel Strip" consists of all of the controls for a single channel. Most of these channel strips are designated as a single (mono) channel. A few of the channels will be stereo...two channels in one channel strip. These channels are typically for media inputs.
- Below, we will attempt to describe most of the controls found on the average GOOD quality mixer that might be found in a church environment:
- There are separate controls on each channel for:

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- **Trim Pot (Gain)** - The Trim Pot or channel gain control is used to compensate for the difference between the various input sources. Generally, you should start with the Trim Pot for each channel set at the 12:00 (or straight up) position. During practice, you should adjust the Trim Pots to compensate for channels with louder or quieter signals. For example, the keyboard may put out a stronger signal than a guitar. In this case, the trim pot for the keyboard may need to be turned down or the trim pot for the guitar turned up.

During practice, listen to each channel one at a time with the headphones (using the PFL or AFL switch). Adjust the Trim Post so that each channel sounds about the same loudness. If your mixer has per-channel meters, they can make it a lot easier to adjust the Trim Pots. On most mixers, when you operate the PFL or AFL switch, it shows that one channel on the main L/R meters. This can also be used to help you adjust the Trim Pots for nearly equal levels from all channels.

When adjusting the Trim Pots, you need to be careful not to over-drive the channel. By setting the Trim Pot too high, you can cause the channel to over-drive and distort or clip. This is not a pleasant sound! Some mixers have a little red LED on each channel to let you know when it is set too loud. You can also use the per-channel meters or press the PFL or AFL button and look at the main L/R meters. If the meter goes into the red, turn the Trim Pot down a little.

- **Mike / Line switch** - The Mike / Line switch is not included on all mixers. It is used to select between the low-level mike signal connected to the XLR jack or the high-level line signal connected to the 1/4" jack. If this switch is not present, usually both of the jacks are active.
- **Phantom Power switch** - The Phantom Power switch is not included on all mixers. It is used to turn Phantom Power on or off. Sometimes one switch controls Phantom Power for 4 or 8 channels. Normally, the Phantom Power switch should be left in the off position unless you are using a microphone that requires Phantom Power to operate. Sometimes the Phantom Power switches are beside the channel input jacks.
- **Equalizer or Tone Control** - The per-channel Equalizer controls are used to adjust the tonal quality of each input and to reduce or eliminate feedback. Low end (low cost) mixers may only have treble and bass tone controls. Better mixers have high, mid, and low frequency controls. Top of the line mixers have additional equalization controls that include frequency adjustment capability and sometimes even an adjustment for the width (or Q) of the control. Often low-cut and sometimes high-cut switches are also provided.
 - **High-cut** - The high-cut switch should usually be left turned off. It is only needed if the input to that channel has an unusual amount of high frequency energy (i.e. a low quality guitar pickup).
 - **High** - The high frequency rotary tone control is often useful to smooth out a channel that is particularly shrill. Seldom should it be used to boost high frequency sounds because this can quickly cause feedback. However, when a keyboard or guitar with a pickup is connected to the channel, the high frequency control can be used to brighten the instrument without danger of feedback.
 - **High-Mid** – This control adds boom to the lower high frequencies giving more dynamic control. High-Mid controls are commonly found on higher quality mixers
 - **Mid** – This controls the middle frequencies of the tonal range. This control allows clarity to be given to the high and low frequencies by allowing the mids to be controlled separately. An improperly set mid will result in a “muddy” sound. Mids are generally to be set under 12:00. Mids can be used over the 12 position when the vocalist has a weak voice. If the mixer does not have a mid control, it is probably a very poor quality mixer or a mixer designed for mobile use only. It is important to be able to control the mids.
 - **Low-Mids** – This control adds control to the boom of lower frequencies giving more dynamic control. Low-Mid controls are commonly found on higher quality mixers. Low-mids allow for the clarity of upper low frequencies to be separated from the boom of ultra low frequencies. This is a great option when it comes to “cleaning” vocals
 - **Sweepable controls** - Sweepable tone controls are very helpful in eliminating feedback. The best mixers have several sweepable controls on each channel. Before the first set-up and every time a new input source is introduced to the board, the sound person should check the channel(s) for potential feedback. Start with all the tone controls set to null (straight up or 12:00 position). Turn the channel on to normal operating level. Then slowly move the channel fader up the whole way. If you get feedback before you reach the top, move it down just a little to keep the feedback quiet and stable.

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Decide whether the feedback is a high frequency or a low frequency. If it is high, use the higher sweepable tone control. If it is low, use the lower sweepable control (if you have one). Turn the level control down about 2 hours (i.e. from the 12:00 position to the 10:00 position). Then "sweep" the frequency control until the feedback goes away. It takes a little gettin' used to, but with practice you will get the hang of it.

Then move the channel fader up a little more and see if you get feedback at another frequency. If you have another sweepable control, you can eliminate that feedback too.

- **Low** - The low frequency rotary tone control is useful in eliminating "boomy" sound in mikes. It can also be used to add or reduce bass for keyboards or guitars. Occasionally, it can be used to eliminate a really low frequency feedback.

If you turn the bass up, you need to be careful not to over-drive the channel and cause it to distort.

- **Low-cut** - The low cut switch should usually be enabled (pushed in) on most channels except keyboard, bass guitar, drums, and CD. This switch takes out low frequency rumbles (like breathing noise and air conditioner sounds).
- **Monitor or Auxiliary send(s)** - The Monitor or Auxiliary sends are most often used to provide a separate "mix" for the monitor speakers.

This allows the performers to hear a somewhat different "mix" than the audience hears. Often a performer will want to hear more of their own voice or instrument than is in the house mix. Possibly the instrument which sets the tempo for the whole group needs to be louder in the monitor mix than in the house mix. Sometimes different members of the performance have different monitor requirements. This can be solved by providing multiple monitor mixes and setting up several monitor speakers (each with its own equalizer and amplifier).

The Monitor or Auxiliary controls are used to produce one or more Monitor mixes. Low-end mixers may only have one set of Monitor or Auxiliary controls. High-end mixers often have as many as 8 Monitor or Auxiliary sends, sometimes even more.

To set up the Monitor mixes, first you must decide how many Monitor mixes you are going to use. You must connect each Monitor or Auxiliary send through a compressor (optional), through at least a graphic equalizer (highly recommended for feedback control), to the monitor amplifier, and then to the appropriate set of monitor speakers (which have been placed in front of the correct person or group of people).

NOTE: See for detailed instructions for setting up the monitor systems

Aux sends are also commonly used as recording sends if the board does not have a sufficient bus system (explained later)

Generally, Monitor, Auxiliary, and Effects sends do not have meters or overload warning lights on them. Generally, you won't have trouble with overload if you keep most of the controls near the 12:00 position.

- **Pre / Post switch** - The Pre / Post switch near the Monitor or Auxiliary sends determines whether the signal sent to Monitor controls is affected by the main Channel Fader (slider). When the switch is in the "Pre" position, the Monitor signal is taken from a Pre-Fader position. The Monitor level is NOT affected by the Channel Fader. When the switch is in the "Post" position, the Monitor signal is taken from a Post-Fader position. The Monitor level IS affected by the Channel Fader. Generally Rock Music groups prefer the "Pre" position and choir type groups prefer the "Post" position.
- If the performance contains solos where the sound technician must move the Channel Fader up for the solo, then if the switch is set in the "Pre" position, the monitor for the solo will NOT get louder when the house mix gets louder.
- If the switch is set in the "Post" position, the monitor for the solo will get louder the same as the house mix gets louder for the solo.

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- **Effects send(s)** - The Effects sends are used to select certain channels that should be sent to effects processors such as reverb, chorus, or digital delay. Generally, processed sound is returned from the Effects processor to the mixer's Effects Return inputs. If you want to have better control over the effects sound, you can connect it to an unused channel.

Low-end mixers generally only have one set of Effects sends. High-end mixers usually have multiple Effects sends. Monitor, Auxiliary, and Effects sends are all similar in nature. The main difference is whether the send is "Pre" or "Post" Fader. It is best to read the manual on your mixer to determine whether its Monitor, Auxiliary, and Effects sends are Pre or Post-fader or whether you have a switch to make the selection yourself.

If the mixer does not have an Effects send, the Aux sends will work just fine

- **Pan (Left / Right control)** - Pan control is used to select whether the signal should be sent to the odd numbered Subgroups (Left), even numbered Subgroup (Right), or both (center or 12:00 position). If the signal is sent directly to main output, then the pan control determines the location of the signal in the stereo mix.

If you are just sending the sound to the house speakers, usually you will use a mono send (unless the house speakers are set up for stereo). However, if you are also making a recording of the sound, it may be desirable to make a stereo mix where the sound on the left and right are somewhat different. By turning the Pan controls part way to the left or right, you can position each sound within the stereo field. When you mix for stereo, generally you need to use the Subgroups in pairs.

- **Subgroup Select switches (Busses)** - The Subgroup Select switches (not included on all mixers) are used to group several channels into a Subgroup (i.e. Subgroup 1 or S1 = soprano, S2 = alto, S3 = men, S4 = instruments). Sometimes there are Subgroup switches labeled L/R that bypass the Subgroups and send the signal directly to the main L/R output.

Subgroups allow the sound person to be able to adjust multiple mixes at once. Each channel can be assigned to any mix of the subgroups offered.

Subgroups can be used for recording purposes

Subgroups can be used as sends for CAT5 monitor systems (high end)

- **Pre-Fader Listen or After-Fader Listen (SOLO)** - The Pre-Fader Listen (PFL) or After-Fader Listen (AFL) button allows the sound technician to listen to one channel at a time using a headset. If the button is labeled PFL, then the level heard in the headset is independent of where the Channel Fader control is set. However, if the button is labeled AFL, then the level heard in the headset is dependant on the setting of the Channel Fader.

During practice, you should listen to each channel using the PFL / AFL button. The Trim Pot on each channel should be adjusted so that the volume (and meter readings) on all channels appears nearly the same.

The PFL / AFL button can also be used to look for troubles, like the source of a hum or buzz. Pressing PFL / AFL on a Subgroup allows you to hear that group alone without the rest of the mix. If your mixer has a PFL / AFL button on the Monitor, Auxiliary, or Effects sends, you should listen to each of them to see that there is no distortion (overload, or clipping) and to see that the mix sounds like what you expected

- **Mute or Channel On switch** - The Mute or Channel On switches are used to enable / disable individual channels. Not all mixers have these switches. Mute switches are more prevalent than Channel On switches. If the Mute switch is pressed, the channel is turned off (muted). Generally, a Mute switch has a light that illuminates when the channel is Muted.

Some mixers provide Mute Automation. These mixers include a computer that can remember a number of snapshots of mute switch settings and recall them at will. This is particularly useful in large drama presentations with many FM microphones worn by all the performers. All the FM microphones can normally be muted (to eliminate background noise and minimize feedback possibilities) and the system can be programmed to un-mute the correct mikes for each scene.

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- **Channel Fader** The Channel Fader, slider, or level control is used to adjust the level of each channel in the main mix.

During practice, many sound engineers like to setup the mixer so that they have a good well balanced general mix with all the Channel Faders are in a straight horizontal line. This way, after making any changes in Channel Fader levels needed for a particular song or solo, they can return all the Faders to a straight line. This is easier than having each Channel Fader set at a different level and after a solo having to remember where that Fader was before you changed it for the solo.

Generally, you should start with the main house L/R control off and all of the Channel Faders up at the position marked either "0" or "U". This is usually about 3/4 of the way up. Then, slowly raise the house L/R controls to their "0" or "U" mark. If you get feedback before you get there, then move the house L/R controls down to about 9db below the feedback point.

While the group is practicing, adjust the Trim Pots on each channel so that you get a good blend or mix. It is helpful to listen to each channel individually with the headset by pressing the PFL or AFL button.

If there are solos or other areas in the performance where one or several performers need to be accentuated, move their Channel Faders up for that portion of the program and then return them back to the "0" or "U" mark.

With most mixers, there is about 10db of gain left between the "0" or "U" mark and the top or maximum position of the Channel Fader. With some performers, this is not enough extra gain to accentuate a solo adequately. You may find it works best to setup the mixer with all the Channel Faders normally set at "-5" or "-10" so that you have 15db or even 20db of room left to accent a solo. It is all a matter of what works best for you!

- If your mixer has Subgroups, there are separate controls for each Subgroup:
 - **Subgroup Left / Right Pan control** - The Subgroup Left / Right pan determines where this subgroup is positioned in the main L/R stereo mix.
 - **Subgroup Left / Right Select** - Some mixers have Subgroup Left / Right select buttons instead of Subgroup Left / Right Pan controls. The L/R select determines whether the Subgroup is sent to the Left main, Right main, or both outputs.
 - **Subgroup Fader** - The Subgroup Fader (level control, or slider) is used to adjust the level of the subgroup within the main mix. This allows the Sound Technician to raise or lower the level of a whole Subgroup of inputs with one control. For example, if the altos have a verse by themselves and need to be a little louder, you can raise the alto Subgroup for that verse.
 - **Subgroup PFL / AFL** - The Subgroup Pre-Fader Listen (PFL) or After-Fader Listen (AFL) button allows the Sound Technician to listen to one Subgroup at a time in the headset. If it is a PFL button, the level in the headset is independent of where the Subgroup Fader is set. If it is an AFL button, the headset level is controlled by the Subgroup Fader.
 - **Mute or Subgroup On switch** - The Mute or Subgroup On switches are used to enable / disable individual Subgroups. Not all mixers have these switches. Mute switches are more prevalent than Subgroup On switches. If the Mute switch is pressed, the Subgroup is turned off (muted). Generally, a Mute switch has a light that illuminates when the Subgroup is Muted.
- The main L/R output usually has only one control:
 - **Master L/R Faders** - The Master L/R Faders are used to control the main output of the mixer to the house speakers. Most Sound Technicians prefer to normally operate the Master L/R Faders at the "0" or "U" position. In order to do this, the volume or gain control on the house amplifier should be adjusted so that the system operates at a normal comfortable level with the faders set at "0" or "U".
- Depending on the type of mixer you have, there may be additional controls, but since these vary greatly with different mixers, we won't try to address them all here.

The mixer controls listed above are used to adjust, blend, and tune the sound, but it is the input and output jacks that are used to connect the mixer to the various other components of the sound system:

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- **Channel Jacks** - Each channel of the mixer usually has two input jacks, one is usually a low impedance XLR jack and the other is usually a high impedance 1/4-inch jack. Normally, microphones are connected to the XLR jack and instruments, keyboards, tape decks, and CD players are connected to the 1/4 inch jacks.

Frequently, each channel will also have "insert" jacks. Better mixers usually have two 1/4-inch insert jacks labeled "send" and "return". Some mixers use a single three-conductor 1/4-inch jack for both functions. The purpose of the insert jacks is to send the signal from one channel to an effects device or a graphic equalizer that is dedicated to that one channel.

- **Effects Jacks** - If the mixer has one or more Effects Sends, each of these will have an output jack. Each Effects Send has a corresponding Effects Return with an input jack.

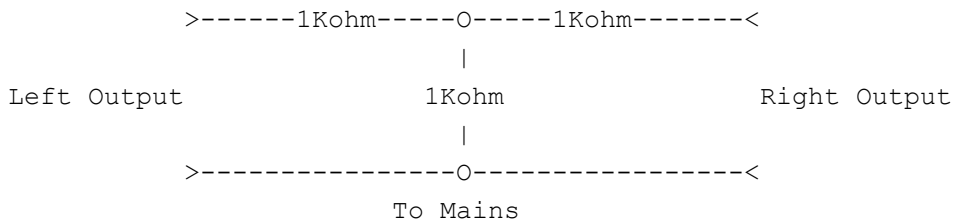
Generally, the Effects Send output jack is connected to the input of the Effects Unit and the output of the Effects Unit is connected to the Effects Return input jack. If the Effects Unit is stereo, you have two choices: You can use only the left channel output jack (which makes the unit operate in mono mode) and connect it to one Effects Return input jack. Alternatively, you can use both the left and right output jacks and connect it to two Effects Return input jacks, but only do this if you are doing a stereo mix.

- **Monitor / Auxiliary Jacks** - If the mixer has Monitor or Auxiliary Sends, each of these will have an output jack. The Monitor and Auxiliary outputs are generally connected through an Equalizer to the Power Amp for stage monitor speakers or auxiliary speakers.
- **Sub-Group Jacks** - Usually, if the monitor has Sub-Groups, each will have its own output jack. The Sub-Group outputs are most often used when doing multi-channel recording. In this case, each Sub-Group is sent to a different track on the recorder.
- **Main Output Jacks** - All mixers have output jacks for the main mix. Usually, they have left and right jacks. Frequently, they will have both 1/4 inch and XLR jacks (it doesn't matter much which type of jack you use). Some mixers have a Mono or Sum output which is a combination of the left and right outputs.

The main output jacks should be connected through an Equalizer to the Power Amp for the main speakers.

If you are doing a Mono mix, you can use just the left output jack to feed the main speakers (because the left and right are identical). You might want to use the right output jack to feed the Narthex, Cry-Room, or cassette recorder.

If however, you are doing a Stereo mix (for the purpose of making a stereo recording), then it is best if your mixer has a Mono or Sum output to use to feed the main Equalizer and Power Amplifier. If you MUST use the main left and right outputs, you need a way to "sum" them together. If you simply use a "Y" cord, your recording will become Mono also. The best way to "sum" the left and right channel is to build a special "Y" cord with a resistor network (probably about 1Kohm in series with each side and a 1Kohm shunt).



If you are doing a Stereo house mix (and we recommend against that), then you will need to connect the left and right main outputs through two separate Equalizers to two separate Power Amps.

- **Recording Jacks** - If you are recording the mix, you have a number of options: Some mixers have a separate set of RCA jacks labeled Record Out, If your mixer has both 1/4 inch and XLR main output jacks, you can use the 1/4 inch jacks for recording and the XLR jacks to drive the house, If you are running a Mono mix, you can use the left main output for the house and the right main output for recording, you could also use an effects or monitor send for recording (but that requires you to set up a separate mix for recording), and finally, you could use "Y" adapters to split the main output for recording.

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- **Headset Jacks** - Most mixers have a headset output jack. If the mixer has PFL buttons (Pre-Fader Listen), then you can listen to one channel at a time or the whole mix. You can also listen to each effects and monitor send.
- Finally, there are a few special items that are provided on some mixers:
 - **Talk-Back** - Some mixers support a "Talk-Back" microphone that allows the Sound Technician to talk through the main and/or monitor speakers.
 - **Clear-Com** - Some mixers support a "Clear-Com" system which is an intercom that can be connected between the Sound Technician, Lighting Technician, Monitor Mixer, Stage Manager, Director, etc. as needed.
- Before we leave our discussion of mixers, we will go over some basic Mixer Operation principles:
 - **Mixer Pre-set** - Before starting to connect a mixer, you should go over all the controls and pre-set them so that when you turn the system on, you won't get disastrous feedback. Make sure all the Trim Pots are set all the way off (left), set all the equalization controls straight up, start with all the effects, monitor, and auxiliary sends turned off (left), turn off (down) all the channel faders, sub-groups, and mains.
 - **Equalizer Pre-set** - Set all the sliders on the main house equalizer and all the monitor equalizers to their mid-point.
 - **Power Amp Pre-set** - Turn the volume control on the main and monitor power amps all the way off (left).
 - **Mixer Connections** - Next, connect all the mixer inputs and outputs, equalizers, main amplifier, monitor amplifiers, main speakers, and monitor speakers.
 - **Power Connections** - To minimize the chance of encountering "ground hum", it is best to connect the entire sound system to a single AC outlet (assuming your system isn't too powerful for one circuit breaker). Select an AC outlet near the power amplifiers and put a multi-outlet strip there. Run 3-conductor extension cords as needed to reach the other equipment. Never cut off the third prong! However, you should have a supply of ground lift adapters (3 prong to 2 prong) handy.
 - **Power-Up** - Turn on the mixer, tape or CD player, the effects units, the equalizers, and finally the main and monitor power amps.

NOTE: as a rule of thumb, the mixer should never be amplified turning on OR off. Failure to ensure this will result in a loud "pop." That pop is the sound resulting from a load of electricity (the pre-amps) being sent unfiltered through the amps to the speakers. This will cause the components to wear quickly and will result in component failure.

NOTE: For setting the House Main and Monitor mixes, see Ch 13 and 14.

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9. Components of a Sound System - Effects Processors



Alesis MidiVerb 4 Multi-Effects Processor

- Reverb
 - The effect that the dissipation of a signal caused by the characteristics of a space has on a sound.
 - A manipulation of sound originally mechanically developed by sending a portion of a signal through metal plates and springs. This would enhance the signal by adding a notable warmth to the sound.
 - Reverb effect varies from the open hall sound to the electric plate sound depending on the device and parameters set.
- Digital Delay
 - A natural phenomenon of sound waves being “bounced” throughout a space.
 - Provides one or more echoes of the original sound.
 - A delay set for just a 10 to 30ms makes the sound fuller, like two people are singing.
 - Delays greater than 40ms are clearly noticeable.
 - Multi-tap delays give a repeating echo.
 - In large auditoriums where the main speaker system cannot adequately cover the whole audience area, additional speakers may be distributed to other parts of the room. Digital Delays are used to delay the sound sent to the distributed speakers so that the audience hears the sound from the main speakers and the sound from the distributed speakers at the same time. If all the distributed speakers are the same distance from the main speakers, a single Delay can be used. If the distributed speakers are at different distances, multiple Delays are needed.
- Chorus
 - An effect that allows a signal to sound like many signals.
 - This effect is often used on acoustic instruments to give them more presence in the system.
- Doubling
 - An effect made by reproducing the signal and replaying the reproduced signal ms behind the original signal.
 - This effect makes as if two signals are being sent simultaneously.
 - This effect is most commonly used by vocalists.
 - Using this effect on instruments can detract from the clarity of the signal
- Multi-Effects Processor
 - Provides a large variety of effects in a single unit.
 - Usually includes reverb, delay, multi-tap delay, chorus, flange, tremolo, vibrato, gates, and other effects.
 - Some units allow effects to be combined.
 - Some units allow you to program your own effects (if you know how).
- Compressor / Limiter
 - Especially useful for a performer whose voice varies from very quiet to very loud, beyond the dynamic range of the sound system.
 - A compressor / limiter reduces the dynamic range of the sound. It allows low volume sounds to pass through unchanged, but loud sounds are reduced in level.
 - A compressor / limiter can be used to prevent over driving the power amplifier. This prevents distortion and possible equipment damage.
- Gate
 - Especially useful to eliminate low level background noise

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- A gate keeps the signal turned off until its volume reaches a pre-set threshold, then it is turned on. When the signal becomes quiet again it is turned off. This process happens very rapidly and can be used to eliminate background noise when the person is not speaking (even between words).

NOTE: Since most effects are imitations of analog responses to sound waves in a space, many rooms have natural effects. The addition of mechanical effects via a processor in these rooms often results in feedback problems. If recordings are dry, add effects into the recording but NOT the mains. This is easily done by bypassing the effects return offered by most mixers and using a channel as the return. The signal can be sent to the aux channel used for recording yet not sent to the main mix by keeping the fader pulled down. This technique can be used for effects processors, compressors/limiters, gates, etc. Use a separate channel for each. This will give you absolute control to use these processors differently as needed in the monitors, in the main mix, and in the recording sends.

- **Setting and using the effects processor**

NOTE: For smaller systems (single mixer systems), the recommended effects setup is a two channel effects processor. Compressors and limiters should not be returned to the mixer. They should be units the sound is sent through from the mixer to the amp.

1. Insert a short TRS cable into the effects send output on the back of your mixer. (If using a two-channel effects processor, and two effects sends are available use both.)

NOTE: Choose an aux send if an effects send is not available on your mixer. (preferably 5 and/or 6 depending on your other sends).

2. Connect the TRS cable(s) to the inputs located on the effects processor.
3. Insert an XLR cable to the output for each channel on the effects processor.
4. Connect the XLR cable(s) to the XLR line in(s) on the channel(s) closest to the stereo channels. Be sure to activate the L/R subgroup!

NOTE: If your mixer (32 – 48 channels) is split with the master section in the center and 8 to 12 channels located to the right, it is recommended to use the first channels to the right of the master section as effects returns.

NOTE: The purpose for placing the effects returns as close to the master control section of the mixer is for ease of control. After getting used to a mixer, a sound person will, as a reflex, look to the master section when wanting to adjust a master feature. This prevents from the stress of having to scan the channels to find the effect return.

5. Set the inputs on the effects processor to the 12:00 (or ½).
6. Set the outputs on the processor to the 12:00.
7. Select an effect

NOTE: Be sure the channel strip(s) for the return is completely turned down. The effects input/output should first be checked concerning possible overrides and distortion (using the LED) should first be done before amplification. Overdriven effects can damage components quickly.

8. Raise the master effects send (or aux send) to the 12:00 position.
9. Have the lead singer perform a mic check at full volume.
10. Check the LED(s) on the effects processor. Make sure they are not going to the yellow. If they are, turn down the input on the processor in small increments until the LED is flashing green when the mic is checked.

NOTE: Typically, instruments are not pushed through the effects processors b/c they have their own on-board effects. In the case of pianos, horns, and other strictly acoustic instruments, it may be desired. But BE CAREFUL to set them low. Pure acoustic instruments have unfiltered highs and lows and can spike the system easily.

NOTE: If at all possible NEVER send drums, keyboards, and electric guitars through an effects processor.

11. Start incorporating the effects with the mains. (USE YOUR HEADPHONES and select the solo feature for the effects return channel) Begin to raise the return channel fader until you can hear the effect signal in the headphones. De-activate the solo feature and adjust the fader to the house mix.

NOTE: Remember, the goal is clarity of sound. Use effects to enhance, add warmth, and soften a signal. It is strongly recommended not to use them to replace a sound. Equalizers have difficulty controlling the affects than an effects processor has on the signals being sent to the amps.

12. Once the mains are set, begin to adjust the other outputs of sound using the monitor and auxiliary sends (ie recording sends, monitor sends, nursery sends, etc)

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NOTE: When sending effects to the monitors, consider that the close proximity of the signal sources on stage to the monitor speakers already causes the equ's to work hard. If effects are used in the monitors, they should be very weak. It is recommended **NOT** to let the effects sends to the monitors to go past the 9:00 position, if at all. Inexperienced singers should **NOT** be given any effects in their monitors. Improper holding and use of the mics will exponentially add to the chance of component failure. Again, feedbacks caused by effects processors can cause more damage than typical feedbacks due to the nature of the sound manipulation.

NOTE: Effects must be constantly monitored. Lead singers should get the priority of effects in the system. Backup singers have natural effects caused by the way their frequencies naturally collide in space.

NOTE: Effects should not be used for a speaker. The nature of the effects makes it difficult for people to pay attention to the speaker and not the effects of the voice. When a singer begins to speak, turn the effects down.

NOTE: Lavalier mics should **NEVER** have effects. The type of mic used and the space between the signal source and the mic cause too much opportunity for feedback!

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10. Components of a Sound System – Equalizer (EQ)

- Why is equalization needed?
 - To control frequencies that recycle through the sound system causing feedback.
 - To increase gain before feedback.
 - To compensate for Acoustical problems in the room.
 - To tailor the tonal quality of the performance.
- Are all equalizers the same?
 - Absolutely not. (See Appendix D)
 - Equalizers vary in quality and application. There are EQ's that work more efficiently in certain spaces than others. There are analog graphic EQ's and parametric EQ's. There are 3 band, 4 band, 5 band, 10, band, 15 band, 28 band, 31 band, etc EQ's. There are digital EQ's that can perform EQ adjustments in real-time as well as crossover functions for the speaker systems.
 - YOU GET WHAT YOU PAY FOR (don't choose quickly)
- Always start with no equalization (all controls set "flat").
 - Equipment manufacturers design their equipment to be used with NO EQUALIZATION.
 - Only use equalization to eliminate problems (i.e. feedback, too much bass, too sharp, etc.).
 - After the problems are eliminated, there is seldom a need to change equalization to enhance the sound.
- Room factors which may require equalization:
 - Sound reflections off of hard surfaces (walls, ceilings, and floors) causes uneven frequency response because of out-of-phase reflections (i.e. drop a stone in a pond and watch the ripples as they hit the shore and reflect back).
 - Sound absorption by soft surfaces (seats, people, acoustic treatment) causes loss at high frequencies.
 - Every room is different! Some seem to increase high frequencies, others absorb highs. Some resonate with base, others seem to have no bottom end at all.
- Individual channel equalization on the Mixer.
 - Adjust for differences in different types of mics.
 - Adjust for specific instruments (keyboard, guitar, sax).
 - Adjust to optimize sound for particular voices (men, women).
 - Eliminate feedback points unique to one mic.
 - Reduce breath noise and "pops".
 - Compensate for "proximity effect" when performer "eats the mic".
- Monitor equalizer
 - Adjust to increase gain before feedback.
 - Eliminate "hollow" or "ringing" sound.

NOTE: Every monitor channel needs its own equalizer unless the monitor systems are in-ear systems. Drum monitors may not need equalization depending on the mic placement.

NOTE: While 31 band graphic eq's are recommended for monitor systems, 15 band eq's will do the job just fine and can be more cost efficient. Additionally, it is more cost efficient to purchase a 2 channel eq than to purchase 2 single channel eq's. Remember, YOU GET WHAT YOU PAY FOR!

- Main System equalizer
 - Adjust tonal quality of main speaker system to compensate for room acoustics (texture of walls, floors, or ceiling).
 - Only if necessary, adjust to increase gain before feedback.
- Automatic Feedback Eliminator
 - This is a special type of equalizer that "listens" for feedback, determines its frequency, and automatically sets a narrow notch filter to eliminate it. Multiple notch filters are set at different feedback frequencies.

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Recently, developments in EQ technology have led to the release of digital EQ's. These EQ's offer two or more channels of digital, self monitoring equalization. The DBX Driverack series, for example, employs the use of a special mic placed in the sound booth to monitor frequencies and control them in real-time. Additionally, by entering the diameters of the space and component gear being used it self adjusts to the parameters. The biggest difference is the EQ's ability to adjust as the characteristics of the space changes. This technology has revolutionized the employment of EQ's.

Until this development, there has been a conflict between frequency control vs sound dynamics. The professional use of spectrum analysis equipment offered no variance once the characteristics of the room were changed. The only way to adjust to the changes were to re-calibrated the EQ's. This could NOT be done in real-time because it requires the testing of frequencies which is very loud and takes a lot of time. Spectrum analysis is also very expensive. If you can afford the spectrum analysis, then you can afford the self-monitoring EQ's, they actually are much more cost efficient.

The other method (analog ring test (ear) : explained later), which if done properly results in nearly the same success, still requires the use of frequency testing. Either way, dynamics are sacrificed and adjustments in real-time cannot be done proficiently.

It is strongly recommended to use digital, self monitoring EQ's. They will extend the life of your components

If the price for the digital EQ's is just too much, then setting the EQ's by EAR is recommended. The process will be explained below, step by step. When setting the EQ's it is best to clear the room other than the help you will need. The process uses frequencies that will be very uncomfortable but necessary to keep from frequency problems in the room.

NOTE: it is best to have EQ's positioned away from where hands can incidentally or accidentally touch them. Once set they must be left alone. I recommend either placing them in the sound booth with protective cages covering the front, or in the amp room off stage.

NOTE: For this process, you will need at least one helper, no more than two. CLEAR THE ROOM

NOTE: For this process, you will need your hottest mic. If you use headsets, or wireless handhelds, use this mic. If you use corded mics, use your loudest mic.

NOTE: EQ the monitors first, the mains after

NOTE: Make sure the EQ's are on and set in the neutral. Turn the masters down for all EQ's that are not being adjusted. After an EQ is set, record the master position, then turn it down. Once all EQ's are set, turn them all back to their recorded positions and see the last step.

REMEMBER: If you are using an in-ear monitor system, EQ-ing the system is not necessary

1. Ensure all components are on and running at the performance levels. To properly set EQ this must be done at the systems loudest level used.
2. Have a helper point stand about 12 – 15ft from a speaker controlled by the EQ and point the mic directly at the speaker so that the body of the mic is perpendicular to the speaker face. (Aim for the woofer, not the horn.)
3. Have the helper slowly walk toward the speaker (snails pace). If your EQ is equipped with LED lights (recommended) the light of any channel about to "squeal" will begin to glow bright. If not, it is important that your helper "catch the frequency" before it becomes amplified.

NOTE: Catching the frequency means to allow the squeal to maintain itself at a constant level, but not become super loud scream. As soon as the squeal is heard, slightly pull back the mic. If the squeal dissipates, try to catch it again. Slowly move the mic forward until the squeal is caught. Move to fast and it will scream. This can cause damage to the components (and your ears).

4. While the frequency is squealing, locate the channel that is causing the control (high pitched to the right, low pitched to the left). If you cannot find the individual channel bc you can't recognize the pitch lower a bunch with the side of your finger (about 7 at a time) just slightly until the squeal dissipates. Once that happens, return the faders that were not involved in the latest group moved back to their original positions and then focus on the last group. Raise each fader back slowly to the original position. The channel(s) responsible for the squeal will show by the return of the squeal. Only lower the fader enough to stop the squeal.

NOTE: The helper is to stand perfectly still the whole time a frequency is being adjusted once it has been caught.

5. Have the helper creep closer. Every time a frequency squeal is heard it must be "caught" and adjusted.
6. Continue this process until the mic is within a foot of the speaker face.
7. Once that is done, turn the master down to set the next EQ. The master should be in the 12:00 position (1/2 power)

NOTE: The drum monitor should only be EQ'd if the drummer sings. Use that mic to EQ his system.

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NOTE: The only time faders on EQ's should be above the neutral is when they are set out doors with no return wall or structure. In this case, there may be the need to boost certain frequencies.

8. After all the EQ's are set, return the masters back to their original positions.
9. Get the worship team to plug in and jam.
10. Attempt to slightly raise the master past the neutral. If squeals are heard, slightly pull them back. The goal here is to maximize the gain before feedback. During this time, try to get the singers loud on their mics and moving as they normally would.
11. Employ EQ security screens over the EQ's. From this point on they should not be touched and only turned on/off via power control.

EQ-ing the main system

There should be minimal adjustments needed for the main EQ if the room is a large sized room. If it a smaller room, the EQ's will need more attention. The hottest mic for the mains, and the most important to be EQ'd is the lavalier mic.

To EQ this mic, follow the same steps as EQ-ing the monitors except start from about 30 – 40ft back from the main speakers and walk, with the lapel mic raised in the air towards the speakers.

Attempt to “catch” the frequency as before. The goal is to allow the preacher to walk in front of the main speakers at anytime during the service without a frequency issue.

NOTE: If the main speakers are positioned at ear level on speaker poles, this may not be completely possible. If the EQ is a quality EQ, this should still be a reachable goal but the dynamics can suffer. In this case, the EQ's should be set with in 5 – 10 FEET of the front of the speakers and the user of the lapel mic must have some stage discipline. Otherwise, the EQ process will detract from the sound quality in the main system. If the speakers are suspended (always preferred) this will be easy.

REMEMBER: The use of at least one digital, self adjusting EQ is suggested at a minimum for monitoring the main speaker system. Purchasing one will not noticeably impact the cost of a system but it will noticeably impact the sound quality and ease of control. And since the parameters of the room are always changing, it is important to have an EQ that can adjust to it without having to either guess or clear the room and adjust.

Additionally, the digital EQ's come with their own, internal high quality crossovers ... a very useful function if subs or bi-amped speakers are used.

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11. Components of a Sound System - Amplifier



- The amplifier receives the combined or mixed signal from the mixer.
- The amplifier is the last component in the sound system before the speaker. Generally, the sound signal progresses through the sound system as follows:
 - Microphone or Instrument
 - Mixer
 - Compressor (optional)
 - Graphic Equalizer (or parametric equalizer)
 - Digital Delay (only for remote speakers that must be time-aligned with the main speakers)
 - Cross-Over (only in the case of bi-amped or tri-amped speaker systems or a sub-woofer)
 - Amplifier
 - Speaker(s)
- The amplifier supplies the power to drive the speakers.
- **See Appendix E for examples of amplifiers.**
- Most speaker systems, especially lower power speakers only require a single amplifier. However, some speaker systems are designed to work bi-amped or tri-amped. In the case of a bi-amped system, two amplifiers are needed, one for low frequency sounds and one for high frequency sounds. In the case of tri-amped, three amplifiers are needed for low, midrange, and high sounds. If a sub-woofer is used for very low sounds, another amplifier is needed for it.
- Separate amplifier channels are needed for the Main System, remote speakers (if required), and the Monitor System.
- When multiple monitor mixes are used, each mix requires its own amplifier channel.
- In order for an amplifier to make the sound twice as loud, it must supply four times as much power. For example, it takes a 400-watt amplifier to be twice as loud as a 100-watt amplifier.
- Always use an amplifier capable of supplying more power than you need. Distortion increases dramatically when an amplifier is operated at its maximum power. Having plenty of "head room" or reserve power reduces the chance of distortion.
- It is important that an amplifier have very low background noise. Even a small amount of "hiss" can be very objectionable.
- The power rating of the amplifier and the speakers must be similar to reduce the chance of damaging the speakers.
- Amps are rated at 8 ohms, 4 ohms, and 2 ohms. The avg speaker used in a sound system is a 4 to 8 ohm speaker. Be sure to check out what your speaker pulls at what ohms. The fewer the ohms, the more power the amp can distribute per channel.

NOTE: As with everything else in the tech world, developments in sound tech have led to the introduction of digital amps. These amps come with present crossover patterns as well as other parameter controls that maximize the sound quality of the signal sent to the speakers as well as protect and maximize the life of the speaker components. It is strongly recommended to use high quality amps to drive your sound system.

NOTE: Since amplification dissipates over distance, place the amps as close to the speakers as possible.

NOTE: Amps store power to generate sound. This process causes excessive heat. Cool air is brought in mostly through the rear of the amp. Amps are to be stacked in a rack system with plenty of space behind the amps to pull clean air from. Additionally, the creation of a cooled "amp room" off stage will heighten the productivity and lengthen the life of the amps.

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12. Components of a Sound System - Speaker

Speakers are usually classified as full range, tweeter, midrange, woofer, or sub-woofer. A full range speaker is designed to handle the full range of sounds most people can hear. A single amplifier is all that is needed to power a full range speaker.

However, tweeter, midrange, woofer, and sub-woofer speakers are only designed to handle a portion of the sound spectrum. These speakers require a device called a Crossover to work properly.



- **See Appendix F**
- **Crossover** - The Cross-over splits the full range audio signal into two, three, or four ranges to be delivered to separate speakers. A 2-way speaker system consists of only a tweeter and a woofer. A 3-way system consists of tweeter, midrange, and woofer. And, a 4-way system consists of tweeter, midrange, woofer, and sub-woofer.

There are two ways that the Crossover can be connected: either after the amplifier or before. Most low to medium power speaker systems connect the Crossover after the amplifier. Frequently, the Crossover is inside the speaker cabinet. High power speaker systems often use a Crossover connected before the amplifiers. This also makes it necessary to have a separate amplifier for each speaker. A 2-way system must be bi-amped (that is, 2 amplifiers). A 3-way system must be tri-amped (that is, 3 amplifiers). If a sub-woofer is used, it also requires a separate amplifier if the Crossover is connected in front of the amplifiers.

- **Sub-Woofer** - The Sub-Woofer reproduces extremely low frequencies from about 100 Hz down to 20 Hz. These frequencies are "felt" more than heard. The Sub-Woofer gives the bottom end "beat" to music and the thunderous effects to movie sound tracks. If your sound system is not used for music with a heavy beat or movie sound tracks, then you may not need a Sub-Woofer.

Sub-Woofer may be placed wherever it is convenient since the human ear cannot tell what direction bass sound comes from

NOTE: If instruments, especially drums and keyboards, are mixed through the system, the use of Sub-Woofers is highly recommended. Their output frequency range goes beyond what full-range speakers can accurately amplify and control. Additionally, most people who think they have purchased full-range speakers have actually purchased mid-range speakers. Sending those frequencies elsewhere protects the full-range (or mid-range) speakers and allows for a much more enhanced quality of sound.

- **Woofer** - The Woofer reproduces low frequencies from about 500 Hz down to 100 Hz, the bass sounds. Speaker placement is not critical because Woofers are omnidirectional.
- **Midrange** - The Midrange speaker reproduces midrange frequencies from about 500 Hz to 6000 Hz. The midrange area contains most of the sound for voices and instruments. Speaker placement is more critical because mid-range sound is more directional.
- **Tweeter** - The Tweeter reproduces high frequencies from about 6000 Hz to nearly 20,000 Hz. It is responsible for the brilliance in the sound, mostly associated with harmonics. Speaker placement and angle are critical because high frequency sounds are very directional.
- **Full Range** - A Full Range speaker is a single speaker which attempts to reproduce the entire audio spectrum, usually not as well as a multi-speaker arrangement. Full range speakers are practical for low power speakers, but not for high power.
- **Main or House Speaker System** - The Main or House Speakers deliver the sound to the audience. Usually the a combination of tweeter(s), mid-range(s), woofer(s), and possibly sub-woofer(s) designed for smooth frequency response over a wide frequency range and able to operate at high volume levels is used for the Main or House Speaker System.

Usually, a central cluster with satellites is best for the main speaker system. A number of multi-speaker cabinets are arranged in an arc and suspended from the ceiling just in front of the center of the performance area. The number of cabinets, angle of speakers, and angle of cabinets is critical for even coverage. The cabs should be hunk to where the listeners in the field should be able to look into the horn of the cab. The spread of the center cluster is dependent on the width of the space. Generally, no speaker should be more than 50 feet from its listeners. Additionally, speakers need to be angled appropriately

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for proper sound quality.

If the room is not suited to a central cluster or the main system must be portable, a distributed system with one or more multi-speaker cabinets just in front of each side of the performance area should be used. The height of the cabinets, angle of speakers, and angle of cabinets is important for even coverage. The cabs should be placed at a height and angle where the listeners can look into the horns.

A distributed system will experience the "comb filter" effect to some degree. Each audience member hears sound from both the left and right speakers. These sounds arrive at different times and therefore are out of phase with each other. The amount of phase difference depends on the frequency of the sound. Therefore, from each individual audience seat, some frequencies are louder (in phase) and some frequencies are quieter (180 degrees out of phase).

- **Monitor System** - The Monitor Speaker System is located in or aimed at the performance area. Monitor speakers enable the performer(s) to hear themselves and other necessary elements of the program (i.e. music).

Usually Monitor speakers consist of a combination of a tweeter and a woofer in a slanted cabinet designed to aim the sound back toward the performers.

Monitor speakers should be placed to satisfy the performer(s). Typically, a monitor should be placed within 10 – 12 feet of the performer using it as a reference. Wedge shaped monitor speakers should be placed on the floor in front of the performer so they aim the sound towards the rear of the performer's mike. Sometimes side fill monitors are needed to cover a larger area (i.e. if the performer moves around). Avoid placing monitor speakers where they face the front of a microphone.

If multiple monitor mixes are required, each performer may have their own monitor speaker(s).

In-ear monitor systems are an excellent choice if installing a new system. Both Aviom and Roland, as well as other companies have grouped in-ear monitor systems that can be reviewed and purchased through any major music store or online

To see the components of the Aviom system, see Appendix G

The cost of a complete in-ear system is high due to the quality and number of components needed. This would not be recommended if the monitor system is functioning but some components are needed to make it more efficient and controllable.

However, if a new system is to be emplaced, I suggest giving much consideration to in-ear systems. The upfront cost will be slightly more than the cost of purchasing new speakers, EQ's, amps, etc but once they are set up, the sound person is free from having to monitor them. There is little threat to components because the signals are not amplified and most communicate through CAT-5 phone cables. Every person can control what they want to hear through their headphones. The best benefit is that there is no monitor noise competing with the main mix. These systems should be considered at length when purchasing a new system.

NOTE: If you transition from wedge based monitor systems to in-ear, give your team time to get used to the sound. The control is awesome but the sound field totally changes the feel of what they are doing. It is kind of like watching a child see a 3d movie for the first time. The majority of the energy seems to be spent trying to figure where the sounds are coming from rather than paying attention to what they are doing.

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13. Components of a Sound System – Recording Media

Most live sound venues have some form of recording media set up with the system. This is for several reasons

- Capturing live productions
- Creating opportunities for those who were unable to attend to experience the occasion
- Recordings don't lie: performers need some solid, objective way to be able to evaluate themselves and their performances rather than relying on the subjective opinions of those listening

NOTE: There are many legal issues involved with recording events. Copyright laws prevent the recording of any protected material. Recording live events that contain protected work is not legal. Recording sermons or original music is legal. For this reason the common method of recording church services is to begin recording AFTER the music portion of the service. For more information concerning legal issues, contact your lawyer. This manual is NOT to be considered a source of legal advice...be careful. God is watching.

Choosing Recording Media

- There is an abundance of methods for recording media
 - CD – Recorder – a device that is made up of a cd deck and some form of internal memory. The quality CD – Recorders come with a track button that allows you to break up the sermon into tracks in Real-Time with out having to edit it later.

NOTE: if a recording is not tracked, it will be one long track and going back to points will be very difficult. Try rewinding a 50 minute sermon.

NOTE: tracks should be about every 2 – 3 minutes.

- Computer – computers offer the ability to record, store, and edit all in one device. This can be very handy. Computers used for recording purposes must have a good speed and memory. Low quality computers are not good recording devices. Since recording uses so much memory, the computer used for recording should not be doing any other tasks concurrently or the recording may have skips or the computer may freeze during operation resulting in the loss of the recording.
- Flash media – devices that record to flash media that allows for editing later.

Setting Up The System To Be Recorded

1. Choose whether the recording will be done as a main recording (the main mix is recorded) or whether the recording is to be separate from the main mix using an Aux out.
2. Connect the recording device to the Mixer output selected for recording

NOTE: You will need adapters to connect your aux outs to your recording in. Typically you will need a 1/4 in TRS male plug adapted to a male 1/8in TRS or a male RCA.

NOTE: It is highly recommended to use an Aux out. Using the main out on the back of the mixer does not allow the sound person to separate the quality of the signal being sent to the mains from the signal being sent to the recording device. This often results in a distorted or weak recording. Many recording devices have little control on the input value of the signal. If the signal is too strong for them to control, it just comes through distorted. The only way to lower the signal would be to lower the channel faders, and that would directly affect the strength of the signal in the mains

NOTE: This section will explain the steps of using the aux out for recording. The main outs need no steps concerning the mixer. The steps for controlling recording device input are identical for either.

3. If using the Aux out, set the aux for all channels being recorded to the 9:00 position.
4. Set the master to the 12:00 position
5. Do a sound check for the recording aux channel.
6. Check the meter on the mixer (if possible) and make sure its registering in the yellow at full volume.
7. Check the input meter on the recording device.
8. If the input meter is not in the yellow, adjust as necessary
9. Perform a sample recording and check the quality of the recording
10. Make adjustments as needed.

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14. Understanding Sound

a) The Decibel - dB

- The Decibel (dB) is the unit of measurement used in sound systems
- A Decibel (dB) describes a ratio between two quantities expressed as a logarithm. Logarithms are used because our ears hear differences in loudness as a Log function.
- In simple terms, 3 dB represents twice as much power, and 10 dB represents 10 times as much power
 - 2 * power = 3 dB
 - 4 * power = 6 dB
 - 8 * power = 9 dB
 - 10 * power = 10 dB
- To make sound twice as LOUD requires 4 times as much power which is 6 dB
 - If you have a 100 Watt stereo, and you want one that is twice as loud, you need a 400 Watt stereo
- Loudness of a sound system is measured in dB of Sound Pressure Level (dB SPL)
- Loudness decreases by 6 dB (half as loud) every time the distance from the sound source is doubled
 - If you start 3 feet from the speaker and move back to 6 feet, it will sound half as loud (-6 dB)
 - If you move from 6 feet to 12 feet, it will reduce in volume by half again
 - By the time you are 48 feet from the speaker, the sound will be 1/16th as loud (-24 dB) as it was at 3 feet

b) Frequency Range of the Human Voice

- Voice range covers 300 Hz to 3500 Hz
- Most energy concentrated below 1000 Hz
- Vowels have most of their energy below 1000 Hz
- Vowels contain the "power and impact of the voice"
- Consonants have most of their energy above 1000 Hz
- Consonants are responsible for intelligibility
- Harmonics in voice can go above 3500 Hz
- Poor high frequency response reduces intelligibility

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c) Recognizing the Frequency of Sounds

It is important for a sound technician to learn to recognize the frequency of sounds so you are able to quickly and correctly adjust equalization when there is a problem (i.e. feedback, hollowness, nasal sound, boomy, etc.)

When you have time alone with a sound system, put on some good quality music and play with the graphic equalizer to learn what frequency range each control affects. Memorize the tonal quality each control affects.

40-60 Hz	Boomy - a sound over abundant in low lows. These waves move a lot of air, hence Boomy.
60-150 Hz	Fat - the octave above Boominess. Makes things sound big, but not earth- shaking.
125-250 Hz	Woofy - a somewhat nebulous term for sounds that are sort of "covered" - masked by low-end energy.
250-500 Hz	Puffy - is like an octave above Woofy. It's still sort of a cloud, but not as big.
200-400 Hz	Warm - obviously a positive characteristic often found between 200 and 400 Hz. Could easily degenerate into Woofiness or Puffiness if overdone.
500-1kHz	Boxy - seems to remind one of the sound in a small box-like room.
500-1kHzLow end of Voice	
500-5kHz	Power range - mid-range band that contains the 1st and 2nd harmonics of most important sounds.
1.5-2.5 kHz	Telephony - accentuating the limited bandwidth characteristic commonly associated with telephones with a roll-off both above and below.
2.5-4 kHz	Cutting - Here, "cut" means to put an incisive "point" on the sound.
2.5 kHz	Punch - Accentuating this range punches through vocals.
3-6 kHz	Presence - Anywhere from 3-6 kHz can be used to make a sound more present.
7-10 kHz	Sibilance - Dangerous "s" sounds and lots of other trashiness can often be found at 7-10 kHz.
10-12 kHz	Zizz - refers to a pleasantly biting high-end resonance (think of a "harpichord"-type brightness found around 10-12 kHz.
12-15 kHz	Glass - A very translucent, but palpable brilliance associated with 12-15 kHz.
15-20 kHz	Sparkle - A real smooth stratospheric brilliance almost beyond hearing, but can certainly be sensed.
Above 10 kHz	Brightness - Most generally achieved by a global (shelving) EQ of everything above 10 kHz.
Below 10 kHz	Darkness - The opposite of brightness (a general lack of highs at 10 kHz and beyond).
125-500 Hz	Muddiness - Actually a compound problem: Woofiness plus Puffiness (excess low end and also low mids).
125-500 Hz	Thinness - The opposite of Muddiness (a deficiency of lows and low mid frequencies).

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d) Ear Sensitivity

- Sensitivity of most people's ears is relatively smooth between 500 Hz and 5000 Hz
- Ears are most sensitive to sounds between 3000 Hz and 4000 Hz
- Below 500 Hz and above 5000 Hz, hearing sensitivity drops off
- At louder listening levels (rock concerts), the frequency response of the ears becomes more equal over a wider range
 - This is why you really can't notice the bass or cymbals in quiet music, but they are quite evident in loud music
 - Many stereos have a "loudness" switch to compensate for this effect at low volumes
- A Sound Pressure Level (SPL) of 120 to 130 dB SPL is the threshold of PAIN for most people
 - Children and women are more sensitive to loud sounds than men

e) Dynamic Range

- Singers and instruments are capable of performing as quiet as 50 dB SPL and as loud as 110 dB SPL
 - This represents a 60 dB dynamic range from the quietest to loudest
- The quietest parts of a performance must still be kept louder than the room noise (called the noise floor)
 - The noise floor is typically 50 to 60 dB SPL
 - The quietest parts must be amplified enough that they can still be heard above the noise floor in the back of the room
 - Assuming 24 dB of loss from the front to the back of a 50 foot long room, the quietest parts would need to be amplified 24 dB to be heard in the back of the room
 - Note: It may not be possible to provide 24 dB of gain before feedback (see Feedback Control)
 - The speakers must reproduce the quietest parts at 74 dB SPL in order to be heard at the back of a 50 foot room at 50 dB SPL
- The loudest parts of the performance must not be so loud as to be obnoxious or painful
 - The loudest should not exceed 110 dB SPL
 - The loudest cannot exceed the capabilities of the amplifier and speaker system (also about 110 dB SPL)
 - However, since the quietest parts must be amplified 24 dB, the loudest parts (110 dB SPL) will also be amplified the same amount, obviously making them much TOO LOUD
- The useful dynamic range of the speaker system is limited by:
 - The quietest part of the program must be amplified to 74 dB SPL to be heard in the back of the room
 - The loudest part of the program exceed 110 dB SPL in the front of the room
 - This leaves a useful dynamic range of 110 - 74 or 36 dB, much less than the 60 dB dynamic range of a typical music group
- Solutions to the Dynamic Range problem:
 - Make the room quieter (requires expensive sound insulation)
 - Get a louder sound system (could annoy the audience)
 - Use a compressor / limiter circuit (expensive, especially in a system with many microphones and instruments in one system)
 - Have the sound engineer turn quiet parts up and turn loud parts down
 - ***** Have the performers reduce the demand for dynamic range by getting closer to the mike on quiet parts and backing off from the mike on loud parts, similarly, have instrument players control their own volume according to the dynamic needs of the program

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f) Feedback Control

- Feedback occurs when the sound from the microphone is amplified too much.
- Feedback is caused by a repeating circular process of a microphone picking up a sound from a speaker, the sound system amplifying it (too much), the speaker reproducing the sound again, and the microphone picking it up again.
- Feedback usually occurs at one frequency at a time. The frequency of the feedback is affected by:
 - Direction the microphone is facing
 - Distance between the microphone and speaker
 - Frequency response characteristics of the room
 - Equalization of the microphone channel
 - Equalization of the monitor speakers
 - Equalization of the main speakers
- Sound systems should be operated no louder than 6 dB before the beginning of feedback (that is half as loud as when feedback starts)
- Operating closer to the feedback point causes a "hollow" or "ringing" sound
- Adding more microphones increases feedback problems. Every time you double the number of microphones, the maximum gain before feedback is reduced by 3 dB. Apparent loudness of each mike is cut in half when the number of mikes is increased 4 times.
- To go from 1 to 4 mikes halves the maximum volume of each mike before feedback.
- To go from 1 to 16 mikes quarters the maximum volume of each mike before feedback.
- Feedback is controlled by:
 - Using directional microphones and carefully aiming them away from monitor and main speakers to reduce feedback
 - Performers must be careful not to re-aim mikes towards speakers during performance
 - Performers must be careful when hand holding mikes not to point them towards the monitor speakers
 - Decreasing the distance between the sound source (performer) and the microphone (so the microphone does not need to be as loud)
 - Increasing the distance between the speakers and the microphones
 - Using equalizers to reduce the system's gain at the frequencies where the feedback occurs
 - Installing acoustic dampening material in the room to reduce sound reflections back to the microphones (expensive solution)

g) Factors Influencing Clarity and Intelligibility

- High monitor levels on stage get into the microphones and muffle the sound because the monitor sound is out of phase with the original sound (don't set monitor louder than necessary)
- High monitor levels can also cause sound to be hollow or ringing
- Instruments playing music louder than necessary on stage causes too much music to be picked up by vocal mikes, making the music muddy (keep music as quiet as possible on stage)
- Excessive use of equalization to prevent feedback effects the clarity of the overall sound (again, don't set monitor louder than necessary)
- Acoustical characteristics of the room (reverberation) affects the intelligibility of the sound. Large flat hard surfaces reflect sound which is out of phase with the original sound. Acoustical treatment of walls and ceilings is desirable.
- When performers are too far from the mike, the mike gain must be increased which causes pickup of more background noise and muddies the sound (the optimum distance from the microphones is 6" except for solos where "quiet" singers should be 2" from mike)
- Microphones aimed at monitor speakers, instrument speakers, or drums (tilt mikes up slightly so they point at a "quiet" ceiling rather than behind you at a guitar amp or drummer)
- Breath noises and "popping" on solos (tilt mike up and sing/speak over the top of it, stay 6" from mike)

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15. Installation of a Sound System

- See **Appendix F for a basic schematic for the wiring of a sound system.**
- Make a diagram of the stage layout with the location of all people and all instruments identified and all mixer inputs numbered
- Decide what equipment needs to be transported
- Carefully pack equipment for transport
- Unload equipment at destination
- Place all equipment (mike stands, speakers, amps, mixer) in its desired location
- Resolve equipment and people placement problems
- Run "snake" from stage to mixer (if snake is being used)
- Put mikes on stands (with stands set too high so that there will be enough slack in the cords)
- Select correct length cord for every mike, instrument, and speaker and lay out cords
- Label all channels on the mixer board
- Run all mike, speaker, power, and instrument cords NEATLY
- Connect mixer to main and monitor amplifiers
- Connect auxiliary equipment such as wireless microphone receivers, equalizer, effects unit, taper recorders, and CD
- Power up all equipment
- Perform a sound check with a tape or a CD, confirming that all main and monitor speakers work
- Check all mixer controls to see that they are in the correct position. Set channel trim pots to expected operating level (from previous experience). Set equalization flat (unless there is a reason not to). Set all monitor send controls to halfway position (unless there is a reason to set them different). Determine which channels should be assigned to each sub-group. Set any other controls unique to the mixer to desired starting point. Start with all channel faders off!
- Perform a sound check on all microphones and instruments (one at a time) to see that they work and are connected to the correct channel
- Carefully position all microphones and speakers in their final positions
- If time permits, use the graphic equalizer spectrum analyzer, a pink noise source, and a calibrated microphone to analyze the room acoustics and set the equalizer to compensate
- Play a good CD through the main speakers and adjust equalization ONLY if needed so that it "sounds good"
- With master control and monitor control off, set all mikes at their expected working level (normally the "0" position on the channel sliders), then slowly turn up monitor and master levels
- ***Mix the Mains*** (See Ch 13)
- Watch carefully for any overload lights and adjust channel trim pots if necessary.
- Listen to each input channel (mike or instrument) individually and adjust its channel trim pot to balance with the rest of the system
- **Set the Eq's** for the main speaker system ONLY if necessary to get enough gain before feedback (this will effect the overall tonal quality of the performance)
- ***Mix the Monitor Systems*** (See Ch 13)
- Listen to what the performers hear on stage and adjust monitor mix to suit the performers
- Listen to tonal quality of the sound from the position of the audience and adjust ONLY if necessary
- **Set the Eq's** for the monitor system using graphic equalizer spectrum analyzer or ***analog ring test***
- Connect recording device(s) and check recording levels.
- Perform a sound check with all people in their final positions

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16. Setting Up and Mixing the House Main and Monitor Systems

- **System Check-Out**
 - Start by bringing up the main faders to normal (0 or U) position.
 - Then bring up the sub-groups to normal (0 or U).
 - You should have a tape or CD player connected to the system. Turn the trim pot on the tape / CD channel all the way off (left) Now play some music (but don't expect to hear it yet).
 - Make sure a sub-group is selected for the tape / CD channel and bring the tape / CD channel fader up to normal (0 or U).
 - Slowly turn the tape / CD channel trim pot up until the main left / right meters read high in the normal (green) range without going into the red.
 - Now, with the amplifier volume turned all the way off (left), turn on the main amplifier power. Slowly increase the volume until you hear the music out of the main speakers.
 - Check that all the main speakers are working and increase the amplifier volume setting until the music is at the desired performance level. When you are satisfied, turn off the main faders to turn off the music in the main speakers.
 - Next, turn the tape / CD channel control for the first monitor mix up half way (to the 12:00 position). Also set the first monitor send level to half way (12:00).
 - Now, with the amplifier volume turned all the way off (left), turn on the first monitor amplifier power. Slowly increase the volume until you hear the music out of the first monitor speakers.
 - Check that all the first monitor speakers are working and increase the amplifier volume setting until the music is at the desired performance level. When you are satisfied, turn off the tape / CD channel first monitor send to turn off the music in the first monitor speakers.
 - Repeat this process for each set of monitors.
 - You still have the effects units to set, but we'll leave that to you to figure out!
- **System Tune-Up during Practice**
 - The first time you fire up your gear it will take some time to get everything just right, but if you will take the time up front, you will have a much easier time going forward.
 - The music team needs to be patient and understand that this will take some time
 - The members of the music team need to do their mic checks at full power in order to be properly mixed and must continue to "blow their mics" until the sound person gives the all clear.
 - During this time, any member who is not doing a mic check should remain quiet. Distractions will only make this process longer.
- **Setting up the main (house) mix**
 - The mixer should be set with all trim, eq, and pan pots at the 12:00 position.
 - The auxiliary and effects pots should be turned all the way down.
 - The faders should all be set at 5 below the neutral (should be numbers visible 20, 15, 10, 5, neutral, +5).
 - The subgroup L/R button should be pressed down but the other numbered subs should not be at this time. If the L/R sub button is not activated, no signal will go to the master hence no signal to the amp and no sound heard.
 - The pre/post button should be set to "pre" for initial mix down.
 - If the mixer comes equipped with an LED monitor, the following process is a little easier. If not, the sound person will have to do the following by ear. The goal at this step is to get everything at an equal (normalized) decibel level. At this step, no adjustments to the mixer equ's will be made. That will be done AFTER the graphic or parametric equ's are set (explained later). Use the talk back mic to speak to the team through the monitors so you don't have to waste your voice. Begin with the singers in position; have the musicians sit down off of the stage.

NOTE: Be sure main amps are on and running at 50 - 75%

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NOTE: Set master fader(s) to -20

1. Have the lead singer perform a mic check by loudly saying “Mic Check One. Mic Check Two” repeatedly. During this mic check, watch the LED display. Initially set the trim to where the meter is reading in the yellow but not hitting the red. If the meter is not hitting the yellow, the trim needs to be turned up. It is important to get full dynamics from each channel to properly mix the signals and have a good sound. Raise master fader until the sound heard in through the mains is full.

NOTE: The volume should feel a little loud. People absorb sound.

NOTE: During this entire process, listen for distortion. All signals should be clear across the frequency range.

2. After the lead singer has checked the mic, have the additional singers check their mics as well ONE AT A TIME. Repeat the same process.
3. When they are done, have them sing a song they know well with out instrumental support in UNISON. IF LED meters are available per channel, ensure they are the same. If not, use your ear. At this step, the goal is everything the same at the -5 position on the board.
4. Once the singers are finished, have them sit down and then bring the musicians to their positions
5. Start with the drum player. Have his channel(s) registering in the same position the singers were. Have the drum player do single snare shots at full velocity in 4 second intervals (One hit every four seconds). Adjust the trim to where the LED meter is registering in the yellow.
6. Once that is done, have the drum player do kick shots on the bass drum at full velocity in 4 second intervals. Adjust if necessary.
7. Then have the drum player do both simultaneously. Adjust if necessary.
8. Allow the drum player to play some improve at full velocity. Adjust if necessary.
9. When the drum has been mixed, go though each musician. Have the musicians set their instrument volumes to 75%. Have them strike their instruments at full velocity in 4 second intervals. Make adjustments to the trim as needed.

NOTE: if the guitarists are using processors, their signals are often too strong for the mixer to be able to close. Have them set the volume on their processors to 50%. If they are using an amp, set the mix with the amp off if possible. If not possible, have them turn their amps on and set them at a volume that YOU CANNOT HEAR CLEARLY (somewhere between 1 – 2). This may seem uncomfortable for them but for you to get an accurate mix, you must be able to differentiate between what is coming through the mixer vs what is coming out of that amp.

NOTE: if they are running though the amp, the amp must have sufficient gain to make a full signal. Turning the amp below 1 will cause a weak signal to be sent to the mixer and it will not sound good mixed. If the building is too small, consider purchasing a processor.

NOTE: once the channel is set for a mic'd amp, any adjustment to the amps volume will directly affect the mix since the mix has been set to the volume of the amp.

10. Once all of the musicians have done their sound checks, have them jam to a fast and loud song they know well. Monitor the meter and make any adjustments.
11. Bring the singers up and have them jam out for several songs. Instruct them to continue until you tell them to stop. Only have them stop if you absolutely have to. Try to use your meter and your ear to get the main mix right.
12. DO NOT ADJUST THE MIXER EQU's!!! Ensure the musicians equ's are set to the neutral as well (acoustic guitar players especially!!)

Your house is now mixed. It does not sound as well as it will when everything else is set, but everything has been normalized and mixing the levels from here will be easy. Now to the monitors...

- **Setting up the monitor mix**

NOTE: There are many different types of monitor mixes. This manual is focusing on the normal monitor mix scenario comprised of the traditional floor wedges powered by amplifiers monitored by equalizers and controlled by aux or mon sends form the mixer. If you desire to employ a mixer to run your monitor mix or employ an in-ear system (ie ROLAND or AVIOM) then most likely you already have a trained sound team since those systems are extremely costly.

NOTE: It is imperative that your worship team understand that the purposes of a monitor system are for sound reinforcement on the stage. They are NOT to be mini PA systems for the singers and musicians to hear every nuance of their performance.

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NOTE: Monitor systems usually have more speakers present than the main system. It is imperative that they are not driven to volumes that compete or overtake the main system. This will cause a muddy sound in the field and will result in equipment failure. If the mains are forced to compete with the monitors, the mains will lose!! Keep the monitor volumes clear and minimal.

NOTE: Monitor mixes should be broken into groups. Typically 4 groups make up a healthy monitor mix. Group 1 (Leader), Group 2 (Singers) Group 3 (Musicians) Group 4 (Drummer)

NOTE: Mix the monitors with the Master Fader turned all the way down. Once the monitors are set, increasing the Master Fader will allow for a much fuller sound on stage.

- Try to avoid crossing the mixes. The singers should be in the singers monitor. Maybe some keyboard to be sure to stay in tune. The musicians should be in their monitor with the lead singers so they can follow their leadership. The leaders will have his or her voice with a selection of the lead instruments and lead harmonizers. The drum player will be spoiled. The drummer should get what the drummer wants ... timing is critical and influenced by much. Typically that monitor is in the drum cage and washed out by the drums.
- If the drum is digital, the musicians will need it in their monitor as well as the drum player. The leader might also want some.
- Monitors should be mixed and placed in strategic positions that allow all groups to hear multiple monitors. In other words, the singers should hear the instruments through the musicians monitor...and vice versa. They shouldn't need it in theirs.
- Keeping the monitors clean and clear of unnecessary sounds will allow everyone to have the support they need without sacrificing the main mix.
- Set all auxiliary or monitor masters to the 1200 position. (Ensure the amps and EQ's are on).
- Make sure all individual monitor pots are turned off.
- Follow these steps

NOTE: Be sure monitor amps are on and running at 75%

NOTE: Be sure aux/mon masters are set initially @ the 10:00 position. This will be adjusted as the process gets underway.

NOTE: Be sure to raise only one aux/mon master at a time. Once a master has been completed, record the setting, turn it down, and begin the next mix.

1. Starting with the leader, have the leader perform a mic check, slowly turning the pot up until the leader is confident in what the leader hears

NOTE: Do not raise the level above the 1:00 position if possible. If at the 1:00 position, the monitor volume is still weak, raise the master, ½ clock position at a time. (A little adjustment makes a big difference.)

NOTE: Remember that the goal here is NOT to create a personal sound system for the individual. The monitor mix should not be clearly heard from the mixing location. If it is, it is too loud and will cause problems once the mains are in. If the singer/musician doesn't feel they are hearing enough of themselves in their monitor, have them play and stand in front of their monitor. If you can distinguish their sound legibly, the mix should be fine.

NOTE: If the singers/musicians are not professionally trained, this will take patience and grace. People are generally uneducated concerning monitor uses and expect the impossible. A gentle reminder of why they are doing what they are doing may be necessary. Also, it may be helpful to remind them that final adjustments will be made once the house turned back up.

2. Have the leader dictate the members the leader would desire to be in the leader's monitor mix
3. Have those individuals perform a mic check ONE AT A TIME until the leader is finished.
4. Have those members and the leader jam for a few minutes to ensure the mix is ok. Adjust as necessary. Move on to Aux 2
5. Have each singer perform a mic check. Adjust as necessary. Have them sing a song in unison. Bring in the keyboard as a support. Have them sing again. Adjust as necessary. Move on to Aux 3.
6. Have each musician perform a mic check.
7. Have them jam for a few minutes. Adjust as necessary.
8. Bring in lead singer to mix and jam some more with the leader. Adjust as necessary. Move to Aux 4.

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9. Have the drummer dictate beforehand who should be in the drummers mix. Preset them all at the 11:00 position. Have them jam and adjust as necessary.

NOTE: All adjustments to monitors should be done in real-time using hand signals. DO NOT STOP unless you absolutely must. Have the individuals point at what they want adjusted and use a thumb up for increase or a thumb down for decrease.

NOTE: Remember to watch your levels. Many people expect too much from their monitors. Protect your system.

10. Have the whole team jam for a song making adjustments as necessary
11. Have the team continue to play. As they play bring the MASTER FADER back up to -5. Check all levels. At this time turn down the auxiliary master pots about 30 – 45 minutes. With the masters up, they won't need as much over all sound on stage as they thought they did when they were mixing the monitors without the mains.

- **System Operation during Performance**

- It is important to remember that more bodies absorb more sound. So the mix that was completed at the practice will have to be adjusted in the assembly. But the adjustments shouldn't be drastic.

NOTE: During performances, all volumes should NOT be the same. There is a priority of signal!

NOTE: When adjusting signals, attempt to pull channel volumes down. Resist raising channel volumes. This could result in overriding the equipment causing physical damage to the listeners and components.

- The lead singer and speakers should be heard clearly above the rest of the team
- The support vocalists should be slightly behind the main singers. If the support vocalists are all on a subgroup (recommended) slightly pull back the subgroup.
- Musicians should be supporting the vocalists. If the system is a stereo system. Set the pan to side they are on. The general idea is that where they are on the stage is where the sound should seem to come from. If the system is a mono system or operating from a center stack, this will not be possible (use pans for subgroups only).
- The drums should be clear but not overbearing. Adjust as necessary.

NOTE: Attempt to imitate the sound and feel of a cd of a musician your team covers. A good sound should be full, yet clear, with the sensation of sounds coming from different locations. This is easily done when the system employs a center stack with side satellites or when the sound system is a left/right split system. This is more difficult when the system is only a center stack. Regardless, clarity and dynamics are the focus, NOT VOLUME. When sound seems cluttered, the first reaction should be to lower volumes, not raise them. This is the purpose for doing the sound check at full volumes.

- During the performance, boost volumes of soloists (vocalists and musicians) then return to their operating level. The reason the system is leveled at the -5 is to allow performers the room to be boosted without distorting the signal. Once the fader is above the neutral (the zero) the signal, based on the quality of the mixer will begin to distort. In any case, levels over +5 will result in distortion as well as the inability for the mixer to use its own self-protecting mechanisms. Distortion in the channel will eventually destroy the channel.

NOTE: It is common for the sound team to want to “enter in” to the service by closing eyes and raising their hands and so on. This is as problematic as the worship team members doing the same. The idea is good, but the fact is all members of the team must be aware of what the leader is doing. A drum player doing his (or her) own thing during worship would be considered immature and obstinate ... even superficial, and that would cause problems. The same is true for the sound team. They play the most sophisticated and important instrument of all ... that is their worship, their offering. The sound team must remain aware AT ALL TIMES during the service. If possible, make a rotation that allows the team to “enter in” when they are off rotation. It is important to teach that true worship is selfless service, not merely the raising of hands. Remember, “WATCH, WATCH, WATCH!”

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Operating a Sound System

- You should have completed sound check before the audience arrives
- If appropriate, play some background music as the audience enters
- Once the room is full of people, the sound is going to be different!
- If a lavalier mic is being used, make sure the performer is wearing it as high as possible, centered, and facing straight up
- If battery operated mics are being used, make sure they have FRESH BATTERIES and are turned on
- Keep all mic channels off until the program begins
- When the program begins, listen first for correct overall volume and make any necessary adjustment quickly
- Check to see that the proper lights are turned on. Are the main lights supposed to be dimmed?
- Listen to see that all performers in the program can be heard and that none are significantly too loud or too soft
- Look at the performers to see if they look at ease. Are they straining to hear the monitors? Are they backing away from monitors that are too loud?
- Listen for serious tonal quality problems - too bassy, too sharp, or hollow sounding
- Follow your program/agenda/Q-sheet to make sure you don't miss any queues
- As time permits, use a headset to listen to the PFL for each channel and make any necessary adjustments to volume or equalization
- If it is a musical program, listen constantly for a proper blend
- Stay alert!

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17. Trouble Shooting the Sound System

What do you do if the sound system doesn't work?

- **First, check the obvious!**

Usually, components don't just go bad overnight. When the system seems to just unexplainably fail, check to see if a switch or button has been inadvertently pressed or depressed.

Check all mixer controls for proper settings: channel trim pot, pad switch, line/mike switch, sub-group select, left/right pan, channel on/mute, channel fader, sub-group on/mute, sub group left/right pan, sub-group fader, main on/mute, main fader

Are the microphones and instruments connected to the mixer correctly?

Are both ends of the snake connected correctly?

Are the L/R sub buttons activated?

Is the proper line switches activated?

- **Try to locate a functioning starting point?**

- Are the mixer, equalizers, amplifiers, and all other equipment plugged in and turned on (check LED's)?

Check plugs/outlets – replace as necessary

Check fuses/breakers

Check electric feed to outlet ... if the outlet is "hot" and the component(s) do not power up, replace the component(s) power line/adaptor with a functioning components similar adaptor. Check again, if a fail, replace the component(s).

- Try playing a CD – see if sound can be generated through any of the systems (mains and monitors)

If the meter on the mixer shows activity, check amps – speaker connectivity

Is the power amplifier gain control set correctly?

Check proper in-outs: Check also for heat on the EQ's and FX modules. There should not be any noticeable heat to the hand. If heat is felt, then the internal wiring of the component is crossing and the module should be bypassed and replaced.

Is the mixer output connected to the equalizer input?

Is the equalizer output connected to the power amplifier input?

Is the power amplifier output connected to the speakers?

- When you speak into a mic, does it indicate on the mixer's meter? Can it be heard on the headphones when the PFL switch is operated?

Check low-z connections to mixer

Check mic/instr connections at signal source

Check direct boxes

Check mic connections to snake

- Can the trouble be isolated to one microphone, instrument, or speaker?

If yes, service/replace component/instrument

- If the power components are functioning but sound is not generated, connect mixer directly to amp

If sound generated, isolate the EQ or FX module by doing the same and replace, if no sound continue

Disconnect mixer from amp and plug a mic directly into the XLR input on the amp. Is sound generated? If yes, service/replace mixer. If not, continue.

Check meter to amp output for proper output, if working, continue, if not, replace amp

Plug in alternate speaker to amplifier, if sound is generated, continue. If not, replace amp

Check connectivity of speaker lines, if malfunctioning, service and/or replace. If pass, continue.

Check proper connection to speakers, if loose OR if seated AND not functioning, service/replace component

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18. Everything Else!

- Sound Technician Supplies:
 - Adapters
A sound technician should have a good variety of Radio Shack audio connector adapters to convert between 1/8", RCA, 1/4", XLR, male/female, and mono/stereo connectors
 - Cables
A variety of short (3') cables are needed to interface between mixer and FM receivers, tape deck, CD, equalizer, effects processor, and amplifiers. Most use 1/4" to 1/4" cords, but some use RCA, XLR, or 1/8"
 - Tools
Variety of screw drivers, wire cutters, adjustable wrench, hammer
 - Cable Tester
To look for broken wires in cables (it happens more often than you'd think)
 - Batteries
Keep several 9V Alkaline batteries for battery powered FM mikes
 - Flashlight
 - Guitar Tuner
 - Patience and a cool temper
- AC Power (See Ch 19):
 - **If** your total sound system does not require more than 15 amps, then connect EVERYTHING to one outlet to reduce the possibility of ground hum.
 - You need several AC power ground-lift adapters (3-prong to 2-prong adapters), a few multi-outlet adapters, several multi-outlet power strips with surge protectors, and a variety of 3-conductor extension cords (of different lengths).
 - You should have a 3-prong AC power tester and always test an AC power outlet before you use it (prevents equipment damage due to faulty wiring).
 - If you do get a ground hum, use your power tester to test the power feed to every unit first, then try a ground lift adapter on each unit of the system, one at a time, until you find the source of the hum.
- Intercom System:
 - An intercom system may be helpful if it is necessary for the Sound Technician to talk to Stage Crew or Lighting Technician
- Projection System:
 - A projection system may be useful if song words are to be displayed for the audience
 - Possibilities include overhead projector, slide projector, or projection video
 - Projecting on a movie screen will give a brighter image
 - Carefully aim other lights so they don't shine on the screen
- Documentation and Labeling:
 - Label all permanent wires
 - Put a strip of tape across the mixer and label all channels
 - Label all equalizers, effects units, amplifiers, etc. as to what they are connected to (i.e. Left Main Amp).
 - Controls which are always to be left set at the same place should be marked with a dot at the proper setting. (white-out works well)
 - Engrave a permanent identity name or number on all expensive equipment (to identify it in case of theft).
- Buying Equipment:
 - Get Educated
 - Read audio magazines, go to various performances and see what equipment other people use, ask other sound technicians what equipment they like or don't like, go to music stores and ask questions

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- Requirements
Before buying any equipment, write down all requirements for the sound system
- Budget
Evaluate the requirements in relation to the available budget
Determine which items are most important to have first
- Insurance / Inventory / Labeling
 - Make sure that all equipment is covered by insurance (you may have to list all equipment for the insurance company)
 - Keep an accurate, up to date, and complete inventory of all sound equipment with manufacturer, model, and serial numbers
 - An identification name or number should be engraved on the equipment in a visible, but not unsightly location
- Other Topics:
 - Lighting Control:
 - Video Taping:
 - Audio Taping:
 - Direct Boxes
 - Impedance Matching
 - 70-Volt Line
 - Clear-com
 - Talk-Back Mike
 - Light for the sound console
 - Soldering iron
 - Sound feed for Video, ambience
 - Sound feed for Radio, ambience
 - Recording
 - Video, camera position, sound source, ambience
 - Grounding, hiss, hum, buzz, dimmers
 - Setup, connecting the wires
 - Tear down, wrapping the wires, shoe strings
 - Microphone care
 - Pink noise generator, Real-time Spectrum Analyzer
 - Guitar tuner, importance of tuning

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19. Things Specific to Your Church

NOTE: Every sound system is different as is every space. If you are the leader of your sound team, create a list of policies and have them visible that deal with some or all of the following situations. If you find other situations not mentioned, add them in!

- Church sound system
 - Breaker Box
 - System Locks
 - How to turn system on
 1. Mixer on
 2. Equ's and FX on
 3. Recording on
 4. Computers on
 5. Amplifiers on
 - Channel assignments
 - Tape deck operation (play / record)
 - Cordless mikes (transmitters, batteries, receivers)
 - Mike jack locations
 - Monitor level
 - Location of music stands, mike stands, mikes
 - How to turn system off
 1. Amplifiers off
 2. Computers off
 3. Recording off
 4. Equ's and FX off
 5. Mixer off
- Church lighting
 - Location of controls
 - Single / All switch
 - Lighting channels
 - Circuit breaker location
 - Aiming lights
 - Lighting jells
 - Location of spare parts
 - Follow Spot Operation
 - Movie screen control, precautions when using screen
 - Curtain control
 - Overhead projector operation, storage location
 - How to control lights
 - How to fix house light switches when they get stuck
 - Existence/Operation of telephone
 - Cross light switch location
 - Air Conditioner controls
 - Circuit breaker locations

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20. General Requirements

GENERAL ELECTRICAL REQUIREMENTS

The building should be powered as a commercial building using 400 amps instead of 200 amps. If your building is run with 200 amps, then it was set up on a residential grid. To change this, have your electrician file the appropriate permits, contact the electric company, and have them change it to a commercial system.

The power for the sound and video systems should come from an independent sub-panel.

The power for the lighting and visual systems should also come from an independent sub-panel

At a minimum, the power for the audio and visual systems should be pulled from an independent sub-panel (breaker box), fed directly the main electrical panel. If your power is not set up correctly, this is not hard to do.

Have your electrician install a 100amp electrical panel on the wall closest to the sound booth directly from the main electrical panel. Use a large ground wire to keep from light noise and 60 cycle hums from occurring. The breaker box will need:

- a 20 amp breaker for the amps
- a 20 amp breaker for the EQ's and signal processors
- a 20 amp breaker for the stage
- a 20 amp breaker for the sound booth (mixer, video mixer, lighting controller, recording devices, computer etc.)
- a 20 amp breaker for every 1000 watts of lighting
- a 20 amp breaker for video components
- All lines leaving the breaker box will be 12 gauge

Run each line through a control switch in the sound booth to give total power control from the booth

NOTE: The florescent lights and fans and such will not be run from this sub-panel

For the stage area:

Run a 12 – 4 Home Run from the Sound Booth to the amp area on stage. The lines will then be spliced in an insulated electrical box to separate lines already run for:

- The amps
- The EQ's
- The stage outlets
- Stage and floor area lights

NOTE: It is strongly suggested to run the lines whether there are plans to place the equipment there or not. Those line scan be set and marked as unused outlets. You may wish to move components later, or add some in. It is easier to do this now than later.

NOTE: All light switches and outlets used are to be 20 amp, 3 pronged outlets.

NOTE: Do NOT use faders for light switches. This is a electrical fire hazard and will damage the components

Concerning the control switches, your electrician will know how to run each line into the switch and them piggy pack them to the different locations.

Be sure you provide the sound booth with plenty of electric outlets. The number of outlets needed quickly exceeds 20 considering mixers, wireless components, computers, etc.

Lines piggy backed from the control box to the booth that also jump to the stage (ie EQ's and Signal Processors) only need one outlet. A high quality surge protector can be sure plenty of outlets are available.

Exercise precaution and make as few splices as needed. Make sure all junction boxes are insulated and accessible.

File the appropriate permits, this is the legitimate thing to do. It may seem to take more time but if any accident happens, you will be in the clear. If you don't, your insurance companies will not cover you and you will be liable for suites.

Also, the only way to get around this is to act deceitfully, and that is contrary to the character we are to have.

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For the lighting and visual:

Run as many 12-2 lines as needed for the lights to all have adequate power. Remember, a 12 – 2 line can provide about 1000 watts of power without overheating. If your lights are high wattage lights, this will require use of individual 12 gauge wires being pulled through a conduit. Be sure every light has an outlet to plug in.

For small venues, as is being described in this manual, two outlets will be needed. These two outlets will be fed by the lines already run (listed previously) to the stage area. Then run medium duty (black preferably) extension cords (100ft max) to the lighting area to power the dimmer packs. The lights will be plugged directly into the outlets on the dimmer packs

The dimmer pack are controlled via XLR cables by the lighting control module.

Run a 12-2 line from the projector control switch in the sound booth to each projector

All lines should be run in the air and out of sight. If they cannot be run out of site, be sure they are strapped neatly and, if possible, in conduit.

Concerning the control switches, your electrician will know how to run each line into the switch and then piggy pack them to the different locations.

Be sure you provide the sound booth with plenty of electric outlets. The number of outlets needed quickly exceeds 20 considering mixers, wireless components, computers, etc.

Lines piggy backed from the control box to the booth that also jump to the stage (ie EQ's and Signal Processors) only need one outlet. A high quality surge protector can be sure plenty of outlets are available.

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EXAMPLE GENERAL BUILDING REQUIREMENTS

The following is a list of general building requirements for good application of sound and light systems:

- All air-conditioning systems will be replaced with new "quiet" units
- Theatrical lighting
- Existing house lighting is adequate
- A complete sound system to be installed with the main speaker hung from the ceiling above the front of the platform
- Additional speakers will provide sound in the cry room, nursery, bathrooms, and office
- A large number of microphone jacks and monitor speaker jacks will be installed at various locations using floor boxes
- All lighting in the Sanctuary will be connected to a theatrical dimmer system with adequate dimmers each capable of 20 amps and an adequate channel controller
- Several electric outlets will also be connected to the dimmer system
- Sound / lighting / video control should be located in the sound/light field:
- Sound equipment storage room should be provided with lockable door and storage space for: mikes, cables, mike stands, music stands, keyboards, instruments, guitar amplifiers, power amplifier equipment rack, and Contemporary music group's "road equipment"
- All sound equipment will be powered from a dedicated electrical panel which is equipped with a noise filter and surge protection
- Thermostats will have remote override located near sound and lighting control

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21. Example Requirements for a Sound System

The following is an example list of technical requirements for a church:

- High quality main speaker system capable of reproducing both speech and music with a high degree of clarity at volume levels sufficient for both Traditional and Contemporary Christian worship services
- Main speaker system should be a central cluster, tri-amped
- Sufficient monitor speakers to cover:
 - Choir seating area
 - Contemporary Music Director area
 - Organist
 - Musician areas (guitar, drum, keyboard, piano, and horn players)
 - Front step area for adult or children's choirs
- Convenient jacks should be provided to plug in monitor speakers
- Jacks should be installed in floor boxes
- Auxiliary speakers for nursery, cry room, bathroom, and office (with local volume controls)
- Power amplifiers appropriate for all speakers
- Minimum Graphic Equalizers for:
 - Main speakers
 - Each monitor system
 - Note: Equalizers should have feedback indicator lights above each slider to make it easier to determine feedback frequency
- Effects processors
- Tape deck with variable speed playback (for accompaniment tapes)
- CDR/DRV for recording sermon / program
- Multiple additional tape decks for making several copies of sermon tape simultaneously
- Media player (CD, DVD, MP3, etc)
- Media recorder (Computer, CD-Recorder, etc)
- Intercom system with jacks at sound mixer, light control, Narthex, left and right of front platform, and Sacristy
- Mic / monitor speaker jack locations: (all jacks should be installed in floor boxes)
 - Musicians area
 - Mic area
 - Drum area
 - Speaking area
 - Choir area
 - Additional jacks should be provided anywhere signal might be sent from
- One 48 channel, 8 sub-group, 6-8 aux mix, 2 effects sends Mixer
- UHF lavalier, headset, and wireless handheld mics (true diversity) as needed plus spares
- Microphones and appropriate stands for Pulpit, Lectern, and Alter (possibly PZM for Alter)
- Microphones suspended from ceiling for traditional choir
- Microphone(s) and stand/holder for piano
- Microphones and stands for drums
- 4 Direct boxes for Keyboard, Guitar, etc.
- Power sequencer controlled by a single button or independent switches to turn the entire sound system on or off
- For a simple program, it should not be necessary to have an operator at the sound console. A particular set of channels should be left on whenever the system is shut down.

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22. Basic Lighting

Most churches employ the use of florescent lighting to save money. Florescent lighting is a main source for hums in sound systems. All light produces noise. This noise is called “light noise.” Florescent lighting produces a lot of dirty light noise as compared to filament or halogen lighting. Additionally, most churches are wired efficiently, not properly. So the ground that connects the whole building together is also carrying a lot of noise that amplified systems will pick up.

Fans and florescent lights should not be on the same circuit ... should not be on the same breaker panel as the sound system. But in small or existing buildings, this is impossible.

The addition of dimmable lights requires a lot of power to be made available for the lights being controlled.

All of these issues cause the need for an electrician if a revamping of the light/electrical system is desired. This will be a very expensive undertaking.

If you are building, or renovating a gutted building, it will be cost efficient and easy to run the power for a super system. This will be discussed later.

This section is for churches who desire lighting but cannot afford a major renovation.

Dimmable lighting requires simple resources.

- Lighting Cans
- Poles and trusses (to hang the lights and run the wires)
- Dimmer switches - boxes with 4 channels of 2 three pronged outlets each that is controlled via XLR. These dimmer switches are powered by a three pronged cord (kind of like a surge protector).
- A lighting control module (looks like a sound board but is specifically for lights).
- Long XLR cables to communicate between the control module and the dimmer switches.

The components for this system can be purchased online or through any major music store.

To set up a basic light system, use the following steps.

1. Plan where the lighting will be needed.
2. Attach lights to poles and trusses at their lowest level. Aim lights before lifting into the air.
3. Plug lights into their dimmer boxes in the appropriate group based on the sequence you want them to be controlled by.
4. Be sure the dimmer boxes are secured to the poles/trusses
5. Be sure the right switches have been turned on/off for your dimmer box based upon the desired sequencing (see the dimmer box owners guide for those instructions)
6. Connect XLR cables from the output on the first box to input of the second second and continue in order leaving slack for when the poles/trusses are raised in the air.
7. Run XLR line(s) from the light control module in the booth to the input(s) on the first dimmer box (es) in your light sequence(s).
8. Plug in the dimmer boxes to the power made available for them

NOTE: Check to see LED lights power up on dimmer boxes

9. Plug in the control module
10. Turn on the control module

The Control Module Explained:

- The control module has several different faders and buttons, much like a mixer board.
- Each channel has a button below it that when pressed activates the “full on” (self descriptive) function of the board for that channel.
- The channel faders control how much power is made available to the master unit.
- The cross faders counter each line’s power. Raising a cross fader causes the other line to dim, and vice versa. This function only



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works properly if two lines are being ran from the control module

- Master Fader controls the total light power AFTER the channel faders have been set. The master fader does not overpower the channel faders (just like a mixer)
- The “blackout” button allows for all lights to be killed simultaneously. The blackout button has command over the master faders and the channel faders.
- The “full-on” button, when pressed, causes all lights to be on full power until it is depressed. The full-on button has command over the master faders and the channel faders
- The time or tempo button, when pressed with the rhythm of the program syncs the preset light programs to the rhythm of the music.
- The program buttons perform different pre-set or programmed light functions such as chase patterns, etc

NOTE: Light systems that have the ability to operate without being controlled are called *INTELLIGENT Light Systems* Many control modules have this capability. It allows the light operator to not have to pay so much attention the module and pay attention to the lighting needs of the stage.

Example Requirements for a Lighting System

The following is a list of technical requirements for lighting equipment

- Simple to operate remote lighting control will be wall mounted at the main entrance to the Sanctuary.
 - Remote lighting control will be a basic 8 button control (7 scenes and OFF)
 - Scenes will be selected as the most frequently used light settings
 - Scenes will transition slowly, over 12 seconds
 - Each button will be clearly labeled
 - A second 8 button lighting control should be located at the Sacristy door (Note: Still need to do this.)
- Main theatrical lighting control will be located in sound / lighting / video booth in loft
- Main lighting control will be versatile and user friendly with 32 channels and memory for 100 scenes (no computer screen - too complicated for the average user)
- All church lighting will be controllable from lighting console (including platform lights, aisle lights, ceiling lights, cry room, but not including stairways or narthex)
- Additional lighting fixtures will be provided to:
 - Increase overall light level on front platform
 - Cover extended (new) areas of front platform
 - Eliminate (or decrease) shadows
 - Add 8 theatrical (leco) light fixtures in loft on 4 control circuits (These lights can be easily aimed anywhere on front platform)
 - Provide better lighting of outside of Cross
 - Brighten ceiling
 - Highlight Pulpit, Altar, Lectern, steps, piano area, or choir areas individually
- Several dimmable and AC power receptacles will be provided around platform for special needs (i.e. Christmas lights, smoke machine, drama lighting)
- Church electrical system will need to be upgraded to support additional lighting (Note: This can end up being a large expense)
- Locations of lighting fixtures will be chosen to:
 - Minimize glare in people's eyes
 - Provide uniform, shadow free coverage
 - Minimize visibility of lighting fixtures
 - Provide easy access to all fixtures for aiming and bulb and gel replacement

NOTE: Every can will have to have a controlled power source (ie dimmer pack).

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23. Video Projection

In times past (and still present in some sense), the overhead projector was the vehicle for visual display. But the overhead was bulky and required a person to stand at the site of the projector, replacing transparencies as needed. This person often had to stand in an comfortable location for the duration of the service. The transparencies were usually hand written and had smudge issues. If transparencies were printed, they were commonly printed using inkjets or dot matrices because they would be reusable and the laser-jet transparencies were much more expensive. The storage of these transparencies was complicated and many were destroyed in the process of recovering them. The light and the heat would cause the printed, more dependable, transparencies to fade and be discolored. If your church is using transparencies, strongly consider making the investment into a video projection system.

The use of video projection in a church service provides several advantages to the quality of the communication of the service (and to the reception of it)

- It helps with engaging the congregation
- It allows for smoother transitions
- It provides the ability to kill dead time
- It allows for visual stimuli to enhance the verbal communication
- It minimizes the need for routine announcements saving valuable time
- It accommodates those in service who might be new
- It frees up the hands of the worshipers
- It allows choirs to put down the books and see the lyrics of the songs above and behind the congregation
- It allows musicians to go “paper-free”
- It is a much more efficient process than the overhead projector
- It allows for the integration of video media
- It allows for more variance within the service format
- It allows for more variance concerning the planning congregational times of fellowship
- It allows for a very large amount of data to be retrieved, used, and stored with little effort
- It limits the need for operators of the system and allows them to be more strategically (and discreetly) located.

The most common (and practical) uses of video projection are:

- Projecting the lyrics of the songs for the congregation
- Projection some form of outline of the sermon along with Scripture verses

Computer Equipment / Song Words

- If a video projection system is employed, then it is strongly recommended (and almost necessary) to have a computer as the main feeder of your video system.
- With a computer you can add:
 - Song words
 - Sermon notes
 - Bulletin Announcements
 - Notification to parents to come to their child's class room
 - PowerPoint slide presentations
 - Video clips (stored on computer)
 - Video played from the computer's DVD player
 - Graphics or scanned photographs
 - . . . your imagination is the only limit!
- There are a several programs you can use on your computer to present the items listed above. Some that I have used are:
 - Media Shout (My Favorite)
 - Microsoft PowerPoint
 - Sunday Service
 - Easy Worship
 - Song Show Plus

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- PowerPoint has a lot of capabilities and is an industry standard, but it is not very user friendly when it comes to keeping a catalog of all your songs and letting you easily assemble the song list for a particular service.
- When preparing your song word or sermon note slides, be sure to use an easy to read font (e.g. Arial) and make it BIG! Keep in mind that not everyone's eyes are as good as yours. Put one of your slides on the screen, get someone who's eyes are not real good, and have them move around the room and tell you how well they are able to read the slide.
- Usually, a slide should contain 4 to 8 lines of text. I think using upper and lower case makes it easier to read than all upper case. Choose the color of your text carefully and look at on the screen to see how well it shows up. Keep your background rather plain, but textures do make the background much more interesting. Use light colored text with a dark background or dark text with a light background. Maybe use a different background for each song. A FEW graphics emphasizing the message of the song may be helpful.
- You will probably find it works best if you keep the words for each song in a separate file. Work with the Music Director and see that you put the verses and chorus in the right order. Make a separate slide for each time the chorus is sung - don't expect the computer operator to page back to the first chorus each time.
- If you want to show sermon notes on the video screen, there are a lot of very good Bible programs out there that can make it easier to import Bible quotes into your slides. Some of these programs contain illustrations and maps too!
- Keep in mind that there are Copy Right issues to be dealt with when you show song words on a screen, but that is beyond the scope of this article (talk to your Music Director).
- Assuming you are using consumer grade equipment, you will need a computer which supports "composite video output" or an external "scan converter" to make the computer's VGA or SVGA video compatible with your other equipment which uses either composite video (the RCA jacks you see on the back of any DVD) or S-video (a small multi-pin plug found on Hi8 and DVD Camcorders and DVDs).
- If you use semi-pro equipment, your video projector may be able to directly accept an SVGA signal from the computer (but you will need some high grade special cable to get it to the video projector). If you connect the computer directly to the video projector, then the computer probably won't be going through the video mixer and probably won't be recorded on the tape of the service. This may be good if you want the tape to show the choir rather than the song words. It may be bad if you want the tape to show the sermon notes.

Video Projector vs LCD Screen

- When the decision is made to install video in a Church, two things must be considered initially:
 - 1) The best location for the screen(s)
 - 2) The location of the video projector be located.

NOTE: You must also decide what size the screen should be, what type of screen surface, and what type of video projector to use.

- LCD screens are excellent vehicles for projecting video in smaller areas (corners, under balconies, etc)
- Here is a list of some things to be taken into consideration:
 - Does the placement of the screen destroy the beauty of the Sanctuary?
 - Can one screen be seen by everyone in the congregation or are two or more screens needed?
 - Should the screen be fixed and permanent or a motorized roll-down screen?
 - What kind of surface should the screen have? (there are lots of choices here and it makes a BIG difference)
 - Do you have an appropriate place to mount the video projector? Is it at the right height and right distance from the screen? (the video projector has to be a certain distance from the screen and even with either the top edge or bottom edge of the screen)
 - Should you use rear projection, front projection, self-contained big screen TV, or tube-type TV screens? (rear projection should be your first choice)

NOTE: Rear projection requires a room or some form of space behind the screen. Smaller church buildings generally do NOT have this capability.

- Should you use LCD or "3-gun" type video projector?
- Is the area where you intend to put the screen dark enough? Do any lights shine on the screen? Can they be turned off? Do any windows allow light to shine on or through the screen? Can anything be done about that?

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- If your Church is brightly lit by sun shining through the windows, a video projector may not be bright enough. - - Try before you buy! Most places that sell video projectors will setup a demonstration in your Church BEFORE you buy!
- How big should the screen be? Images of people shown on the screen should be bigger than life. People in the back need to be able to see images and song words clearly - even if they don't have 20-20 vision. Keep in mind, not everyone sees as well as you do!
- Is it possible to run power and video cables to where they are needed?
- Can the video projector be accessed for repair?
- Video Switches: at a minimum you will need a video switcher to allow you to simultaneously employ several video sources (i.e.: media projection while video clip is on hold). Video switches allow for several inputs to be sent to multiple receivers. But they do not allow the transition between signals to be smooth. Video switches generally have a short life.
- Video Mixer: Allows the video person to smoothly transition (fade) between video sources. Video mixers are much more costly than Video Switcher but last much longer.

NOTE: For some examples of video control components, see APPENDIX K

- Video Cables: There are basically three types of video cables: RCA, S-Cable, and VGA. They can all be ordered in length via computer stores or internet sources BUT the VGA signal is the strongest, highest quality, longest lasting, and, of course, the most expensive.

A good source of video projection equipment is SweetWater (Appendix L).

NOTE: When choosing a projection system, consider the mounting of the projector or the LCD display. In smaller or older church buildings, framing for the mounts is most probably not available. This will affect the mounting process. Typically, a 3 chained platform will allow you to make use out of awkwardly spaced ceiling studs, rafters, or purlins to mount, level, and stabilize a projector. Cross studs can be mounted on the walls for securing LCD mount brackets. BE SURE TO GET A MOUNT THAT IS COMPATABLE to your projection system.

NOTE: PROTECT YOUR INVESTMENT: Projectors require maintenance in order to extend their life to the max. Additionally, the projector bulbs are extremely costly (many cost around \$500.00). It is very important to be sure to never touch the bulb with your hand directly...always use a clean, cloth glove. Any oily or chemical residue on the bulb will cause it to quickly wear. Pay attention to the filter of the projector. Check your owners manual for proper filter maintenance.

NOTE: Be careful to allow a video projector at least 4 hours to cool of before servicing!!! The bulb is extremely hot.

NOTE: For a simple schematic to follow concerning the setting up of a video system as well as tying it into the main sound system, see APPENDIX L.

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24. Entry Level Video for Churches

a) Introduction

- This section of the A/V Training Manual deals with Video in the Church. It is written from the prospective of the experience I gained in researching, specifying, ordering, installing, and operating an "Entry Level Video System".
- If your Church seats more than 500, then I strongly recommend that you use ALL semi-pro grade equipment or better and that you get a qualified Video Contractor to install everything.

b) Reasons for Video in the Church

- If your Church is considering installing Video, there are those who will oppose installation of Video. Some of their reasons to oppose Video in the Church will include:
 - seeing no need for more "technology" in the Church
 - thinking that video will be distracting
 - believing that video screens will ruin the beauty of the Sanctuary
 - resisting change - want to "keep doing it like we always did"

Members of your Church will certainly have other reasons why they don't want video!

- Reasons for installing Video are:
 - to show the Pastor during the Sermon
 - to show video announcements
 - to show close-ups of children during their performance
 - to allow the Choir (who face the back of the Pastor) to see the Pastor's face during the Sermon
 - to allow Ushers and overflow crowd in the to watch the service
 - to allow people in the back of the Church or balcony to see the service more clearly
 - to record the Service for archive, duplication, and distribution
 - to record Weddings, Baptisms, and special events
 - to show videos of Missionaries, Church functions, promote upcoming events, etc.
 - to replace the current overhead projector or slide projector you are using now with "state of the art" technology
- There are other purposes that Video in the Church can serve:
 - to show Christian videos to Youth Groups
 - to have a family "Movie Night"
 - to record congregational meetings
 - to allow Sunday School teachers to take home a video of the service
 - to provide a better view of the service in the Cry room
 - to show the service in an Overflow room on occasions such as Easter and Christmas
 - to show the service on community Cable TV
- Please keep in mind that it is NOT always appropriate to use video in a Church. The congregation may feel uncomfortable if you show them taking communion on the big screen! Sometimes things that go on in a Church are very personal, spiritual, and private. In these cases, video can be seen as intrusive and offensive. Some examples of events that may be better without the aid of video might include:
 - a funeral
 - a prayer meeting
 - an altar call
 - a healing service
 - communion

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- After reading this manual, visit some other Churches in your area that are currently making use of video. Look to see what kind of screen and projector they use. Look for their camera locations and what types of cameras they use. Check out their video mixer. Ask them if they videotape the service. Ask if they sell copies - (buy a copy!). Ask them about their successes and their problems. Ask them if they used a professional Video Contractor (and get the name of the contractor).

c) What Grade of Equipment is Best for Your Church?

- Basically, the bottom line question this all comes down to is: Are you going to use consumer grade video equipment, semi-professional grade equipment, or Network Television grade equipment? For a few thousand dollars, you can install consumer grade. For a few tens of thousands of dollars you can install semi-professional grade. For a few hundreds of thousands of dollars (or more) you can install Network Television grade video equipment.
- Usually, the size of your Church will be the greatest factor in determining what grade of equipment you should use (or can afford). A small Church of less than 200 people is likely to only be able to afford consumer grade equipment. A medium size Church of 200 to 500 people may have the option of using either consumer or semi-pro equipment. A large church of 500 people or more should use at least semi-pro equipment and possibly Network grade equipment if they ever plan to have their service aired on public TV.
- As with anything else, you get what you pay for in video equipment. There is a noticeable difference in quality and in capabilities between consumer grade equipment and semi-pro equipment. I think there is a less noticeable difference in quality and capabilities between semi-pro and Network Television grade equipment.
- As I stated back in the intro to this section, this manual deals with an "Entry Level Video System" and as such assumes that all consumer grade equipment will be used.
- In one way, Video is much like "chain". A chain is only as good as its weakest link. Similarly, video is only as good as its weakest component. What this really means is that ALL of your equipment should be of similar grade.

d) Video Cameras

- There are three basic things to determine when considering video cameras:
 - How many cameras are needed to cover your Church service and other activities you want to video?
 - Where should the camera(s) be placed?
 - What type of camera is best for each application or location?
- If your video system is going to be very basic, you may only need one camera. With one camera, you could videotape the service for shut-ins or Sunday School teachers. You could show a close-up of the Pastor during the service. You could video other portions of the service, but with only one camera, it is difficult to make a graceful transition from one area to another (e.g. Choir to Pastor).
- If you are more "serious" about video, you really need more than one camera! As a minimum, you should have one camera for the "wide shots" and one camera for "close-ups". But keep in mind, multiple cameras REQUIRES a Video Mixer!
- If you want to go farther, you may want to consider cameras for some of the following:
 - The wide view of the whole front of the Sanctuary
 - Close-up of the Pastor
 - Medium view of the Pastor
 - Separate cameras for the Pulpit, Altar, and Lectern areas
 - One or more cameras for the choir
 - View of the organist or choir director
 - Front view of the Pastor when he is facing away from the congregation
 - View of the congregation
 - Center aisle Procession (from the front)
 - Center aisle Recession (from the back)
 - Hand held camera that can be moved around as needed (but this may be distracting)
- Assuming you have now decided how many cameras you want, now you have to decide where to put them.

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- If you've ever been to a Television Studio to watch the "shooting" of a program, you have undoubtedly noticed the cameras: they are large, ugly, and usually block your view of the show. This is hardly appropriate for a Church. However, with today's technology, a good camera does not have to be large or ugly and it does not have to block people's view.
- With a powerful telephoto lens, a camera can often be located in the back of the room, rather than the front. If you get a remote control camera, it can be located almost anywhere and the camera operator can be in the back of the room or even another room.
- Here are a few things to consider when deciding where to locate your camera(s):
 - Usually you can place at least one of your cameras at the sound booth. You may want to put two cameras at the sound booth, one for wide shots and one for close-ups. With the camera operator in the sound booth, they may be able to help with additional jobs (e.g. video mixing, lighting, sound, or computer slides).
 - When a camera is located in the back of the room, be sure it is high enough that its view won't be blocked when people stand up.
 - Balconies are another great place to put a video camera.
 - A camera located near the front at the side aisle may get a nice profile view. A remote control camera would be best here. Look for a place to mount it where the structure of the Church hides the camera from most of the congregation.
 - A remote control camera located behind the Altar and off to one side is good for getting faces of people when they turn away from the congregation (e.g. the Bride's face) and you may also be able to get a view of the congregation. If the location is selected carefully, this same camera may be able to get the organist's hands.
 - Be careful when mounting a camera very high up. It may give an unflattering view of people if it is aimed down at too steep an angle.
 - Try to avoid placing a camera, a large tripod, and a camera operator down front in the middle of the Church. The distraction this causes is not appropriate for a Church service. With the cost effective remote control equipment available today, there should be no need to place camera operators in the middle of the congregation.
 - Although most people don't notice the difference, a picture shot from a camera that is 20 feet from the subject has more "depth" to it than one shot with a telephoto lens from 100 feet away. It is also easier to keep a camera steady when it you are closer to the subject. For these reasons, it would be desirable to have your "Pastor camera" near the front.
 - Keep in mind that you are doing video in a Sanctuary. Priority should be placed on making the video cameras and operators as unnoticeable as possible. Remote control cameras serve this goal best!
- Now that you have decided how many cameras and where they will be located, you need to decide what kind of cameras to use.
- Again, I need to remind you that I am writing from the perspective of an "Entry Level Video System". That means that I am only considering consumer grade equipment. If your budget allows you to consider semi-pro or higher-grade equipment, they your choices will be much more numerous.
- There are three basic categories of cameras to consider:
 - 1) cameras directly controlled by a camera operator,
 - 2) remote control cameras, and
 - 3) fixed cameras.
- First, let's discuss cameras controlled by an operator:
 - Probably the most cost effective cameras are consumer grade Camcorders. These cameras have a built in video recorder. Depending on the camera, the tape format may be DVD, miniDVD, 8MM, Hi8, or Digital (with several different formats). There are literally hundreds of different models available with a wide assortment of features.
 - If you are only using a single camera and you are video recording the service then it may be important to you what format the Camcorder uses. If you want to be able to immediately give the video to ONE person, DVD is best because they can play it at home. If you plan to copy the video and give it to several people, then, if not recording to DVD, you should be sure you have the capability to convert the video from whatever format your video recorder uses to DVD format.

NOTE: Hardware is available to quickly convert the media types to DVD in most cases. If the hardware has not been acquired, the only other method is to play the media into an input channel on the DVR and record (minute for minute). This

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process is long and tedious. **IT IS IMPORTANT that the person operating the equipment be there when the video is completed or the DVD will record dead time.**

- If you are using multiple cameras, then you will need to use a Video Mixer and an external Video Recorder. You will not be recording directly to the Camcorder, so the format of the video makes little difference. However, DVD, miniDVD, Hi8, and Digital Camcorders are smaller and do produce a better quality image.
- If you are placing one or more cameras at the sound booth location, you should select cameras that have a good OPTICAL zoom lens and a LARGE flip-out viewfinder.
- Be careful to check the OPTICAL zoom ratio, not the DIGITAL zoom ratio. For example a camera may have a 360/1 DIGITAL zoom ratio, but only a 12/1 OPTICAL zoom. When you go beyond the OPTICAL zoom to the DIGITAL zoom, the picture will begin to get "grainy" or look like mosaic tile.
- Cameras with a LARGE flip-out viewfinder are much more comfortable to use than cameras where you have to put your eye up against the viewfinder. You can also install a video monitor next to the camera for the camera operator to watch, but this should not be necessary with a LARGE flip-out viewfinder.
- Keep in mind that in order to use a separate video monitor with the camera, you will need a video amplifier (so you don't double terminate the video signal).
- The white balance capability of the camera is also very important. Most Camcorders have automatic white balance, but when you are using several cameras and they don't all automatically balance the same. For us, this has been a problem we have not solved. Many cameras have several different modes of white balance. Some cameras have ability to manually set white balance, but you need to know what you are doing, and it takes time every time you power-up.
- All Camcorders have auto-focus, but some auto-focus systems work a lot better than others. We have had some trouble with auto-focus (e.g. on a white or black robe) and sometimes find it works better if you set the camera for manual focus.
- "Steady-Shot" is another good feature to have.
- Don't forget that you will also need a tripod for each operator-controlled camera. There are lots of different kinds of tripods and you need to make sure you get a tripod designed for video cameras. It needs to have enough weight to be steady. It should have a long handle with a movement that is SMOOTH (no jerking) and EASY, yet holds the camera solid (no drooping). A good tripod is worth the money. Don't skimp here!
- Second, let's consider remote control cameras:
 - For remote control cameras, a Camcorder is NOT suitable. Generally, you cannot control the zoom and focus of a Camcorder remotely.
 - Security Cameras are probably your most cost effective source for remote controlled cameras.
 - Generally, a remote controlled camera is purchased as several separate units: the camera, the remote control zoom lens, the motorized pan-tilt unit, a mounting bracket, and the joy-stick remote control unit.
 - Some joystick remote control units are capable of controlling multiple cameras and some have multiple memories that can be programmed with frequently used "shots" (e.g. Pulpit, Altar, and Lectern).
 - You also need a video monitor at the operator's location for each remote control camera.
 - Variable speed zoom and "smooth" variable speed pan-tilt are important features.
 - The joystick remote control unit should be located near the video mixer so that the operators of both can communicate well (and maybe share the same video monitors).
- Third, we'll consider fixed or stationary cameras:
 - There are relatively few uses for a fixed or stationary camera (e.g. for the organist or the wide shot of the whole Church) because in most cases your subject is moving, at least to some degree.
 - A Camcorder may be used as a fixed camera, but you might have problems with color balance, especially if the color balance returns to the default setting on power-up.
 - It is better to use a Security Camera for a fixed camera. They either maintain their color balance or have the ability to set it remotely.
- When connecting your cameras to the other equipment, keep in mind that the output from a camera will only drive ONE other device. For example, if the output of the camera goes to the video mixer, you cannot use a simple splitter add on a TV

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monitor. Doing so will degrade (overload) the video signal causing it to be much darker and probably changing the color balance. To add a TV monitor, you MUST use a multi-output video amplifier.

- Similarly, if you have a long video cable run (e.g. more than 25 feet) between your camera and your video mixer, you will need a video amplifier. It is preferable to locate the video amplifier near the camera so the signal is amplified before going through the long cable rather than putting it near the video mixer.
- Be warned! Low cost video amplifiers sometimes give correspondingly low performance. They may add noise to the signal or fail after a shorter than expected time. (I know this from experience!)
- If you just can't figure out a way to run a video cable between the desired location of a camera and the video mixer, you could try using a video transmitter / receiver. There are a few companies that now make cost effective video transmitter / receiver units that work just like an FM mic over about the same distance. At Advent, we use one of these units when we need to put a camera behind the Altar. The quality isn't perfect, but it is acceptable for our needs.
- Although consumer grade video cameras can provide good quality pictures (considering the cost of the camera), there is sometimes a noticeable problem with white balance on these cameras. Often they have several modes of white balance, so you need to select the correct mode for your Church's lighting. If you use a Camcorder as a remote stationary camera and you power it up/down with the rest of the equipment, it may not power back up in the same white balance mode - this could be a PROBLEM! Differences in white balance between different cameras may be especially noticeable if you use several different camera models or brands.

e) Video Mixing

- Now you're ready! You got lots of cameras, DVD players...you even got a computer, but how do you get all this video "stuff" mixed together into one program? You need to use your Video Mixer (previous chapter)!

f) Video Recorders / Players

- You will probably want to have at least two video recorders (DVR) connected to your system, one for recording and one for playback. It is possible to get away with one DVR for both, but then you can't record a service that contains a video playback.
- Video Playback: Probably a standard DVD unit will do for the playback DVR. Most videos you will be asked to play are DVD.
- Video Recording: You may want to give more thought to what type of DVR you use for recording. Who will be watching tapes recorded at your Church? Will you be selling copies of the tapes? If you are just going to make ONE tape and do not expect to copy it, then a DVD unit will do. If you want to copy the tapes, then you should consider S-VHS, Hi8, or Digital because these formats will allow you to produce a better quality VHS copy. My #1 requirement for a video record deck is that it have sound level meters. It is the only way you can get a good consistent sound level on the videotape and avoid distortion.
- Computer Recording: Due to the advances in tech, it is very practical to record high quality video directly to the hard drive. With storage media being as large as it is in small packages, there is almost a limitless amount of storage ability along with the stopping of needless usage of DVD's until ordered. Additionally, recording to a computer's hard drive allows for much easier editing.
- It is a good idea to have additional LCD monitors (with sound) monitoring the various media devices.
- No matter which video tape format you choose for your record videa, make sure the video has sound level meters so that you can tell when you are recording sound and whether or not the level is correct. Keeping a close eye (or ear) on the video sound level is critical to making good video recordings. Video recordings will not tolerate nearly as large a change in volume as the house sound system will tolerate. Remember, video is not just picture, it is sound too!

g) Video with Style!

- So what do I mean by "Video with Style"? I mean the difference between just doing video and doing it right. It is important when doing video in a Church that it add to the service rather than subtract from it. Technology should never be a source of distraction. Video done wrong can be VERY distracting.
- Smooth: One of the most important aspects of video is SMOOOOOOTH camera work. The slightest jerkiness is easily noticeable and very distracting. The two things that contribute most to smooth camera work are a good heavy video camera tripod and a steady hand. Having the camera relatively close to the subject minimizes the amount you have to zoom in and that also makes the picture steadier.
- Framing: Learning how to properly frame the picture is important. If you are showing the Pastor during the sermon, the image of the Pastor's face on the screen should be bigger than life. The video screen should allow people in the back to clearly see the expression on the Pastor's face. This means that you should use an upper body shot - showing just the head and

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chest, having the Pastor's mouth in the center of the picture. If your Pastor stands still at the Pulpit to preach, this may be easy enough to do, but if your Pastor (like ours) constantly walks around while preaching, the camera operator may have great difficulty following the Pastor around yet keeping the picture smooth. In this case, a somewhat wider shot may be necessary.

- **Zoom:** A zoom lens on a video camera is absolutely essential, but it should seldom be used on the "live" camera. Zoom in or out to get the picture framed the way you want it BEFORE switching to that camera. Occasionally zooming on the "live" camera may produce a nice effect (such as zooming out from the organist's hands to show the whole organ console and organist), but keep "live" zooms to a minimum. Be especially careful of a "live" zoom-in because the camera will lose focus for a moment on a zoom-in. Multiple cameras to switch between allows you to zoom when the camera is not "live".
- **Background:** Often the camera operator is so focused on watching their subject (e.g. the Pastor) that they don't notice what's in the background of the picture. Catching a yawning acolyte or a sleeping choir member behind the Pastor can be embarrassing. When choosing the location(s) for your camera(s), it is important to look carefully at what will be in the background. If the background will be distracting, consider choosing an alternative camera location or move something (or someone) so that the background does not contain distractions. Be careful that the background does not contain lights or windows that will show up as bright spots on the video.
- **What's Next:** Both the camera operators and the video mixer operator need to know the "flow" of your Church's service. They need to know what is going to happen next so they can anticipate and have the next shot already zoomed and framed BEFORE switching to that camera. The video crew needs to know things like: the announcements will be read from the floor, the scripture lessons will be read from the Lectern, the Pastor will start the sermon from the Pulpit and then walk all over the front platform, there are five slides with sermon notes and there is a queue sheet telling you what the pastor will say just before you are to show a sermon note slide, the choir will sing immediately after the sermon and the words are on the computer, but you need to show the organist hands during a fancy interlude between the first two verses, and show Suzzie when she sings a solo on the last verse.
- **Titling:** If you are recording video to tape, you may want to use the computer to insert a title slide or two at the beginning of the video giving the name of the church, date, Pastor's name, and the sermon title. It is a good idea to record the title slides before the service starts. Another title slide or credits slide at the end of the video makes it look more professional.

h) The Video Crew

- **Camera Operator:** A GOOD camera operator is the MOST important factor in successful Church video. You can have a million dollars worth of video equipment, but if you don't have a GOOD camera operator, your video will detract from the service, not add to it. Trust me, I know! It takes TALENT to be a GOOD camera operator - just like it takes talent to play an instrument or to sing. Just because you once took a picture with a Polaroid camera does not make you a video camera operator! It takes unrelenting concentration (look away for a second and that's when your subject will decide to move), an eye proper framing of each scene, knowing exactly how far to zoom in, getting close when facial expressions are important, getting a wider shot when body movement is important, knowing what should be in the center of the picture, keeping an eye out for distracting backgrounds, anticipating when the subject will move and following movement SMOOTHLY, and anticipating the next shot and having it ready.
- **Video Mixer:** The second most important factor in successful Church video is a GOOD video mixer operator. Just like a camera operator, a GOOD video mixer needs TALENT. Again it takes unrelenting concentration, the ability to watch multiple video monitors simultaneously and instantly decide which picture is best at any given moment, a feel for timing - when is the right time to change to the next shot, planning to have the right camera free to get the next shot, and anticipation to know what shot is needed next. The video mixer operator may also have to operate the computer for song words and/or sermon notes. The video mixer operator must also keep in mind that this is a Church, not a music video, and transitions from one camera to another should be kept discrete and subtle. Just because your video mixer has 200 different types of transitions does not mean you have to use them all! You probably won't find more than 3 or 4 that are suitable for a Church service.
- **Calling the Shots:** You need good communication between your camera operator(s) and the person operating the video mixer. It is possible for one person to operate several video cameras and the video mixer (all at one location) - I know, I've done it, but it can drive you crazy, and mistakes happen more frequently. It is much better to have a person operating each camera and another operating the video mixer. However, in order to do this successfully, you really need an intercom system. Generally the person operating the video switcher calls the shots. That person tells the camera operators which camera is currently "live" and what shot is needed next. To minimize distractions, the camera operators should not talk. It works even better if another person "calls the shots", preferably from another room so that the congregation will not hear them. It is essential that the person "calling the shots" know what is going to happen next - that means they MUST talk to the Pastor and to the Music Director BEFORE the service.

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- **Video Sound:** If you are only using video for big-screens in the Church, then you don't need video sound. However, if you are showing video in the cry-room, narthex, overflow room, or recording it on tape, then you need sound to go with it. In most small to medium size churches, the best source for video sound is the house audio mixer. However, the person mixing sound for the house may not include things that are important for the video. For example, the house sound mix generally does not include the organ and may not include other instruments such as bass guitar and drums. The house sound mix does not include the congregation singing and it does not include an "ambience" mike to pick up things like laughter and applause. In order to do video sound RIGHT, you need a separate mix. You need to add in the missing sounds. The simplest way to do this is to set up your house mixer for pseudo-stereo operation; that is, use the left channel out of the house mixer to drive the house sound and use the right channel to drive the video sound. You will need to add other inputs to the house mixer to add organ, bass, drums, and congregation ambience. These additional sources should be "panned" all the way to the right. That will keep them out of the house mix, but put them in the video mix.
- **Video Sound Level:** Getting the correct sound level for videotape is much more difficult than getting the correct sound level for the house mix. If you record the sound level too low, then when people watch the tape, they have to turn up their TV volume. If you record the sound level too high, it WILL distort! The best way to monitor the video sound level is to use a video recorder with sound level meters. Basically there are two ways to get it right - either watch it real carefully and make adjustments, or install a compressor between the mixer and the video recorder. When properly set, the compressor will reduce the volume of loud passages enough to prevent distortion.
- **White Balance:** Before each service, check the white balance of each of your cameras. If you are using architectural or stage lighting, then your cameras should probably be set for tungsten light. If you have an area of white wall lighted by white lights, you can aim all the cameras at it and then switch back and forth between them to see if the color stays about the same. If not, follow the camera's instructions to set the white balance.
- **Test the Equipment:** Before each service, test everything. See that all the cameras are working, check the white balance, see that the big screen is working, switch to the computer and see that it is working, check sound levels on the video recorder, and record a few minutes of tape and play it back to make sure the picture is clear (no noise) and the sound is good.

i) Trouble Shooting

- **You get what you pay for.** If you have purchased consumer grade video equipment (as we did), then you can expect to have some problems. If you are able to afford semi-pro equipment installed by a professional video contractor, then you should expect less problems (theoretically speaking).
- **Noise:** One of the most difficult problem has been noise in the video signal. I think it is caused by using low cost / low quality video line amplifiers and the fact that our wiring plant required connecting three video amplifiers in series (not a good thing to do!). I expect that if we upgraded our video amplifiers it would solve our problem (but we haven't don it yet). The amplifiers we are using are only able to drive one video monitor from each output. The output of our video mixer feeds a four output video amplifier. That first video amplifier feeds the record video deck, the narthex big screen, and two more video amplifiers for the left and right sides of the Church. The left and right side amplifiers each feed three video monitors (balcony, back, and middle) and another video amplifier that then feeds two more video monitors (front and choir). The "live" monitor for the video mix position is fed by the output of the video record deck. If you are able to use one or two big screens in your Church, your video wiring will be a lot simpler!
- **Multiple Terminations:** Video signals are much more particular about multiple terminations than audio signals. If you "double terminate" a video signal, it will make the picture much darker. Normally, each video output can only drive ONE other device. If you need to drive multiple devices, you will need a video amplifier.
- **More Noise:** Sometimes when the video signal gets noisy, it is because two pieces of equipment are too close together. The computer may be too close to the video mixer - solution, put the computer on the floor (if it's a tower system). The video amplifier may be too close a video monitor - solution, raise the video monitor. Another thing to watch for as a cause of video problems is ground loops. If you end up passing a ground current through a video cable, it is likely to cause noise. The best way to avoid ground loops is to plug ALL the equipment into the same electric feed (see Ch 21). A likely source for ground problems is the audio sound source from the audio mixer. If the audio system is powered from a different outlet than the video system, a ground loop may occur.

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Appendix A: Microphones



Shure SM-58
Cardioid Dynamic
Vocal



EV ND767a
Cardioid Dynamic
Vocal



Shure SM-57
Cardioid Dynamic Mic
Instrumental



Sennheiser e935
Cardioid Dynamic Mic
Vocal



Shure BETA 58
Supercardioid Dynamic



Shure BETA 87a
SuperCardioid Condenser



Sennheiser e945
SuperCardioid Condenser



AKG D5
SuperCardioid Condenser



Shure PGX Wireless



Shure SLX Wireless



ATW 3192b Headset System



Shure ULX WH30 Headset



ATW 3131b



Sennheiser ew 110 G3 Lapel



AKG C 520 Headset



AKG BP892C Discrete Mic

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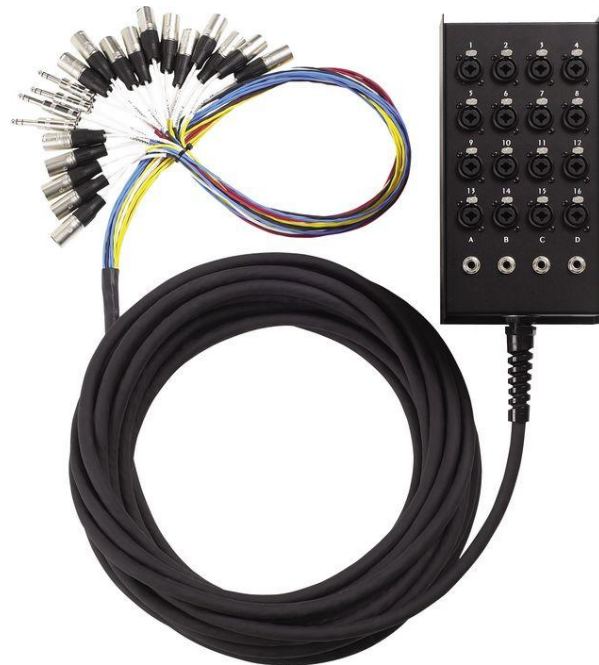
Appendix B: Snakes



Stage Master Snake 100ft 16/4



Horizon Snake 50ft 16/4



Advantage Snake 50ft 16/4

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Appendix C: Examples of Mixers



Allen and Heath GL2400
6 Aux 4 Bus Mono/Stereo



PEAVEY S-32
6 Aux 4 Bus Stereo

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Mackie SR40*8 mixer
8 Aux 8 bus, per-channel metering

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(MASTER SECTION)
Allen and Heath GL3300

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PreSonus Studio Live 24.4.2
Fully Digital Mixer



TASCAM DM-4800 DMC
Fully Digital Mixer

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TOFT ATB-32A
8 Aux 8 Bus



Allen and Heath ZED
USB Capable Digitally Integrated Mixer
6 Aux 4 Bus Mono/Stereo



Yamaha IM8-32
8 Aux 8 Bus

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Behringer SX3242FX Eurodesk
2 Aux 4 Bus 2 FX



Yamaha EMX 5016CF
Powered Mixer 500watts/channel

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Mackie PPM 1012
Powered Mixer 1000watts/channel



Peavey XR 8600D
Powered Mixer

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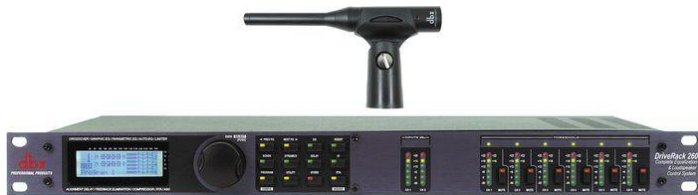
Appendix D: Examples of Equalizers and Signal Processors



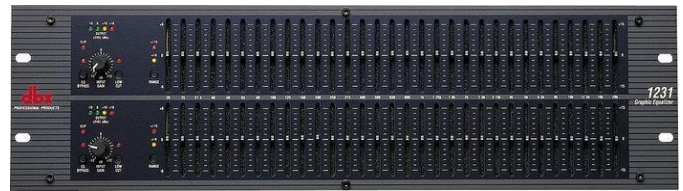
Peavey Q-431FM 31-band EQ with feedback finder lights



Peavey Q-431FM 31-band EQ with feedback finder lights



DBX Driverack 260 digital self-monitoring EQ



DBX 1231 Basic 31-band EQ



DBX iEQ15 Dual 15-band EQ



EL Parametric EQ

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Appendix E: Amplifiers



Crown XTI 4000



Peavey IPR-3000



QSC PLX 3602



Behringer A500



CROWN XLS 2500

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Appendix F: Examples of Speaker Cabinets



JBL VRX932LA
Freq Rng 57Hz-20kHz
Peak 3200W,132dB, 100x15deg cvg pattern



PEAVEY EU 112 (Main/Monitor) Mid-Range
Freq Rng 89Hz-18kHz
Peak 1600W,124dB, 84x53deg cvg pattern



JBL MRX515 Mid-Range
Freq Rng 52Hz-20kHz
Peak 1600W,130dB, 70x70deg cvg pattern



PEAVEY EU 115 Mid-Range
Freq Rng 65Hz-18kHz
Peak 1800W,125dB, 89x50deg cvg pattern



JBL MRX518S Sub-woofer
Freq Rng 40Hz-200Hz
Peak 2000W,100dB,



PEAVEY SP 118 Sub-woofer
Freq Rng 49Hz-300Hz
Peak 1200W,98dB



Typical Back Plate
NOTICE: ¼ in AND Neutrik Speakon

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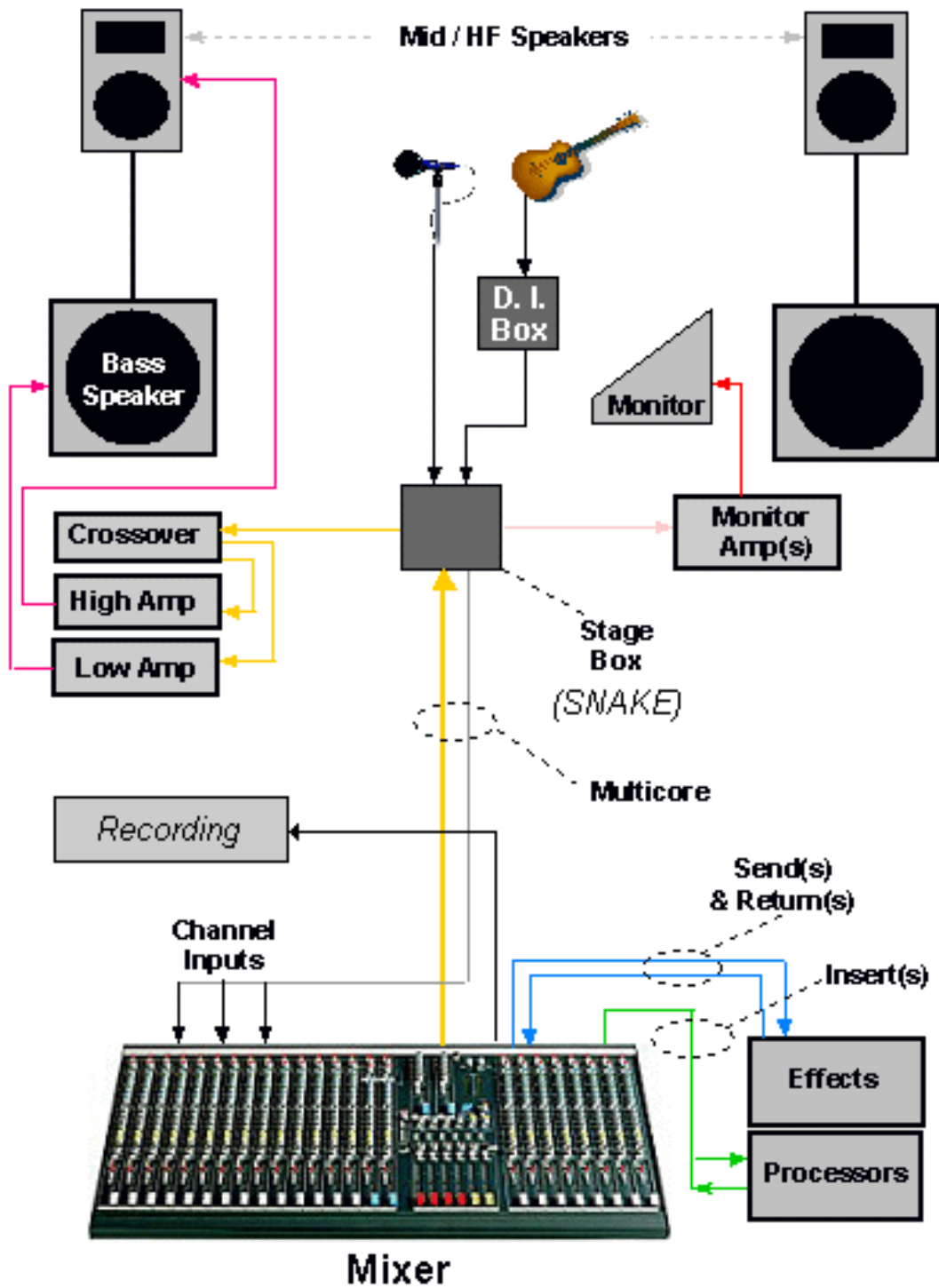
Appendix G: AVIOM Monitor System Components



Aviom M-1 Mixer Microphone Stand Mount

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Appendix H: Basic Sound System Schematic



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Appendix I: Basic Light Systems



Elation Stage Setter 8
16 Channel Light Controller



Sample Lighting Electrical Components required for operation
Control Unit, Dimmer Packs, XLR wires

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IntroLighting Package available through www.musiciansfriend.com



Elation Show Designer 2
Intelligent Light Controller

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Appendix J: Simple Starter/Mobile Systems



Yamaha EMX Package w monitors



PEAVEY XR Package



Yamaha EMX Package with JBL JRX

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Appendix K: Video Components



Edirol LVS-400 Video Mixer/Switcher



Shinybow Video Switcher

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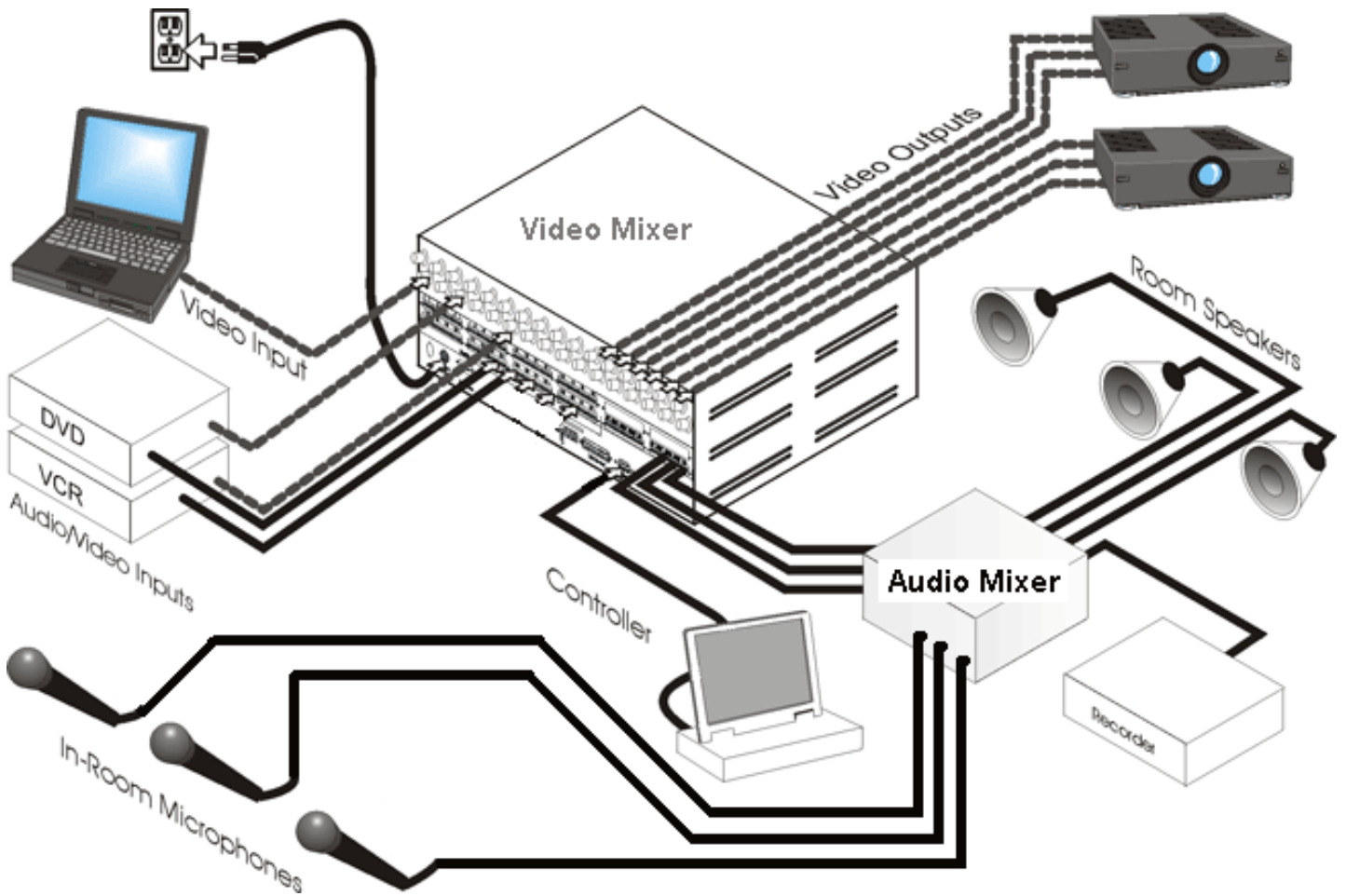
Pioneer SVM-1000



TriCaster Studio

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Appendix L: Basic Video Schematic



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Appendix M: Connectors Named



From Top left to bottom right

Top Row: Neutrik Male, 1/4 TRS Male, Neutrik Female, Video RCA Female, Audio RCA Female, Neutrik Female

Bottom Row: Video Male, XLR Male, Audio RCA Male, 1/4 TS (mono), XLR Female

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Appendix N: Recommended Gear

I believe it would be a great error to not pass on the gear I have had great experiences with:

Instruments

Guitars – Martin, Gibson, Fender, Guild, Epiphone, Jackson, Ibanez, Taylor

Keyboards – Roland Fantom, Korg, Yamaha Motif, Ensonic, Kurzweil, Alesis

Drums – Mapex, Pearl, Yamaha, Roland

Amps – Peavey, Fender, Marshall, Mesa Boogie, David Eden, Hartke

Processors – Boss GT Series, Roland, Line6

Sound Boards

Allen and Heath, Soundcraft, Yamaha, Peavey, Mackie

Cabs

JBL, Yorkville, Mackie, EAW, Yamaha, Peavey, CGM (Monitors), EV

Amps

Crown, QSC, Peavey

EQ's

DBX, Peavey

Effects

Alesis

Sound, Light, and Video Links

Below, you will find a variety of links to Sound, Lighting, and Video resources separated by category and quality. Enjoy!

Sound Audio

High Quality

- AKG Acoustics (<http://www.ake-acoustics.com/>) - microphones
- Allen & Heath (<http://www.allen-heath.co.uk/>) – professional grade mixing consoles
- Audio-Technica (<http://www.audiotechnica.com/>) – wireless microphones (discrete)
- Crown International Inc. (<http://www.crownaudio.com/>) – professional grade amplifiers
- DBX (<http://www.dbx.com>) – EQ's and signal processors
- EAW (<http://www.eaw.com>) – professional grade speaker systems
- Electro-Voice (EV) (<http://www.electrovoice.com/>) - microphones, speakers, etc.
- JBL (<http://www.jblpro.com/>) - professional grade speaker systems
- Lexicon (<http://www.lexicon.com/>) - digital audio processing equipment (effects)
- Meyer Sound Labs (<http://www.meyersound.com/>) - professional loudspeakers systems
- Roland (<http://www.rolandus.com/>) – keyboards, guitar processors, synths, recording DAW's, and more...
- Sennheiser (<http://www.sennheiserusa.com/>) – high quality durable mics microphones
- Shure (<http://www.shure.com/>) – high quality durable microphones
- Soundcraft (<http://www.soundcraft.com>) – professional grade mixing consoles
- Tascam (<http://www.tascam.com>) digital mixers, recording DAW's
- Yamaha (<http://www.yamaha.com/>) - keyboards, guitars, professional grade mixing consoles, powered mixers, etc.

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Economical

- Alesis (<http://alesis.com/>) –keyboards, mixers, signal processing (effects)
- Behringer (<http://www.behringer.de>) – economical mixing consoles
- Ensoniq (<http://www.emu.com/>) – affordable keyboards and synths
- Mackie Designs Inc. (<http://www.mackie.com/>) - quality affordable mixers
- Nady Systems (<http://www.nadywireless.com/>) – super economical wireless microphone systems
- Peavey Electronics (<http://www.peavey.com/>) - rugged sound equipment of all types, mixers, amps, mics, instruments, etc. etc.

Instruments

- BOSS (<http://www.boss.com/>) – guitar processors, recording DAW's, and more
- Epiphone (<http://www.epiphone.com>) – affordable, quality guitars
- Fender Pro Audio (<http://www.fender.com/>) - guitar amplifiers, mixers, and more
- Gibson (<http://www.gibsonusa.com/>) - guitar amplifiers, mixers, and more
- Korg (<http://www.korg.com/>) – keyboards, DAW's and guitar processors
- Kurzweil (<http://www.kurzweilmusicsystems.com/>) – accurate digital piano sounds
- Martin Guitars (<http://www.martinguitar.com>) – quality acoustic guitars
- Roland (<http://www.rolandus.com/>) – keyboards, guitar processors, synths, recording DAW's, and more...
- Taylor (<http://www.taylorguitars.com>) – acoustic guitars

Miscellaneous

- Clear-Com (<http://www.clear-com.com/>) - intercoms
- Flight Form Cases, Inc. (<http://www.flightform.com/>) - protective cases, including custom designs
- Neutrik USA (<http://www.neutrikusa.com/index.html>) - audio connectors
- Rapco (Horizon) (<http://www.rapcohorizon.com>) – audio cables to fit every need
- Whirlwind (<http://www.whirlwindusa.com/>) - manufacturers cable products and systems
- Switchcraft (<http://www.switchcraft.com/>) - connectors, jacks and plugs, jack panels, cable assemblies, patch cords, and switches
- Sound And Light Training (SALT) Manual, Ken Ellis <http://www.kodachrome.org/salt>

Recording Software

- Cakewalk (<http://www.cakewalk.com>) Recording software
- PreSonus (<http://www.presonus.com>) Recording software
- Pro Tools (<http://www.avid.com>) Recording software
- Logic (<http://www.apple.com/logicstudio>) Apple recording software (Mac users)

Video

Software

- Media Shout (<http://www.mediashout.com>)
- Easy Worship (<http://www.easyworship.com>)
- Sunday Worship (<http://www.sundayworship.net>)
- Sunday Morning (<http://sundaymorning.com>)
- Microsoft PowerPoint (<http://www.microsoft.com>)

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Hardware

- Edirol (<http://www.edirol.com>) – Video mixers
- JVC Professional Products (<http://www.jvc.ca/en/>) - primarily Video

Lights

- American DJ (<http://www.americandj.com>) – lighting and accessories
- Chauvet (<http://www.chauvetlighting.com>) – lighting and accessories
- Elation (<http://www.elationlighting.com>) – lighting control modules, dimmers, and more

All-In-One A/V Centers

- C&M Music (<http://www.musiccenter.net>) Local (NOLA) walk-in audio and lights super store with online ability
- Guitar Center (<http://www.guitarcenter.com>) International walk-in audio and lights super store with online ability (owns musiciansfriend)
- Musicians Friend www.musiciansfriend.com International complete online audio and lights store
- Sweetwater www.sweetwater.com International complete online A/V (video too!) super store *and service center*

This manual is protected under copyright law. This ministry training manual was assembled and written by combining my own knowledge, experience, and resources with the incredible amount of resources available on the internet. The format of this manual was adopted from the SALT Manual written by Ken Ellis. A link for this manual can be found in this APPENDIX (N). There are significant differences in many areas due to the major advancements of technology since his manual was written. It is free for use to meet your ministry needs. This manual may be freely given to others as well. No funds are to be collected for the distribution of this manual for any reason including but not limited to donations, cost of printing, etc. God is watching.

Audio/Visual Training Manual

From the “organizer” of this manual.

I first started dabbling in this stuff(A/V tech) when I was playing as a road musician. I saw the frustration obvious in most sound techs and several times had to face the repercussion of adding to their dilemma. I was setting up at this Christian “night club” and it was apparent that the sound guy didn’t have much understanding of his gear nor how to mix it with ours. It was also very obvious that he didn’t like the situation and felt that we were the cause. He ended up throwing a cable at me to get me to finally “shut up” ... it worked but he obviously didn’t stay for the meet and greet. I found two problems that day that I felt I could address.

1st – He was a very mad minister.

I’ve seen it a lot over the years and it should be confronted with love. Jesus didn’t get up on the cross mad. We should serve in love, or take a break and reprioritize. In this I began my research on how to develop leaders (another book being written) to recognize and deal with stresses before the gauges crack. I have spent my ministry life trying to help those serving with and under me to fall in love with serving again. It has been a daunting task but worthwhile. The fact is there are many angry people in ministry.

2nd – I didn’t know enough to help him. That I could fix.

I decided I would do whatever it took to learn sound. I began by volunteering at my church to help out with the media. Some stuff just made sense. I approached it from a “if I don’t know it, I won’t touch it – instead I will ask” mentality. That has served me well. Soon after, I had the opportunity to learn at a local music store the ins and outs of sound installation. As a volunteer for his ministry branch, I would go and help them set up, run, and tear down mega systems. Eventually I began to design and install my own systems. When I travel, I bring my own gear and just tie into a channel or two.

To this day, I minister to various churches concerning media (as well as other) matters.

I also do everything I can to ensure that anyone who desires to learn this ministry can get the info they need. I also try to educate ministers. The nature of traveling ministry causes many stresses on a sound system. If the minister understands sound, the minister can keep from making avoidable mistakes and the sound team can enjoy the ministry they have come to bring. It also extends a huge “I care” that goes much further than the spoken words.

This manual is now in your hands. I hope it serves you well as a resource.

Yours truly,

Patrick Hazard