Basic Principles of Sound

From notes by Paul Bristow

Equipment (Part 1)

DEFINITION OF SOUND

Sound is a pressure wave, requiring a medium through which to travel i.e. Air; to observe this imagine throwing a stone, into a pool of water; this will create a series of concentric waves. This displays how sound waves emanate from a sound source. Now consider a cross section of the surface of the water along which the wave travels it would appear as shown in the picture to the right:

This is a sound wave, in which the amplitude (a) will determine the volume of sound (i.e. how loud it is). The distance (shown as "one cycle") relates to the frequency of the wave form i.e. how many complete waves occur per second; this will determine the "musical" note which is produced.

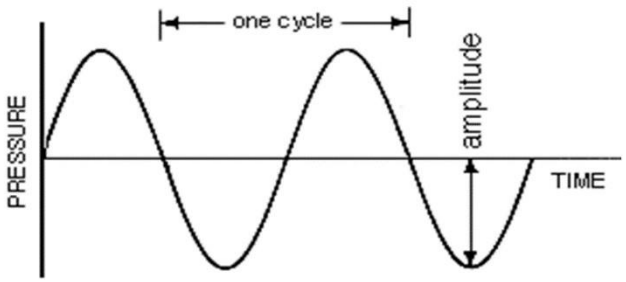


Figure (1) - a Sinusoidal Wave Form

Four Elements of a "Sound System"

Our Sound Systems today essentially comprise four items: (1) Microphone (2) Music Generating Device (Lap-Top, Turntable or other) (3) Amplifier and (4) Loudspeakers.

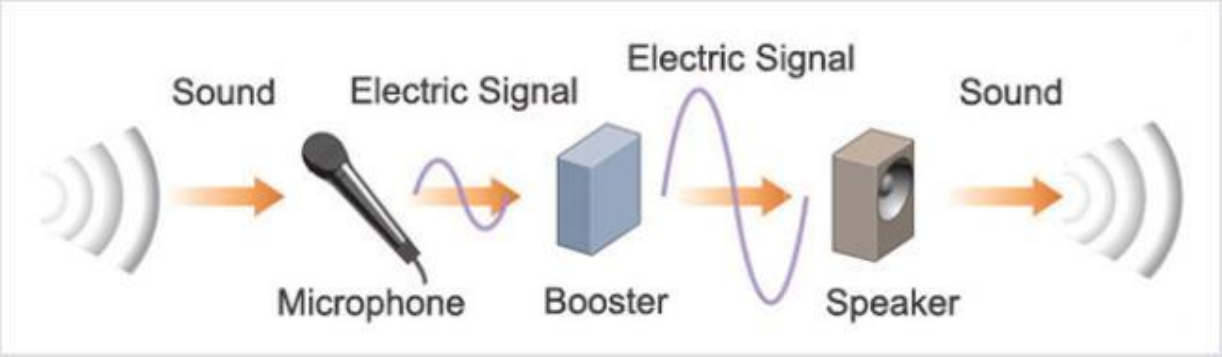
(1) **MICROPHONE**

This comprises an "element" suspended within a casing which can vibrate in sympathy with the frequency of the sound wave. As the element vibrates it produces an alternating (vibrating) electrical signal which vibrates in a similar fashion to the sound wave form. The accuracy, with which the microphone reproduces the sound waves as an electrical signal, will depend upon the quality and characteristics of the microphone. This signal passes along the connecting wire to the amplifier.

It should be noted that the more pure (or - if you prefer "cleaner") the vocal signal is, the better the quality of sound it will produce; i.e. if you use your voice correctly, it will sound a lot better.

(2) **MUSIC GENERATING DEVICE**

At present the most common device used to generate music is the Lap-Top computer (or Note-Book), this provides a library of music in the form of MP3s and - with the software that is installed on the Lap-Top - can also make available the lyrics (to be read from the computer screen), as well as the functionality that allows the Caller to adjust the Tempo and/or the pitch (key) of the music. Other Digital music devices can be used: e.g. CD players and Mini Disc players that may be able to offer Tempo adjustment.



There are still a number of Callers who rely upon analogue systems such as using Vinyl Records (played upon a turntable), or Audio Cassette tapes played upon Audio Cassette players.

All these devices provide an electrical signal which "vibrates" in a similar fashion to the sound wave form produced by the music; this signal passes along the connecting wire to the amplifier.

(3) **AMPLIFIER**

The purpose of the amplifier is to take the relatively low powered input signals (from the microphone or the music generating device) and amplify it to the extent necessary to drive the loudspeaker elements, in order to reproduce a much louder - but essentially accurate and faithful - version of the input signals.

The amplifier is divided into two sections:

1. The Pre-amplifier receives the input signal and provides the facility to the user to vary both the volume and tone of the signal by affecting the amplitude and frequency. It may also adjust the strength of the signal before passing it through, via any internal mixer, to the power amplifier.
2. The Power Amplifier significantly increases the strength of the signal but does not alter the quality in any way; the loudspeakers are connected to the output stage of the main amplifier.

(4) **LOUDSPEAKERS**

Physically a loudspeaker comprises an element - not unlike the microphone element in reverse - which converts an electrical signal to a mechanical signal which vibrates a paper/plastic (or resin-impregnated cloth cone) in the same fashion as the original input signals. Loudspeaker cabinets may comprise a single loudspeaker unit or a number of loudspeaker units to provide and distribute the output sound wave, complete with the various tone enhancements (from the Pre-Amplifier or computer software), at a level that is significantly louder than the original input but which is a faithful and true reproduction.

IMPEDANCE (*note – this concerns, speakers, microphones and other connected equipment***)**

It is very important to have a simple understanding of Impedance; in very basic terms this is the resistance to electrical flow which occurs when a signal drives (or is driven by) an element or other circuitry. There are two places where a Caller will encounter the need to understand this subject - Inputs and Outputs:

INPUT (1): (Microphones): The size of the electrical signal from the microphone must match the input stage of the amplifier; if it is too large it will distort and may cause damage, if it is too small it will not be enough to make the pre-amplifier work effectively. Hilton amplifiers require a high impedance microphone signal to be able to work correctly; as most microphones are low impedance, Hilton installs a low-to-high transformer in their microphone chord, thus - when you plug a microphone into a Hilton - you should find that the best setting for the microphone control will be somewhere in between the "twenty to" and "ten to" position (if you think of a clock face, you will be able see where these are). If you need to turn the volume control up beyond the "twelve-o'clock" position, there is a good chance that the microphone signal will distort; in this situation you may need to use an "in-line low-to-high transformer".

INPUT (2): (Music Generating Devices): Hilton Amplifiers (as well as some of the more recently produced Turntable/Amplifier units) have input sockets to which digital devices can be connected and used without any difficulty; the MA150 and MA220 amplifiers have an input level control attenuator. However, when you are using the majority of the

older Hilton Turntable/Amplifiers (those with the larger head shell on the tone-arm), it will be necessary to boost the output signal of a digital music device, either by a purpose-built signal booster (e.g. the Hilton Audio Products unit), a small pre-amplifier, or by using a low-to-high impedance line transformer

OUTPUT: The output stage of an amplifier is designed to expect a certain impedance. If it is too high the resulting sound will be reduced - you may have to turn the volume controls above the "best" range to get a reasonable output. If it is too low the amplifier will "run-away", this will cause the amplifier to get very hot; it may "overload" thus blowing a fuse or activating a heat-sensitive cut-out; in addition to this there will be some (quite probably a great deal) of distortion. It is foolish and dangerous to allow an amplifier to overload itself by connecting too low an impedance; although modern circuitry tends to be designed to prevent damage, eventually expensive damage, to the output stage of the amplifier, will occur. To safely connect loudspeakers to the output stage of the amplifier, you will need a simple understanding of the concept behind SERIES and PARALLEL connection.

SERIES AND PARALLEL: Correct connection of speakers to the amplifier is essential to produce the most efficient output and to prevent damage to the amplifier. Hilton devices have two speaker connections and you might assume that you can simply just "plug-in" two speakers... The fact is that you cannot make this assumption, unless you have an understanding of Series and Parallel and know what the impedance of the two speakers are. The two connections, on the back of a Hilton, are connected in Parallel, this means that - if you connect two speakers - you will end up with a total impedance that is lower than either of the two units (if you connect two 4 ohm units, you will end up with 2 ohms); a Hilton **MUST** have at least 4 ohms connected to it. The safest way to connect an extra speaker, is to use the "Series Y" connector that you get with your Hilton - if you connect two units together, in Series - you can just add the impedances together (if you connect two 4 ohm units, you will end up with 8 ohms); you will have to increase the volume slightly - but a Hilton will work very efficiently with 8 ohms connected to it.

LEADS (PATCH CHORDS) - FOR CONNECTION: Connecting equipment to a standard Square Dance amplifier, or turntable - i.e. a Hilton or similar unit - is achieved by using a short lead (or chord). There are four different types of connector, in common use for this purpose, these are:

1. RCA or Phono Plugs
2. ¼ inch Mono Jack Plugs
3. 3.5mm Mono Jack Plugs
4. 3.5mm Stereo Jack Plugs

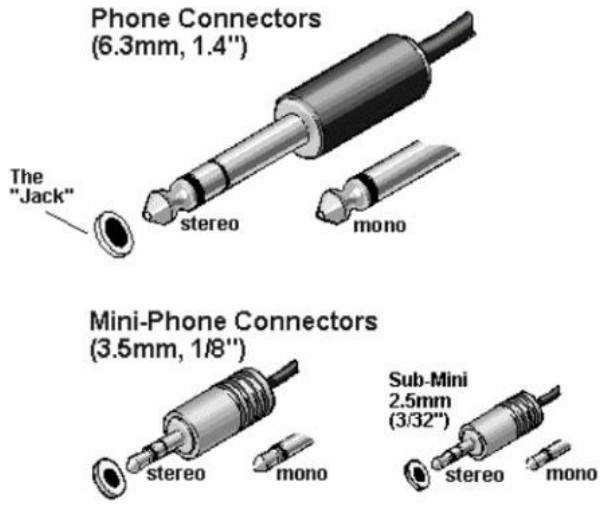
To cover all eventualities, you will need several leads, using these connectors (shown below):

1. **RCA or PHONO PLUG**:

These are used for microphone reset controls and some digital / recording inputs and some digital / recording

outputs used in pairs for stereo connections

2. **JACK PLUG** (which comes in 3 types)



Audio Jacks

Phone and mini-phone sockets are the traditional audio jacks. Jacks are sockets, not plugs, and audio jacks are not much more than a hole in the case.

- **¼" JACK PLUG -** used for loudspeaker and microphone connections and some digital connections
- **3.5mm MONO (STEREO) JACK PLUG and the 2.5 mm sub mini -** used for music remotes and extensions loudspeaker and microphone connections in cassettes and some digital connections

SCREENED LEADS: All input leads and most output leads (except Speaker leads), carry very small sensitive electronic signals and require the use of screened cable, this prevents extraneous sounds (hum and buzz) and noise (hiss) being picked up and amplified. Always use the best leads, not the "cheap and cheerful" type; it is worth spending a little more on studio-quality leads to enjoy the advantage of a better connection and a better fitting plug. Adaptors that allow one size (or type) of connector to convert to another can be useful - but - once again, make sure that you use good quality units for this purpose.

LOUDSPEAKER LEADS: The leads that are used to connect between the amplifier and loudspeakers do not need to be screened but you must be careful not to use leads that are too thin; the thicker the better!

TURNTABLE AND OTHER EQUIPMENT: The cartridge of the turntable comprises a small stylus connected to a cartridge which translates the mechanical vibrations caused by the shape of the indentations in the grooves on the record to an electronic signal for amplification. Any other sound source e.g. tape player etc. will also, effectively, provide an electronic signal, which needs to be amplified to be heard.

MONITORS: Many modern sound systems include a monitor output, which enables Callers to "monitor" either music, voice or both; some require a separate monitor amplifier and loudspeaker, while some have a built-in monitor amplifier that can be attached to a loudspeaker. Although there are situations where a monitor will be necessary, in order to allow the Caller to hear the music (and - on occasions - the voice), I would suggest it is always better to use the main output of the sound system as your reference.

CARE OF YOUR SOUND SYSTEM: Ensure all the volume controls are turned down before switching on the amplifier. NEVER switch on the amplifier unless the loudspeakers are connected. Regularly inspect the leads and connections and repair or replace any suspect items. In particular, check for "intermittent" faults - these usually result from cables that are breaking (or becoming disconnected); if you encounter these type of problems, early repairs will save a lot of embarrassment!

Make sure your insurance cover is adequate - should the need arise. Do not be afraid to be very firm with people who offer to "help" set-up or take-down your equipment, if you are not happy that they

know what to do, thank them for the offer - but - firmly and politely refuse.

POOR SOUND SITUATIONS: Getting the best from your sound system and overcoming problems in poor sound situations requires experience which can only be gained from experimentation. Do not simply set the controls to the same positions every time you use your set, be aware of the effect of careful use of the tone, volume and speed controls to enhance certain recordings.

CONNECTING AMPLIFIERS: Connection of amplifiers and turntable/amplifiers may be possible, you can "slave" one amplifier to another - but - be absolutely certain that you know what you are doing; when in doubt don't be too embarrassed to ask someone - a little more experienced - if they know the answer.

SPEAKER PLACEMENT: As you will realise, all halls are different and the way sound travels, is reflected, absorbed and altered will depend upon the acoustics of the hall. Acoustic conditions in a hall can be changed by wall hangings, heavy curtains and by the number of dancers that are present; so, sounding an empty hall may lead to some erroneous conclusions.

The most common speaker system in use is the single column "phased array" – most often the popular "Yak Stack" unit, which comprises a number of loudspeaker elements arranged in a vertical stack, this produces a directional sound that is unlikely to reflect from the floor or ceiling, with a limited frequency response, that is particularly beneficial to reproducing the characteristics of the human voice.

This type of speaker should be placed fairly high i.e. above the heads of the nearest Dancers and tilted slightly to avoid reflection off the back wall and off the ceiling of the hall, in effect you will be using the Dancers' bodies to absorb sound and reduce echo.

The other popular unit is the single (or dual) speaker assembly, used either as a single sound source or as one of a pair of units. These have a much better frequency response but are less directional. This type of speaker will perform very well in halls that have a good acoustic characteristic - but may encounter problems when used in halls that are prone to echoes as a negative acoustic factor.

Placement of speakers in a hall is very difficult but a few simple rules exist.

1. Place all speakers along one wall unless you alter the wiring to reverse the phase or use a delay circuit to prevent destructive sound wave interference.
2. Column speakers in square halls are best located centre stage, as are single speakers; dual speakers should be placed - one on the left and one on the right.
3. In long rectangular halls, requiring more than two speakers, a number of speakers along a long wall with stage centre will probably work best.

None of the rules above will work in every hall, very few are perfect; the best answer may still leave much to be desired - don't be afraid to experiment to find an adequate solution. Do not change the arrangement of the speakers after each tip. Remember people's ears sometimes take a while to become adjusted.

FEEDBACK: Avoid acoustic feedback. If a microphone is too close to the loudspeaker it can give rise to a very unpleasant howling noise. You can overcome this by moving the loudspeaker(s), although it can also be controlled by reducing the volume or turning down the "Treble" control on the microphone. N.B. if anyone that is not familiar with microphone technique

borrows your microphone - to make announcements, draw the raffle tickets etc., it is wisest that you stay close to the amplifier controls, in case they “wander” into the field of the loudspeaker and cause a feedback howl.

USING TREBLE CONTROLS OR A "BASS ROLL-OFF" SWITCH: Sometimes, “Poor Sound” situations can be resolved by increasing the “Treble” on the microphone input. Some microphones feature a "Bass Roll-Off" switch e.g. the Electro Voice N/D 967, the AKG 1200e and the Toa F1.

USING YOUR VOICE, CORRECTLY: At the end of the day it does sometimes occur that - the only way to resolve bad sound - is to improve or alter the primary input: i.e. your voice. In this situation good vocal techniques, especially projection, enunciation and diction offer the only solution.

In the December issue we will follow on with a second article from Paul on this subject.

Equipment Part 2

The purpose of this section is not to provide an exhaustive guide to the workings of sound Equipment but rather an overview of the subject in, hopefully, easily understood terms. It is intended to provide a basis for understanding the operation of Sound Equipment.

DEFINITION OF SOUND

Sound is effectively a pressure wave. It requires a medium through which to travel i.e. Air. If you throw a stone into a pool of water, it will create a series of concentric waves. This displays how sound waves emanate from a sound source. Now consider a cross section of the surface of the water along which the wave travels. It would appear as shown below.

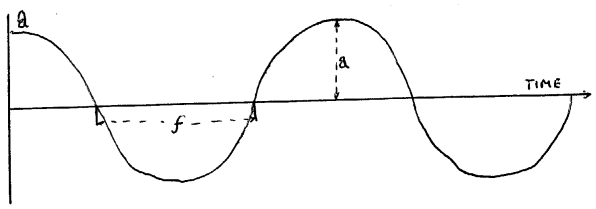


Figure (1) - a Sinusoidal Wave Form

This is a usual method of drawing a wave form. If we consider this as a sound wave the amplitude (a) will determine the volume of sound. The distance (f) relates to the frequency of the wave form i.e. how many complete waves occur per second; this will determine the "musical" note which is produced.

Our Sound Systems today essentially comprise three items:

1. Microphone
2. Turntable (or other Music Generating Device) /Amplifier and
3. Loudspeakers.

Some people use systems which include a separate turntable and amplifier, but the two items can still be considered jointly.

1. MICROPHONE

This comprises an "element" suspended within a casing which can vibrate in sympathy with the frequency of the sound wave. As the element vibrates it produces an alternating (vibrating) electrical signal which vibrates in a similar fashion to the sound wave form. The accuracy with which the microphone reproduces the sound waves as an electrical signal will depend upon the quality and characteristics of the microphone. This signal passes along the connecting wire to the amplifier/turntable.

2. AMPLIFIER/TURNTABLE (OR OTHER MUSIC GENERATING DEVICE)

The purpose of the amplifier is to take the relatively weak input signal (e.g. from the microphone) and amplify it to the extent necessary to drive the loudspeaker elements. The amplifier is divided into two sections

(i) The Pre-amplifier - This receives the input signal and provides the facility to the user to vary both the volume and tone of the signal by affecting the amplitude and frequency. It also increases the strength of the signal and then passes it through any internal mixer to the main amplifier.

(ii) The Main Amplifier significantly increase the strength of the signal but does not alter the quality in any way. It is to the output stage of the main amplifier that the loudspeakers are connected.

Turntable and Other Equipment

The cartridge of the turntable comprises a small stylus connected to a cartridge which translates the mechanical vibrations caused by the shape of the grooves on the record to an electronic signal for amplification. Any other sound source e.g. tape player etc. will provide an electronic signal which needs to be amplified to be heard.

Digital Music: - Digital Versus Analogue

Whilst it is not necessary for callers to fully understand the complexities of digital – as opposed to analogue – music, it is useful to have a simple appreciation of the difference. An analogue signal is relatively simple to "hear" or understand, whereas a digital signal must be "decoded" in some way before it is understandable.

Sound, like your voice, is an example of an analogue signal. As you speak, your voice contains lots of different frequencies at lots of different amplitudes. These are created in a linear fashion, one after the other, another way to think of this would be to think of a 45-RPM 7-inch vinyl recording; the single groove has a number of protrusions and cavities, which cause the stylus to vibrate and thus recreate the original analogue sound.

Audiocassettes and other tape recorders, achieve the same thing, without vibration; these devices use magnetic signals – of varying intensities – that have been copied to the metal coated (ferrous or chromium) plastic tape, to carry the analogue musical information, in a linear sequential pattern.

A digital signal is just a sequence of ones and noughts. Digital signals are made by converting the analogue signal (soundwave) to binary code; best described as turning a light on and off. To create a digital signal, you have to have a laser and be able to switch it on and off fast enough to send all the information. Technology has only recently been able to do this.

There are several advantages to digital music, these include:

1. the fact that it won't suffer from noise (hiss) and interference as badly as analogue signals,
2. it can be processed by computers very easily, and
3. it can be sent "compressed" – i.e. in a much smaller, fashion and at considerably faster speeds.

Digital Music: - Leads (Patch Chords) – For Connection

Connecting digital equipment to a standard Square Dance amplifier, or turntable – i.e. a Hilton or similar unit, is achieved by using a short lead (or chord). There are four different types of connector, in common use for this purpose, these are: RCA or Phono Plugs, ¼ inch Mono Jack Plugs, 3.5mm Mono Jack Plugs and 3.5mm Stereo Jack Plugs – all shown below. To cover all eventualities, you will need several leads, using these connectors.

All input leads, and most output leads, except for Speaker leads, carry very small sensitive electronic signals and require the use of screened cable, this prevents extraneous sounds (hum and buzz) and noise (hiss) being picked up and amplified. Always use the best leads, not the "cheap and cheerful" type; it is worthwhile to spend a little more on studio-quality leads and thereby enjoy the advantage of a better connection.

Digital Music: - Signal Boosting Devices

It is often necessary to boost the output signal of a digital music device, either by a purpose-built signal booster (e.g. the Hilton Audio Products unit), a small pre-amplifier or a low-to-high impedance line transformer. However, this may not be necessary on some of the most recent purpose-built Square Dance systems.

Digital Music Equipment – General Description

- **Mini-Disc and CD Units**

Recordable Mini-Disc or CD units were the first digital devices to become popular with callers. Mini-Discs are similar to CDs in that they provide a media, which is

“recorded” and – subsequently – can be "read" by a laser. The electronic signal from the laser is then transferred, via the output of the Mini-Disc or CD, to an amplifier.

The advantages of using the Mini-Disc or CD are that the media itself is physically more compact and is much more robust and less likely to suffer damage or to “wear-out” than a relatively fragile 45-RPM 7-inch vinyl record; a 74 Disc can provide 148 minutes of recording time (when recorded in Mono) which will allow as many as 42 Square Dance records to be contained on one Disc!

In addition, locating a track for use on a Mini-Disc or CD is an instantaneous process; whereas locating a track on an audiocassette will require fast-forwarding or re-winding and is thus much more long-winded.

- **MP3/WMA Units, IPODS And Mobile Phones**

Essentially, these devices work in the same manner as other digital devices. However, they have a significantly larger storage capacity and rely upon a fixed digital data storage device, rather than a removable medium i.e. a Mini-Disc or CD. Consequently, a very small device (or – in the case of a mobile ‘phone – a multifunctional device) can be used and can be easily connected, by a single lead (or patch-chord). Some CD players can play MP3 and WMA files that have been recorded on to a CD from a computer, thus you could carry almost all your music on one CD.

Mobile ‘phones can be used to provide the music provided that they offer a “line-out” or “Headphone-out” socket and provided that you can prevent them from working as a ‘phone (i.e. “ringing”) when you are using them for music! Any mobile ‘phone with a “flight mode” will usually be suitable.

The terms MP3 and WMA refer to different compression systems that are used to significantly reduce the size of digital files so as to allow a large amount of music to be held on a single device. The actual amount of music that can be stored in this fashion, will depend upon the compression rate that is used - but at a rate of 128kbps, each file will take up one tenth of the space that a normal CD WAV file will require.

- **Laptop Computers**

The most popular “new” digital music sound-source is the Laptop Computer. Modern Laptop Computer have a fantastic amount of storage capacity, i.e. can hold a very large number of tunes and can provide many additional benefits for the caller.

There are several caller-designed music programmes that offer a complete Square Dance package. This will allow the caller to play the music – as per any other digital device – but will also offer the chance to change the tempo (speed) and/or the pitch (key) of any tune, alternatively you can change the pitch without affecting the tempo. These programmes offer a far greater range of equalisation (tone control) and can display the lyrics to each song together with choreographic routines/suggestions that the caller may wish to use.

As the Laptop Computer is a full computer, it can also provide the caller with instantaneous reference to CALLERLAB lists, definitions and other material; as well as access to schedules (the caller’s calendar, local dance plans etc.) and even provide e-mail/internet access. However, “multi-tasking” on the Laptop Computer may interfere with the music playback, so you should run the minimum number of other programmes whilst playing music.

Connecting the Laptop Computer to an amplifier must be done carefully. Quite often the headphone outlet may be used as a connection, however, this is not always the best method; it will depend

upon how the Laptop Computer has been designed and upon what other programmes are running. Some callers prefer to use a converter to allow access to a USB port on the computer, whilst some will use a separate sound-card (again connected to a USB port) in order to provide the best possible output signal; a separate sound-card will also provide a high quality method of recording on to the Laptop Computer hard drive. Depending upon the design of the Lap-top, it may be possible to use a PCMCIA card that slots into the port on the Lap-Top, this will provide an excellent connection to the unit.

Recording to Digital Media

Special care needs to be taken when you transfer your music, from vinyl (or another source) to a digital device. Digital devices will copy exactly what you put in, including pops, scratches, distortion, noise (i.e. hiss) etc. and will do nothing to improve or mask the sound quality. Many PC software programmes exist that will allow you to remove unwanted parts of a recording from vinyl or audiocassette and some of these programmes will give you a chance to "brighten" or "clean-up" the sound, to your preference. However, for the best results, you need to work from the best possible source material and use a sound-system that provides the best quality output.

It is worthwhile experimenting a little with different recording methods and finding a method to provide the quality that is best for your purpose. These days it is quite often possible to obtain music on CD or as an MP3 download. Whilst, the MP3 download is quite convenient, the CD will give you the highest possible quality.

Getting the best from your digital music sound system and overcoming problems in poor sound situations requires experience, which can only be gained from experimentation. Do not simply set the controls to the same positions every time you use your unit, be aware of the effect of judicious use of the tone controls – especially if you have a graphic equaliser on your Laptop Computer– to enhance certain recordings.

3. LOUDSPEAKERS

Physically a loudspeaker comprises an element - not unlike the microphone element in reverse - which converts an electrical signal to a mechanical signal which vibrates a paper/plastic or resin-impregnated cloth cone. A loudspeaker cabinet will usually include several loudspeaker units which together provide and distribute the output sound wave, complete with the various tone enhancements, - much louder than the original input.

Impedance (note – this concerns, speakers, microphones and other connected equipment)

In very basic terms this is the resistance to electrical flow which occurs when a signal drives or is driven by an element or other circuitry. The size of the electrical signal from the microphone must match the input stage of the amplifier. If it is too large it will distort and possibly damage the circuit. If it is too small, it will not be enough to make the pre-amplifier work. Similarly, the output stage of an amplifier is designed to expect a certain impedance. If it is too high the resulting sound will be very low. If it is too low the amplifier will run away and eventually damage will occur. (Modern circuitry tends to be designed to prevent damage but even so, it is foolish and dangerous to allow an amplifier to overload itself by connecting too low an impedance.)

Series and Parallel

Correct connection of loudspeakers is essential to produce the most efficient output and to prevent damage to the amplifier. Each loudspeaker has two connections. The signal live or hot connection (marked + or with a red dot),

and the common, earth or return connection (normally marked -). The signal and common connections are similarly marked at the amplifier output.

Let us consider the hypothetical connection of eight “8 ohm” loudspeakers to an amplifier with a design rating of 4 ohms. If they are connected to one output of the amplifier in series, this will be the effect.

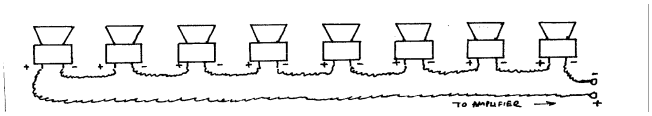


Figure (2) Series Connection of Loudspeakers

The effective impedance will be 64 ohms. i.e. series connections simply add together to establish the effective total impedance. This will be a very high impedance and the sound output will be noticeably low. The same 8 speakers connected in parallel will give the following circuit:

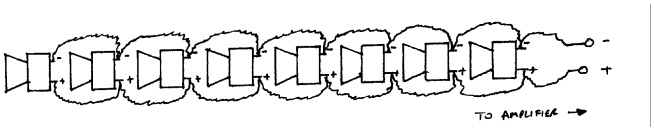


Figure (3) Parallel Connection of Loudspeakers

The effective impedance will be 1 ohm. This is derived from the following formula:

$$\frac{1}{8}+\frac{1}{8}+\frac{1}{8}+\frac{1}{8}+\frac{1}{8}+\frac{1}{8}+\frac{1}{8}+\frac{1}{8} = \frac{1}{\text{resulting impedance}}$$

The mathematics involved in this calculation are quite complex, if you are not familiar with this type of calculation it is enough to be aware that connecting loudspeakers in parallel will effectively reduce the impedance and that you will need to find someone who understands parallel connections in order to be certain that the connection will not be harmful to your equipment.

N.B. Loudspeaker outputs on amplifiers are normally connected in parallel.

Therefore, by connecting all the loudspeakers together in parallel, the impedance will be far too low, whilst the sound output will be quite high. The output side of the amplifier will overheat rapidly and fail, possibly causing irreparable damage to your sound equipment.

The best way to connect this number of speakers would be via a series/parallel combination.

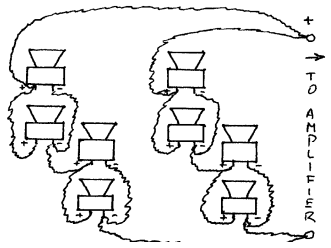


figure (4) Series/Parallel Connection of Loudspeakers

This connection would produce an effective impedance of 4 ohms and would thus be the most efficient arrangement.

If you are not certain about loudspeaker connections, seek professional advice before you cause damage to the amplifier

Power

The term “watts” is used to describe the power rating of equipment. However, there are several different ways of measuring power. Be certain which type of measure has been used, before trying to match the output stage of an amplifier to a loudspeaker assembly.

1. R.M.S. Power (Route Mean Square),
2. Peak Power,
3. Peak to peak or total peak or total music power

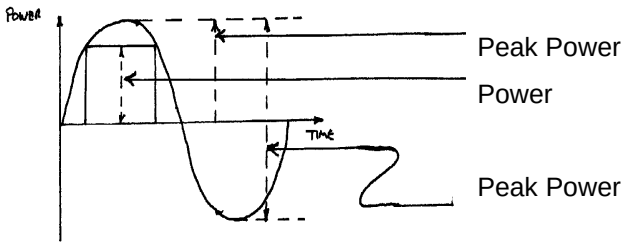


figure (5) Power from the Wave Form

Therefore, an amplifier rated 100 watts total peak power:

= 50 watts peak power

= 35 watts R.M.S.

It is important to know the power rating system being used when sizing and connection loudspeakers and amplifiers. If you connect a 100-watt (R.M.S.) amplifier to a 100-watt (Total Music Power) loudspeaker and turn the amplifier volume all the way up, the loudspeakers will distort and could possible even be destroyed! I would suggest that it is best to work in R.M.S. Power ratings.

Speaker Placement

As you will realise, all halls are different and the way sound travels is reflected, absorbed and altered will depend upon the acoustics of the hall. Acoustic conditions in a hall can be changed by wall hangings, heavy curtains and by the number of dancers that are present; so sounding and empty hall may lead to some erroneous conclusions.

The most common speaker system in use is the single column “phased array” – most often the popular “Yak Stack” unit, which comprises a number of loudspeaker elements arranged in a vertical stack (an explanation of how this works is included as an appendix to this syllabus). This produces a directional sound with limited frequency response.

This type of speaker should be placed fairly high i.e. above the heads of the nearest Dancers and tilted slightly to avoid reflection off the back wall and off the ceiling off the hall, in effect you will be using the Dancers’ bodies to absorb sound and reduce echo.

The other popular unit is the folded horn assembly, normally used in pairs which has a much better frequency response but is less directional. This type of speaker will perform very well in halls that have a good acoustic characteristic – but will be poor when used in halls where echoes are a negative factor.

Placement of speakers in a hall is very difficult but a few simple rules exist.

1. Place all speakers along one wall unless you alter the wiring to reverse the phase or use a delay circuit to prevent destructive sound wave interference.
2. Column speakers in square halls are best located centre stage. Folded horn units one on the left and one on the right.
3. In long rectangular halls a number of speakers along a long wall with stage centre will probably work best.
4. Do not be afraid to experiment. None of the rules above will work in every hall and it may be possible, due to the acoustic nature of the hall, to produce a better sound by disregarding some or all the rules.

   Be careful, very few halls are perfect, the best answer may still leave much to be desired. Try to compromise and find an adequate solution. Do not change the arrangement after each tip. Remember people’s ears sometimes take a while to become adjusted.
5. Avoid acoustic feedback. If a microphone is too close to the loudspeaker it can give rise to a very unpleasant howling noise, which is known as feedback. The best way to overcome this is to move the loudspeaker(s), although it can also be controlled by reducing the volume or turning down the “Treble” control on the microphone.

   N.B. If anyone borrows your microphone and is not familiar with microphone technique, it is wisest that you stay close to the amplifier controls in case they wander into the field of the loudspeaker and cause a feedback howl.

6. Notwithstanding the problems of acoustic feedback some “Poor Sound” situations can be resolved by increasing the “Treble” on the microphone input. Some microphones feature a "Bass Roll-Off" switch e.g. the AKG 1200e and the Toa F1.
7. At the end of the day it does occur that the only way to resolve bad sound is to improve or alter the primary input - i.e. your voice. In this situation good vocal techniques, especially projection, enunciation and diction offer the only solution.

Monitors

Some sound systems available to the modern Caller include a built-in monitor amplifier which enables the Caller, by attaching a loudspeaker, to “monitor” either music, voice or both. Some Callers use a separate monitor amplifier and loudspeaker for this purpose. There are situations where a monitor will be necessary, but by and large, I would suggest it is better to use the main output as your reference.

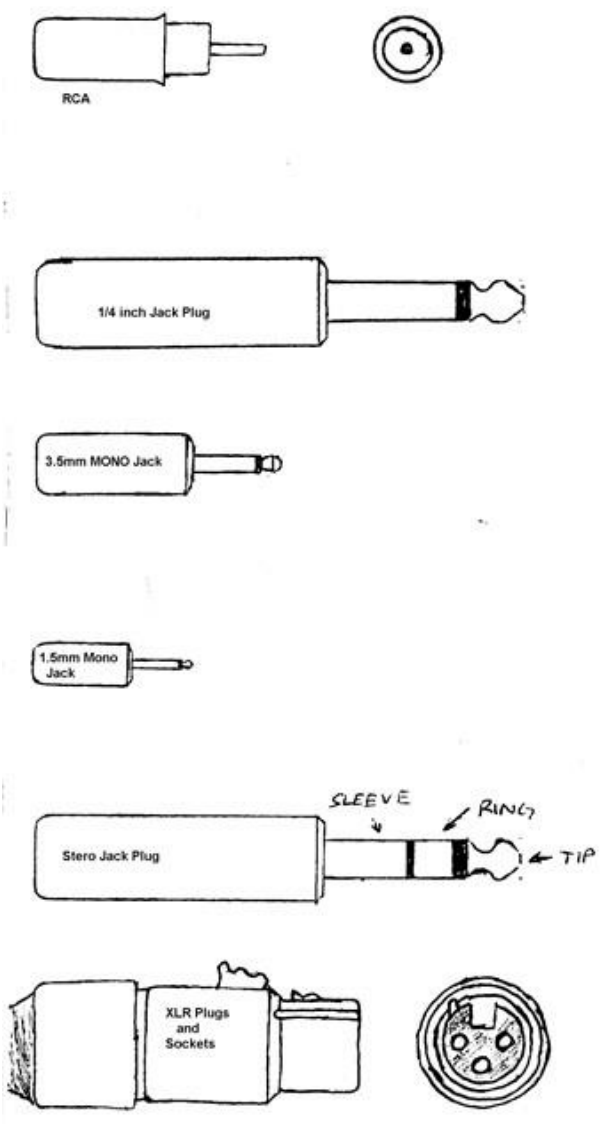
CARE OF YOUR SOUND SYSTEM

Ensure all the volume controls are turned down before switching on the amplifier. NEVER switch on the amplifier unless the loudspeakers are connected. Regularly inspect the leads and connections and repair or replace any suspect items. Generally, respect and take care of your equipment, keep it locked up when not in use and make sure your insurance cover is adequate - should the need arise.

Getting the best from your sound system and overcoming problems in poor sound situations requires experience which can only be gained from experimentation. Do not simply set the controls to the same positions every time you use your set, be aware of the effect of judicious use of the tone controls to enhance certain records. Make sure you are getting the best from your sound system.

TYPES OF CONNECTOR

There are several different types of connectors in present use. Sound system designers tend to use different connectors for different functions to prevent incorrect connections being



made to the amplifier. These connectors include:

1. **RCA or PHONO PLUG**:

- used for microphone reset controls
- and some digital / recording inputs
- and some digital / recording outputs
- used in pairs for stereo connections

2. **JACK PLUG** (which comes in 3 sizes):

- **¼" JACK PLUG**
  - used for loudspeaker and
  - microphone connections and
  - some digital connections
- **3.5mm MONO (STEREO) JACK PLUG**
  - used for music remotes and extensions
  - loudspeaker and microphone connections
  - in cassettes and some digital connections
- **1.5mm MONO JACK PLUG**
  - used for remote powerswitching
  - and on some.1ow voltage plug-in
  - transformers

3. STEREO JACK PLUG

- includes an extra contact used for
- stereo headphones and insert sockets

– i.e. the sockets that allow an effects pedal to be used

4. XLR (plugs and sockets)

- used for connections from
- microphone to signal lead
- used extensively in studio
- professional sound systems

Additionally you may come across DIN plugs: two pin used on speaker input/outputs on Hi-Fi systems, three pin used with monaural equipment, five pin used with stereo equipment, seven pin used with computers and five pin (star) used on headphone outputs on certain equipment.

Older equipment from America uses a plug and socket set like a two pin DIN which is called Cinch-Jones connector. These fell out of favour with Callers owing to corrosion problems and are no longer used, many have been replaced with ¼" Jacks.

Certain microphones use a four pin Ring Connector which could be connected in one of two aspects in order to change the connections on an internal impedance transformer thus allowing the impedance rating of the microphone to be changed.

GENERAL

A Caller's sound equipment represents a considerable financial investment, take good care of your equipment, if it should become damaged due to incorrect connection you will be faced with further expense. Do not be afraid to be very firm with people who offer to "help" set-up or take-down your equipment, if you are not happy that they know what to do, thank them for the offer but firmly and politely refuse.

Choosing Sound Equipment To Meet Your Own Needs

CHOOSING SOUND EQUIPMENT TO MEET YOUR OWN NEEDS Your sound system is one of the biggest dollar investment that you make in your teaching career. We're talking real money here, and we hope that the following will help you to choose sound equipment that will give you your money's worth in performance, dependability, portability and convenience of operation.

The basic sound system has four components: Microphone, amplifier/mixer, a music source such as a turntable, Laptop, MiniDisc, MP3 player, or CD player, and loudspeakers. Look for convenience of operation, ruggedness, and portability in choosing portable sound equipment.

The microphone: This is the one component to which a lot of general rules do not apply. Your choice of a microphone should be based on its having the response characteristics that make **your** voice sound the best. Some mics. have a lot of bass response. If your voice is in the bass or low baritone range, this is a bad choice for you: You will sound like you have your head in a barrel. If your voice is high in pitch, this is exactly the kind of response that will make you sound the best. When you test a mic., hold it touching or almost touching your lips, and use a normal speaking voice. Use words like "Testing, this is a test," and "Pick up the tempo." Do the "S" sounds come over crisp and clear? Does the mic. have enough pop filtering that the "P" sounds don't sound like explosions? Have someone else listen while you compare mics. Your voice over a mic. sounds completely different to those who listen to you than it does to you. Chose the mic. that your partner says makes you sound the most natural: Don't rely on yourself. You will use that mic. for a long time, and a few dollars difference in price should not be the deciding factor in your choice.

The amplifier/mixer/turntable/tape player is the heart of the sound system, and usually the most expensive component. Here are some things to check out before you buy, most also apply to microphones and speakers.

What features must I have? You need enough power to cover the halls you work in and the size groups you have. If you don't have enough power to cover your groups, you have made a bad buy no matter how much money you saved. Do you need a variable speed turntable or tape player? What is your music source? If you are using a laptop or MP3 player you will need the proper input on the sound system. Will you be connecting more than one music source at a time? If yes, then you need more than one auxiliary input on the sound system. Microphone tone controls must be completely independent of the music controls, or every time you cut the treble in your music your voice will sound as if you were down in a well. Do you need to make and/or play back recordings? Other available built-in features to consider are such things as vumeters, tone arm reset, monitoring capability, etc. If you have use for these, go ahead; if you don't, you may be paying extra for something you will never use. One option that many find very useful is a remote music volume control like the one on our Hilton sound systems microphone cables. Once you have decided how much power you need and which optional features will be useful to you, there are still several others to consider, in making your choice.

Performance: Will it do the job for you? Can you get your money back if it doesn't? Of course you can get a refund or an exchange if you buy something and it doesn't work. But what happens if it does work, and you just don't get the coverage that you need? Is there a time period during which you can try the unit and get your money back if it doesn't do the job? Don't buy new equipment without a clear understanding about this.

Dependability: What is the track record of this particular brand? Dependability is more important than appearance or extra features. When a sound system breaks down it is more than just an inconvenience. Check with other people who use this make and get opinions based on experience.

Warranty: Check the length and terms of the warranty. Get the answers to these questions: How long does it take to get repair if you need warranty service? Free parts and labor are not the whole story! If you have to ship the unit somewhere and wait while it is repaired, what do you do in the meantime? Are rental systems available? Does the warranty include shipping costs? Find out before you buy.

Customer Service: What is the reputation of the people with whom you are dealing? If you are buying from a dealer, will the dealer provide warranty service? What happens after the warranty expires? Will parts be available if you need them? This is especially important if you are buying used equipment. When this unit is several years old, can you still get parts for it? Unless you can get replacement parts the whole unit is a piece of junk if one component goes bad.

Price: Once you have picked out your first choice, will your budget stand the price? If not, what are you willing to give up to get the price down into your range? If you buy something that is inadequate it is no bargain at any price.

All too often, we consider only the initial purchase price and ignore other things that have just as much impact on your finances. First, how long will it last? Replacing a $500.00 unit every two or three years is more expensive than buying a $1200.00 unit that will last ten years, not to mention the superior performance that you will get from the better unit. Second, what will be the cost of repairs and availability of service over the next several years? Third, what will its resale value be in five years? To arrive at your real cost, take the original purchase price and add a reasonable estimate, based on the experience of others, for repair and maintenance over the next five years. Subtract that total from its cash value at the end of five years. This will give you the true cost of owning the sound system. If you shop for price alone and fail to consider the other things that we have mentioned, you will spend more money in the long run.

The loudspeakers: Here is a real jungle. For every established manufacturer of a full line of portable sound equipment, there must be a dozen entrepreneurs who buy loudspeakers wholesale, put them in enclosures and sell them under their own brand name. It is quite possible to buy two different brands at two different prices and find exactly the same type of speakers inside.

Check with other instructors and see what they use and what their experiences are with different speakers. Go to dances where different speakers are being used and do your own evaluation while you dance!

If you have an amplifier that you know has adequate power and sound quality, you can still get poor results by using speakers that are inefficient and/or have

very limited frequency response. A complete discussion and comparison of various types of loudspeakers and speaker enclosures would take far more space than we have, and probably nobody would read it anyhow! But here are some bits of advice, to help you in making a choice of loudspeakers:

1. Never buy loudspeakers which have a lower power rating than that of your amplifier. You'll get distortion, overloading, maybe even eventual damage to your speaker or your amplifier.

2. Never buy a loudspeaker without getting a guarantee that after a fair trail if it isn't giving good results, you can trade up or get your money back, at your option. You will know in a very short time whether you are getting your money's worth.

3. Make sure the impedance correctly matches the amplifier you are using.

4. When you have decided on the make and model of sound system that you want if you are also buying speakers, first try the same brand as the amplifier. Even if you have a guarantee of satisfaction that we mentioned, if two different sellers can point the finger at each other, you may have some difficulty in bringing a problem to a satisfactory conclusion. If for example, you buy a Hilton sound system, try Hilton speakers with it first; if you don't like them get your money back and try another brand. Another consideration: If you buy a complete package sound system you'll usually get a discount on the speakers: If you buy two different makes you'll likely pay full price on both sound system and speakers.

Checking The Hall

SIZING UP THE HALL Two halls may look very much alike, but one may have excellent acoustics and the other may be terrible. The single most important consideration which determines whether you will be successful in providing good sound is its REVERBERATION TIME. This is the number of seconds that it takes for a single sound to die away in a single hall. A hall with low reverberation time will be easy to sound. A hall with a high reverberation time will be difficult if not impossible to sound properly. To measure the reverb time, stand in the center of the empty hall and clap your hands. Count very carefully the seconds it takes for the sound to die away completely. If your watch has a second hand, use it; or you can count one thousand one, one thousand two, etc.

If the reverb time is more than three seconds the sound will not be good. With a music tempo of 120 beats per minute and a reverb time of two seconds, along with each music beat the dancers hear, they will also still be hearing the last three beats. This is what causes the music to run together and make it hard to distinguish the rhythm and the melody.

Let's look at the things that affect reverb time. Reverberation is caused by sound reflecting back and fourth from one flat surface to another. The harder and flatter the surface, the more reverb will be present. Conversely, soft and irregular surfaces tend to absorb sound and reduce the reverb time. A ceiling of acoustic tile or blown fiberglass will greatly reduce reverberation. Heavy velour drapes covering a hard surface will also reduce reverb. A wall covered with acoustic tile will not reflect sound and will reduce reverberation.

Here are some suggestions to help minimize reverberation. If there is one wall which reflects more sound than the others, never aim speakers at that wall. If there is one wall which absorbs more sound than the others, direct speakers

towards that wall. Try to aim speakers downward, at the dancers, so the sound won't bounce directly off the opposite wall. Think of the sound as a beam of light, and aim it at the dancers, not at a surface from which it will bounce back. In a reverberant hall, the less volume you can use the better the sound will be; if your speakers are well above the dancers' heads you can reach the farthest dancers with less volume than if they are at head height or lower. There are things you can do with the volume and tone controls on your sound system which will be of some help in a reverberant hall; they will be discussed later.

Reverberation time is important. One and a half seconds or less is a good indication that a hall has good acoustics. If you don't have good sound in such a hall, either your sound system is inadequate or you are doing something wrong. Two seconds of reverb is usually acceptable. If you set up correctly and use care in operation of the sound system, your sound should be at least passable. If the reverb is three seconds or more it's unlikely any type of sound equipment or amount of expertise will produce truly good sound in this hall. Certain things can be done, as mentioned above, to make it less bad, but nothing short of acoustical treatment of the hall will produce good sound with such a reverb time.

Operating Your Sound Equipment

OPERATING YOUR SOUND SYSTEM

We have discussed how to check a hall to determine whether it is possible to get good sound coverage in it; we have talked about how to set up your sound equipment to get the best sound coverage possible; this time let's talk about how to use that sound equipment, once you have set it up.

Your microphone--what it does and how to use it:

The microphone has a diaphragm which when vibrated by the sound of your voice striking it, generates electrical energy and feeds it to your amplifier. Unfortunately, it also picks up all of the other sound waves that strike it. How do you hold a microphone so that only your voice goes into it, and not the other sounds that you don't want to pick up? Up close to your lips. Forget about all of the people you see on TV with a mic. clipped to their neckties or held 8 inches away from their lips. That won't work for you! Why?

Two reasons. First: The law of inverse squares, if you hold your mic. a half inch from your lips it receives a given amount of sound energy from your voice. Move it twice as far--1 inch--does it receive half as much energy? No--only one fourth as much! That extra half inch takes away three quarters of the efficiency of your sound system! Second: When you move the mic. away from your lips, you must turn up more power to be heard, and more outside sound enters the mic.. When sound from the speaker enters the mic. it is fed back into the amplifier, and in a split second it builds into the earsplitting screech we know as feedback. Feedback is always the result of poor microphone technique: not working close enough to the mic..

Form the habit of holding your mic. correctly and it will soon become second nature to you.

Now that we know how to hold a microphone, there is more that must be learned, involving projection and enunciation. Did you ever hear somebody use a mic. and you couldn't understand a word they said? The next speaker uses the same mic. and he doesn't sound any louder, but suddenly

every word is clear? There's more to it than working close to the mic..

How loudly should you speak into a microphone? If you are sitting at a table that is six feet in diameter and you project enough so that someone sitting across the table can hear you clearly, that's about how much you should project into a microphone. You don't need to shout: In fact, doing so can overload a mic.. Form the habit of projecting your voice into it. Again, it will become automatic in a short time.

It is quite possible for people to hear you clearly, and still not be able to understand what you say; a loud mumble is still a mumble! Many of us don't open our mouths very much when we speak. Most of us are not consciously aware of the locations, inside our mouths, where we form our words. How we enunciate is very important.

Here's an experiment you can do yourself: It won't take much time or trouble and it will prove all of the things we have been saying. It is also good practice at forming the correct habits. Set up your sound system at home. If you have a tape recorder, so much the better. Plug it into your amplifier so you can play back your experiments and listen to the results.

Let's take some words; they don't have to make sense: shuffle, step slide. Set the mic tone control at normal an turn up some volume. Say the words in a normal voice, holding the mic. about an inch from your lips, and listen carefully. Now hold the mic. so it touches your lips and say them again at the same volume. Now move the mic. an inch to the side and say them again. Notice how the sound drops off. Mic. technique is important!

How and where you form your words in your mouth is also very important. Try this: Say some words into the mic. as you would normally say them. Now, consciously try to form the same words as far back in your mouth as you can and say them into the mic.. Now, consciously try to form each sound of each word as far forward in your mouth as you can, and say them again. The difference is amazing! When you are using a microphone, try very hard to form your words as far forward in your mouth as you can, using your lips, teeth and the tip of your tongue. This kind of practice pays off. In a very short time it becomes automatic and you couldn't mumble if you tried! Try smiling as you speak--the words will form in the front of your mouth and you can hear the improvement in clarity.

Here is one more test: Say the same words again, this time turning the mic. tone control towards bass. Notice how the sibilants disappear, and you sound as if you had developed a lisp? Now turn it towards the treble. The sibilants come back, but your voice sounds less mellow. If you have to choose between sounding mellow and being understood, which do you pick? Take out a little treble to make your voice sound more pleasing, but not to the extent that you lose any intelligibility.

Handling your music:
Since you are all set up, let's move over to the music side. You normally have three knobs there:. volume, bass, and treble. A lot of people don't use the volume control enough. You can't just set it and forget it.

Different recordings are recorded at different levels. This means that you must check volume every time you change CD, MiniDisc, record, or tape, and sometimes it's a good idea during playing. Do you drop the music volume a

bit while you are cueing over the music so the dancers can hear you clearly, and bring it up when you are not? Doing this insures the dancers are hearing the cues they need to hear while still being able to dance to the music. Are you cueing a routine the dancers know very well or is it a new one where they have a greater need to hear your cues? Ask yourself these questions when adjusting the volume and tone on your sound system.

The bass control is for the low frequencies in your music. If your music source has a real booming bass, you can take some of it out. If it is mostly fiddle, with a weak bass beat, you can put some more in, to get a more solid rhythm that the dancers can hear. More about this control when we discuss balancing the program and playing back taped music.

The treble control is for the high frequencies in the music. A fiddle tune may sound a bit screechy, especially in some halls--taking out some of the treble can make it sound a lot better. If you have an old favorite record or tape that sounds a bit worn and scratchy then take out some of the treble and you cut down the surface noise and hiss. For a weak melody lead boost the treble and it may come through better.

Using MP3 music:
If you use MP3 music, either on a laptop or MP3 player, make sure the level is correct and recorded correctly, especially if you have created the MP3 yourself. "Normalizing" insures the volume levels are consistent on MP3 songs. Abide by all legal considerations when using MP3's.

Music on tape:
With many makes and models of cassette recorders the music will sound much bassier than the original, when played back though your sound system. With some of them you may have to turn the bass all the way to minimum and the treble to maximum in order to get the music to sound normal. Any tape which was made by air pickup through the microphone that is built into the recorder will suffer a loss of highs and sound more bassy than the original. Again, you must cut bass and boost the treble to improve the results on playback.

Balancing the program:
In any hall there is three levels of sound: The ambient noise, made by the dancers, sideline conversations, etc.; the music level, which must be louder than the ambient noise, and the voice program, which must come through clearly over the other two.

In almost every piece of music there are certain frequencies that interfere with the voice cueing program so that your cues don't come clearly over the music. Do some practice cueing with your sound system, and as you do, experiment with the music bass and treble controls. The chances are that for any given piece of music you will find a combination of settings that really make a difference and helps your voice stand out clearly over the music. A little homework can make a difference in how well your dancers can hear you.

Recordings with vocals: Any dance instructor can tell you that these are the toughest to work with. The dancers are put in the situation of listening to two voices at the same time and trying to understand what each is saying. Try lowering the music volume as mush as you dare while you are cueing; cut some treble out of the music and add some to your voice--or vice versa. One or the other (more likely the first) might help.

In a reverberant hall, certain frequencies will echo worse than others. If high sounds like snare drums, rattle around,

cut the treble as far as you dare. If the echo sounds boomy and bassy, cut the bass and boost the treble a bit. Always hold the volume down as much as you can: The louder the program the worse the echo. As we have mentioned before, you can't get good sound in a truly bad hall, but maybe these tips will be of some help.

Setting Up Sound Equipment To Get The Best Results

YOUR SOUND SYSTEM: SETTING IT UP TO GET THE BEST RESULTS

Before we talk about setting up your sound system. let's talk a bit about what you have to work with.

The amplifier is the heart of the sound system. The music source (phonograph, Laptop, MP3 player, tape, MiniDisc or CD player) generates a feeble electrical current. The diaphragm of the microphone is vibrated by the sound waves of your voice and it also generates a feeble electrical signal. Because they change energy from one form to another they are called transducers. Feel free to use that word any time you want to impress somebody. The amplifier picks up these feeble signals, makes them much stronger, and delivers them to the third transducer in the system, the loudspeaker, which changes the electrical energy back to sound energy again. Unfortunately, it changes only part of the electrical energy to sound; the rest is changed to another form--heat.

When you turn up the music volume control on your amplifier, the music will get louder until you reach a certain point. At that point it begins to get distorted, and the more you turn the knob, the more distorted it will be. You have reached the maximum undistorted output of your amplifier. From that point on, you will get very little more volume and much more distortion. Lesson number one: It is useless to turn up the knobs as far as they will go.

The speaker, as we said, changes electrical energy into sound. The two factors that limit the amount of sound a speaker will produce are its power handling capacity and its efficiency. Every speaker has a point at which applying more amplifier power will not produce any more sound; it just produces distortion which gets worse as more power is applied. This is called overloading, and too much overload can actually damage a speaker. It is quite possible that you could unhook that speaker and plug in another that would produce much more sound, without touching the volume control! The second speaker is more efficient than the first. More energy is turned into sound and less onto heat.

The amount of power that the amplifier delivers is measured in watts. Let's say that you have an amplifier that will deliver 25 watts without distortion, and a speaker that will handle 50 watts without overloading. If only you had a 50 watt amplifier, you could get twice as much sound from that speaker, right? Wrong. To double the sound level from a speaker requires ten times as much power from the amplifier. If you apply twice as much power you will get more sound, but nowhere near twice as much. That's lesson number two.

If you use two speakers instead of one you ought to get twice as much sound, right?. Wrong again. The maximum undistorted output limitation still applies. You will get more sound at the same control knob settings, because you have lowered the impedance. That's another impressive word, which we put in to convince any experts that we know what we're talking about. But anyhow, your amplifier has only so much undistorted output, and dividing it between two

speakers isn't going to get you twice as much sound. What you can get, if you set up your speakers correctly, is much better sound distribution. That's lesson number three.

Better sound distribution may well enable you to cover twice as much area as you could with a single speaker. With a single speaker you often have to waste part of your amplifier output by making the sound too loud in the front in order to get it loud enough at the back and sides of the hall.

In setting up your equipment, the most important consideration is where you locate and aim your speakers. A speaker sitting on a stage will cover only a fairly small area of the floor. If you raise it up a few feet, it will probably cover twice as much area with better sound. That's rule number one. Aiming your speakers at the dancers, not at the opposite wall, is rule number two. The sound must pass over the heads of the nearest dancers and reach the farthest dancers without bouncing off the opposite wall. If you can't cover the entire hall with the sound system you have, mark off the area you can cover with chairs or tables so the dancers stay within that area.

Square shaped hall:
One speaker: Place it at the midpoint of one wall: If the sound drops off too much at the sides, try placing it in a corner and see if you can reach the opposite corner with sound. If your speaker is of the open back type, try to place it against a wall. Just as much sound comes out of the back as from the front; if it is against a wall the reflected sound will reinforce the sound on the floor, and if it is very far out from a wall you lose efficiency and may well create an echo. Two speakers: Divide the area in half and use one speaker to cover each half.

Rectangular shaped hall: (length less than twice the width)
A consideration here is that different types of speakers have varying angles of lateral dispersion--the angle at which the sound fans out to the right and the left. Speakers with wide angles of dispersion ordinarily won't cover nearly as far straight ahead as those with narrower, more intense beam of sound.
One speaker: Try setting up at the midpoint of one (narrow) end. If you can't reach the other end, set up at one (wide) side and aim across the shorter dimension. The sound may be thin at the ends, but should be good in the central position of the hall.
Two speakers: In most cases driving across the shorter dimension gives best results. Place speakers so that each covers half the area.

Long, narrow hall:
One speaker: Set up at one (narrow) end. The higher you get your speaker the farther it will reach; if it won't reach the other end, it won't.
Two speakers: If the ceiling is so low that you can't set up at one end and reach the other end, use a long cord and place one speaker at each end of the hall, aimed at each other. Tilt both speakers down at the heads of the dancers at the center of the hall. This will give good sound with no "time lag effect" which would distort the sound at the center. Never set up one speaker at the end and another partway down the hall aimed the same direction as the first. Without sophisticated time delay devices such a setup will have the affect of creating an echo in the back of the hall; this is the same problem caused by excessive reverberation.

Outdoor setups:
These require much more power because there is no sound reinforcement from reflected sound. Aim speakers at trees and shrubbery if possible, never at

a flat wall or you will really have an echo. One or two additional speakers are often require outside to keep the coverage even as well as the extra power to push them.

Sound For Large Festivals

SOUND FOR THE BIG CONVENTION

The job of sound coordinator, or contractor, for a big convention or festival is a thankless one. If the sound is good--well, that's what everyone expected; if it's bad, it's all your fault. Don't take the job unless you know what you are getting into. That's the best way to keep out of trouble.

Unfortunately, there is no possible way to tell you everything you need to know, in this publication. If you are thinking of doing sound for a large convention we recommend talking with as many people with experience in the field as you can. Also make sure you know exactly what you are getting into. Listed below are a few of the questions you need to have answers to.

- how many halls
- are the halls acoustically good enough to use for dancing
- make sure the halls are acoustically isolated from each other
- have you sounded these halls before, and if not, have others and what was the sound like
- what are the sound equipment requirements for each hall
- what is the schedule for when each hall will be in use
- when can you get in to set up and check out the sound
- is adequate AC power provided at each stage
- will power be on before the start of the event so you can do your sound tests
- how close can you park your vehicle for unloading and later for packing out
- do you need a permit to bring a vehicle into the facility or park close
- do you need AC outlets available for each instructor to plug into at each stage table
- what music sources will be used
- do you need to supply a record player, MD player, CD player.... for each hall
- what are you expected to supply so each instructor can connect in and play their music
- do you need to supply a microphone and cord for each hall
- do you need to supply a wireless microphone for any hall
- will instructors be using their own microphones, cords, and wireless microphones
- if there are multiple wireless systems, are you prepared for possible interference between them
- do you need to provide a "sound person" in each hall while the dance is on
- who covers insurance for stolen or damaged equipment
- do you need hotel space or RV spot close to the event

- do you and anyone working with you need special event ribbons
- do you need to supply "hearing assistance" equipment
- will you need a "walkie-talkie" to keep in touch during the event
- what "spares" do you need to have available during the event
- do you have a central secure location for the spares for quick access during the event
- do you need to provide a "monitor" speaker on each stage
- are there "union only" requirements for the facility, regarding set up and running of sound equipment
- will there be special demonstrations, fashion shows, or such, during the event -- what is required from you for each of these
- will "practice/rehearsal" time areas be needed by demonstration groups before or during the event
- demonstration groups often have special requirements, is a mechanism in place to convey their requirements before the event starts

Keep in mind -- each event is different and will require a fresh look.

Multiple Speaker Hookup

MULTIPLE SPEAKER HOOKUP In a multiple speaker hookup, it is necessary to consider impedance. This is the electrical resistance of the voice coils of the speakers. The lower the impedance, the more electrical energy is applied to the speakers. This is why specifications on power amplifiers will show a given power rating into an 8-ohm load, and a considerably higher power input into a 4-ohm load.

If a loudspeaker were 100% efficient, all of the electrical energy delivered to it by the amplifier would be converted into sound energy. Unfortunately, speakers are not 100% efficient; in fact even the highest quality speakers in the best designed enclosures are not more than 25% efficient. The electrical energy which is not converted into sound by a speaker is converted onto another form of energy--heat. This heat must be dissipated at two points: the voice coil of the speaker, and at the amplifier. Excessive heat at either point can cause damage to the sound system.

The minimum impedance load for a Hilton amplifier is 4-ohms per channel, for best operating results. Any speaker hookup that is 4-ohms, or higher, will not cause a problem with your sound system **but** you will have a loss of power converted to sound as the total impedance increases.

The hookup diagrams, in section 9 - "Diagrams", show correct use of the series Y connectors for hookup of 2, 4, 6, and 8 speakers, to obtain equal volume level from each speaker and maintain proper net impedance. If it should be necessary to connect 5 or 7 speakers, a slave amplifier should be used. It is impossible to get equal volume from these combinations with a single amplifier, unless you connect all of them in series; this hookup is not recommended.

If you must use a speaker hookup not shown in these diagrams, or if you plan multiple hookup of speakers not manufactured by Hilton, the following points must be considered:

1. You must use a hookup which will produce a net impedance load of 4-ohms or higher to one amplifier channel.

2. The net impedance to each leg of a series Y connector should be the same, or the speakers driven by one leg will receive more energy and therefore produce more volume than those driven by the other leg.

3. Different makes and types of speakers have different degrees of efficiency and will produce different sound volumes when driven at the same amplifier output level. Mixing different types of speakers is not recommended, but if you must do so, use the more efficient speakers nearest the center to cover the main portion of the floor, and the less efficient ones at the ends to cover the two front corners of the floor.

HOW TO DETERMINE NET IMPEDANCE

To determine the net impedance of a given combination of speakers, it is necessary to understand and apply the following:

IMPEDANCE: The resistance produced by the voice coil of a speaker, expressed in ohms. As an example Hilton "Workshopper" speakers are 8-ohms, the PS-10 and LB-1 are 4-ohms; other makes have varying impedance's, usually from 4 to 16 ohms.

PARALLEL CONNECTION: A hookup in which the output of the amplifier is divided among speakers, with part of the output going to each speaker. As an example the 2 speaker jacks on each channel of a Hilton system are connected in parallel. Connecting speakers in parallel decreases the net impedance.

SERIES CONNECTION: A hookup in which all of the amplifier output passes through each speaker in turn, instead of being divided up among them. If you plug a series Y connector into the amplifier and connect one speaker to each leg, you have the speakers connected in series. Connecting speakers in series increases the net impedance.

SERIES-PARALLEL CONNECTION: If you have two groups of speakers which are connected in parallel within the group, and connect one group to each leg of a series Y connector, you have a series-parallel connection. Series-parallel hook ups are used to get the correct, or optimal, speaker impedance for a given multi-speaker hook up.

NET IMPEDANCE -- The combined impedance of all speakers in a hookup:
IN PARALLEL -- the impedance of 1 speaker, divided by the number of speakers in the parallel hookup. This assumes that each of the speakers in the hookup have the same impedance.
IN SERIES -- the impedance of 1 speaker, multiplied by the number of speakers in the series hookup. This assumes that each of the speakers in the hookup have the same impedance.
IN SERIES-PARALLEL -- the net impedance of each parallel group, multiplied by the number of parallel groups connected in series. This assumes that each group in the hookup is the same impedance.

CONNECTING SPEAKERS OTHER THAN HILTON SPEAKERS

Any **one** speaker with the impedance of 4-ohms or higher can be connected directly to a Hilton amplifier.

Before connecting two speakers to the same channel, first find out their impedance, if possible. If they are 8-ohms or higher, connect them in parallel. Two 4-ohm speakers must be connected

in series. For other combinations, follow the instructions given above to obtain a net impedance of 4-ohms or higher.

CHECK THE POWER RATING OF THE SPEAKER AND BE CAREFUL NOT TO EXCEED IT. Overdriving of a speaker with a low power rating can result in any of the following: 1. Distortion of the program. 2. Voice coil may become jammed at one end of its excursion, making the speaker inoperative. 3. A short circuit may occur in the voice coil, ruining the speaker and possibly causing damage to your sound system.

Multiple Speaker Hookup Diagram
CORRECT HOOKUP FOR A SLAVE AMPLIFIER In certain situations it is desirable to use not one, but two or more amplifiers, each driving its own speakers, for proper sound coverage in halls which are too large to cover with one amplifier; to put sound in an additional room which requires a different sound level than the main hall; or to cover an ell which requires less volume than the main section of the floor, etc.

On Hilton sound systems the "low signal" out or "tape record" jack (depending on model) is designed for this purpose. To connect a slave amplifier, use the following instructions.

Set up the main amplifier with its speakers to cover the area desired. Set up the slave amplifier with its speakers to cover its assigned area. If the slave amplifier is to be located no more than 30 feet maximum away from the main amplifier, plug a shielded cable from the low signal out jack of the main amplifier into a microphone input on the slave amplifier. SET THE TONE CONTROL FOR THIS MICROPHONE INPUT TO FULL BASS, ALL THE WAY COUNTERCLOCKWISE. Play some music, preferably with vocals on it, thru the main amplifier and turn up enough volume to cover its assigned floor area at a comfortable sound level. Then turn up the microphone volume on the slave amplifier to produce sound coverage of its assigned floor area at a comfortable level. No further adjustment of the slave amplifier will be necessary. Every change of volume, treble, or bass which is made on the main amplifier will be duplicated by the slave amplifier.

If the slave amplifier must be located more than 30 feet away from the main amplifier, the use of a plain shielded high impedance cable is not recommended, because of the noise that will be introduced into the system. In this case, you must use sufficient length of LOW IMPEDANCE cable, and a pair of LINE MATCHING TRANSFORMERS. Adapter plug/s may be required so that the line matching transformer can be plugged into your amplifier. Plug one transformer into this adapter which is plugged into the low signal out or tape record jack on the main amplifier, and connect the cable and the other transformer. Plug the second transformer into the microphone input on the slave amplifier and proceed as described above.

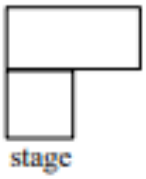
Disconnecting a slave hookup: Before disconnecting, make sure that both the main and the slave amplifiers are turned off. If they are turned on and volume controls are turned up, unplugging will cause a loud pop in the speakers, and even possibly damage them.

Some installations may require more than one slave amplifier; additional speakers or other considerations. Please contact Hilton Audio for advice before attempting such installations.

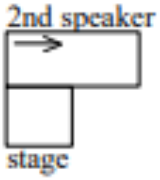
USING A YAK STACK

We have always found that the Yak Stack a much better sound has than other speakers and we wrote a note to Gloria Roth, who has learned the best way to set up a Yak Stack from the inventor of this system, Irvin Gross. This is what Mr. Gross has to say concerning the set up of the Yak Stack.

1. **Never** separate the column unless you have a hall shaped like this:



then, of course, you will need a speaker set for long side as well:

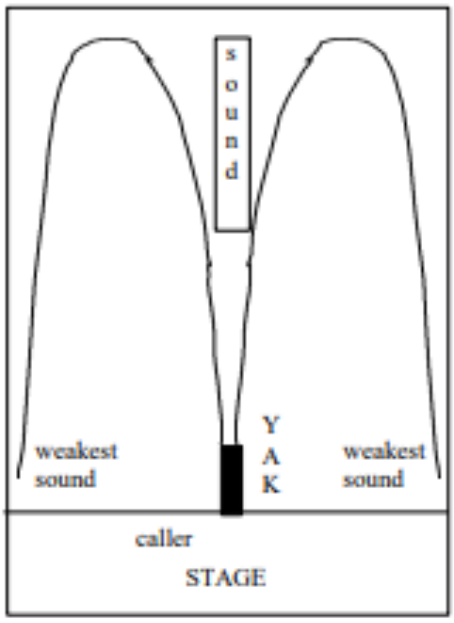


OR, if another hall is being sounded, like in a school where 2 classrooms are being sounded.

2. The height of the Yak off the floor should be such that the **lowest** speaker is at **head** level of the dancers. If the speaker is set too low or too high the sound is bad.

3. A Yak is constructed to send the sound down the hall in a "column", hitting the back wall and curling around, coming back up the hall on either side. The place with the least sound would be to the caller's immediate left and right corners.

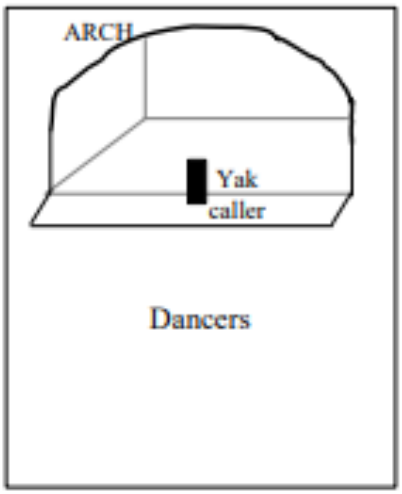
DIAGRAM OF COLUMN SOUND



Since often the better or more experienced dancers dance near the front, they can "handle" the weaker sound - and "weaker" sound does not mean bad sound. Experience has shown that even in large crowds with 30 to 50 squares there has never been sound problems with the Yak Stack set up this way.

4. **Always** have the Yak **in front** of the caller, near the edge of the stage and out **beyond** any overhead arch or curtains. If it is behind the arch, it will not be effective.

Set up of Yak by a stage with an arch (looking at the stage from the floor)



Usually the stage extends a few feet beyond the overhead arch, and that is where the Yak should be placed. The caller would stand beside the amplifier, just behind the Yak.