



Accusound

27th Edinburgh International Harp Festival – How to Amplify your Harp

How to Amplify your Harp

by
David Anderson CEng
Accusound.

27th Edinburgh International Harp Festival
28th March – 2nd April 2008

www.accusound.com
David Anderson CEng
Acoustic Consultant



Amplifying your Harp.

- Louder not noisier

Firstly lets start by defining what we or I mean by amplification.

*Amplification is the increasing of the sound level not just making the noise level higher.

This means you need to increase the level of all the sound, i.e. full frequency range and you must increase it linearly, i.e. without distortion, in level or frequency.



Process of amplification

- Sound chain has four phases
 - Pickup or collect the sound
 - Process the sound
 - Amplify the sound
 - Replay the sound.

So what is involved in the process of amplification

*I have split the amplification sequence into 4 parts;

*Picking up or collecting the sound – collecting all the sound correctly

*Processing the sound – changing the tone of the sound or adding reverberation or effects – making alterations that YOU want

*Amplifying the sound – making the signal louder and suitable to operate a loudspeaker

*Replaying the sound – changing the electrical sound back in to an acoustic or audible signal or sound.

All 4 parts are equally important to get a correct any fully functioning amplification.



The Source of the Sound

- Where does the Harp sound come from
 - Strings
 - Sound board & Sound box

To start at the beginning WHAT IS THE SOURCE OF THE SOUND?
WHERE DOES THE SOUND COME FROM?

The Harp is a large instrument sound the sound comes from more than one location;

*The strings start the sound and are responsible for the type and frequency of the sound

*The sound board and sound box amplify this signal with the tones and characteristics of that make and variety of instrument, this produces the character of the instrument which presumably you like.

These two parts make up the initial sound of the harp or the excitation signal.



The Final Sound is a Combination of Effects

- What makes up the total sound of the Harp
 - Source
 - Strings & Soundboard
 - Room/hall in which it is played

The final sound heard is a combination of effects;

*What makes up the final sound

*Source – as we have discussed

*The strings and soundboard & soundbox

*The room/hall where you are playing and where the music is being listened to.

Once the harp has created the initial sound or signal it combines with the surroundings to create the final sound heard by the audience.

A very dry or soft room can make the instrument sound dull or timid

A very hard room or one with many echoes can make the instrument sound very warm and alive or if it has a lot of echoes, it can sound very blurred.

But it also depends on the music you are playing as to which is the “better” or “nicer” sound.

It also depends on you and what you want to sound like and what you want to get over to your audience.



What sound do we need to capture?

- Where do we “Collect” the Sound?
 - Outside the instrument
 - As and audience
 - Sound board
 - As original as possible
 - Inside the instrument
 - ? resonant

So if all these parts make up the sound and feel of the instrument what sound do we need to capture and where do we collect it from?

*

The obvious choices are

*Outside the instrument

*– like the audience would hear it or someone else on the stage, depending where you had your microphone

.

This is indeed what you do if you are recording the music and wish to replay it again in a different location, i.e. your living room. It helps to keep the ambience of the venue and gives more life to a recording. But perhaps it is not the best if you just want to increase the level of your sound whilst playing.

*From the soundboard/box

*– This could be considered as the origin of the sound so it is close to the actual sound the instrument is making with no added effect of the room/hall

*Inside the instrument – again this is a close sound it is also a good representation of the original sound of the instrument.

*However depending on how you collect the sound, the sound box can be very resonant, and very dominant on one narrow band of frequencies. But more later.



How?

- How do we “collect” the sound
 - Microphone
 - Contact strip

*How do we collect the sound.

Again I will split this into two main methods we have

*Microphones – traditional hand held type microphone picking up sound travelling in the air. May not be a hand held type it may be much smaller, but the way of working is the same.

*Contact strip – this converts physical vibrations in to an electrical signal, will work just in air but it is very quiet, it is intended to work on a vibrating surface like the soundboard of an instrument.



Pros & Cons of pickup device

Which type of pickup

– Microphone

- Feedback (-ve)
- Natural sound (+ve)
- Hindrance to player (-ve)
- Bulk on stage/in rehearsal (-ve)

– Contact strip

- Reduced Feedback (+ve)
- Dryer sound
- Small and hidden (+ve)
- Lightweight (+ve)

*So do you use microphones or a contact strip?

*A microphone works by picking up sound in the air,

*-it has a higher susceptibility to feedback, the howling noise sometime heard from PA systems, more later.

*-Because it picks up what we actually hear, it can give a very realist and natural sound,

*-Sometime more than one may be required and these may require to be on stands so can be a hindrance to the player or a distraction to the audience preventing them from seeing the player.

*-For the same reason they can be bulky and can cause problems on stage.

*The contact strip,

*- because it picks up the vibrations of the soundboard it can be less susceptible to feedback and so allow a higher amplified sound. It is not immune.

*-Because they pickup the soundboard vibrations they can sound dryer than a standard microphone, but this is not always the case.

*-They are often small so can be easily hidden, because they stick to the instrument, there is no need for stands to hold them. If the whole system is done well, the audience often cannot tell the harp id amplified at all.

*-They are also very light weight.



Process the Sound

- Preamplifier
- Tone controls
 - Parametric equaliser
- Effects
 - Reverberation

The second phase of the amplification is to process the sound.

This is manipulation of the signal between the microphone and the sound coming back out of the speaker. It can be minor or it can be major.

*Firstly there is generally a preamplifier – to interface with the microphone or pickup strip and make the signal compatible with the rest of the amplifier circuitry.

*There are likely to be some tone controls,

*-and/or a parametric equaliser.

*There may be some special effects, either in the main unit or available from an external unit.

To go deeper into each of these.....



Process the Sound - Preamplifier

- Preamplifier
 - Matches the microphone/contact strip
 - Provides power to microphone
 - Allows interference free transmission along cable

*The preamplifier;

*This is used to make the signal from the microphone or input device compatible with the main circuitry.

There are various different types of preamplifier but this is dependant on the pick up device you are using, it is best to get this with the pickup device as a package so compatibility is assured. It often comes as a set, pickup and preamp, sometimes called a power adapter, battery box or similar.

*It also provides power to the pickup device, microphone or contact strip, if this is required. It may do this by phantom power or by battery. (Phantom power will be explained later)

*It generally boosts the microphone signal so it will travel down a long cable to the main amplifier unit.

It is usually located very close to the microphone or it may be built in to the mic and be part of the microphone or pickup. It can also be in two parts, one part as part of the pickup and the other as a discrete device.



Process the Sound – Tone controls

- Tone controls
 - Allows adjustment of bass and treble
- Parametric equaliser
 - Allows variable adjustment
 - Allows “correction” of instrument or room

*The tone control is just like a tone control on a hi-fi or radio.

*There may be separate bass and treble controls or there may be a third mid control. This is just the same but at a frequency between the bass and treble.

*There is sometimes a parametric equaliser, or parametric control.

This is exactly the same as a bass or treble control but there is an additional knob which allows you to select which frequency it acts upon. This can be useful if your instrument has a strong resonance at a particular frequency or a particular string makes another part vibrate rather more strongly than you like. You can tune it into that frequency and reduce the amplified level. This is quite common with violins when the microphone is placed over the f hole. The instrument has a strong resonance from the f hole which when you listen at some distance just becomes part of the character, but when you place a microphone at this location it over emphasises this frequency and makes the sound a bit boomy. This may also be true for a microphone placed inside the soundbox of a harp.

*Both these types of controls also allow for room corrections, in the same way a particular venue may have a particularly resonant frequency or conversely a venue may appear to suck all of a band of frequencies out of the sound, the parametric can be used to boost a small range of frequencies.



Process the Sound - effects

- Effects – Reverberation
 - Add warmth
 - Add distortion
 - Make your sound unique

*Reverberation is a common effect available on amplifiers.

This adds a little reverberation of various types to the original signal.

There can be one or two to choose from or there may be 16 or more, some are more useful than others.

*Addition of reverberation can add warmth and give the sensation of more than a single instrument playing.

There are other effects available;

*Simple distortion, as you might get with electric guitars, can be useful if you are playing in a more rock scenario.

There is compression, this reduces the dynamic range of the instrument, so loud notes aren't so loud and quiet notes aren't so quiet. This can be useful in amplification as it can make the sound appear louder without actually being as loud and also it can reduce the onset of feedback.

Often amplifiers allow external effects to be connected to the amplifier so anything which is available from your local music shop can be used.

There are many effects available and perhaps there could be whole session spent just discussing the merits of each.

*This allows you to make your own unique sound.



Amplify the Sound

- Amplification & Power amplification
 - Increase the level of the signal
 - Convert the signal to be capable of operating a loudspeaker

*Once all the “fiddling” has been done the signal needs to be made ready to go to the loudspeaker.

Just as we had a preamplifier at the input side of the amplifier we now have a power amplifier to make the signal suitable for the loudspeaker.

*This increases the signal level and

*increases the power capability to make the loudspeaker work.



Replay the Sound

- Loudspeaker
 - Size
 - Cabinet
 - Loudspeaker device
 - Number
 - Cabinets
 - Loudspeaker devices per cabinet

The last phase is to replay the sound – the purpose of all the previous work.

*The loudspeaker is essentially the reverse of the microphone, it converts the electrical signal back into sound energy so we can hear.

There are many things which will effect how well the speaker works.

*Firstly the basic size of the loudspeaker.

Just as the longer heavier strings on an instrument make the lowest notes, for a loudspeaker to replay these lowest notes it also needs to be large, generally the larger it is the better the low notes will sound.

*- This then dictates the size of the cabinet or box the speaker can fit in. The physical size is one aspect but also the speaker requires an amount of air behind it to allow it to produce these low notes. (there are various tricks manufacturers can do to reduce the size and still maintain good low frequencies but they can never get away from the fact that the larger the cabinet and speaker the better the low frequency will be.)

*- So the loudspeaker device itself also needs to be large.

*The number of speakers can also have an effect,

*- If you want a very loud amplification then you may be better off with more speakers rather than a single speaker trying to do the same job, each one then works a little less and is less likely to cause distortion.

*- Similarly the number of loudspeaker devices in each cabinet will make a difference. – I will discuss this a little more later.



What do you buy – microphone/contact strip

- Microphone or Contact Strip
 - Your choice
 - Listen before you buy
 - Our suggestion
 - Contact Strip
 - Good sound quality
 - Simple
 - Robust

So we have talked about what does what, how we do this or that but the question remains

*What do you buy;

*Microphone or contact microphone?

*-This is really the choice of the player and what they like, I would not like to say that anything is bad. Certainly if you buy from a respectable supplier, then all microphones or contact strips will be good, but they may not be what you like want or need.

*I would say you must try any system before you buy it. When you try it you also need to try it in your surroundings, not in a shop not on a stand at an exhibition although this can be a start, you need to use your equipment in your surroundings with your instrument, preferably even at one of your gigs.

*- Our suggestion

From us at Accusound we can provide a standard type microphone or a contact strip. From customer response and work done by Pilgrim Harps,

*-we recommend the contact strip.

*-This seems to produce a very good sound, very natural,

*-it is easy and simple to use and

*-quite robust.

We always suggest you try the product before you buy it. Listening to something will tell you if you like it, spec sheets or other people will tell you if they like it but you need to try it yourself.



What do you buy - preamplifier

- Preamplifier
 - Supplied with microphone or contact strip
 - Ensures compatibility
 - Buy specialist preamplifier
 - Can give more flexibility - complications

*As we said earlier,

*-the preamplifier should come as part of the microphone or pickup.

*-this ensures compatibility and gets you started.

* You can buy specialist preamplifiers with various extra functions, these are not strictly necessary but if you want some of the functions or it fits your needs better in another way then there is no reason not to use one. You do need to make sure it is compatible with your microphone or contact strip.



What do you buy - amplifier

- Amplification & Replay
 - Combo amplifier
 - Amplifier and speaker in one unit
 - Compact & lighter
 - Everything is compatible
 - Discrete amplifier and speakers
 - Can mix makes
 - Upgrade parts later
 - Specialist parts

*There are many amplifier/speaker units available on the market from music stores etc.

*The combo amplifier, - combo because it combines the amplifier and the speaker in one cabinet.

*This is compact and lighter than separate units and you know

*everything is compatible.

*An alternative to the combo amplifier is to use Discrete units – amplifier and speakers in different boxes.

This can give more flexibility as you or your band grows, you can easily add instruments and functions but it can be bulky.

*You can buy from different manufacturers, there is a general compatibility between parts, mixers, amplifiers and speakers.

*You can then upgrade only one part at a time, increase the size of your mixer to allow new members of your band.

*You can have specialist parts, perhaps you find an amplifier which has something you particularly want you can add this without having to bin everything else.

I won't go any deeper into the discrete route but if you have any questions later I will be happy to answer them.



Amplification & Replay – Combo amplifiers

- Combo amplifier
 - Acoustic amplifier
 - Keyboard amplifier
 - NOT electric guitar amplifier

There are several types of combo amplifier

*The Acoustic amplifiers

These are made to reproduce the sound of acoustic instruments. They are intended to give the full frequency range and to give it with minimal distortion so reproducing the original instrument sound.

*There is the keyboard amplifiers also designed to do the same thing.

*Then there is the most common combo amplifier, and one you generally want to keep away from, this is the electric guitar combo amplifier.

These are made to give a particular sound, perhaps the 60's Hendrix sound, it is as if they are instruments in themselves, adding their character to the sound.

Many of these amplifiers are equipped with electric guitar type input connectors and input electronics. This is not always the case and there are increasingly more amplifiers with good high quality microphone type inputs, some with phantom power – again more later.



Amplification & Replay – Discrete systems

- Discrete Amplifier and Speakers
 - Mixer
 - Input to system
 - Power Amplifier (Head Amp)

 - Satellite Speakers
 - High frequencies
 - High energy
 - Bass Bins
 - Low frequencies
 - Feeling to the Sound

This system is more complicated but more flexible and is more suited to larger setup for large halls and/or large groups.

The start of the system is the mixer, this is just a number of input sockets for different instruments or microphones.

It is called a mixer because it allows all the input signals to be mixer together and fed to the single amplifier/speaker system.

It allows you to adjust each instrument or microphone level and tone, sometimes in quite elaborate ways, it also can allow different effects to be added to each input or a group of instruments.

This generally then goes to the main amplifier. This is the same as the amplifier inside the single box unit we have talked about but it is in a separate case and as such can be changed for larger or smaller units depending on the size of the venue.

Following on comes the loudspeakers, there are generally two varieties, mid and high frequency as one and bass as the other. The mid/high units are often called satellite speaker because they are placed at various places round the hall or stage. The bass speakers are often called bass bins, because they are large open top boxes looking like large waste bins. The location of the bass speakers is not very important as the human brain is not able to tell the direction of low frequency sound as well as it can with higher frequency sound for this reason the satellite speakers are place in locations to make the amplified sound appear to come from the players. The low frequencies add feeling to music and also give an added feeling of quality.



Amplification & Replay – House PA

- House PA
 - Discrete system
 - You need to provide Preamp or DI signal
 - DI - Direct Injection
 - Signal output from preamp
 - Monitor amplifier
 - » Your personal amplifier

I'll only touch on this subject

*A house PA system is like the discrete system but the speakers are often fixed in location.

*-There will be a mixing desk to take the inputs so you will have to provide a preamp for your instrument or a DI signal.

*A DI or Direct Input signal is just a preamp output but often taken from a separate box. It is often used to convert one type of connection to another, i.e. guitar signal to microphone input.

*-It can be the output from your preamp

*-or a signal from a monitor amplifier or your personal amplifier, you have on stage to hear yourself.

You can buy DI boxes but if you have a personal amplifier it will often have a DI output and you can then use your personal amplifier as a stage monitor.



Effects

- Built into amplifier
 - Part of your system
- Foot pedals
 - Add as many extras as you like
 - Plug into effect socket of amplifier

*Effects;

*The simpler effects are often built into the amplifier so are

*-part of your own system

If they are not you can use

*Foot pedals.

*-Generally you can add as many as you like, one after another so building up a great range of effects, but normally one or two suffice.

*-These can be plugged into your amplifier via a socket call “effects” or sometimes “send/return”

The most common effects like reverb are often available built in the amplifier and accessed via switch to select the reverberation type and a knob to control the level of the reverberation.

.



Connections

- ¼" jack
 - guitar/headphone plug
- XLR
 - pro-audio, microphone, connector
- Mini-XLR
 - Smaller version of XLR

Another confusion is the type of connectors on microphones and amplifiers.

*The oldest and perhaps the most common is the ¼" jack plug or socket.

*-This is the guitar type connector or headphone type of plug.

This is not usually suitable for microphones, although some microphones do come with this connector but generally they are not very high quality.

*The next is the XLR connector For microphones we use the 3pin XLR,

*-this is the normal professional microphone input type connector.

*Finally is the mini-XLR, The most common types are the 3 and 4 pin version.

*- Basically a smaller version of the XLR above and is common on wireless systems and some microphones.



Professional inputs

- **Balanced XLR**
 - Higher quality
 - Uses high quality microphone inputs on amplifiers
 - Inherent immunity to interference
 - Not usually suitable for effects (we produce a breakout box)
- **Phantom power**
 - Batteries not required
 - Preamplifier can be as close to pickup as possible.

*Balanced XLR connector

*- These are very robust and high quality connectors

*- They are found on the better microphones and amplifiers

*- Because they are balanced they are almost immune to interference

Balanced systems use three wires for the signal, one earth as normal but two for the actual signal, one has the normal signal and the other has the exact opposite signal. When connected to a balanced input the input circuitry measures the difference between these two signal wires, because they are opposite the input sees twice the signal level. If there is interference on the cable then this is generally the same on both wires and then the input looking at the difference see no difference and so does not amplify the interference signal.

*- The down side for these connections, as far as use with instruments go is that they are not generally suitable for effects pedals, Accusound however make a break-out box which allows the signal to be used with effect pedals, but maintains other facilities like the phantom power, we will talk about that in a minute.

One other facility of this type of system is that it also provides;

*Phantom power;

XLR Microphone inputs provide power for the microphone, this is phantom power, it is generally 48v but may be 12v on some systems,

*- this means batteries are not required,

*- also any preamplifier which is required can be very close to the microphone or contact strip.



Problems and drawbacks.

- Problems that arise
 - Feedback
 - Amplifier sound getting back to microphone
 - Un-natural sound
 - Localised pickup
 - Too distant pickup
 - Resonant pickup

*There are various common problems that arise in amplification systems;

*Feedback is probably the most common and most disturbing problem that arises.

*Feedback is caused when the sound going into a microphone is amplified, goes to a loudspeaker and then gets back to the microphone louder than it started. This self generates to produce a loud shrill sound.

In the short time the way to avoid this is to reduce the amplifier level, turn the volume down, move the microphone and speaker further away from each other.

In the long term, higher quality microphones are less susceptible to feedback because of their smoother frequency response, but it will still happen, or to add specialist feedback eliminators to your system. This is expensive but does work but not as well as the name suggests. It can give a noticeable increase in level but it will not change a moderate system into a loud system.

The only way is to keep your speakers and microphones well away from each other and take time setting your system up before a performance. The use of stage monitors often makes the situation worse as this sends amplified sound directly back to the player and their microphones or pickups.

The use of contact strips also helps as these pick up the vibration of the sound board rather than the sound in the air. Obviously the sound in the air will also cause the sound board to vibrate but this is generally much less of a problem so you can often get a much louder signal from a contact mic than a standard microphone.

*Un-natural sound can be due to an imbalanced in low to high frequencies/notes.

*- Localised pickup is caused by perhaps the microphone is too close to the strings, you will pickup only a small range of the strings and not the full balanced instrument. You would need to move the microphone further away, so it is equal distant from all the strings, or add more microphones so all strings have at least one microphone close to it.

If however if you do move the microphone further away from the instrument then the balance of the instrument is better but you will get more ambient sound and the instrument sound will be quieter.

*-This then leads to a too distant sound

*-Also if you have the microphone close to a resonant chamber, not so true with the harp, you can get a strong resonance and signal of that frequency which colours the amplified sound.

What you require for amplification is not the same as you require for recording.

To record an instrument you often need the pickup device, microphone etc, further away from the instrument so you can hear the instrument as the audience would hear it, with ambiance of the room etc added in. If you are amplifying the instrument you often want a dryer signal, i.e. one which is more raw with little ambiance so when amplified it is the original sound of the harp being amplified and the room or hall then adds the ambiance to the sound and is mixed with the direct sound of the harp. If you amplify the ambient sound then this will have more ambient added to it and it can sound quite un-natural.



Important facilities.

- Features to look for in an amplifier
 - Input gain or volume
 - Tone control 3 band
 - Parametric tone control
 - Reverberation
 - Output volume
 - Number of channels
 - DI output – for larger events
 - Headphone output
 - Insert point
 - Power rating (watts)
 - Weight.

*Features to look for;

*-You will need an input level or gain control, this allows you to control the level of your instrument, the input control is most important if the amplifier has more than one input, it will allow you to control the two inputs separately.

*-Tone control;

Minimum of bass and treble, if possible also a mid control but not vital.

*-Parametric allows for more advanced adjustment and can be useful but is not vital.

*-Reverberation;

Again can be useful and interesting to try or to use. Most amplifiers come with some sort of reverberation, some are very artificial but other are quite good.

*-Output volume control;

All amplifiers will have this, it allow all the signals input to the amplifier to be adjusted all at one time.

*-Number of channels;

Obviously you need at least one, but two will allow a second instrument to be added or allow you to add a microphone to sing or make announcements, or have a friend to come and play with you.

*-DI output;

Only required if you expect to use your system in a large group. This is an output signal suitable for inputting in to other PA systems

*-Headphone output;

Good for practice or private listening if you want to add effects etc. and want to eliminate the original sound of the instrument.

*-Insert Point;

This is a connection which allows the amplifier signal to be taken out of the box, fed through some effects or the like and then put back in to the box.

*-Power;

This is an indication of how loud the sound will be. Normal small/medium units will be rated at 60w to 100watts. If you double the power rating then the human ear will hear an increase in level but not a huge one. If you go above 200w then you probably are looking at a large system and you should consider discrete components like we discussed earlier.

Sometime there is an actual sound level related to the output, e.g. 94dB per watt at 1m, this means when the unit is running at one watt and if you are 1m away then the sound level would be 94dB. This is fairly loud but is only the capability of the amplifier, if you play softly or your microphone is very quiet then it will be less, if you play loudly and your mic is loud then you are likely to overload the system and you would get distortion, you would need to turn down the input setting on the amplifier.

Alternatively it may say 112dB max at one metre. This is actually the same as the previous specification but given as the max it can give out.

Of course feedback may prevent you achieving these max levels, it will depend on the situation and room you are in.

*-Weight;

This is a personal limiting factor. The larger and heavier the unit then generally the better the quality can be, but if it is too heavy then it is too heavy. It is unlikely that you will get everything you want electrically and acoustically plus have a very light box to carry.



Expansion

- Wireless systems
 - Freedom of movement
 - Low cost

All microphones or contact strips must be connected electrically to an amplifier and hence a loudspeaker.

Normally this is done by wires.

*The connection from the harp to the amplifier could be done by a wireless connection.

You still require the contact strip and the wire from that, but then instead of connecting to the preamplifier you connect to a radio transmitter. This would be battery powered but would allow you to

*move your harp if you wanted but would also allow you to position your amplifier further away from you and not have a wire trailing across the ground between you and the amplifier.

*They are very small these days and also very economic, so they are no longer only for those who play every day as a profession but for those more hobbyist players who just prefer the convenience.



Accusound

27th Edinburgh International Harp Festival – How to Amplify your Harp

Accusound

- Any questions
- Or come and see me, with your harp and you can try some systems.
- Thank you for listening

www.accusound.com
David Anderson CEng
Acoustic Consultant

*Any Questions

*Come and see us, bring your harp and try a system or use the harp on our stand.

*Thank you for listening