

# A Better Surround

## B+ Format

- **Definition**

B+ format is the standard 4 channels of B format material known as W, X, Y, and Z plus 2 channels of L/R dry stereo recording. This method of recording separates the dry/direct sound from the ambient/room sound in recording and reproduction. Each serves a distinct purpose and is ideally suited to it.

- **Design Criteria**

In the development of a recording/playback system I have attempted to identify sound system philosophy that will provide the following attributes.

It will be *ambient*. In other words it must capture the whole acoustic event and be able to regenerate it in an audibly convincing fashion in a way which conventional stereo manifestly does not. A soundfield must be present on reproduction. We are recording two parts of a performance, the first is the direct sound of the performers and the second is the hall in which the performance was recorded or a virtual hall where the producer wishes you to be. It is the ambient sound that gives reproduction spacious and enveloping qualities.

It will be *accurate*. Sounds must come from the correct direction, wherever the intention: front-stage, to the sides, above, below or behind. Sounds must be free from audible distortions of tone, timbre or position. The system must equally suit Schubert as well as Stockhausen as well as Madonna.

It will be *scaleable*. The system must support listening by groups as easily as an individual also scaling from small rooms up to large listening room size. The listening experience for an individual should be substantially the same as for a group. It should also be scalable to your economic status.

It will be *approachable*. There must be no unusual requirements involved in listening to the system. No microscopic sweet spots. No narrow listening seating. No forbidden locations. You should hear an obvious difference from what you normally hear as recorded sound. It should sound natural.

It will be *practicable*. It must be possible to tailor the system to suit ordinary domestic listening environments without causing divorce - at least not much more than conventional stereo.

It will be *compatible*. The system must satisfactorily replay the historical legacy recordings of mono and stereo material. Sound recorded using this technology must replay satisfactorily on conventional stereo systems or must be readily convertible to match them (as is, for example, FM stereo being broadcast as a mono-compatible Sum and Difference rather than directly as a Left and Right signal).

I am most interested in presenting an audible image that is similar to that of a picture, that is it has some semblance to reality. At this time most audible images being presented are collages, which is simply a collection of objects pasted together. I believe that it takes more effort and talent to construct a picture rather than a collage.

- **Design of a recording/reproduction system**

B format is a system that delivers 3D information and its advantage is that it correctly presents spatial information. It is particularly useful in presenting ambience. B format uses only intensity differences to present the soundfield. It is particularly good in presenting the ambient information. Its disadvantage is that localization and intimate detail are not as well presented.

Stereo format is a system that delivers good reproduction of instrumental detail and localization. Good localization results from both intensity differences and time differences. Multi-track pan pot images only present intensity localization. There are many stereo techniques that exploit intensity and time localization. Stereo does not present ambience well.

In order to be accurate, especially with respect to localization and timbral quality, requires the addition of a direct signal from the front occurring earlier in time than the ambient B format recording. I have added a stereo pair which can be recorded in many different techniques to be added to the B format signal at the time of decode. Because it is earlier in time we now have added a time differential to assist with localization. This keeps a frontal event up front regardless where you listen. This increases the realism because now we are using both time and intensity to give location information. We also now have the ability to balance the direct and ambient sound to taste by the consumer.

By increasing the number of speakers you can increase the accuracy of presentation i.e. of the created soundfield. You should not be limited by the format to the number or location of speakers. One should create a soundfield in the room rather than a collage of sounds. I have named this system **B+ Format**

This design places the choice of the number speakers at the decode part of the system. The B+ Format can be decoded to any number of speakers that you have at your disposal. You can decode in any mode from stereo to 16 channel 3D surround. You do not have to decode the vertical information if you do not have the speakers for this. Thus the system is scaleable. The media is universal.

This system is approachable because it creates a soundfield in the listening room and the sweet spot is large in proportion to the number of speaker that you have available. The more speakers that you use the larger the sweet spot and less you will localize to a single speaker. The more the speakers the better the bass response.

This system is practical because it requires no new technology that we do not now have at our disposal. Whether our wives will accept the increase in the number of speakers I will leave to you.

The system is compatible because you can play ordinary stereo recording though the system. You can have the ability to add generated B Format signal to the stereo recording to give you the ability to enjoy older recording in 3-D Surround. The B+ Format is playable on stereo speakers.

- **Time, Location and Spatial Representation**

The direct sound best gives directional and instrumental timbre definition. The direct sound should arrive earlier than the ambient signal. The direct sound doesn't have any spacious or enveloping qualities.

The ambient sound gives spaciousness, spatial depth and envelopment to the reproduction of sound. It is known that B format presentation is not accurate in presenting location and many are trying to improve the reproduction with higher order of B format decoding. First order of B format is probably satisfactory for presenting the ambient sound because ambience is not well localized.

Whether any one of the surround systems will satisfy the presentation an idealized sonic image is a problem but I think B+ comes the closest to that solution today.

- **A Universal Media—An Answer**

B+ Format consists of B format ambient-recorded signal plus two channels of L/R direct recorded signal. It is recorded on 6 channels and when reproduced it is decoded into however many channels you have at your disposal.

By using the two channels of L/R direct recorded signal presented only in the front we will have the directional sound clues from the direct signal as well as the sound of the instrument. There is no vertical height information in this pair and it is added to the frontal speaker array.

The B format consists of 4 channels of sound, which are W, X, Y, and Z. X, Y and Z are the differential signals which gives the directional information to decode the W omni signal. B format does not provide accurate localization or recorded detail but rather presents the ambient information and spatial clues. This includes vertical height information. I have chosen to use two rings of speakers to reproduce the vertical height information. This gives another stereo field between each pair of up and down speakers and you lose the sense you are listening to speakers.

By having the ambient and direct information stored separately you can now chose the balance of direct and ambient information at the time of reproduction. This will allow for many different sized reproduction spaces. The larger space will need less ambient information while the smaller spaces will need more. In addition you as a listener can chose the amount of ambience that you prefer, very much like choosing your seat in a theater.

- **Storage Requirements**

B+ Format recordings require 6 channels of storage. This is now obtainable with either SACD or DVD-A using MLP compression. The advantage of using B+ format disks is that you are not limited to the speaker arrangement that the format will dictate but you can set the decoder for your listening set up.

## **Technique of Recording B+ Format**

- **Direct Recording**

### **Stereo Mics**

The recording of the direct channel is done by conventional means and can use stereo microphone techniques of X/Y, M/S or OCT and can be stored as L/R or M/S information. The direct signal should contain little reverberant information and is recorded using direction microphones.

### **Spot Mics**

You can use spot microphones or flanking microphones to help balance your recorded sound. You will need to add ambience to the spot microphones and may need to add ambience to flanking microphones. The ambience added should be in B format and added to the B format channel.

## Multi Track Techniques

Multi-track techniques can be used to generate the direct signal and you will then need to add ambience in B format. If you wish to locate images not in the frontal plane you can present images in B format in the rear locations but remember their localization will not be as good as the frontal image. For artists who are investigating space compositions you could add another stereo pair directed towards the rear and occurring again earlier than the B Format ambience of the rear signal. A special decoder would have to be built.

- **B-Format Recording**

### Room Recording

Room ambient recording is done with the Soundfield microphone generating a B format output, which is a combination of direct and ambient sound. The location of the Soundfield microphone is typically at the location in the room where the direct and reverberant sounds are equal, i.e. the critical distance. This gives accurate spatial information about the recorded location

### B-Format ambience by convolution

Another method of obtaining a B format ambient sound is by convolution. This is a digital technique where a room ambience is measured in B format and can then be impressed upon another signal. This is also accurate. You can choose whether you use any direct signal in the impulse response.

### B-Format ambience by multiple reverberation devices

You can also obtain B format ambient information with multiple reverberation devices. It will take at least 3 engines to generate B format reverberance, one for each axis. I have developed a B-format mixer to help generate the B-format ambience.

## Decoding B+ Format

- **Ideal decoding with 16 channels**

Decoding of the B+ format is ideally presented as 16 channels, which is arranged as two rings of 8 speakers with 45 degrees of separation between them. From stereo we know that 60 degrees is the maximum separation between speakers without a hole in the middle. By using an upper and lower ring of 8 speakers I am able to present vertical/height information. The L/R stereo is presented on the front speakers without height information. You are able to adjust the balance of dry versus ambient sound. I have developed the decoders for 16, 12, 10 channels of 3D surround or, without height, as 8, 6, or 5 channels.

- **Decoding in your present control room**

You can use your present control room to work in B+ format. The decoding will be done with 60-degree speaker spacing with two rings of 6 speakers. The front up and down speakers will be combined and your present control room speakers would be used for the sum of the front up and down signals. You can use your present console to obtain the L/R stereo mix and use a pair of auxiliary sends to sent to the B format ambience generator.

I have build a number of decoders with 5, 6, 8, 10, 12, and 16 speakers. I also have built a B Format manipulator and an 8-channel B Format mixer. These are build using the Creamware Scope Development system and is ported to the Pulsar system with is hardware and software that is installable in either a PC or a Mac. You can run any recording program such as Logic, Deck, Vegas, and Digital Performer on top of the Pulsar board.

## • The Results

I have installed a 16 speaker decode system at my studio and have been recording in this technique for the past 2 years and have concluded that this is a far superior method of reproduction of sound. I do not hear any location of the speakers. You cannot hear an individual speaker until you are within a foot or so of a speaker. The definition of the individual instruments in complex orchestral passages if remarkable. The wide image of the orchestra fills the end of the listening room. You are not aware you are listening to reproduction but rather listening directly to the music. The emotional involvement is great. The sweet spot is very large filling 3/4 of the listening room. As you walk closer to the front speakers you move closer to the orchestra and conversely as you move further away you move further from the orchestra. You are immediately aware of the recorded room. I make a stereo CD from the same master.

I would invite any that wish to listen to this system to contact me for a demonstration.

In conclusion I believe B+ Format is a universal media and an answer to the delivery of surround sound now and in the future. If you make your masters in this format you can decode it to a delivery system in today's style.

Nomenclature of abbreviations used in the software:

Speaker Location abbreviations

F = front, B = back, R = right, L = left, A = anterior(forward), P = posterior(rearward), U = up, D = down, Ctr = Center

Device abbreviations:

Bias = a mix controller that will adjust the balance of stereo and front B format

Center = a volume controller that will adjust the amount of L+R stereo that is added to front X and you will hear a filling of the center image as the volume is increased

Volume = a volume controller located at the output of the decoder and controls the overall lever out

Speaker location drawer = there are data fields for the location of the speakers which are active data input fields. You can adjust the location of the decode to match your room or to achieve the desired results. The speaker location assume that there can be an upper and lower speaker at each location.

Shelf filter drawer = there are individual data fields for gain and frequency of the low frequency shelf filters. There is a single data fields for gain and frequency of the high frequency shelf filter. It controls the shelf filter of X, Y, and Z. Peak controls the level at which the red led of the level indicator lights. The other leds threshold level will also be changed in relation to the peak.

Manipulator = Domnce is dominance which will enable you to distort the sound field in a forward or rearward direction. Azimuth will enable you to rotate the soundfield +/- 180 degrees. Tumble will enable you to rotate the soundfield vertically +/- 90 degrees. The data field is calibrated in degrees. There are individual volume controls for each of the differential channels, i.e. X, Y, and Z.

Design of the decoder is based on the decoding of B format material. The localization of the speakers are entered as degrees with straight ahead i.e. front center is consider as 0 degrees and to the left is considered as negative degrees and to the right is considered as positive

degrees. Within the circuitry, B format represents left as negative Y. This is taken into account in the design of the decoder. The master volume control is at the output of the decoder and adjusts the volume to the speakers. The display is post volume control and indicates both up and down whichever is louder. There are two further controls. The Bias controls the amount of B format vs the Stereo pair going to the front decode—this effectively allows one to adjust the balance of the direct against the room sound to produce the most pleasing sound in your listening room. It adjusts the position of the listener in the room. The Bias is modified by a three position switch which allows the rear B format either to remain at full level or track with the front B format or turned off. The correct balance of the B format against the stereo is best set with the rear turned off. The gain of the B format or stereo is then adjusted until both are the same level. The Center control adjusts the amount of L+R that is added to front X which is a center fill. You adjust this to give a solid center and even spread in the front. The inputs to the decoder are labeled W, X, Y and Z inputs of the B format and L, R inputs of the stereo. There are also Mid, Side inputs which can also be used instead of L, R inputs to the stereo.

The B format manipulator allows you to adjust various parameters of the B format signal. It is patched into the circuit before decoding. You have the ability to change the spherical soundfield. The azimuth will rotate the soundfield + or – 180 degrees and the tumble will change the vertical axis +/- 90 degrees. The dominance control causes the soundfield to become more prominent in the front or the rear; at the extreme it changes the B format to only a front or rear mono cardioid. There are also gain controls to control the X, Y, and Z gain.

The B format mixer is an 8-channel mixer that allows you to add 2 B format channels and 6 stereo or mono channels into a B format signal. You have control of the azimuth and tumble as well as X, Y, Z gain. In the stereo channels there is a 0 to 40 millisecond delay control. Each of the stereo channels can accept either a L/R or M/S signal. You can also activate a differential button which generates only one axis with a L/R input, i.e. it will only generate a Y signal for a L/R input (no X) which can then be rotated 90 degrees to give an X signal and then tumbled 90 degree to give a Z signal. This is the method that can produce B format reverberance.