“Principles of Audio” Web-based Training Detailed Course Outline

The Signal Chain

The key to understanding sound systems is to understand the signal chain. It is the "common denominator" among audio systems big and small. After this lesson you should understand the components that are in the chain and why they are there. This will aid in a "divide and conquer" approach to optimization and troubleshooting.

Four video clips covering these topics.
1. The Signal Chain Overview
2. Program Sources
3. Interface Boxes
4. The Mixer
5. Signal Processing
6. Power Amplifiers
7. Loudspeakers
8. The Acoustic Environment
9. The Listener
10. Conclusion

The Time Domain

It may seem strange to begin the course with a discussion of the time domain. When working with sound and sound systems, it is sometimes necessary to *quantify* the signals that pass through it.

Quantify - "To express or measure the value of." In our context, "to assign a value to something that is measured or heard."

The **time** and **frequency** domain lessons are key to understanding sound levels, audio meters, and audio and acoustic instrumentation. *- Pat Brown*

Five video clips covering these topics.
1. Audio vs. Acoustic Waves
2. Piston Source
3. Wave Analysis
4. Functions
5. Voltage
6. The Time Record
7. The Sine Wave
8. Putting it all Together
9. Loudspeakers as Pistons
10. Sines, Cycles and Circles
11. Time and Frequency
12. Harmonics
13. Superposition
14. Phase Relationships
15. The Square Wave
16. Audio and Acoustic Superposition

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The Frequency Domain

Another way to look at audio and acoustic signals in the frequency domain. It is the preferred perspective for adjusting filters and other system tuning tasks. Modern audio and acoustic analyzers allow the user to quickly switch between the time and frequency domains when analyzing sound systems.

If the time domain shows us "when" the signal is arriving at a reference position, the frequency domain can tell us "what" is arriving. The audio practitioner needs to know both.

Four video clips covering these topics.
1. What is Frequency
2. The Audible Spectrum
3. Pitch
4. Proportional Change
5. Linear vs. Logarithmic
6. Dividing the Spectrum
7. Loudspeaker Bandwidth
8. Introduction to the Decibel
9. Spectrum vs. Frequency Response
10.Octaves and Octave Fractions
11.Frequency Resolutions
12.Spectrum Analysis

Wavelength

Both electrical and acoustical waves have a **physical size**. When considering how waves **behave** in their medium (i.e. air for sound, wire for electricity) the size, or **wavelength** must be considered. Think of wavelength as a **deeper** description of *time* or **frequency**, one that we will refer to when describing audio interfaces and the acoustic behavior of loudspeakers and rooms. Perhaps foremost, **meaningful** acoustic measurements and system design predictions require the consideration of wavelength. *- Pat Brown*

Three video clips covering these topics.
1. Wave Dimension
2. Audio vs. Acoustic
3.Audio Wavelength Issues
5. Acoustic Wavelength Issues
6. Wavelength Examples

The Decibel

I avoided the use of the decibel for several years at the beginning of my audio career. I found it seemingly complicated and certainly confusing. But when I finally decided to dig in and "get it" I discovered the truth of Don Davis' saying

"The decibel is the language of audio."

It is my hope that these lessons on the decibel will shorten your path to that important place. - *Pat Brown*

Six video clips covering these topics.
1. Sound and Sound Pressure
2. Proportional Pressure Changes
3. Sound from Electrical Power
4. Logarithms and the Bel Scale
5. "Power-like" Quanties
6. A Different Perspective
7. The dB Chart
8. An Example
9. Caution!
10. The Power Equation
11. Signal Voltage
12. Relative Level Changes
13. Absolute Level Changes
14. The dBV and dBu
15. What is +4?
16. Using the Decibel

Sound Pressure Level

Listening is something that we do naturally and without thinking. We are wired for it. But how can sound be *quantified*? When do I need to quantify it? How can something like "loudness" be monitored, measured and constrained?

The Sound Pressure Level lesson is an extension of the Decibel lessons, applying the decibel to sound and the hearing process. - *Pat Brown*

Three video clips covering these topics.
1. Sound Pressure Level
2. Loudness Time-Dependence
3. Loudness Frequency/Level-Dependence
4. Weighting Scales
6. Measuring SPL
7. Calibration

Audio Meters

The top three complaints regarding the performance of sound systems are probably

1. Feedback
2. Noise
3. Distortion

Items 2 and 3 can be easily avoided by the proper use of audio meters. In this lesson I'll describe the different types and what they mean. - *Pat Brown*

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Three video clips covering these topics.
1. Why Do We Need Audio Meters?
2. Clipping Distortion
3. Monitoring Audio Signals
4. Peak-Program Meter
5. "True" Peak Meter
6. The Volume Indicator
7. Which Meter Do I Have?
8. Which Meter is Best?
9. Combo Meters

Basic Electricity

We take electricity for granted. Few people understand even the most basic principles of how an electrical circuit works. This is unnecessary, as the principles of electricity are at work in many other aspects of daily life, and can be understood through analogies and metaphors.

Audio is **electricity**. If you understand how a flashlight, water pump, spray can or household outlet works, you can understand how an **audio circuit** works. After these lessons you will undertand the concepts of **voltage**, **current**, **impedance** and **power**, and how they apply to audio systems. *- Pat Brown*

Six video clips covering these topics.
1. Introduction
2. Nature Loves Equilibrium
3. Pressure and Flow
4. Opposition to Flow
5. Resistance, Reactance and Impedance
6. Hydraulic Examples
7. Circulating Pump Example
8. DC Electrical Circuits
9. AC Electrical Circuits
10.Sources and Loads
11. Voltage
12. Current
13. Impedance
14. Interface Types
15. Input and Output Impedance
16. Ohm's Law
17. Some Practical Examples
18. Universal Principles

Audio Interfaces

What is "high impedance?" What is "low impedance?" What does "impedance matching" mean and is it necessary? What about "constant voltage?"

The principles were covered in the **Basic Electricity** lessons. Let's apply them to audio. - *Pat Brown*

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Three video clips covering these topics.
1. Active vs. Passive Components
2. Audio Ground
3. Unbalanced Outputs
4. Balanced Outputs
5. Unbalanced Inputs
6. Balanced Inputs
7. Polarity
8. The Cable Shield
9. Parallel-Connected Loads
10. Series-Connected Loads
11. Series-Parallel Loads
12.Conclusion

Loudspeaker Fundamentals

There are probably more loudspeaker choices in the audio marketplace than any other component. How do they work? Why are there so many different types? How are PA loudspeakers different than hi-fi loudspeakers?

Many think of loudspeakers as they do light bulbs - *"More watts, more sound."* This is completely erroneous and the basis for many of the myths regarding both amplifiers and loudspeakers. Let's look at what really matters. *- Pat Brown*

Six video clips covering these topics.
1. Reality
2. Important Loudspeaker Attributes
3. Efficiency
4. Sensitivity
5. Impedance
6. Power Ratings
7. Polarity
8. Spherical Spreading
9. Near, Far and Free Field
10.Direct vs Reflected Sound
11.The Polar Plot
12.The Balloon Plot