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35 MM SOUND SYSTEMS

BY

JOHN F. ALLEN

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35 MM SOUND SYSTEMS

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John F. Allen

It ought to be noted that sound systems for 35 mm movie theatres are among the simpler commercial sound systems built today. The theatres themselves are somewhat similar in shape though dissimilar in size. Monophonic systems usually have their one speaker behind the screen driven by a single "all in one" preamp / power amplifier unit in the booth. Stereo systems are far more complicated but still differ in only a few respects from theatre to theatre.

One misconception I often hear is that small theatres don't need big sound systems. While it's true they won't need as much power as large theatres, if you really care about quality, that is just about the only difference. Owners of small theatres, say less than 60 feet long can save additional money by using smaller speaker systems and, except for deep bass, still achieve all the performance of the larger systems. So the essential difference in sound system requirements for small and large theatres is the size of the speakers and power amplifiers.

How much power a system needs depends on how loud it will need to play. I have found general agreement among engineers from studios, acoustical consulting firms and experienced installers that a level of about 106 dB SPL (sound pressure level) per channel is a good design criteria. This means that in a theatre equipped for stereo, each channel including the surrounds should be able to produce this volume level in the center of the room when the amplifiers are at maximum power or just before clipping.

This criteria can be arrived at by measuring the loudest passage that the loudest films produce and adding a safety margin. A good example of a loud movie is "The Empire Strikes Back". In the middle of a properly set up theatre with first class speakers, enough power to sustain levels of 115 dB SPL and the volume set for a "normal" dialog level, I consistently measured peaks of 103 dB SPL using a sound level meter. Since this was with all four channels at full level, one deducts 6 dB to find that each channel was producing 97 dB SPL. Adding 3 dB for meter lag, I found that each channel was producing instantaneous peaks of 100 dB SPL.

Knowing how much the system absolutely must deliver, the question is how much of a

safety margin to add. This margin should take into account several things such as film splices, amplifier aging, operator error and perhaps even louder films. Keeping in mind that every increase in level of 3 dB is a doubling of power and only moderately perceptible to the listener, it seems that a 6 to 8 dB safety margin is reasonable as well as affordable. Thus the 106 dB SPL per channel criteria.

Such a margin translates into an insurance policy for your loudspeakers. Since the amplifiers will be able to deliver more power than they will be asked to, it is very unlikely the speakers will be damaged or destroyed by a clipping amplifier. In fact, none of our systems has ever failed anywhere in the world. Obviously since the amplifiers are not distorting, the sound.

If you are using speakers that require much equalization, you may need more power. If one has to "turn up the bass" just 3 dB in order to overcome a bass deficiency (a common problem), you may have to use amplifiers twice as powerful. Since turning up the bass also increases the speaker's own distortion, it's best to use speakers with woofers with a flat frequency response down to 40 Hertz (cycles per second) or employ subwoofers.

To produce the levels we're speaking of, you need horn type speakers capable of playing loud. In movie theatres and other large places there is no such thing as a speaker system that is too big. Since speaker distortion increases as the volume does, two things must be considered; efficiency and distortion. Efficiency refers to a speaker's ability to convert electric watts into acoustic watts. Distortion is the unwanted production of frequencies not present in the original sound. The most efficient speakers currently available are about 20 percent efficient.

These large theatre speakers are four times more efficient than the smaller ones commonly used and so have about four times less distortion. In other words, choosing the large system reduces the power required by 75 percent as well as the distortion produced by the speaker. You will hear clearer sound and better bass.

The smaller systems may not even be able to handle the power required to push them to the desired levels without failure of the drivers. Consider a case where the theatre with the large speaker needs 150 watts per channel. The smaller system would need 600 watts to do the same job. The large speaker will survive, the small one will not. So when purchasing loudspeakers for theatres, or your living room for that matter, the bigger the better.

Let's now look at two theatres and see what these concepts mean. The first theatre is the Auburn Twin Cinemas in Auburn Maine, operated by Theatre Management Services.

TMS partner Bud Rifkin is well known as one of this industries' champions for quality presentation. In what some might consider a rather small operation, he has installed Schneider lenses for clearer pictures, a Dolby CP-50 for Dolby Stereo films, a Kintek KT-30 mono enhancement system to play monophonic films in four channel sound, Crown amplifiers and Klipsch speakers. The system was designed by TMS's Ray Gaudet. The theatre is 53 feet long and 29 feet wide.

This is a case where the medium sized speakers can be used. It being a multiplex one needs to be careful about how much bass a sound system will deliver or those in the other houses will be disturbed. The smaller speakers don't produce deep bass so they are actually a better choice if they can produce the necessary sound levels. Mr. Gaudet chose the Klipsch TLSI theatre loudspeakers. This system is about 10 percent efficient with a one watt 4 foot sensitivity (sound output at 4 feet with one watt input) of 104 dB SPL. The TLSI requires 70 watts to produce 106 dB SPL in the center of this theatre. As they have a 200 watt capacity, they are acceptable. The Crown D-150 amplifiers were selected. These units deliver 80 watts into 8 ohms and 125 watts into 4 ohms.

Here is where an efficient surround speaker can save money on amplifier power as well as sound better. Most surround speakers are about 1/2 to 1 percent efficient. Some are even lower. The TH-SR systems used at the Auburn are about 2 percent efficient with a one watt sensitivity of 96 dB SPL.

One can determine the total power required for a surround array by determining the power that just one of the speakers will need to produce the SPL one desires 1/2 way across the room. The additional speakers are simply used to disperse the sound evenly over a large area.

A surround speaker with a 96 dB sensitivity will need only 131 watts to produce 106 dB SPL at 141/2 feet. If one wires the surrounds together in such a way that they present a 4 ohm load to the Crown D-150 it becomes a 125 watt amplifier. This is only six watts (.22 dB) shy of our goal which is just fine. Money is saved because no additional surround amplifiers are needed.

The second theatre I'd like to describe is the Rivoli. Located on Broadway in New York City, this 70 mm equipped theatre is owned by UA Communications and was recently twinned. See BOXOFFICE April, 1982. Though only 80 feet long, the wedged shaped seating area is quite wide at the rear and accommodates 890.

The sound system was designed by UAC's Joe Kelly and consists of a Dolby MPU

magnetic preamplifier unit, a Dolby CP-200 processor, Altec Lansing incremental amplifiers and Klipsch speakers with an Allen Surround Array.

This system was built entirely by Mr. Kelly's staff and represents the neatest, best laid out wiring job I've ever seen in a projection booth. Heavy gauge wire was used throughout. All leads were cut precisely to the proper length and dressed perfectly. Too bad the same can't be said of every theatre.

Soundtracks for 70 mm films differ from those on 35 mm films because they are recorded on magnetic stripes which are applied to the print after developing. 70 mm stereo is a discrete six channel format with five channels behind the screen and a surround channel. Stereo soundtracks on 35 mm films using Dolby's optical stereo format are four channel, matrixed on to two. 70 mm Dolby stereo uses the two additional screen channels for bass enhancement. The magnetic recording offers 10 dB or more dynamic range and so can deliver a lot more impact. As a result of this, 70 mm systems should be powered to deliver 109 dB SPL per channel in the middle of the theatre.

The CP-200 is designed to process both 35 mm mono and stereo as well as 70 mm Dolby encoded and non encoded stereo films. It is a very sophisticated piece of audio equipment which can be programmed to change formats as well as projectors at the push of a button. In this installation, Mr. Kelly went one step further and designed a unique automation system that controls both the CP-200's programming and projector selection so that a single button accomplishes both functions.

This being a 70 mm theatre the large Klipsch TCM's were used for the three main screen channels. Two TMWM's were used for the bass enhancement-channels. The TMWM's are in fact the woofer sections of the TCM's. 18 TH-SR-70 surround speakers were also installed.

The stage speakers have a one watt 4 foot sensitivity of 107 dB SPL and so required 150 watts to produce 109 dB SPL per channel in the center of the room. The surround array required 500 watts to do the same.

The power was supplied by Altec incremental amplifiers. This type of amplifier has been around for awhile but is relatively new to movie theatres. While it costs more than conventional amplifiers, incremental amplifiers take far less rack space plus are more versatile and easily serviced. The concept allows one to install separate 75 or 150 watt amplifier modules to build up the power desired; 150, 300, 450 or 600 watts. The modules are plug in type units and so are easily changed. But the real beauty of incremental

amplifiers is their ability to be combined in so many different ways. They can drive loads (speakers) from 16 ohms to as low as 2 ohms or be used to drive 70 volt systems. 70 volt systems are sometimes used where an amplifier is powering a lot of speaker systems.

With a crossover card plugged in ahead of the amplifier cards, the system can drive woofers and high frequency speakers separately (this is called bi-amplification) with different power levels (woofers need more power).

This issue contains a great deal of information about theatre sound, a subject which is basically simple, complicated by bad ears as well as a great deal of misunderstanding, misinformation and foolishness. While there are many amplifiers, processors and speakers available from different manufacturers, the equipment you purchase must still perform measurable functions; sound level, frequency response etc.

Quality counts! Cutting corners in one area will degrade the sound of an entire system which may be perfectly capable of sounding better. A GOOD sound system is a good investment. when properly advertised it will increase your business.

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