GOLD LINE
MANUFACTURED IN U.S.A. SINCE 1961

New Projects
Lutron's "Ultimate Home Theater Experience" at Disney Epcot, Orlando, Florida

by: **Greg Miller,**
National Sales Manager
Gold Line

We are not at liberty to discuss all the details of this amazing new system, but here is a sneak peak into the creation and tuning of what is almost certainly the finest home theater room currently open to the public.

Lutron, one of the giants in the field of home system control, came up with the idea of setting up a great home theater that would be open to the public. By joining up with Disney's Epcot Theme Park and other leading manufacturers of home theater electronics, they created Disney's new "Ultimate Home Theater Experience". The name is a trademark of Lutron, and if you are anywhere near Orlando, Florida you need to hear this system. Whether your interest is home theater, corporate multi-media or even conventional pro-audio, the technologies displayed in this room are a window into sound system design for the 21st Century.

The man responsible for the acoustical design and the calibration of the sound system is Russ Herschelmann. His Napa, California based design firm of R. Herschelmann Designs is frequently featured in magazines such as Audio Video Interiors. He writes a column for Stereophile Guide to Home Theater, and is one of the core instructors each year at the Industry's Annual Trade Show- CEDIA Expo. He is known for demanding excellence in system calibration, and when we heard he had designed this system we knew it would be something special.

Russ' calibration gear was all manufactured by Gold Line. He uses an EZ Test T system, with the DSP30 digital real time analyzer, the CVOW computer interface, an MX4 four channel multiplexer, MK8A microphones and MkCA20 ultra quiet audio mic cables. He also owns a pair of APT2 Polarity testers and a TS3 portable audio oscillator. Per our recommendations, he returns his system to us annually for calibration. He carries a laptop for the DSP30 computer interface, digital equalization control and to run his computer modeling (which he regularly consults while looking at the room analysis data.)

The calibration process began with a visual inspection of the loudspeaker installation and placement. Locations were measured and wiring was compared to the specification drawings. Loudspeaker aiming was done with a SAS Checkpoint 770 Laser. The magnetic attachment on the laser snaps right onto the small steel plates on the loudspeaker giving a true point of aim, and allowing future verification that the loudspeakers have not been accidentally moved.

All loudspeakers were then checked for Polarity with a Gold Line APT2. Given the large number of loudspeakers in this type of a system: Left, center, right and two subwoofers in the front, multiple sides and multiple rears with two additional subwoofers, the ability of a polarity checker to quickly make measurements without removing loudspeaker grills was a tremendous time saver.

The room was then checked for rattles using a Gold Line TS2 Audio Oscillator. By slowly sweeping up and down through the frequency bands sympathetic vibrations could be easily spotted. The room had been built by Acoustical Innovations of Boca Raton, FL and was impeccably assembled. Joints were screwed and glued and overall the room was just great. The problems arose from items that were outside their control. The code required exit signs, and they rattled loudly. Also, some small lighting fixtures required a little careful attention to get them silenced.

We then checked the room for ambient noise levels. This test is done with the NC option on the DSP30 real time analyzer. The HVAC had been carefully designed to provide the large quantities of cooling air required for a Florida facility, while flowing it into the room silently at low velocity. Failure to understand the complex nature of ambient noise is a common design flaw. Russ is a master of quiet rooms, and if you are a contractor look carefully at how the HVAC issues and projector box have been handled in this room.

One of the primary areas of concern when setting up a room are the modal room acoustics. Russ had done a computer model of the room's modal characteristics and the RTA data correlated well with the predicted data. The loudspeaker position is largely dictated by the requirements for surround sound, but side loudspeaker positions and subwoofer positions reflect a careful analysis of optimal location to avoid energizing standing waves in the seating area. We also carefully examined the subwoofer positions using both pink noise analyzed in $1/12^{th}$ octave mode, and with sine waves set to known room mode frequencies, which we had from the computer model. Once again the modeled data and the measured data were well correlated.

The theory behind the modal analysis is based on the fact that the speed of sound is effectively a constant (it varies very slightly with temperature and air pressure). Because sound goes through a specified number of cycles per second, and the distance that it travels in one second is fixed by the speed of sound, we know the wavelength of every frequency. Sound travels at approximately 1,130 feet per second. To calculate the wavelength you divide the speed of sound by the frequency (how many times does the wave cycle in once second). Accordingly, a 100Hz standing wave has a wavelength in feet of $1/100^{th}$ the speed of sound or 11.3 feet. Once the wavelength is known, the node and the null will reach their maximum at either the ¼ or ¾ point of the wavelength. Simple programs will predict which frequencies have the correct relationships to create significant constructive or destructive interference. The low frequency constructive frequencies we typically refer to as standing waves. Destructive interference we typically refer to as cancellation.

Once the loudspeaker position had been chosen for minimal standing waves, the system was equalized with a digital parametric equalizer. To measure the sound in the room we used a DSP30 with the MX4 multiplexer and four microphones. This method is common in the cinema and home theater industry, and is becoming increasingly popular in pro audio applications. The four microphones are set out with one in each quadrant of the seating area. By simply pushing a button on the MX4 multiplexer, it is possible to look at individual areas within the room, or an average of the entire space. The plots were compared using the multiplot mode on the DSP30 computer interface.

Finally, after equalization had been set on each of the channels in the room, reference levels were set. Home theater processors are equipped with a special band limited pink noise which is used to set the system gain so that all loudspeakers produce exactly 75dB(c) when in the test mode. Levels are critical in surround sound applications as changes in level are largely responsible for the apparent shift in image location. If the movie wants the plane to zoom to the left, the level is progressively moved from the center to the left front loudspeaker. If the levels are not correct, the acoustical image will not coincide with the visual image seen on the movie screen. Additionally, when calibrated to the 75dB(c) standard in test mode, the system will produce a maximum SPL of approximately 103dB(c) during the loudest parts of the sound track.

Our hats are off to all the people at Lutron, Disney and to all the project partners. The Ultimate Home Theater should bring a wide recognition of surround sound technology to the general public. Over the three year life of the exhibit something like 2,000,000 people are expected to attend. If you have ever wondered about home theater or surround sound calibration, the exhibit should be high on your list of trip destinations.

address inquiries to:
Greg Miller,
Audio Division of Gold Line
gmiller@gold-line.com