HPS-4000®

HIGH PERFORMANCE STEREO

Sound IS the Experience !™

THE CARIB THEATRE REVISITED

A MAMMOTH SOUND SYSTEM BY EFFICIENT DESIGN

BY

JOHN F. ALLEN

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In the October, 1982 issue of BOXOFFICE, I described Kingston Jamaica's 1700 seat Carib Theatre as "one of the big ones". In 1991, this is certainly as true as ever. Originally built in 1938, the Carib is by far the largest theatre in the West Indies. At 180 by 84 feet and a volume of nearly one half million cubic feet, the Carib is also the largest theatre ever to house one of our HPS-4000™ sound systems.

The 1982, installation of Carib's rather hefty HPS-4000™ sound system became something of a national event, and propelled the Carib to become the highest grossing theatre in the entire West Indies. With 31 speakers, powered by a total of 6000 watts, it was the most powerful system of its kind ever constructed. Needless to say, neither those of the Palace Amusement Company (1921) Ltd. (the theatre's owners), nor their

customers knew quite what to expect when we finished. I myself was pleasantly surprised and impressed by the "enhancement of dimension" which the acoustics of such a large space can bring to the sound of motion pictures. When something flies through this theatre, it really moves!

Since 1982, we have added Dolby SR. But several advances in speakers and amplifiers, plus the opening of two other HPS-4000™ theatres in Jamaica, have given us enough cause to completely reexamine the Carib.

To deliver motion picture soundtrack peaks at their full level with a few dB to spare, a theatre of this size should have about 800 watts of amplifier power per screen speaker. To accomplish this with so "little" power, the speakers must have a one watt / one meter sensitivity of 109 dB SPL across their operating frequencies. The Klipsch TMCM-3 three-way (woofer, midrange, tweeter) fully horn loaded stage speakers employed at the Carib are indeed this sensitive. As a comparison, most speakers sold for theatre use today offer 1/10th to 1/8th of this sensitivity. This means they need eight to ten times more power to play at a given level. This also means that such direct radiator based screen speakers would require 6400 watts per channel at the Carib. In other words, forget it!

BI-AMPLIFICATION

In 1982, the most reliable way to get 800 watts for a screen speaker was bi-amplification (separate amplifiers for the low and high frequency speaker sections). This was because the available 800 watt amplifiers of the day lacked the sound quality and dependability desired. Three 250 watt amplifiers were, therefore, used for each TMCM-3. One 250 watt amplifier section powered each of the two woofer drivers. A third 250 watt amplifier powered the midrange and tweeter sections together. This is possible since the tweeter uses its own internal passive crossover circuit and is simply connected to the midrange horn in parallel. The three 250 watt amplifiers total 750 watts, which is about 1/2 dB shy of our goal.

Rather than a single amplifier, feeding a crossover at the speaker, to divide the audio into its high and low frequency bands, bi-amping requires the use of an active (powered) crossover which then feeds two amplifiers.

There are many situations where bi-amplification is very useful, if not mandatory. Speaker systems with large mismatches in woofer and tweeter sensitivity, such as the familiar direct radiator/horn combinations, should be bi-amped. Speakers with poorly designed and power-wasting crossovers should be bi-amped, as well as arrays of multiple woofer and tweeter sections.

The HPS-4000™ sound systems are specifically designed around highly efficient fully horn loaded speaker systems. The woofer, midrange and high frequency sections have matched sensitivities. The crossovers are particularly well designed and waste virtually no amplifier power. The reasons for bi-amplification just don't exist with such speaker designs, and we have found that the HPS-4000™ systems neither require nor benefit from bi-amping. Indeed, the TMCM-3's at the Carib have never sounded one bit better for having three amplifiers. They just simply have had the power they needed to play loud enough in this theatre.

Today, we have several amplifiers that not only sound better, but which can reliably offer all the power required for the Carib Theatre. The three-way TMCM-3 speakers have been improved with the addition of a separate sub-midrange section and are now optionally available as the four-way TMCM-4. We have also found ways to improve our surround speakers. So it is time to upgrade the Carib.

THE UPGRADE

The first thing we did was to add a discrete bass enhancement system in anticipation of 70 mm or digital soundtracks. This included four Klipsch TMWM low frequency horns. (MWM stands for Magnificent Woofing Machine). Each of these woofers comprises two 15 inch drivers mated to a 7 foot long acoustic transformer (horn), carefully folded to make the cabinet only four feet deep. The 10 1/4 square foot horn mouth of just ONE of these woofers exceeds, by 30 percent, the total low frequency radiating area of an entire direct radiator based 70 mm sound system. Loudspeakers of this type are the most efficient way we have to get control of the air in the room.

The next step was to upgrade the three-way stage speakers to four-way systems. Because the lower midrange information is now delivered by a separate speaker section, the upper midrange clarity is noticeably improved.

For several years now BGW Systems, Inc. has been offering superb commercial grade power amplifiers which combine high power with sound quality as good or better than some audiophile units I've heard. The BGW models GTB, GTA, and 750 feature clean sounding low feedback designs and can safely operate into speaker loads (impedances) as low as two ohms. Two ohm capability can be especially important for theatres particularly in the surround channel. In this case, it allows us to use both channels of the amplifier in a "bridged" mode while safely driving a four ohm speaker system.

Using a dual channel (stereo) amplifier in the bridged mode results in a very powerful

single channel amplifier. For instance the BGW GTB can deliver 275 watts per channel into eight ohms, 400 watts per channel into four ohms and some 600 watts per channel into two ohms. Note the additional power with lower speaker impedances. With the use of rear mounted switches, the GTB becomes a bridged amplifier capable of delivering 800 watts into an eight ohm speaker. At the limit of its power supply, it can deliver nearly 1000 watts into the four ohm TMCM-4 loudspeakers.

A NEW POWER AMPLIFIER

Given the efficiency of the loudspeakers, a four ohm rated, bridged amplifier replaces the 1 1/2 stereo amplifiers powering each of the bi-amped stage channels, provides 33 percent more power, eliminates the costly need for bi-amplification, saves two amplifiers and $4,000.00.

We felt that since the GTB's would be used in this manner in Jamaica's hot climate, it would be wise to add more output transistors to the amplifiers. This increases the "safe operating area" of the amplifier's output stages. BGW readily agreed to build these special GTB's.

THE ALL IMPORTANT SURROUNDS

Readers of these columns may recall that the HPS-4000™ sound systems have found wide acclaim for the use of the Allen Surround Array™. This is a proprietary and precise mathematical approach developed for locating surround speakers that provides exceptionally even coverage and an absence of single speaker localization.

The Carib theatre has a balcony. So we must install two complete surround arrays; one for the balcony and one for the main floor. In 1982, the two surround arrays which I designed for the Carib did not include a provision for split (or stereo) surrounds. Along with the side wall speakers, the surround array formulas provided full coverage with five speakers spaced across the rear walls. I have since come to disagree with myself about this.

Split surrounds require the left and right surround speaker groups to become separate channels. This forces us to have an even number of speakers across rear wall so they may be split symmetrically. It seems to me that theatres should be prepared for this.

In upgrading the Carib's surround speakers, the 24 original surrounds have been transferred to the two new theatres on the island. The additional speakers for the rear walls have been included and 26 new High Performance Stereo model SR-70 three-way surrounds have been installed; 14 downstairs and 12 upstairs.

A TOUCH OF MIDAS

Theatres like the Carib have relatively low ceilings at the rear of the balcony. This plus the elevation above the main floor of the balcony's leading edge, limits the height of the surround speakers to about one half of what they ideally should be for such a large theatre. When surround speakers must be installed lower than their ideal height for a particular theatre, more of them are required at closer spacing to avoid localization to a single speaker.

This, of course, makes perfect sense. But rather than localize to a single speaker, we can begin to localize to the side wall speaker groups which we are closest to when not seated in the center. In other words, those seated in the center of a reduced height surround array, will hear a good "surrounding" effect. Moving off to one side, however, can result in the surround sound tending to be perceived primarily from the nearest side wall.

We've studied this problem and found it can be easily overcome by adding an additional delay to the sound coming out of the side wall speakers. The rear wall speakers remain at the normal surround delay required for the theatre. This makes the lateral surround information to arrive at our ears just enough later to restore the effect of being surrounded by the sound. Localization to the side wall speaker groups is dramatically reduced. With the added delay, no sense of echo is detected. We have now installed this multi-staggered delay system in several theatres around the world with complete success. It's an elegant crowning touch.

ADDING UP THE CHANGES

In 1982, the Carib was outfitted with a single delay for the main floor surrounds (provided by the cinema processor) and a single outboard delay unit for the balcony surrounds. The updated Carib incorporates a Klark-Teknik DN-716 triple delay. The DN-716 provides three outputs with individually adjustable digital delays and levels, allowing the superior control of the surround effect just described.

We have also replaced the original seven surround amplifiers, which totaled 1750 watts, with only three of the more powerful BGW GTB's. This increases the total surround amplifier power to around 3000 watts with four less amplifiers and brings the system up to modern specifications required for Dolby SR and digital sound in a theatre of this magnitude.

All in all, we have upgraded an excellent 6000 watt, 31 speaker sound system with 16 amplifiers and three electronic crossovers, to a 10,000 watt, 33 speaker sound system with only ten amplifiers, no electronic crossovers and added multiple surround delay control.

We have more dynamic range available and noticeably clearer sound.

ELECTRIC AND ACOUSTIC POWER

I am often questioned about amplifier power requirements in movie theatres. I point out that bragging about how many amplifiers and how much power your speakers require is like bragging about how much gas your car an burn. Doubling the speaker's efficiency cuts the amplifier power required in half. So we must know which speakers we are using before we can determine their needed power. Therefore, it's not the electrical watts that count with a sound system. Rather, it is the total speaker output in acoustic watts which is the true measure of a system's power.

For the cleanest sound reproduction and the greatest reliability, I generally recommend that cinema sound systems be equipped with about four times the amplifier power required by the speakers employed for the highest peaks in the program material. If you think this is a lot, it is only six dB, or less than the difference in raising your voice. (See BOXOFFICE January, 1983, page 34).

Such "overpowering" or headroom is an extremely prudent design practice. In normal operation, the amplifiers are never overloaded. The sound system merely coasts along effortlessly, even under the most demanding circumstances. This ensures the cleanest sound reproduction and reduces listener fatigue associated with distortion during the louder levels. Since the amplifiers never distort (clip), the speaker systems are spared from this form of destructive abuse and can be expected to last "forever".

Acoustic power is not easy to measure. However, using the manufacturer's approximate speaker efficiency ratings of 20 percent for the stage speakers and 1 1/2 percent for the surrounds, we have now provided the Carib Theatre with a total power output of some 1400 acoustic watts; up from 685. This is equivalent to about 20 symphony orchestras.

This is a truly enormous amount of acoustic power, most of which is unused headroom. But, this system is designed to deliver program peaks no louder in this large theatre than a 60 acoustic watt (800 total electrical watts) system would deliver in a 250 seat theatre. How's that for perspective!

Palace Amusement Company's flagship Carib Theatre now enjoys a completely modern digital-ready sound system; one which clearly holds the title of the most powerful of its kind in the world. The extensive use of today's most efficient components and design techniques, have allowed us to build such a high performance system with an impressive degree of reliability, clean full sound, yet at an attractively low cost.

John F. Allen is the founder and president of High Performance Stereo in Newton, Mass. He is also the inventor of the HPS-4000® cinema sound system and in 1984 was the first to bring digital sound to the cinema. John Allen can be reached by E-mail at JohnFAllen@aol.com.