M4 Installation Profile

# A Multi-purpose Arena System Built Around the M4

## *Two-years of abuse and no failures*

Large indoor arenas are often plagued with severe acoustical problems. Noise levels tend to be high, reverberation times very long, and concave roof surfaces can cause focused reflections that create severe intelligibility problems. A possible solution is the use of extensive acoustical treatment. A better solution is to implement a carefully designed, well-controlled sound reinforcement system.

The Pepsi Coliseum of Indianapolis, IN is used for hockey, public skating, equestrian events, tractor pulls, and exhibits. The original system had very poor intelligibility when the ice was in the arena, and insufficient level during tractor pulls. The M4-based array solved both problems completely. Even with a 4.5 second mid band reverberation time and strong focused reflections, Percent Alcons scores are about 7% at distant seats with no audience present. Improvement from audience absorption brings intelligibility scores to the excellent range.

Figure A is a TEF TDS measurement of the M4, PC1564 horn, and a coaxially mounted high-frequency horn/driver. Both magnitude and phase are shown. While the magnitude response is smooth and broad band, the phase response reveals that these two devices are properly synchronized and truly behave as a single device. This combination is capable of delivering a direct sound-pressure level of 108dB at the farthest seat in the venue (150 feet).

The main cluster in this arena consists of six of these devices. Figures B, C and D show measurements made during a performance test two years after the original installation. The devices are extremely similar, with no failures during that period, even though the system experienced almost constant use. Sound personnel at the arena say that there has never been an event that the system could not handle.

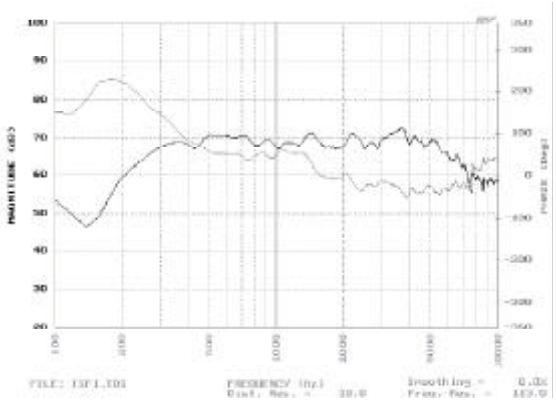


*Figure A. Magnitude and phase response of the M4 CoAx system. The 1200 Hz crossover point is difficult to discern.*

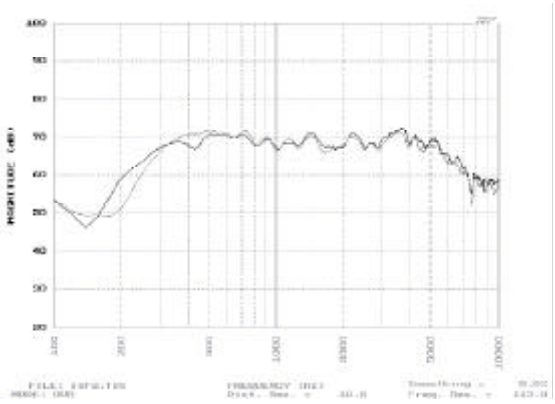


*Figure B. Overlaid measurements of two M4 CoAx systems (two devices from the same cluster)*

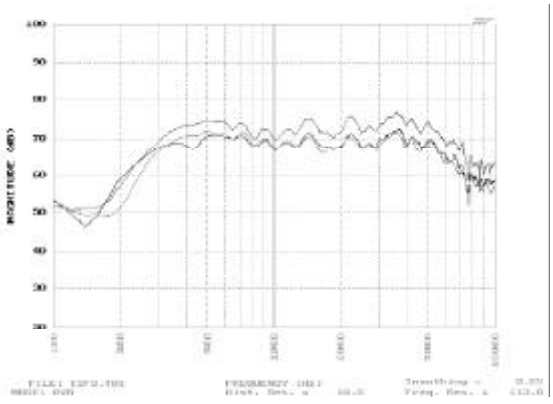


*Figure C. Overlaid measurements of three M4 CoAx systems (three devices from the same cluster)*

M4 Installation Profile

# The First Baptist Church of Orlando, FL

*Three M4 Arrays provide high-level, low-distortion sound reproduction for a 6200 seat house of worship*

Sound reinforcement for worship spaces is one of the most challenging tasks for the system designer. The needs of the First Baptist Church of Orlando, FL. were as follows:

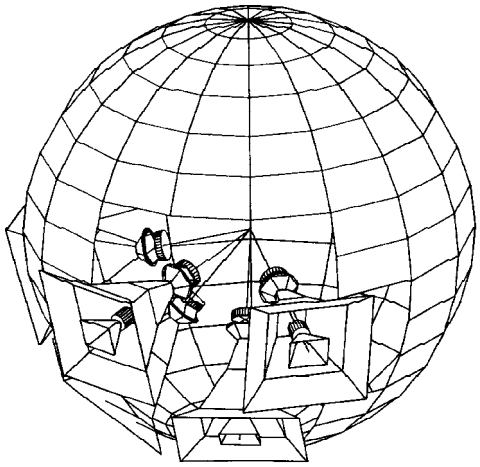
High-level voice and music reproduction
Very low distortion
Smooth full-range coverage of over 6000 seats
A stereo sound field for as many seats as possible
Pattern control to 250 Hz to minimize acoustic feedback

With these goals in mind, system designers Jim Carey, Bill Thrasher and Phil Allison chose the M4 driver as the nucleus of the system. This would assure that voice reproduction would be the best possible. By designing around the midrange, the bandwidth of the system could then be extended for full-range reproduction.

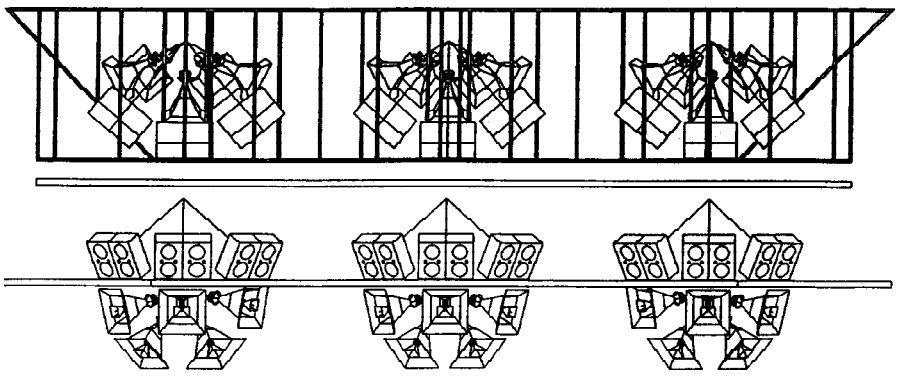
The system utilizes three (3) arrays containing six (6) M4 CoAx systems each. The arrays are arranged in a left-right-center arrangement, providing stereo reproduction for music and a point-source configuration for speech. $M_E$ is a measure of increased gain-before-feedback that can be achieved with device directivity, and is very frequency dependent. Large devices are required to extend $M_E$ down to the bass region. The M4 pattern control horns provide an "$M_E$ factor" that extends down into the 250 Hz region, resulting in excellent gain-before-feedback. The coaxial design provides a smooth transition between the mid and high-frequency devices. Total electrical power is over 26,000 watts (approximately 35 horsepower), the vast majority of which is used on the subwoofer and woofer systems.

The loudspeaker clusters were arrayed using a laser aiming system that projects the orientation of each device from a single point in space. This arrangement best approximates a common wavefront of spherically expanding sound with minimal phase distortion due to device overlap, and has become well accepted as an optimum method for arraying horns.

The M4 CoAx systems used in these arrays received some proprietary modifications from the system designers/installers. Bill Thrasher explains that for this application, the performance of the horns were improved by reducing the spacing between their acoustic centers (apparent apex). This served to provide a better transition between the mid and high frequency devices, and gave the smoothest attainable coverage across the full coverage pattern of the device.



*The spherical arraying technique developed by the system designers has become an accepted method of arraying horns.*



M4 Installation Profile

# The Houston Astrodome

*A near twenty second low-frequency reverberation time made the management of energy emitted from the sound system of prime importance.*

When the Harris County Domed Stadium (better known as the Astrodome) opened in Houston in 1965, it was the first domed stadium in the world. Along with all of the benefits offered by an indoor arena of this magnitude came acoustical problems that presented the system designers with quite a challenge.

The original distributed loudspeaker arrays were state-of-the-art for the mid 1960's, and served the dome for an almost unbelievable 25 years. System designer David Klepper (then of Bolt Beranek and Newman) used many innovations to make the system work, including tape delays for synchronization of the distributed arrays.

Acoustical studies of the venue revealed what everyone had known for a long time, that the Astrodome was an acoustical nightmare. The reverberation time at 2kHz was in excess of 4 seconds, and it continued to rise for each lower octave band to a high of 17.6 seconds at 63Hz. It was decided early in the process that acoustically treating the Astrodome would be too expensive for Harris County to consider in the foreseeable future. The sound system would have to tame this harsh environment and provide intelligible speech to all seating areas. In addition to the acoustic problems, strict budget and weight limitations were placed on the project, and the maximum budget was set at $1 million.

It was known that the Community M4 driver could take an enormous amount of power, was very efficient, and had a proven track record in large system installations. Ford Audio/Video installed (10) M4 drivers on PC1542 horns for the central array.

Another reason for using the M4 were the weight constraints placed on the system. The dome was already near its maximum load capacity, and the prospect of suspending a huge full-range array from the center was quickly ruled out. The final design was a hybrid system, utilizing the M4 central cluster in conjunction with (12) circumferential loudspeaker clusters. This shortened the required throw distances, distributed the loudspeaker load, and seemed like the best overall compromise for the design.

The project proved to be a success, and the Astrodome was tamed with innovative sound system design, well-controlled devices, and adherence to the most basic principle of speech intelligibility: Preserve the integrity of the critical midrange.

*(10) Ten M4 drivers are at the core of this massive hybrid sound system.*

M4 Installation Profile

# Pegasus Studios

*When Dave Engelke was called upon to outfit a state-of-the-art studio, he built the proprietary monitors around the critical midrange.*

Pegasus Studios of Tallahassee, Florida can handle virtually any project, from the recording of albums to the scoring of motion pictures. Studio owner Butch Trucks, who gained fame as drummer for the Allman Brothers Band, hired Dave Engelke to update the original design of George L. Augspurger. Engleke became a key player in revamping the studios interior to meet the latest in acoustic standards.

"Monitoring was a paramount consideration when we built Studio A's control room, so we literally built the room around the speakers," Engelke revealed. "Our goal was to have a system which was accurate, and provided a true representation of the actual sounds in the studio. For that reason, we went to great lengths to create a physical environment which would be conducive to proper acoustical presentation, and were highly selective about which components went into the cabinets themselves."

After producing a series of prototype monitors, Engelke settled upon a proprietary 4-way design he named E IV/D. Standing 45 inches tall and measuring 38 inches wide by 24 inches deep, the cabinets each weighed 600 lbs. Not your average square box by definition, the cabinets, like the shape of the control room itself are highly geometric with many angular planes. Power for the cabinets is provided by five Crown amplifiers, while the crossover network was provided by Creative Electronics of Nashville.

Engelke relates that he chose the M4 because of its strong midrange performance, intelligibility, low distortion characteristics, and power handling capabilities. "We selected the M4 because, in my estimation, the midrange section is too often ignored when choosing the proper components for a loudspeaker system," says Engelke. "I think people tend to ignore the midrange because they are so preoccupied with high-end response and low-end bass. As a result, when you listen to some monitors, you find that the midrange band simply isn't accurate in its representation of sound, especially with snare drums or the male vocal range. To illustrate my point, try running a signal off of a snare drum into a woofer. Without question, you will not obtain true reproduction of sound. Conversely, the same thing will occur when you try to run sound from a low-end component into a high frequency driver. Over the years, it became obvious to me that something had to be done to get accuracy back into the midrange spectrum, and that's where the M4 comes in. When you look at the M4's total response, the midrange frequencies between 200 and 2000 Hz are just about as optimum as you can get for accurate performance."

For low frequency reproduction from 120Hz to 400Hz, a Crown Micro-Tech 1200LX powers twin TAD 15-inch woofers in each cabinet. At 400Hz, the signals are crossed over into the M4s, which are driven by a Crown PSA2. At 1600Hz the signals are routed to a TAD 4001 coupled with a Community SH864 horn, which can theoretically carry them up to 22kHz using the Crown PS400 amplifier.

The use of the M4 at Pegasus Studios helps to dispel the myth that this device is only for large stadium arrays and very long throw distances. Low distortion is one of the M4s most appealing features, which makes it ideal for any application that requires exceptional fidelity in the critical midrange.

M4 Installation Profile

# The Orange Bowl

*An experienced design/build team and the M4 driver bring the dreams for a new sound system for the University of Miami to reality.*

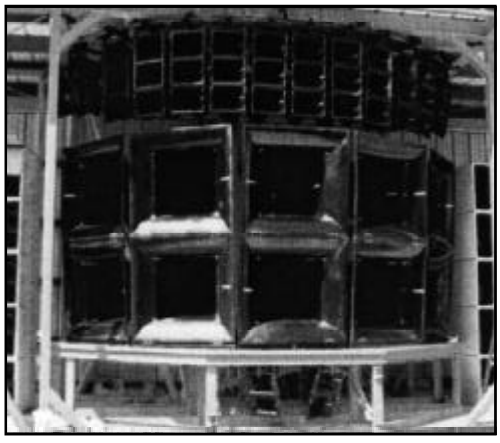
When the Miami Dolphins moved from the Orange Bowl to Joe Robbie Stadium, one of the reasons cited was that a better sound system was needed. The Joe Robbie system was built around the M4 midrange driver, and became one of the best examples to date of how to cover a large stadium from one end zone. The success of that system gave birth to a new system at the Orange Bowl. While there are many differences in the system, the critical midrange was reinforced using the same proven device, the M4 driver.

Due to scheduling constraints, only two months were available for the design and installation of the Orange Bowl sound system. The project was financed by the University of Miami, and $300,000 was allocated to ensure a professionally designed and installed system. Florida Sound completed the design/build project in record time, drawing from their turnkey capabilities and long-term experience in sound reinforcement. L.W. "Mac" McGowan and his crew carried the project from the start, from generating the AutoCad drawings to calibration of the last amplifier level control.

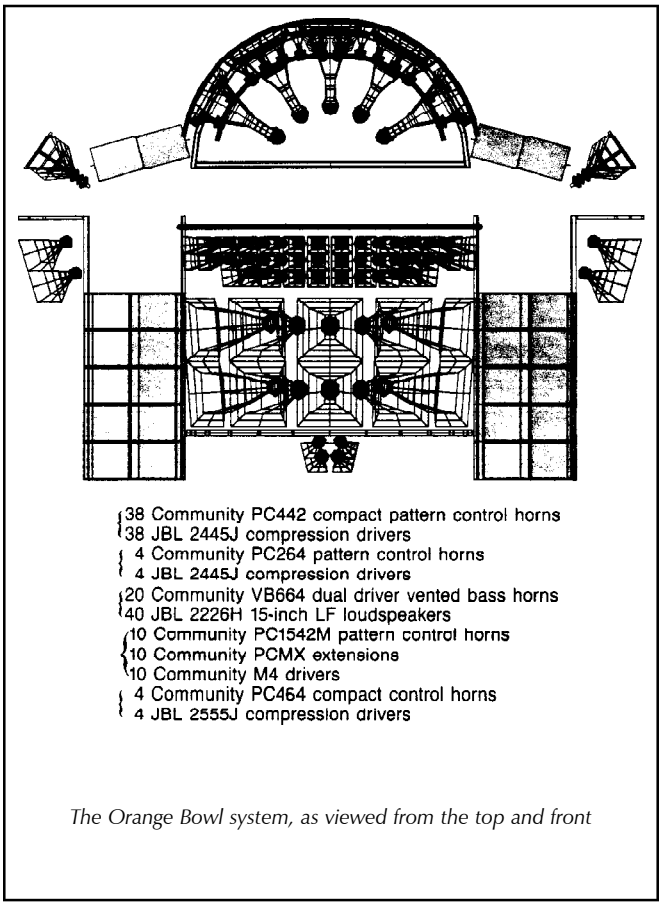
The nucleus of the system is the M4 midrange driver. Ten of these devices are used to cover the frequency band extending from 260Hz to 1800Hz. The M4s are coupled to the environment via ten (10) PC1542M 40x20 horns. The bandpass from 1800Hz and up uses 38 PC442 horns, each driven by a single JBL 2245 driver. This 3.8 to 1 ratio between the number of high frequency and mid frequency devices is not uncommon, and is a testimony to the massive acoustic output of the M4. To round out the long-throw section of the array, Community VB664 bass horns are used, and are loaded with (40) JBL 2226H drivers.

"Everything arrived on-site as planned," says McGowan, "and out of hundreds of devices delivered, there were no defects. Excuses wouldn't have helped me on game day, and all of my suppliers helped make sure that I didn't have to make any."

Is it possible to complete such a massive project in a two-month time window? The powers that be at the University of Miami think so, who commented "It sounded like they had been working on it for months, and not just weeks."



*An excess of 3-to-1 ratio between high-frequency and mid-frequency devices was required to produce similar acoustic outputs.*




*The Orange Bowl system, as viewed from the top and front*

M4 Installation Profile

# Cincinnati Music Hall
# Cincinnati, Ohio

*Low distortion was a main criteria in the design of a system for this historic performing arts facility.*

The Cincinnati Music Hall is a historic and architecturally impressive facility with a worldwide reputation for acoustical excellence. But even with fine acoustics, sound reinforcement is needed for many of the productions at the facility. Such a setting presents some difficulties for system designers, who must balance fidelity and aesthetics in providing a workable system for the client.

A state-of-the-art sound system was needed to replace the 15-year old column loudspeaker system in this historic venue. Manager of the Music Hall, David Curry, explains, "We were looking for the best quality system we could get with the funds we had available, approximately $160,000.00."

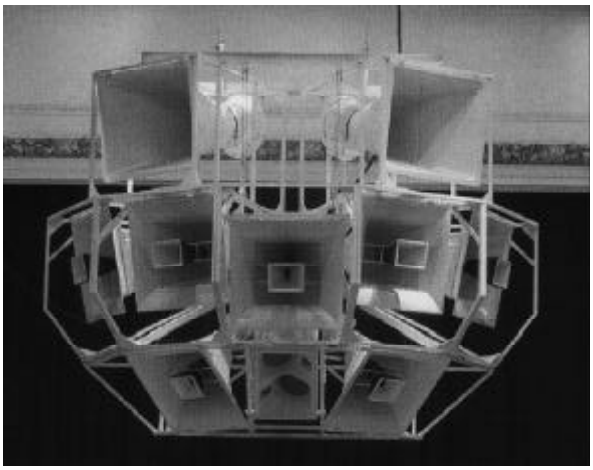
The new system had to solve some ongoing sound problems in the Music Hall, including poor coverage, poor frequency response, lack of definition and intelligibility, high distortion and insufficient loudness. In addition, the system had to keep up with the orchestra, which was producing 100dB average levels at the front edge of the balconies.

With these criteria in mind, system designer Charles C. Baxley chose the M4 driver as the cornerstone of an elaborate array of constant directivity horns. This format would allow well-defined coverage of the audience with minimal overlaps in coverage between adjacent devices.

The main array consists of two long-throw Community CB594 bass horns (60Hz - 250Hz) loaded with 18" JBL woofers, five large format PC1542M pattern control horns and two PC1564M pattern control horns, all loaded with the M4 driver (250Hz to 1250Hz), and seven CLS small format constant directivity horns with JBL drivers which are mounted coaxially in the midrange horns. Additional front bass fill is provided by one CLS CB594 dual 15-inch pattern control reflex cabinet.

Why were such large horns necessary? According to Baxley, "These devices have the pattern control needed to achieve the extremely high intelligibility desired in this reverberant space. The Pops runs nominally at about 85dBSPL with crescendos averaging 100dB, so we also needed a sound system that could keep up with the high sound levels. If a vocal or instrumental soloist performs, they need reinforcement against the full orchestra. We had to have a system capable of reaching those same levels while maintaining the low distortion required."

How does the system work? David Curry comments, "We have been very pleased with the result. Usually after a show we would have a fair number of complaints from people who just couldn't hear well. Since the installation of the new sound system, we've had no complaints whatsoever and I am sure we won't in the future." Even performers have commented on its quality, he says, adding, "I believe we probably have the finest sound system anywhere."



*A perfect example of an array design driven by the physics of sound and the basic requirements of the human ear/brain system.*