

**Field Report: Yamaha PM-3000**

# **SOUND & COMMUNICATIONS**

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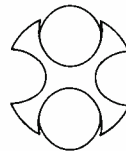
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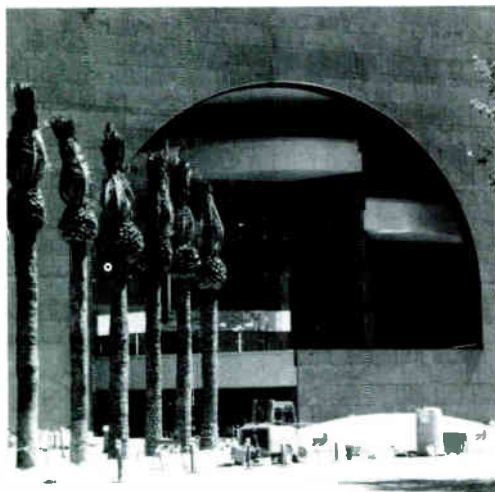
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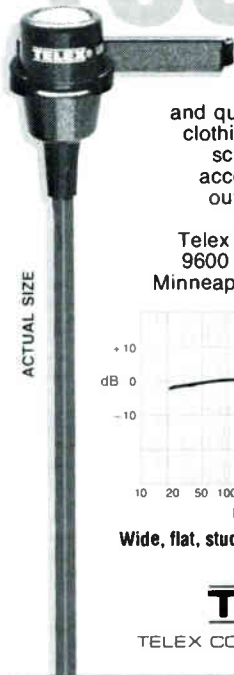
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# The Telex LM-100 miniature lapel mic system

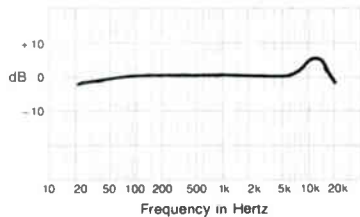
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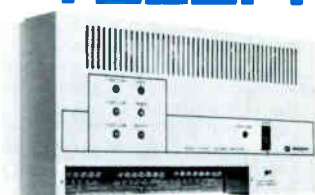
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## **FIELD CORPORATION BUYS MUZAK, EYES YESCO**

Pittsburgh-based Westinghouse Electric Corporation has sold Muzak—a supplier of background music—to Field Corporation of Chicago. Details of the terms were not disclosed at press time. Muzak has more than 135,000 subscribers through about 200 franchised affiliates in the United States and 15 foreign countries and had sales about 150 million dollars last year. The sale is part of Westinghouse's Group W division's strategy to divest itself of operations that aren't part of its core commercial broadcasting and programming division. Lee M. Mitchell, Field's president, said the Muzak acquisition is part of the company's strategy to buy underperforming, yet profitable communication companies. The Field Corporation announced it has also reached an agreement in principle with YESCO, Inc. to combine YESCO's music services business with Muzak. The agreement is subject to the completion of the acquisition of Muzak and to the negotiation of a definitive agreement between Field and YESCO. Field also announced that upon completion of these transactions Mark Torrance, president and principal shareholder of YESCO, will become president of the combined businesses, which will operate under the Muzak name. Field was formed in 1984 by owner Marshall Field V after the liquidation of Field Enterprises Inc. The company, which owns Pioneer Press and 40 weekly suburban Chicago newspapers, has annual revenues of roughly \$225 million.

## **SOUND CRAFT SYSTEMS PURCHASES FRAZIER INC.**

Sound Craft Systems has announced its purchase of Frazier, a Dallas-based loudspeaker system manufacturer. According to Earle Love, Sound Craft's president, "Frazier complements our line of lecterns and portable speech reinforcement products, and as a separate division Frazier will continue to support and develop its current markets." Frazier administration and manufacturing were recently relocated to Sound Craft's Morrilton, AK, facility. Jay Mitchell joined the company as chief engineer and George Meals is sales manager.

## **BOGEN TO BE PART OF LEAR SIEGLER'S NEW TELECOMMUNICATIONS DIVISION**

Bogen, a division of Lear Siegler, has been combined with two other Lear Siegler divisions—Electronic Instrumentation of Anaheim, CA, and Sierra Electronic of Menlo Park, CA, to form one single Telecommunications Division. Joseph W. Back, a former president of Sierra Electronic, was named president of the new division, which will be headquartered in Anaheim, CA. John H. Ochtera will continue as president of Bogen, and LeRoy R. Coutts, former president of Electronic Instrumentation, will become an executive advisor to Back. Barry Rodgers, vice president of Lear Siegler's Electronics/Material Handling Groups, said the combination would provide significant technological and manufacturing benefits and would result in a division that is more responsive to customer needs. All the operations serve the telecommunications and related markets.

## **ICIA SCORES A VICTORY FOR SMALL BUSINESSES ON UNFAIR COMPETITION**

The White House Conference on Small Business concluded its meetings with a list of 60 final recommendations voted on by 1,715 small business delegates from across the nation as the top priorities for action by Congress and the administration. Number three on the list is a recommendation that tax-exempt organizations, government agencies, and other tax-favored or government-funded entities be prohibited from competing with small companies in the sale of products and services.

The International Communications Industries Association (ICIA) has sponsored this recommendation throughout the 57 state level meetings of the White House Conference which began in August in Virginia. A total of 42 states plus the District of Columbia and Puerto



Rico adopted resolutions against unfair competition at their state meetings. "We started with an issue that was important for our industry but relatively obscure on the national scene," said ICIA Legislative Committee Chair John Moore. "Many other industries face the same problems—unfair competition from nonprofits, including universities and government agencies. By communicating with those industries, we were able to build a strong coalition of delegates from across the country who supported our efforts and helped us to victory."

#### **EDGE TECHNOLOGY ACQUIRES TURBOSOUND AND BROOKE SIREN SYSTEMS**

Edge Technology Group Limited of London, England, a new name in pro-audio, has acquired both the Turbosound Group of companies and Brooke Siren Systems (BSS). There was no merger of Turbosound and BSS as reported in the July issue of Sound & Communications. Both companies will retain their current U.S. distribution because they have proven highly successful, according to a spokesman. "EdgeTech was formed to become a diverse and powerful force in the marketplace, a goal reflected in its first two acquisitions," said the spokesman. Turbosound has been very successful in gaining acceptance in the high-end MI and pro reinforcement sectors, as well as the sound contractor market. Brooke Siren Systems, distributed in this country by Klark-Teknik of Farmingdale, NY, is known for its high-end electronic crossovers and signal processing equipment for the sound reinforcement, studio, broadcast, and sound contracting industries.

#### **RECORD ATTENDANCE ANTICIPATED FOR THE 81ST AES CONVENTION IN LOS ANGELES**

The coordinators of the 81st Audio Engineering Society Convention have reported that they are expecting a record number of attendees at the November 13-16 meeting in Los Angeles. The convention is expected to attract 15,000 spectators and 215 exhibitors, according to Ron Bennett of the Cosmic Muffin Group. Bennett expects this "to be the biggest show yet because of the resurgence in the pro audio-video business. There will be new technical developments announced in technical conferences and at press conferences. The contractors can expect to see new developments in the sound and communications business such as new speaker technology, microphone technology, and a revolution in control and high density storage in optical and digital recording." The keynote speaker for the convention will be Stan Cornyn, president of the Record Group. Cornyn won two Grammy awards and is a past director of the National Academy of Recording Arts and Sciences. For more information contact AES at (212) 661-2355.

#### **AIPHONE CORPORATION OPENS FIRST MIDWEST OFFICE IN CHICAGO**

The Aiphone Corporation has opened its first Midwest office in Chicago. The office is the company's second outside its Bellevue, WA, headquarters (an East Coast regional office is located in Chantilly, VA). Albert Burns, who has been named the company's Midwest regional sales manager, will manage the new operation. Burns, who has experience in the sound and security business, has worked for Wells Fargo Alarm in Chicago, Edwards Corporation in Lombard, IL, and Taylor Lock Co. in Philadelphia. The office, located at 8850 S. Bennett Ave., will provide support to eight Midwest Aiphone sales representatives.

#### **STUDER REVOX MOVES NEW YORK OFFICE**

As of September 2 the New York City field office of Studer Revox America has moved to 161 Avenue of the Americas, Suite 901, which is across the street from its previous location. "Not much bigger but a whole lot better," said Northeastern Regional Manager Nick Balsamo. "We'll be able to use available floor space much more efficiently than we could in the old building. We'll have seminar rooms for service training programs, something many customers have requested. We'll have expanded service facilities to accommodate our larger technical staff, plus an expanded parts inventory. And we'll have improved demo facilities for showcasing our new products."

## THE GROWING CCTV MARKET

One of the hottest growth sectors of the security market today is closed circuit television (CCTV). Sources have reported that in 1986 the CCTV market is close to \$400 million and in 1987 that number will increase an additional 10 to 15 percent. This growth is attributed to more sophisticated and less expensive technology as well as a wider range of applications.

### Technology

According to Fred Posner, sales manager for Hitachi Denshi America, "The latest addition to the CCTV market is color. Traditionally all CCTV has been black and white. The introduction of the color chip camera will help in the recognition of clothing, hair color, etc. You couldn't do this before with black and white."

Bob Milecki, national sales manager for Vicon Industries Inc. said that he expects the color chip camera to cost almost the same as the black and white camera. He also agreed with Posner as to the advantages of color. "Color cameras can help in identifying shoplifters because you can distinguish between brown and black hair unlike the situation on a black and white camera," Milecki said.

Irving Rossman of Crest Electronics sees color CCTV being of use in casinos where "they can see what color chips are being played. As a result they can tell a \$1 chip from a \$100 one." Rossman added, "In medicine, where cameras

have been used for years to tape operations for observation, the color the cameras now have will help the doctors see exactly what is going on."

Another development which is affecting the CCTV market is the solid state sensor. According to Russell Mayworm, sales manager, Javelin Electronics, "Solid state sensor cameras use a solid state sensor instead of an image tube. These cameras offer a significant advantage. As an image tube degrades with usage, so does the picture. On the average, tubes have to be replaced every 18 months. The solid state sensors never need to be replaced, they're virtually maintenance free. They can also avoid such things as image burn and comet tailing. The solid state cameras can also stand more shock and vibration than the image tube."

The miniaturization of cameras, according to Rossman, has applications in the military and police departments. He said, "Some cameras go as small as one inch cubed. They can be put into a briefcase so that a guard can watch a person without him knowing he's being watched."

Joseph Goetz, national sales manager of Panasonic Industrial's CCTV Equipment Division agreed that camera size has gotten smaller. He also noted that, "housing has not stayed up with camera size. Manufacturers will be making smaller housings which will result in lower cost of the camera as well as lower

maintenance costs." Goetz predicted that more cameras will be put in a plastic dome instead of steel housing. The camera will then be able to rotate a full 360 degrees inside the dome.

CCTV recorders are also becoming more sophisticated. According to Judy Artunian of Gyrr, time lapse recorders are now being used to condense time. For example, a standard two hour VHS cassette can last up to 40 days Artunian said. "There is a convenience of not having to hire security personnel to sit in front of the cameras. You can have a visual log of what went on in the store."

### Applications

CCTV is also enjoying a wider range of applications. According to Peter Sherwin, marketing director, Impart Inc., whose firm specializes in franchised restaurants, "There will be an increase of restaurant drive-thrus with cameras used to see what's happening. A manager can keep track of what is going on in the store as well as what's out the back door from his office."

In addition to watching customers, store owners and factory owners may be watching their own employees as well. Sherwin said he sees CCTV on "the production line to keep control of the work environment—especially in the industrial area in keeping track of low wage employees because of the high turnover rate. Employers have a hard time getting to know these employees and sometimes

they're not as well trained thus requiring closer supervision. We will be walking a fine edge between big brother and work efficiency."

Bud Wilkey, president of Surveillance Video Systems, said CCTV will become popular in homes because "the simplicity of the TV systems allows you to see what's going on around you. A housewife in a kitchen can see who is at the door. The cameras allow people to put themselves in more than one place at the same time."

CCTV has been used in agriculture and research. Rossman said CCTV has been used to monitor cows and horses in a barn as they foaled. He also said CCTV has been in underwater exploration (such as the Titanic exploration) and checking sewage and oil lines. Along the same line, Artunian reported that Gyrr is in the midst of a project where they're donating recorders to the Los Angeles and San Diego zoos to monitor the condors.

CCTV is also being used as a safety device. Margaret Wall, sales coordinator for Elbex America said her company makes Tailvision for car, bus and truck driving. "It's different because there is a dash monitor that can be mounted in the dash or on it as well as on the ceiling. The system can have up to three cameras that pan or tilt. This is good for school buses because a mirror can only go so far. There's always the possibility that a driver can not see everything behind him."

*(continued on page 30)*



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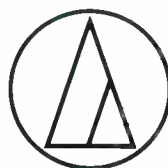
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# THE CONSULTANT'S ROLE

**A** system contractor's involvement in a project begins when a specification is issued for bidding by a general contractor or construction manager. For the consultant, on the other hand, bidding is only a milestone, a halfway point for a project.

The issuing of construction documents signifies the end of the design phase for the architect and his team of consultants and engineers. This process is often long and arduous, and although contractors are not involved during this time, the scope of the contractor's work is being determined. System contractors should understand the steps consultants have to follow to get to this point.

***The contractor never sees the interaction of the design team—the discussion of ideas, the integration of design concepts, the evaluation of proposals, the give and take and compromise among the many priorities each member of the team brings to the process.***

The design team for a theater—a typical project for an acoustical consultant—consists of the architect; mechanical, electrical, and structural engineers; acoustical, theatrical, and other specialty consultants. Their objective is to carry a project from concept to reality.

The contractor never sees the interaction of the design team—the discussion of ideas, the integration of design concepts, the evaluation of proposals, the give and take and compromise among the many priorities each member of the team brings to the process. The contractor only sees the final design, and may not be aware of design decisions that result in specifications being as they are.

The design of the sound system—which is of paramount interest to a sound system contractor—is most frequently in the workscope of the acoustical consultant. Like other members of the design team, the consultant's recommendations are directed to the project architect. But long before this happens, the owner of the building has to select the project architect who will form the design team. This process is very different from the bidding process for contractors.

On a major theater project, the owner may hire an arts management service and/or theatrical and acoustical consultants to analyze the arts requirements of the community and conduct feasibility studies of the various options. This work can result in a program statement, which lists the basic projected parameters of the proposed facility: the physical size and seating capacity, the extent of the support facilities, the type of events, and a budget. All of these

play a role in determining the program requirements of the facility.

Based on the program statement, competing architects put together proposals to the owner to show their qualifications and to indicate the direction of their design concept based on the program statement. In doing so, architects often invite consultants and engineers to join their proposed team to demonstrate to the owner that their architectural concepts will include good acoustical and theatrical design. The field of submitting architects is "short-listed" down to a small number of firms, generally five to 10. At this time, full-scale presentations are put together by the remaining architects for final interviews with the owner. Architects often spend a great deal of time and money developing an impressive proposal and are generally not reimbursed for this work. Consultants and engineers often play a strong role in this portion of the process in order to strengthen an architect's position.

It is entirely possible for a well known consultant to be associated with more than one architectural team on the short list. This, of course, can make the final interviews very interesting. It is also possible, although infrequent, for an architect to select a different consultant after being awarded the project. And likewise, an owner may direct the select-

ed architect to employ a particular consultant based on his interviews. An increasingly popular strategy is for owners to hire the specialty consultants (acoustical or theatrical) directly, which forces the architect to give the recommendations stronger consideration. All of these situations can cause havoc in the relationships among the members of the design team even before the design phase actually begins.

For a consultant, a project is divided into three major phases: design, construction, and post construction. The design phase, which is complete upon issue of contract documents, consists of three components: schematic design, design development, and working drawings. If the program statement and initial proposal were of sufficient detail, the schematic design component may not be very lengthy, assuming that the owner has construction financing available and has not changed his mind about the project's magnitude or program. Because all projects begin on a fast track while the owner is enthusiastic, schematic design may take place concurrent with negotiation of contracts for the consultants, while the level of their involvement is being determined.

If all is well, the schematic design component of the design phase consists of a number of concept meetings

*(continued on page 49)*



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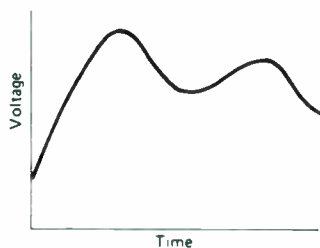
World Radio History

## Digital Audio Basics

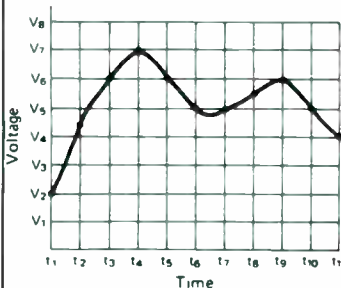
# ANALOG—DIGITAL CONVERSION

**N**ow that digital recording and playback systems have become common in our industry, you may want to review some basic principles of digital audio. If digital audio is still a mystery to you, now is a perfect time to learn about it.

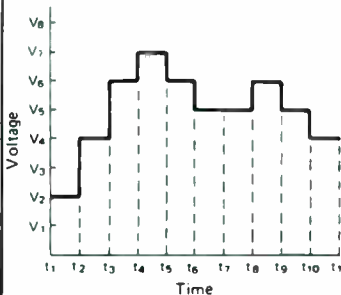
This article describes the characteristics of analog and digital audio signals and the conversion between the two domains. Whether you are



(A) Analog Audio Signal



(B) Digitization Grid



(C) Digitized Signal

Figure 1

dealing with digital recording, synthesis, or types of signal processing, the basic principles of conversion between the analog and digital domains are the same.

### The Analog Signal

The electronic analog of an acoustical signal is a waveform that is continuous in both amplitude and time, having frequency components in the audio range of 20 Hz to 20 kHz.

The key word relating to analog is *continuous*, and over the whole dynamic range of the signal channel (from the noise floor or minimum resolvable signal to the upper limit of the channel's signal excursion), the electronic signal exactly represents the acoustical signal.

In the analog domain, a number of factors such as nonlinearity, frequency response, slew rate, channel noise, etc., can contribute to distortion of the signal.

### Time-Amplitude Grid

The essence of the digitization process is the *sampling and quantization* of the signal at discrete time points and into discrete amplitude levels.

The easiest way to visualize this is to imagine the analog signal superimposed on a sheet of graph paper (Figure 1). The horizontal grid represents sampling the signal at discrete time points. The vertical grid represents the quantized levels of amplitude.

You can see that the sampling process leaves us with a signal that only *approximates* the original signal. It would appear that the approximation is as accurate as the fineness of the grid. In essence, the fineness of the vertical grid determines amplitude resolution and is reflected in the digital word length.

The horizontal grid, or sample rate, also determines accuracy, but in a different way. The allowable frequency range of the signal is proportional to the sampling rate. The sampling rate must be at least twice as fast as the period of the highest frequency component of the audio signal.

### The Digital Signal

The digital signal is really just a series of numbers. Each number in the series represents the quantized approximation to the analog signal at each sample point in time.

Since present-day digital systems and computers use the binary number system instead of the familiar decimal number system, the numbers look different to us. Don't be deceived: a list of numbers is still just a list of numbers.

Binary numbers have only two symbols for each digit: 0 and 1. This system is popular in digital systems because it corresponds to the basic "on" or "off" condition that is easy to work with in digital switching, computation, and storage systems.

Figure 2

| Word Length vs. Signal-to-Quantizing Error |                            |
|--|----------------------------|
| Number of Bits                             | Signal-to-Quantizing Error |
|  | Error                      |
| 4  | 24 dB                      |
| 8  | 48 dB                      |
| 10   | 60 dB                      |
| 12   | 72 dB                      |
| 14   | 84 dB                      |
| 16   | 96 dB                      |

### The Analog-to-Digital Conversion Process

The essential process of transforming an analog audio signal into a sequence of digital numbers can be understood as mapping a wavy line on a piece of graph paper. The wavy line corresponds to the analog audio signal, a continuously varying voltage in time. The graph paper corresponds to the two dimensions of the digitization process, sampling the analog voltage at regular time intervals, and *rounding off* the measurements to a digital number (Figure 1).

The period of time between each measurement of the analog signal corresponds to the *sampling rate*. If the sampling rate is at least twice as fast as the highest frequency component of the audio signal, there will be no loss of signal information. The signal can be completely represented and reconstructed from the information content of these samples (Nyquist's Theorem). An audio signal with frequency components up to 20 kHz could be sampled at a 40 kHz rate with no information loss, though in practice a higher sampling rate is used.

The quantizing process,

by Michael L. Beigel  
Beigel Consulting Services

the assigning of a limited set of discrete numeric values to a continuum of analog voltages, results in a loss of signal information. Since each digital number represents a range of analog values, a *quantizing error* occurs. The more digital numbers used to represent the signal, the smaller this error will be. Thus, by increasing the number of binary digits (bits) in the conversion process, the accuracy or resolution is enhanced.

The *signal-to-quantizing*  
(continued on page 48)

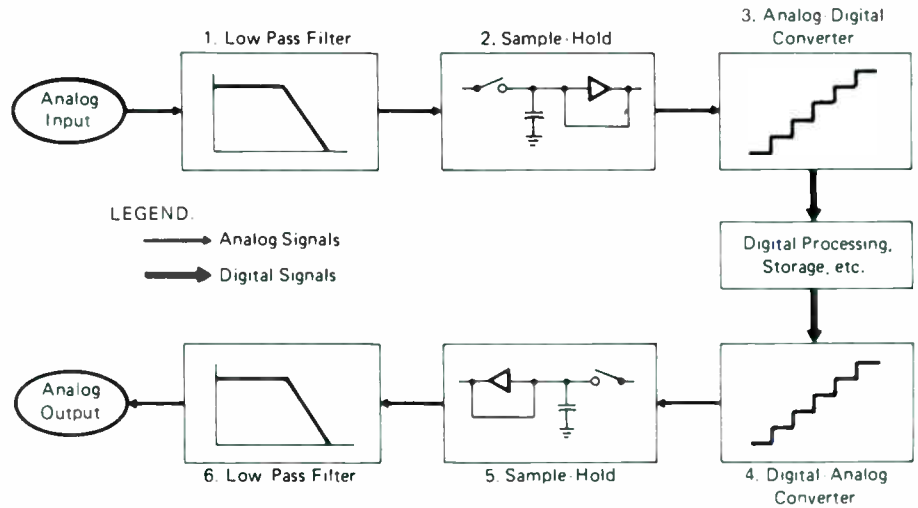
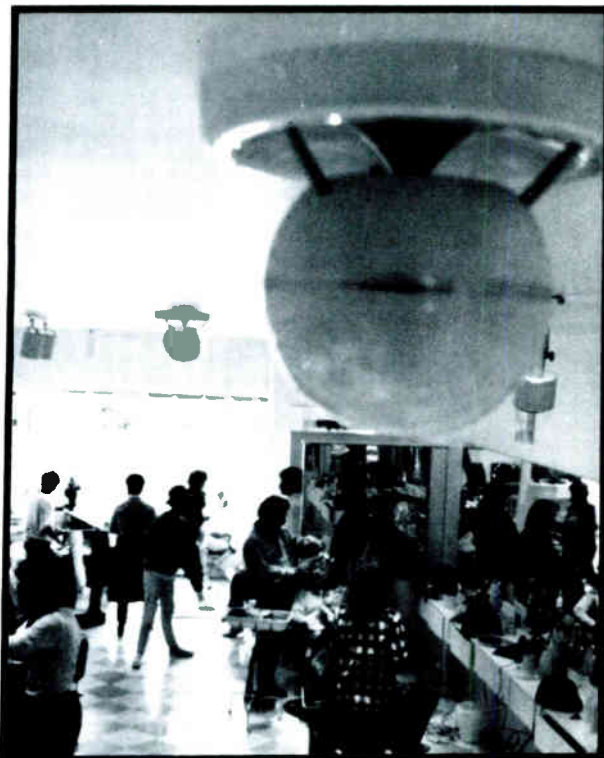


Figure 3 - Digital Audio System Block Diagram.

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# How to Wreck a Nice Beach...

or

## How to Recognize Speech

---

### Speech Intelligibility: Do the Testing Methods Work?

---

by Steve Orfield  
Orfield Associates

**I**ntelligibility, as a concept in acoustics and audio design, is in the midst of both a technical renaissance and a competitive race for the acceptance of measurement methodology. While it may be fair to argue that the evaluation of performance of spaces and sound systems is taking great leaps in terms of technical explanation and measurement, there is no question that the concept is simple in any clear definition; “intelligibility is the ratio, expressed in percent, of the number of sentences understood to the total number of sentences spoken during an ordinary verbal conversation.”





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Intelligibility is a function of many well defined variables including:

- original source level
- physical distance to listener
- background noise level
- reverberation time of space
- multiple source paths or multiple sources
- electronic reinforcement system performance.

A number of lesser known variables also play a major role in the prediction of intelligibility:

- familiarity with message
- ability to see the person talking
- hearing impairment of the listener
- clarity of the talker, voice spectrum
- speed of the person talking
- difficulty level of the vocabulary/message
- motivation/interest of the listener
- thermal environment; temperature, humidity

Intelligibility has been evaluated experimentally since the early part of the century via such methods as listening tests (ie. phonetically balanced Word Score tests), the Articulation Index (AI), the Speech Transmission Index (RASTI), and the Articulation Loss of

#### Consonants Methods (ALcons).

Listening tests are the basic reference for all intelligibility testing, since they are the only way to validate intelligibility directly. In this type of test, a clear speaker enunciates a message of known intelligibility probability, and a jury of listeners attempts to replicate those words, sentences, or sounds. This type of test can be performed with or without a sound system in use; and like all intelligibility tests, results in a numerical value of change in intelligibility over changes in other variables. This test procedure is difficult to perform accurately, and it is seldom used in sound system design; it is used far more heavily in basic research.

The Articulation Index test is based on measuring the change in the level of a signal between a source and a listener. It is often performed by generating pink noise at a talker position and measuring the reduction in each of 15 frequencies at a listener position. This *transmission loss* is compared to the background noise level in a space to determine a final signal to noise ratio of the voice to the background. The S/N ratio in each frequency is then reduced by multiplying it by a factor based on the contribution of each fre-

quency band to intelligibility, and these reduced values are arithmetically summed to provide a result between 0 and 1. Corrections are added for variable background noise, speaker orientation, and reverberation time to arrive at a final rating.

The Speech Transmission Index has only one current method for evaluation—the Bruel & Kjaer RASTI meter, which uses the short form IEC standard test for intelligibility. This meter consists of a transmitter that sends out a signal in the 500 Hz and the 2,000 Hz bands which varies by means of a modulation function in each frequency. A receiver is used to evaluate the reduction in modulation index and to calculate the Rapid Speech Transmission Index (RASTI). The test is based on the frequency distortion measurements inherent in AI measurement, and on the need to measure the time distortion of a signal inherent in the use of correction factors in the AI method. The current test has some limitations in its application to specific rooms, but it is clearly the easiest and quickest method under which to perform a test. (A new STI test program is being introduced by Bruel & Kjaer to deal with a more in-depth calculational procedure under this method, and the TEF analyzer has been programmed to calculate RASTI, although this disk has not been offered as yet by the manufacturer, Techron.)

The final test method used in evaluating intelligibility is the Articulation Loss of Consonants method, which is known in the audio field as a calculational procedure based on a group of measurements or predicted values. This method considers room reverberations, volume, speaker distribution geometry (Q), distance to listeners, background noise level, and signal-to-noise level. (Recently, this measurement was incorporated into a disk that has been privately distributed to some TEF users. Techron will be making this calculational disk available shortly.)

While the RASTI method is very simple to perform, the AI.cons method on the TEF analyzer is far more difficult, in that it assumes some proficiency with the TEF computer, some understanding of parameter settings, and some understanding of the basic configurations under which the results are useful. While the TEF analyzer provides the potentially most sophisticated set of information with the highest level of ability to select methods of analyzing that information,

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—John H. P. Smith, Chief Audio Communications Officer, Cunard Line, Framingham, MA, U.S.A. (Bose professional sound systems for the Queen Elizabeth 2)

It's hard to imagine a more challenging place to install a sound system than the Queen Elizabeth 2. After all, she is the world's most renowned luxury liner, and people enjoying her hospitality naturally have great expectations. They expect to dine, play and relax on their cruise in style and comfort. *And almost everything on board the Queen, including the sound system, is important in cultivating the right atmosphere.*

But the QE 2's sound system has to do more than sound good. Should the need arise, it also has to be capable of providing passengers with vital safety information. It must meet the strict standards set by a number of organizations including Lloyds' Registry of London, the U.K. Dept. of Transport and the U.S. Coast Guard. It needs to be rugged enough



Bose professional sound products.

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it puts the user under great pressure to understand the theory and practice of using the device. (This hopefully will change with the introduction of newer software and with the introduction of AUTO-TEF, a program that allows procedures performed on the TEF to be automated and performed with little user input.)

All of these methods are intended to detect and predict the change in the signal between the source and the listener in both the time and frequency domains. All of them exclude the consideration of many of the lesser known issues noted above.

Thus, we come to one of the principal issues that is so often debated in the field of intelligibility measurement—the issue of what is being measured. Certainly, no current objective measurement (ALcons,

that there is some basis for holding many other variables constant and in measuring the change in signal distortion due to changes in the variables of time and frequency. Thus, the basis for all objective measurements of intelligibility (that I am aware of at this time) is the change in signal integrity due to changes in two main variables. This measurement provides no absolute information about the intelligibility of any particular speaker or of a message to any specific listener. Unfortunately, the rating systems used by each of these measurement procedures draw distinctions as to the intelligible quality of the message or the tendency of the listener to understand that type of message, rather than rating the *distortion* contribution of the communication process.

Therefore, it is possible to obtain an

the current benefits to be derived from consideration of intelligibility in the context of the audio community.

With regard to audio system design, in order to provide some control over intelligibility, the designer must respond to two large-scale variables: the quality of the architecture and the quality and adjustment of the sound system. The difficulty in sound system design comes principally in the difficulty of understanding and predicting the performance restraints of these two variables and in the level of control over the ability to change either variable. In terms of architecture, it generally is appropriate to assume that in any large room there are some intelligibility reducing conditions such as high HVAC noise or environmental noise, high reverberation time, room shape problems, large talker to listener distance, or specific specular surface reflections.

If the room in question is used for the performance of music, the design will often be intended to provide performance that is the opposite of what one would ideally want for room intelligibility (high sound diffusion and long reverberation times). In addition, there may be an architectural restriction, on the placement of the basic cluster or other speaker system, that will further reduce intelligibility.

As for the design of the reinforcement system, a number of basic issues affect intelligibility beyond that of room performance. They include cluster vs. distributed system, single point vs. multipoint system, degree of monitor use, type of components selected, selection of equalizer types, degree of user control, and need for use as a music system.

Finally, to tune and evaluate the sound system and room performance in question, a number of test technologies can be used:

- pink noise with real time analyzers or serial frequency analyzers
- reverberation measurement
- time delay spectrometry
- RASTI measurement
- live performance, transfer-function EQ

These measurements range from the simplest evaluation tools, such as RASTI measurement, to the most complicated systems of evaluation, such as time delay spectrometry. They do not evaluate the perceived quality

(continued on page 30)

### Figure A

### Guidelines

#### Rooms

1. Provide maximum reverberation times of 1.5 seconds or less.
2. Do not design symmetric rooms (identical width and length).
3. Determine one speaker position (if possible).
4. Provide a sound absorptive rear wall.
5. Do not use focusing surfaces in room design (concave shapes—domes, barrel vaults, etc.).
6. Do not use high ceilings that cause time delays.
7. In selection of materials, assume that reverberation time should taper from lower frequencies to higher frequencies and not be constant or near constant. Do not provide high reverberation times in the mid-frequency area.

#### Sound Systems

1. Use single point speakers in rooms that permit this position. If a combination speaker (i.e., three-way, etc.) will work, do not use a cluster. (This assumes that the combination speaker is properly aligned.)
2. Prototype and align the cluster with some type of analyzer (i.e., TEF, etc.).
3. Do not use mixing boards in difficult rooms without experienced operators; the sound system control should not be in the hands of an unsophisticated user.
4. Avoid processing the signal whenever possible via compressors, limiters, reverberation controls, etc.
5. Use the minimum EQ that will provide controlled, clear sound to the seating area. Do not assume a flat or standard EQ taper.

RASTI, AI, etc.) is evaluating directly the intelligibility of a speech signal. If it were, the interesting contradiction in all of these measurements would be that each can predict the intelligibility of a non-intelligible signal (i.e., the ETC sweep, the RASTI modulated signal, or the pink noise so often used to measure AI).

Is it true that methods which can be used to analyze the frequency and time distortion in a signal can also be used to directly measure intelligibility? If it is, what assumptions are inherent in this type of measurement? I doubt that any current or past theorist would argue that intelligibility is a function of only the variables of time and frequency changes in a signal. What such a theorist would probably suggest is

intelligibility rating, based on current test procedures, that suggests very high performance of a room or an audio system in which a particular speech communication is completely unintelligible, due to the communication not meeting the assumptions of the measurement. Some variables that could contribute to this situation are lack of familiarity with message, inability to see the person talking, hearing impairment of the listener, lack of clarity of the talker, speed of the person talking, difficulty level of the vocabulary/message, motivation/interest of the listener, or frequency distortion of a particular voice.

Having discussed some of the issues not dealt with in current measurement procedure, it is important to look at



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# INTEGRATED SOUND SYSTEMS FOR SOUND REINFORCEMENT

by Jesse Klapholz

The use of integrated sound systems is gaining popularity in today's sound reinforcement industry. The success of these systems is attributed to the fact that they offer several advantages over traditional systems. These advantages include minimized engineering time, reduced fabrication time, and simplified installation.

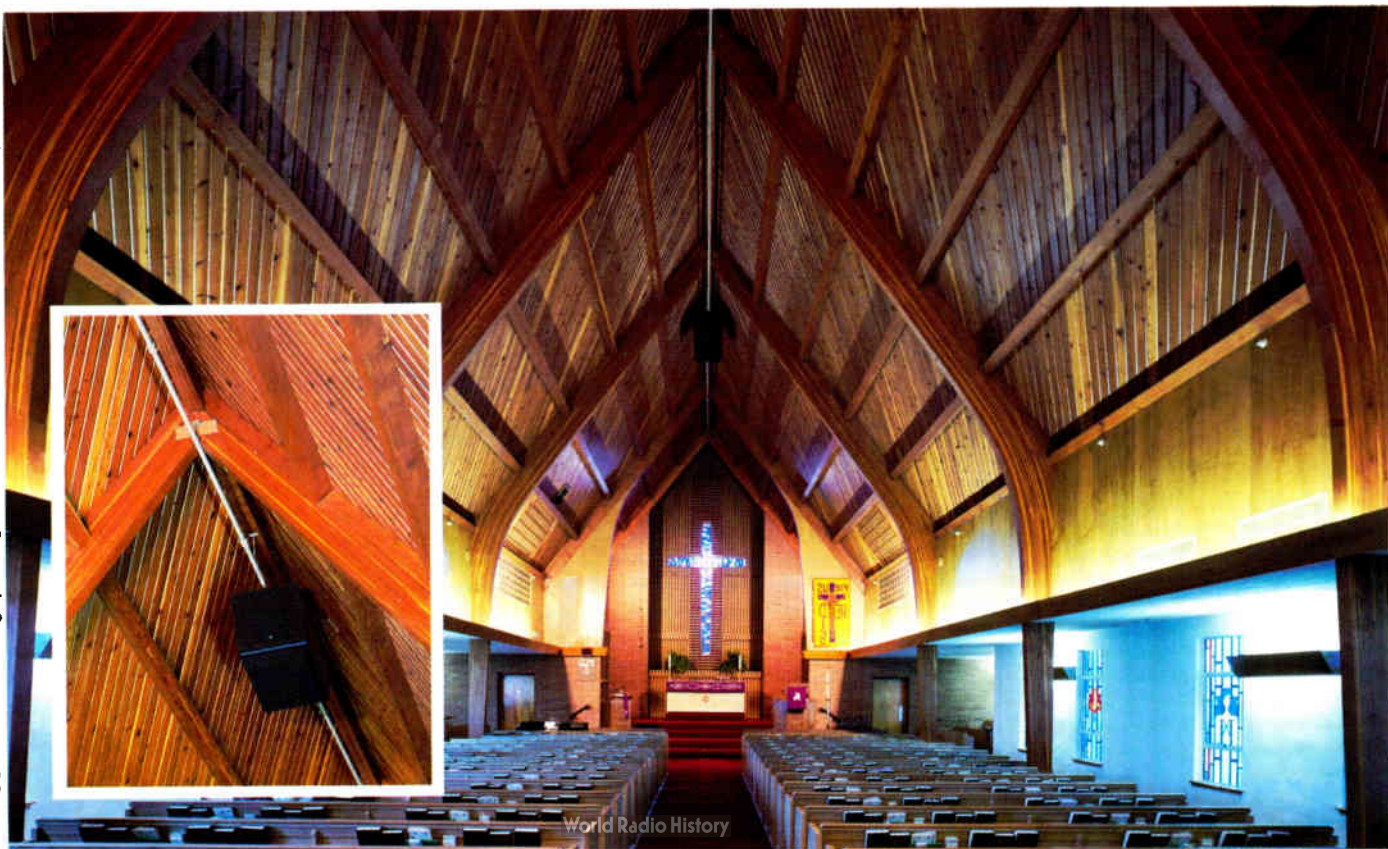
Although it wasn't until the last decade that the real benefits of integrated sound systems were recognized, it was back in the early days of cinema that the first integrated systems were used. At that time, the systems were typically two way using a passive crossover.

But the real growth toward the use of integrated sound systems was in the early 1970s when touring

sound for "pop" generated the need for wider bandwidth and greater SPLs. To meet their needs, sound companies began to "cherry pick" components from manufacturers' catalogs and spec sheets and make their own *component* systems. As these component systems were used in various venues around the country, their practicalities and economics began gaining widespread recognition and interest. As a result, the demand for such systems started to rise, and loudspeaker component and small system manufacturers began to design and

*Trinity Lutheran Church utilizes a JBL system which was installed by His Sound in Fresno, CA.*

© Strode Eckert Photographic Engineered and Installed by His Sound, Inc., Fresno, CA.



produce one-brand integrated systems. Today over a dozen manufacturers offer high level sound reinforcement systems.

### Design-Performance

In the use of integrated systems, engineering specifications and drawings are simplified by the availability of information from the manufacturer of the selected system. As more systems are designed, and more computer programs are developed, performance data will be available in many forms so that any sound system designer will be able to “plug in” to their design. As computer aided design (CAD) is integrated into future sound system design programs, once an integrated loudspeaker system is selected, not only will dispersion, acoustic power, and intelligibility criteria be present for calculation, so will mechanical information be present for hanging and fabrication design as well as information for full-view and isometric drawings.

On the practical side of things, one of the often sought after requirements is size. When integrated systems are designed one of the design criterion is total package size and weight versus performance. The reduction of size is what will often make the difference between a mechanical nightmare and a system which fits nicely with a decorator’s or architect’s idea of a two-foot by three-foot opening above a theater’s proscenium.

The electroacoustical performance is actually the bottom line that will qualify or eliminate a system as a candidate for selection in a sound system design. When a designer is laying out a discrete-component cluster he may not necessarily know in advance what it’s acoustical performance will be—both temporally as well as spectrally. While more of these types of predictions are becoming possible with newer computer programs, they are limited in the amount of accurate detailed information especially for larger clusters. The information published by the manufacturer will obviously tell the whole story for a single system—as is the case in many small areas or high-level distributed or delayed systems. Furthermore, this published informa-

*Turbosound system at the Royal Albert Hall in London.*



Photo courtesy of Martin Audio

*The Howard Jones rig in use at Wembley Pool, London, 1985. This 42 cabinet RS 1200 all-in-one rig (30 in the air, 12 for ground support) constitutes a distributed “line-source” system.*

tion will aid the designer and his computer simply by virtue of information reduction.

Often, the customer will ask, “All this engineer mumbo-jumbo is really confusing. But, how will it sound?” The answer in most cases ends up as a demonstration. More than you care to recall, you have lugged woofers, mid-bass cabinets, horns, and lots of signal processing gear to give a “live demo.” Due to its design, the integrated loudspeaker eases the pain a lot.

“Tweak” is a word perhaps not easily found in the dictionary—but one found in many audio shops. In fact, countless unbillable man-

hours have been spent on tweaking sound systems. Playing with innumerable combinations of polarities, crossover points, EQ, limiting, impedance correction circuits, etc., has contributed to many headaches. What a pleasure it is to open a couple of boxes, hook up a few cables, turn on the system and listen to this week’s reference CD, while thinking of all those hours of some poor guy back at the factory—tweaking.

After the tweaking is done, in many cases, the integrated package outperforms the component system. Physical relationships between drivers and electrical parameters

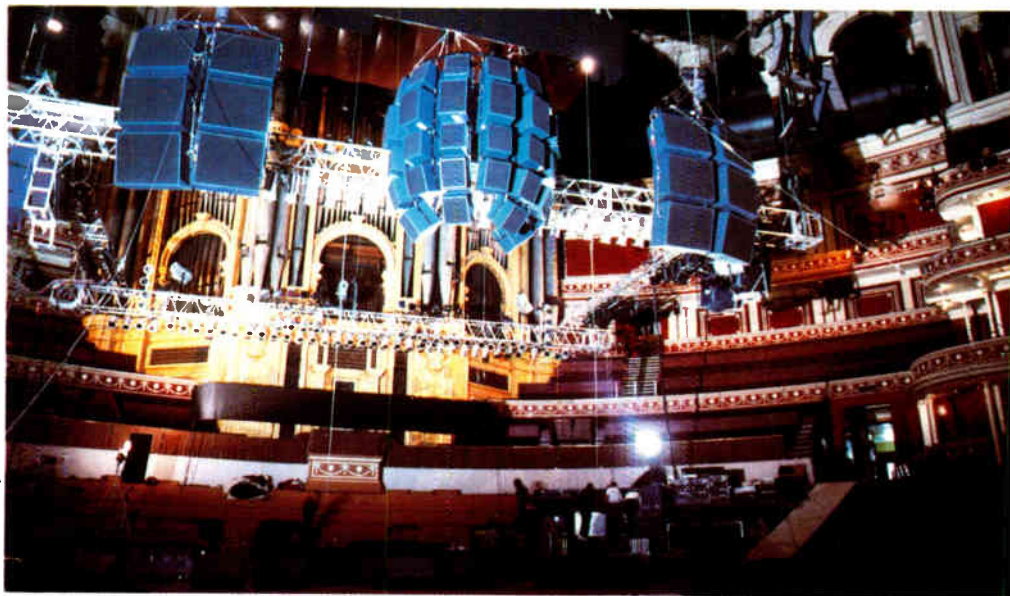


Photo courtesy of Martin Audio

can be incorporated in the design of specific components. Horns can be designed to match other parts of the system for example. The first embodiment of this approach was the RCA LC-9, a two-way "congruent wave-front" loudspeaker introduced in 1963. The directivity and pattern of the hi-frequency horn matched the low-frequency horn,

not to mention that the two drivers were vertically aligned making it the first commercially available aligned-in-time integrated loudspeaker system. The current trend appears to be reintroducing this technique.

The packaging of the integrated system minimizes the installation time/labor, and also allows for elec-

tricians, in some cases, to install the system with high degrees of confidence in its success. The incorporation of universal hanging hardware makes it easy for everyone from the designer, the estimator, to the installer. Servicing of the system and its components is also minimized.

Ten years ago, biamping was considered a mysterious technique. Some thought that it meant a second amplifier on "standby." Equalizers have replaced discrete filters for the most part; mixers have replaced the custom-built langevins; and now integrated sound reinforcement systems are replacing discrete components in many applications. As more types and sizes of integrated packages become available to the contractor, he will be able to spend more time tweaking the room-speaker interface and the human-system interface.

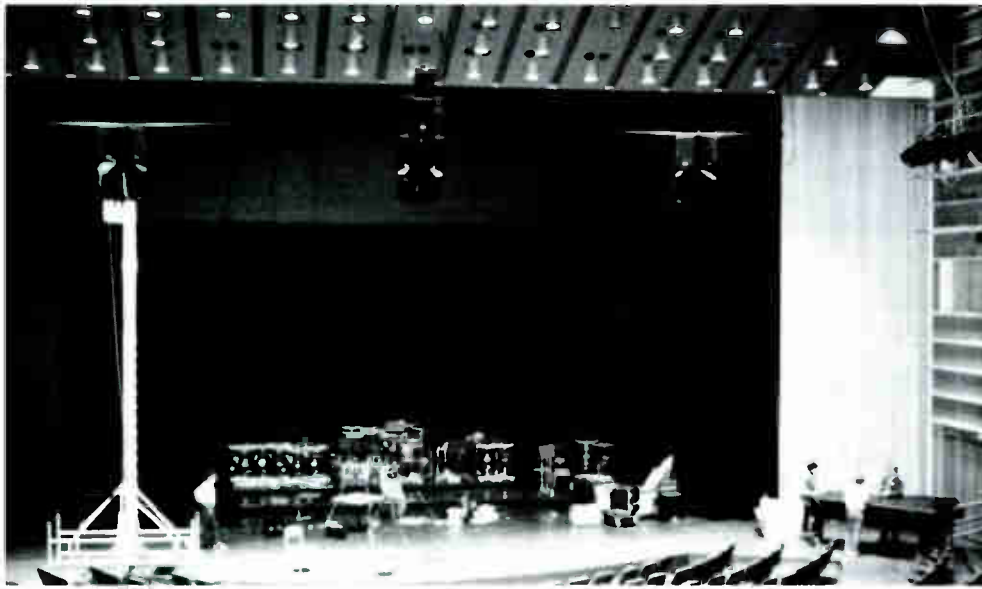


Photo courtesy of Meyer Sound Labs

*Meyer Sound Lab's integrated stage monitor system consisting of six UM-1A loudspeakers and six M-1 control electronic units.*

## Manufacturers on Applications and Ease:

A contractor can use an integrated system approach in applications where a high-level distributed, distributed/delay, mid-level, small cluster, or auxiliary system is called for. In these cases, the integrated system may be used as a stand-alone or in conjunction with a component system. The specifications and guidelines of the integrated system manufacturer will enable the designer to accurately choose the appropriate package.

The benefits of integrated systems to the sound contracting sector of the industry are also recognized by the manufacturers. Irwin Laskey, vice president of AB Systems, said, "Integrated sound systems are the mainstay of the market today." Ted Pelesky, president of Martin of America added, "Integrated sound systems can be used for touring sound as well as permanent installations such as clubs or arenas...anywhere people need high level and broad bandwidth sound." John D. Strand of Community Light & Sound said he expects to see integrated systems in "anywhere from a church to a mobile DJ."

The popularity of the integrated sound systems can be credited to their simplicity. According to Hector Mar-

tinez, market manager of JBL, the integrated sound systems need "fewer cables and they're easier to set-up, and have less chance for error. People want to have the time to worry about other things than what gets hooked up with what." Larry Doran, president of Professional Audio Systems, said, "Because they're fully designed and engineered they're simpler for contractors to use. There are many things engineered into the system such as time correction, equalization and protection devices that makes it easier to put together."

The simplicity of the systems means "the contractor doesn't have to involve an outside engineer to set it up. Component systems have a Chinese menu of design and not many people are comfortable with designing their own system," said Laskey.

According to Jean Pierre Mamin, head of engineering at Meyer Sound Labs, "In most complex pieces of machinery a thorough knowledge of the individual component and its behavior in the complete system is required in order to achieve expected results and reliability. For this reason I think that integrated sound systems are a necessity and inevitable."



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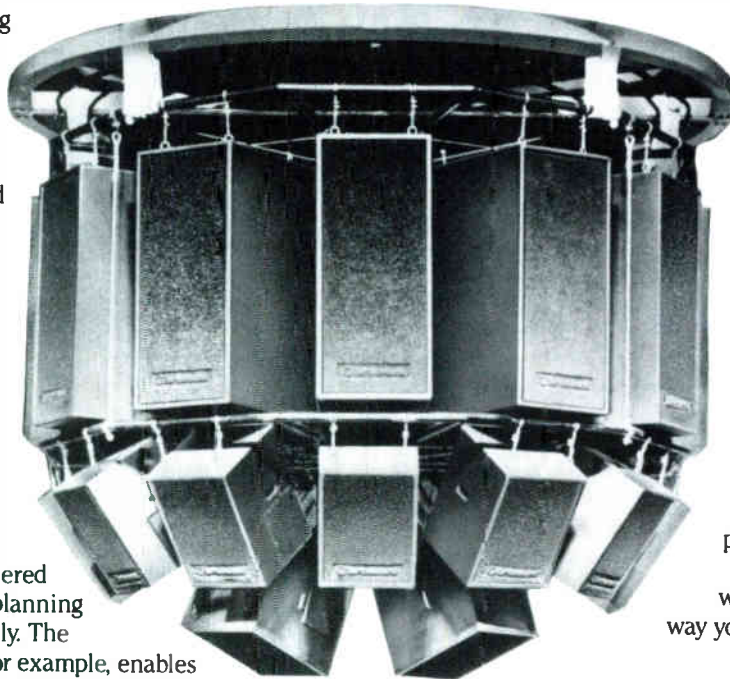
To make your job easier, we design certified, load-rated flying and angling points as an integral element of every Turbosound full-range enclosure. And the innovations we've put inside our pre-engineered speaker modules will cut your planning and installation time significantly. The patented\* TurboMid™ device, for example, enables our proprietary 10" driver to reproduce a seamless midrange from 250–3700 Hz. Its unique internal geometry creates a much higher 'Q' factor than conventional horns of equivalent frontal area. Tighter directivity greatly reduces interaction problems in multiple unit arrays, so planning an installation often involves nothing more complicated than laying coverage patterns over a set of blueprints.

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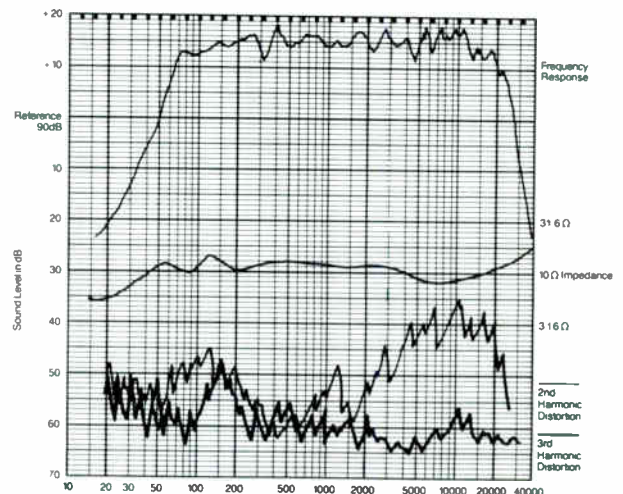


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# TELEPHONE PAGING SYSTEMS

by Nancy Peterson

Paging systems permit the distribution of messages over a broad area. With the integration of the telephone with paging, easier and more time-efficient communications is achieved.

Today, telephone paging systems have applications in most every business. With benefits to the user such as reduced callbacks, increased productivity due to more efficient communications, and zone paging capabilities which eliminates noise to select areas, telephone paging systems are no longer a convenience or luxury, but a

necessity.

According to a 1983 survey conducted by *Sound & Communications*, user companies reported that telephone access was the most desired paging feature. This was followed in order by zone paging, talkback, background music, and tone signals. Music on hold is also popular, although not covered in the survey.

The need for both small and large paging systems is also substantial. As reported by the survey, almost 60 percent of businesses with 10 to 20 employees require a paging system. And 86 percent of businesses with 100 to 500 employees need a paging system.

Yet due to a lack of knowledge and apprehension toward installation, many contractors are not suggesting telephone paging as a natural extension to a communication system installation. With the relative simplicity of many of today's telephone paging systems, contractors need not avoid those sales.

## Systems

Traditional paging systems utilize a central amplifier concept in which the telephone system (PBX, PABX, Key, etc.) interfaces with an access control unit, amplifier, and speakers (Figure A). With such a simplified one-way system, paging can be accessed from any telephone. This type of system design is used in applications when only one-way all call communications is necessary.

Two-way, hands-free communications is also possible under the same design by using a paging/talkback amplifier in place of the regular paging amplifier. With two-way, hands-free communications the person who is being paged can respond without stopping what he or she is doing to pick up a phone or push a button. When utilizing a two-way system, the number of paging speakers should be limited to two. With any greater number of speakers, it is more likely that extraneous noise will be picked up—thus limiting the intelligibility of the person responding.

Some applications require the ability to limit a page to a specific zone. For example, if a receptionist wants to page someone in the stockroom, she need only page that area and not the entire building, hence reducing the amount of unwanted noise in other sections of the building. For zone paging, a zone module is installed between the





speakers and the amplifier and control access unit (Figure B).

Newer to the telephone paging industry are distributed amplified speakers in which the amplifier is incorporated into part of the loudspeaker, thus eliminating the need for a central amplifier. In distributed amplified loudspeaker paging systems, an additional power supply is necessary (Figure C). The benefit of distributed amplified loudspeaker systems is that if one of the amplified loudspeakers goes down, the whole system doesn't go down. Manufacturers, such as Bogen and Communitron, offer both central amplifier systems and distributed amplified systems. For greater system

flexibility Bogen recently introduced a two-way amplified horn to its line.

Valcom offers a distributed amplified system with a 24 VDC central page control unit which incorporates the central access control unit, zone paging, and talkback capabilities. The system also uses telephone wire as opposed to heavy gauge wire for easier installation.

Microprocessor-based telephone paging systems are also now available. One such unit from Harris Dracon, the Ibis system, can be function programmed by the user at any time by using the telephone to communicate with the microprocessor. So the telephone paging systems can be modified

or redesigned without rewiring. Ibis is sold under the name Pagepac 20 by AT&T. Other manufacturers, such as Aiphone, X-Tel, and Dukane, also offer microprocessor-controlled systems.

### Options

There are also several options which can be added to upgrade any of these telephone paging systems. Such additions include music tuners for business music, pre-announce tone generator, and microphone access.

### How to Choose the Right System

When deciding on the right system for an installation, the user's needs should be analyzed so to determine the

type of system which best suits his company. Factors which should be considered include:

- the number of employees
- the size and location of the areas which need paging
- type of communications: one-way or two-way
- expansion capabilities of the system
- options: business music, voice compression, music on hold, pre-announce tones, zone and power selection
- cost per output watt—a basic comparison method used to compare similar systems. Simply divide the number of output watts into the total cost of the system. The system with the lowest cost per output watt is usually your best bet.

In addition, many manufacturers offer seminars and brochures analyzing system selection as well as design and installation. A contractor which takes advantage of these is well on his way to more successful telephone paging system sales.

For a full listing of manufacturers which offer paging systems please see the 1986 *Sound & Communications Blue Book*.

Figure A: Central Amplifier System

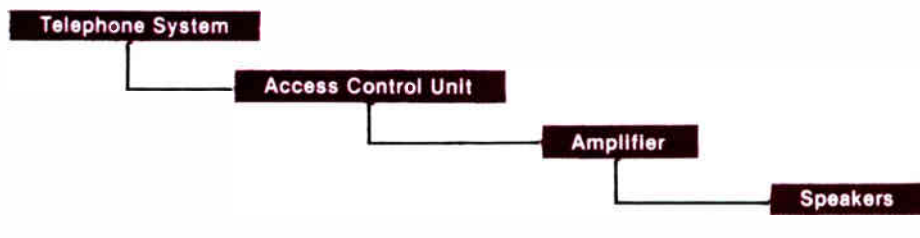


Figure B: Central Amplifier with Zone Paging

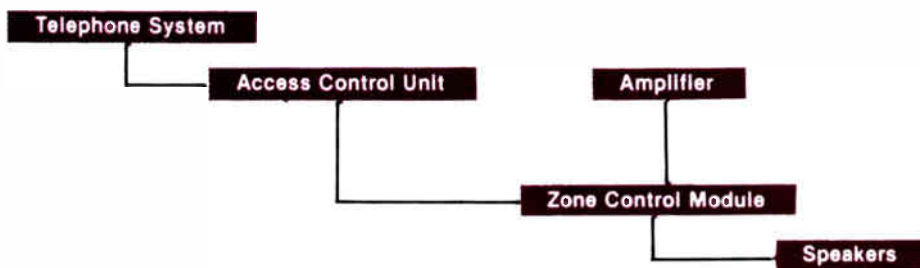
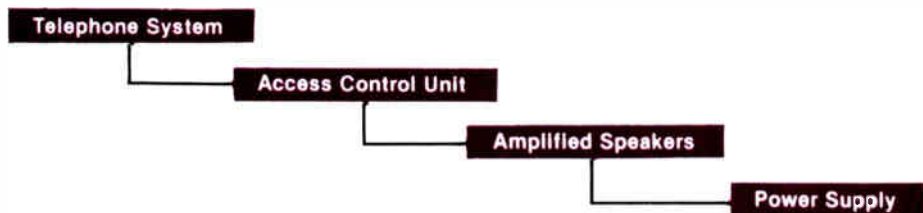


Figure C: Distributed Amplifier System



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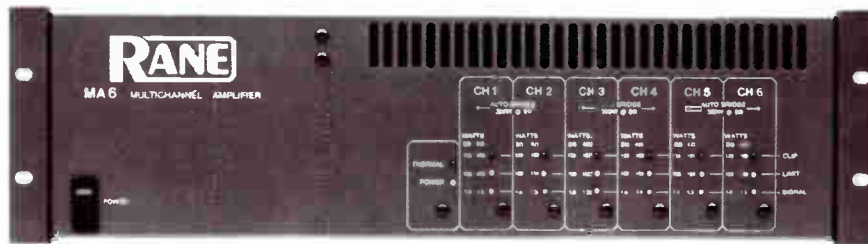
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## SALES & MARKETING

(continued from page 10)

### Future

Just like everything else, CCTV will become computerized. Jeff Fossan, advertising manager for TOA, speaks of "digital communications in security where a sensor can be turned on or off by a computer. Not only can the camera be computer controlled, but we may see video signals being transmitted over phone lines."

Jacobs said he sees computerized CCTV's playing a role in medicine. "Computer graphics and imaging (this may stretch CCTV a bit) will make computers capable of projecting images. A computer can generate two or three images on a special slide pick up system. The computer can take the image and enhance it, magnified it, etc. So far we've seen our system used this way in buildings. Someday we may see it used this way on satellites."

## SPEECH INTELLIGIBILITY

(continued from page 20)

of a sound system, but only some types of signal degradation. (It is interesting

to note that when a sound system is tuned for the highest intelligibility for a given signal level, it is often retuned for perceived quality improvement.)

The jury certainly is out on any complex theory of design of either spaces or sound systems based on intelligibility, and the next few years of research and testing will add much to this diffusion. In the meantime, there are some generally accepted approaches to increasing intelligibility in rooms (Figure A). Although this discussion is certainly oversimplified, it should provide a framework for looking at these problems.

*Next Month: The specifics of intelligibility testing and the difficulty, expectations and conclusions of this type of measurement, with an eye toward contractor approaches.*

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*1985 Annual Book of ASTM Standards*. Volume 04.06. American Society for Testing and Materials.

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\* = presently distributed and published by D. Van Nostrand Inc. of New York.

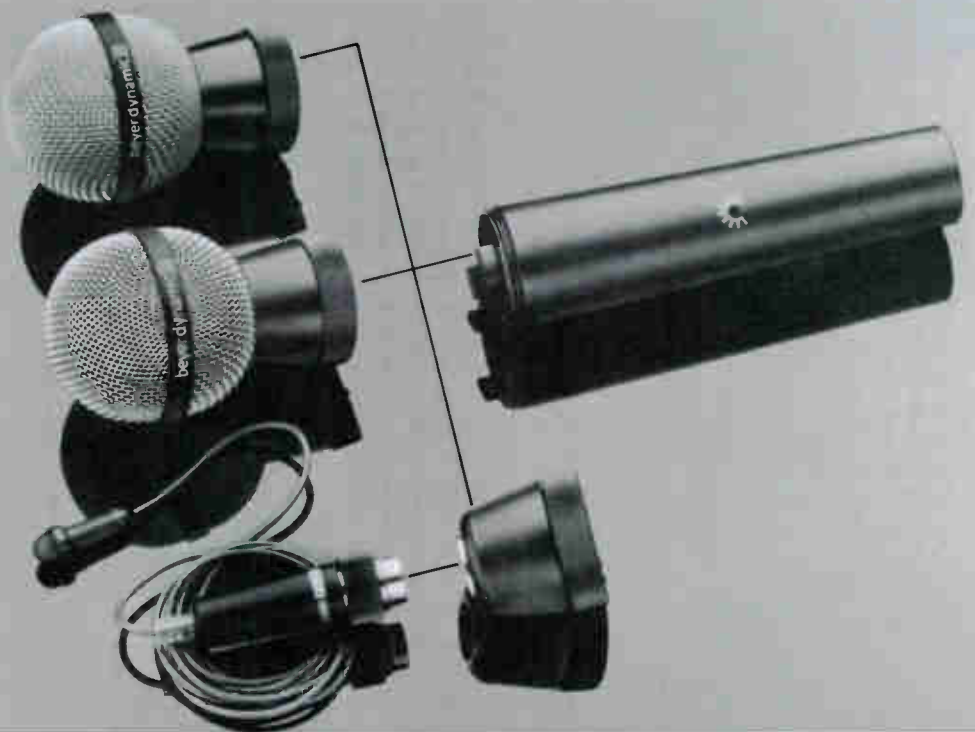
Steven J. Orfield founded Orfield Associates Inc. 15 years ago. The company specializes in lighting and acoustics as it relates to architecture and has done work for the Bell System and IBM. Orfield is a member of NASI, IES, and AES.

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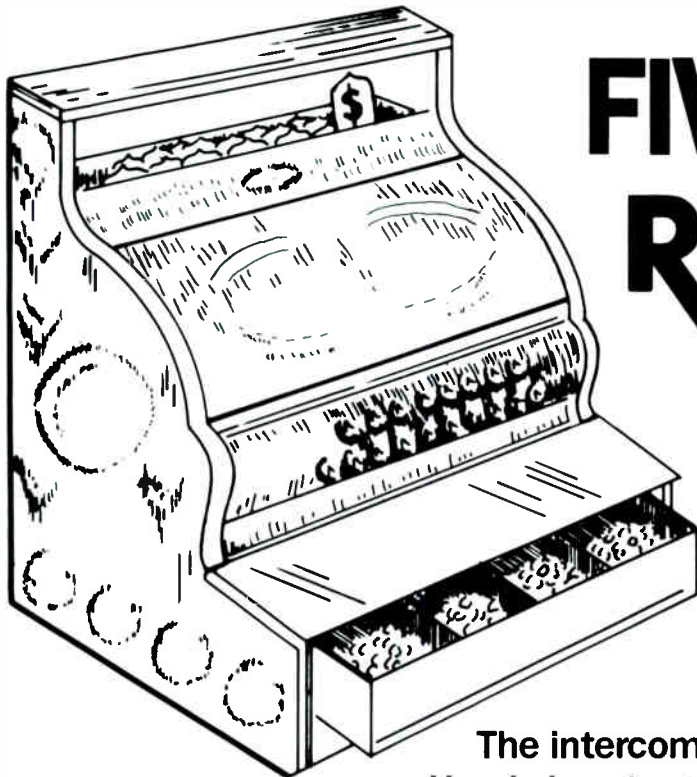
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## Installation Profile:



# The Orange County Performing Arts Center

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by Patrick Baltzell

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On September 29, 1986 the Orange County Performing Arts Center officially opened. The center is part of an 11 acre, multi-purpose development by C. G. Segerstrom and Sons, that includes a 21-story office building and a 1,200 car parking facility. The Center consists of a 3,000-seat main theater, a 260-seat black box rehearsal studio, extensive rehearsal and support spaces, and administrative offices. Originally conceived as a conventional facility with a budget of \$45 million, the project evolved into an \$80 million state-of-the-art multipurpose facility with an additional \$20 million endowment fund.

The project is the combination of unique architectural and acoustical approaches. Integration and flexibility best describe the design approach and





and required a novel interpretation of fire code regulations regarding exits and exiting. Each steel member is different, with different slopes and different loads. Each member had to be designed separately and comply with California's strict seismic code. In the end, computer-aided design techniques were used to close the structural dimensions.

The design goal was to build a multi-purpose performance facility to accommodate symphony, opera, ballet, drama, musical theater, and special television events. In addition to this flexibility, efficient and timely change overs from one performance mode to another were important.

### ACOUSTICS

When designing the theater, the acoustics were a major priority. As a result the interior layout is completely asymmetrical. There are no parallel surfaces and no symmetrical relationships between any of the walls or between any of the surfaces and the center line. The audience area is comprised of four staggered tiers of seats intended to bring the listener closer to the sound reflecting surfaces while retaining adequate sight lines. In a multi-purpose facility, the problem is how to make the space wide enough so that the audience is visually close to the production, yet narrow and deep for ideal acoustical properties.

### SCALE MODELS

Joint Venture Acoustical Consultants, a specially formed group including Hyde, Marshall and Paoletti-Lewitz Associates, employed extensive use of scale modeling. A 1:50 scale model, constructed in San Francisco,

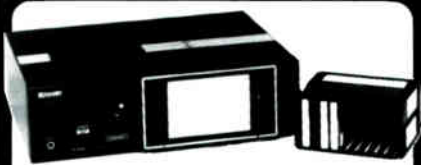
was used for acoustical tests and analysis to obtain preliminary verification of basic theater design concepts. The results were scaled and normalized then compared to accepted criteria for determining good listening conditions. The measurements yielded data on intelligibility, SI, and early lateral energy levels. Tests taken in 48 test positions produced a 3 dB variation in early energy and total energy (early and late). The reflection sequence varied predictably with location, but in all instances the early energy was temporally dense, which is desirable for good articulation and SI. Preliminary measurements found the early lateral/frontal energy ratios to fall in the -7 dB to -3 dB range. Later measurements in the actual theater confirmed these findings. Optical studies performed on this model were used to visualize specific reflection patterns by observing light reflecting off foil-covered surfaces.

The use of a 1:10 scale model was particularly interesting. Built in Auckland, New Zealand by Joint Venture Acoustical Consultants and Marshall's Acoustical Institute personnel, this model was used to perform objective as well as subjective acoustical measurements. The construction not only scaled the dimensions, but also the acoustical properties of the materials and surfaces (ie: absorption/reflection) were precisely simulated so that the data obtained would yield reliable predictions about the acoustics of the actual hall. The air was dried to below 7 percent relative humidity to reduce the high frequency and ultrasonic propagation loss and 3,000 1:10 scale cast-lead people with the proper absorption co-efficient were seated in the

the results are a stunning example of form following function. The design process involved a series of squatters—intensive concept development sessions where key design team members and consultants move on location for one or two weeks to determine programming, site design, acoustical design concept, and preliminary final schematic designs. This system brings the design team together in an atmosphere free of interruptions, allowing total concentration on a given design issue. With so many consultants and specialized subconsultants involved, this was the easiest way to produce a fully informed and timely concept development. Furthermore, the asymmetrical nature of the interior presented an engineering nightmare



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audience. Objective measurements included reverberation tests, integrated early to late sound energy ratios, and integrated early lateral energy ratios. The actual room measurements yielded a very high degree of correlation to the results obtained from the model studies.

The subjective tests involved anechoically-recorded music and speech frequency scaled, then played back through a small transducer array chosen to simulate the spectra and directionality of the various sections of an orchestra. The careful control of this miniaturization process—the hall, the acoustics, the air, the audience, and the orchestra—made it possible to frequency scale the results back up by the corresponding amount and hear the room as it would sound from a variety of locations. These tests provided useful reverberation data that was used to refine the absorption characteristics of the adjustable curtains.

### DESIGN

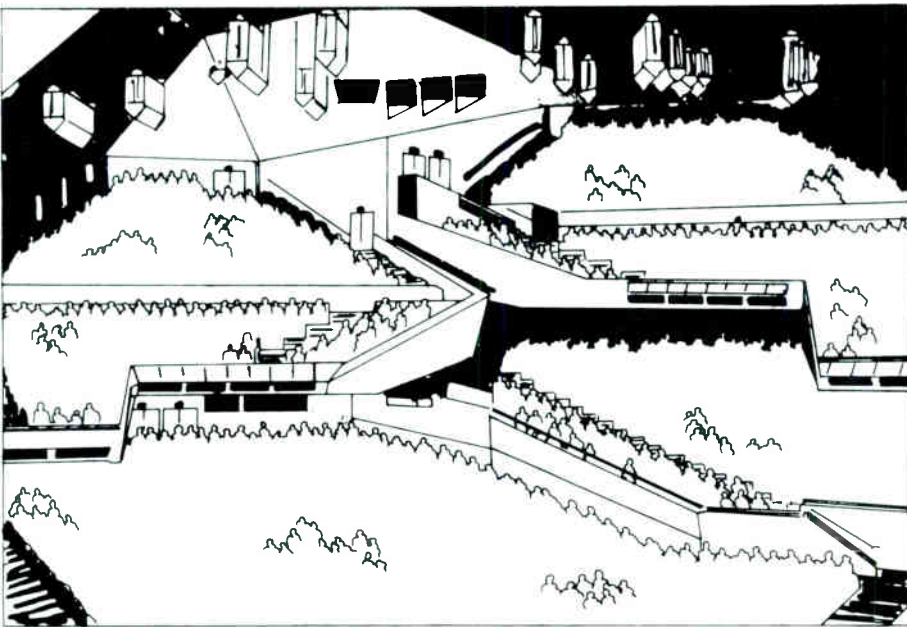
The acoustical rule of thumb is a hall should have a “shoebox” shape—twice as long as it is wide. The solution in this case was to design two side-by-side long narrow theaters that focus on a common stage. The orchestra level seats 1,236, a second tier to the right and raised four meters seats 679. Each of these areas has a balcony seating 478 and 607 respectively. The result forms a 1 and 3, 2 and 4 orchestra/balcony arrangement with each level having a unique vertical placement. The concept of staggering the four levels provides active sound reflecting surfaces in the middle of the theater, which yields lateral reflections from many directions, a key element in the binaural hearing process.

Included in this concept is the sidewall configuration. The proscenium opening flares out into the house employing 10 Quadratic Residue Diffusor panels, which are in mathematically determined stepped sequences to scatter and diffuse early energy across the seating plane. The mid-house sidewalls are angled inward to bring reflecting surfaces close to the audience and primarily in the lateral plane. This effectively keeps the lateral reflected energy 3 dB to 7 dB higher than the frontal energy.

The spatial impression (SI), that is the listener's ability to identify the origin or spatial quality of a source or sources, is dependent upon a higher lateral-to-frontal ratio. The ceiling consists of large reflector panels sus-

ended at appropriate angles to provide a dense reflectional pattern, while reducing very late arriving energy. These panels, as well as the central speaker cluster, are suspended from a forestage gridiron. The roof of the building is actually separated from the internal ceiling forming a “shell within a shell” to provide an acoustical barrier against air travel from the nearby Orange County Airport.

The way that the stage couples to the hall and the proscenium opening adjusts is an example of the flexibility designed into the project. The hall can function in the standard stage/proscenium mode or function as a single volume room for symphonies and recitals. Acoustician Jerald R. Hyde maintained that “good performances begin with the performers. So we have developed five configurations of the orchestra shell and ensemble reflectors; soloist, chamber, small symphony, large symphony, and symphony with choir.” In each case the reflective surfaces and reverberation pattern are tailored to the performance. In order to maximize the acoustic coupling to the house, the maximum proscenium opening of 68-foot wide x 42-foot high is used in symphony mode. A shallow 14-foot orchestra shell is wheeled into place which continues the lines of house walls and provides the diffuse early sound reflections necessary for the performers. This arrangement eliminates long reflection distances and joins the stage and audience area to provide a natural progression of reflective surfaces. The majority of the orchestra is situated on two concentric pit lifts and a series of risers that replace the first three rows of seats. This places two-thirds of the orchestra members in front of the proscenium line which acoustically couples directly to the house. The combination of lifts accommodates various size pit orchestras from musical theater to Grand Opera. An added advantage is four different stage apron positions. In much the same way that the sides of the orchestral shell continue into the house walls, three large ensemble reflector panels form a canopy that extends the orchestra shell out into the house again enhancing the early reflection pattern. Many types of performance require smaller proscenium openings. Frequently, road productions are designed for 42-foot or 40-foot openings. In this case, the side panels move in to reduce the width from a maximum of 68 feet to a minimum of 52 feet. Soft trims frame the opening down to 42 feet or less. The central cluster unit with attached panels is flown in to adjust the vertical



*The auditorium's seating area is divided up into four asymmetrical sections.*

trim down to 28 feet or even less. The flexibility of the proscenium opening was taken into account in the seating layout. In the narrowest configuration, the maximum viewing cone is 34 feet off centerline, while for most modes no seat lies beyond a 30-foot viewing cone to the proscenium edge.

The acoustical properties of the hall, in particular the late reflected energy and the reverberation decay, are varied by a computer-controlled system of vertical banners. The majority of these flexible curtains, located toward the rear, extend upward from V-shaped reflector structures that also contain house lighting. Those situated near the stage function only as acoustic curtains. The primary function of these acoustic curtains is to close off a sizable volume of space without disturbing the reflection sequence in the early sound field. The reverberation time varies from 2.2 seconds to 1.6 seconds with full deployment. Hyde cautioned that "the statistical interpretation of RT60 time does not tell the complete story. The application of high early-to-late energy ratios perturbs the classical RT60 values, and in fact longer reverberation times do not conflict with good intelligibility."

The control console for the system was designed by Hyde and manufactured by Hoffend and Sons, Inc., who was also the rigging contractor for the project. The console includes a custom monitor with a superimposed layout of the theater with LED status lights for each curtain. The various configurations and positions of the system have been preprogrammed into the com-

puter enabling the operator to "dial up" the appropriate acoustical parameters to meet the performance and program requirements.

A major element in the pre-opening acoustical "tuning" was the subjective analysis of actual performances. Of the many recitals, the most interesting was that of the designing acousticians themselves. Hyde is a serious amateur tenor and Dr. Harold Marshall is a baritone. Together they gave a recital, which was a rather unique method of evaluating the acoustical environment for the performers.

#### SOUND SYSTEM

The audio-visual systems at the Center were designed by Paul Magil and Steven Hood of Paul Magil and Associates. The installation contractor for all A/V systems, sound reinforcement, security, and MATV was Otto K. Olsen Electronics. The central cluster is a three-way system. Six short throw JBL two-inch horn/compression drive units reproduce 1,200 Hz to 16 kHz. Eight JBL 12-inch transducers mounted in custom computer-designed tuned port enclosures reproduce 80 Hz to 1,200 Hz, and eight JBL 18-inch transducers in tuned port enclosures reproduce below 80 Hz. Amplification, electronic crossover, equalization, and delay for the central cluster are all packaged in the new BGW SPA-3 and SPA-1. Designed for just such an installation, the SPA-3 features three channels of amplification, factory-set electronic crossover, a low frequency parametric filter,

*(continued on page 38)*

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# THE YAMAHA PM-3000

**Richard Feld  
TekCom Corp.**

*Editor's Note: This is a Sound & Communications Field Report. Unlike the products reviewed in our Lab Test Report series, Sound & Communications did not test the Yamaha PM-3000. Instead, Richard Feld of Tekcom reviewed the PM-3000's capabilities and design philosophy and talked to users in the field as to its performance and abilities.*

The PM3000 is Yamaha's latest offering to the realm of live sound mixing. Though primarily intended for front of house mixing, the PM3000 will surely find acceptance in other applications, including video production, live TV sound, and on-stage monitor mixing.

The console comes in 24, 32, or 40 input channels, with the 40 input version supplied with the master section centrally located enabling two people to work on a mix together.

The PM3000 is supplied with transformerless, differentially balanced inputs and outputs with dramatic sonic improvement over the PM2000. Though transformer options are available we have experienced no situations where this has been necessary. The console is loaded with features that make the soundman's job easier for live theater and other complicated mixing situations. For fast scene changes, the eight Master mute groups with eight mute assigns on each input no longer demand that the soundman be an octopus. In addition, the eight VCA groups make the PM3000 a most flexible mixing console.

The mix matrix is configured 11 x 8 and delivers 11 possible sources to create an output. The possible uses for the matrix are too numerous to list but enable the operator to supply many different mixes at various levels without any additional outboard equipment.

The four auxiliary returns are each able to accept a stereo signal and apply it to any of the groups, aux sends, or the 2 mix. The returns are also switchable to accept a mono signal. Some EQ is available to "sweeten" the returns.

Excellent care and attention has been paid by the manufacturer to necessary functions such as cue and solo capabilities, talkback functions, physical construction, and weight. Though subjective, its appearance is an improvement over the PM2000.

## Users' Reports

TekCom delivered its first 3000-40 in March to the Golden Nugget Hotel & Casino in Atlantic City, NJ. Tom Young, lead sound engineer at the Golden Nugget, has reported that the 3000 meets or exceeds his every expectation. "User friendly" were among the first words he used to describe the console. Young was also impressed with the console's flexibility, since his productions run the gamut from stand-up comics to rock 'n' roll bands. Young said the board sounds great, the EQs are "musical," and the VCA faders are invaluable for tight control of the mix, especially when he has a big band mix assigned to many sub-groups.

Don Pacitti, technical coordinator for Music Fair Group in Devon, PA, said he loves his PM3000-40. This console went to Valley Forge Music Fair to satisfy two needs; more mixing channels and greater flexibility for book shows. The board has been in place for some months now with no failures of any kind.

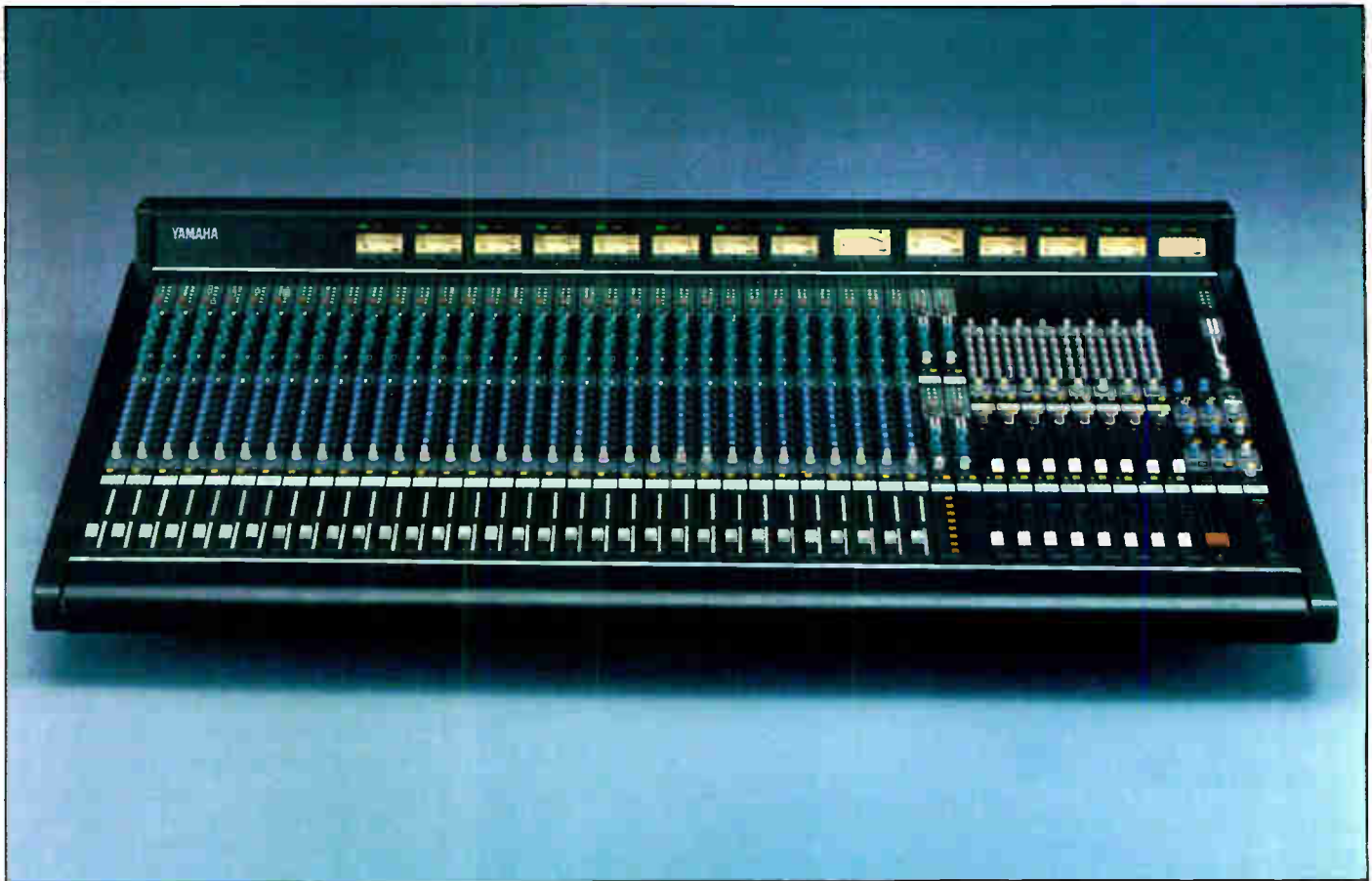
Pacitti insisted that before his 3000 was delivered he mixed the theater productions with both his hands, feet, and elbows in order to keep up with the show. Needless to say that the mute system on the Yamaha has changed all that. Pacitti said he enjoys making scene changes now by pressing a few buttons.

The center output section on the PM3000-40 has enabled Pacitti to work closely with visiting soundmen. On complicated mixes, two engineers can work side by side and stay out of each other's way. Pacitti reported that visiting engineers, not yet familiar with the console, take to it quite easily and like the way it sounds and feels.

Pacitti's only complaint is that it takes a bit longer to set up the console for an act due to the many routing options, gain settings, EQs, etc. He said he is also not happy with the working lights dimmer being a screw control located at the rear of the console.

Not to be ignored is the touring sound user. Lee Jennings, president of Thunder & Lighting, Inc. in New Castle, DE, reported excellent sonic quality and good attention to function.

Though T&L has only had the con-



sole a few months, they believe it to be well built and able to stand the rigors of the road. They certainly appreciate the dramatic weight reduction over the PM2000; two people can handle the PM3000.

Although Jennings feels that the 3000's EQ sound is good and tight, he had some trouble getting accustomed to the boost/cut control location which is reversed from most consoles. He added that the dual gain structure on each input was initially confusing.

And he said, because of the module length, a swept-up design would be preferred, as it can be difficult to see in low light conditions.

#### **In Review**

The Yamaha PM3000 is undoubtedly a real value relative to today's market. Much of the design work on this console was done in the United States and it shows. Yamaha has listened closely and responded to the many comments regarding the 2000's

shortcomings. It appears that their efforts have resulted in an eminently desirable mixing console which should stand the test of the marketplace.

L. Richard Feld has been president of TekCom Corp. since its founding in 1980. Feld has extensive touring experience and is a member of AES and the ASA.

*The center output section on the PM3000-40 has enabled Pacitti to work closely with visiting soundmen. On complicated mixes, two engineers can work side by side and stay out of each other's way.*



**O**n August 21 to the 24, the International Business Music Association held its annual gathering in Traverse City, MI. This year's convention was entitled "Management for the '80s" and, along that line, it featured seminars on the cost of doing business, collections, salesman's compensation, and contract cancellations. The convention floor also hosted some 30 plus product exhibits.

As conventions go, the IBMA is on the small side. According to the association, attendance reached just over 210. But more noticeable at an IBMA convention is the style in which they are held. IBMA conventions are family events with a certain amount of emphasis on the Annual Golf and Tennis Tournaments. They are held in cities such as Scottsdale, AZ; Vancouver, British Columbia; and Traverse City, MI, which are not your typical convention towns and not always the easiest cities to get to. And if you're a manufacturer who has attended an IBMA convention you know that there is little, if any, business written. The convention itself is not run by a professional exposition organization, but by the Association's officers and board members who donate their time in addition to their own very full business schedules. And for all these things, the IBMA has received criticism.

But where is it written that conventions have to have three days of fighting your way through crowds on a convention floor the size of four football fields to be successful? Some of the largest business deals that were ever made were negotiated between the 17th and 18th holes. And sales that are made on the convention floor are often the result of a customer's *established* relationship with a company which started somewhere else—most likely with the regional rep in the customer's own hometown.

What is most important is that a convention is held in a style that suits its members. And according to IBMA President Joe Elum, the members like it this way. Elum said that the association surveyed its members as to what they wanted and "most said that they wanted a convention that was part vacation, part business. And we've planned accordingly."

"Actually, the fact that the show is laid back is an incentive," said Randy Johnson of Music Incorporated in Mexico, MO. "What you can learn from some of the one-to-one conversations outside the climate of business is

more than going to school for 25 years."

In the same light, Mike Bradley of Business Music and Communications in Phoenix, AZ, said that the atmosphere at the IBMA is a primary benefit. "It was at the 'hallway chats' where I was able to learn and discuss what is on the cutting edge in the business music industry. I found most of the seminars were aimed towards the basics—they were very elementary in scope." Although, Bradley did add that the talk given by Dennis Waters on "The Market Impact of New Distribution Technology" was excellent.

The manufacturing sector also recognizes the need for informal business relations among Association members. Mark Torrance, the manufacturers' representative to the IBMA and president of Yesco in Seattle, WA, said, "The association is so little that there is a great cultural need for bonding. The relaxed atmosphere of the IBMA allows for this."

Torrance also noted that it is not the time of year or the place which influences someone to attend a convention, but the quality of the subject matter to be presented and the importance of maintaining the bonds which have been established.

"The style offers an alternative to the other conferences a contractor is likely to attend," said John Stiernberg, sales manager for Bose Corporation. "Virtually all IBMA members attend at least one other conference every year. They appear to enjoy the alternative style the IBMA offers. And for the members who prefer the style, the IBMA is a potential outlet."

As far as having the convention run by a professional exposition company, Elum said that they approached the members at the 1985 show in Vancouver. "We had a professional show organization give a presentation to our members. Afterwards we decided it wasn't feasible. We just don't have the finances or the membership to support it."

**T**he Association's small membership and light attendance of annual conventions still remains to be a factor. Some manufacturers have expressed an interest in seeing more traffic on the floor, Torrance said. "It's unfortunate that not more installers and contractors are attending—the numbers really need to increase."

"Many from my circle of friends in the business said they were not coming, so I wasn't expecting much. But it turned out better than I had thought."

To increase membership Elum has announced that later this year the association will be holding a membership drive in which they will sponsor a direct mail campaign and advertising in national trade magazines.

Elum also said that the association will be sticking to the same formula for next year's convention scheduled for October in Palm Springs, CA.

With the exception of the attendance (which will hopefully be remedied somewhat with the membership drive), most said they were satisfied with the show in Traverse City. Particularly Randy Johnson who reported that he found a new source for tuners that will save him about as much money this year as it cost to go to the IBMA.

---

#### 1986 - 1987

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(216) 8333-4164

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\*newly appointed to the position

## Management for the '80s

# 1986 IBMA Convention

by Nancy Peterson



(Left, Top) IBMA President Joe Elum; (Middle) Convention floor in the Grand Traverse Resort; (Bottom) Manufacturers introduce themselves at the opening session.

# PRODUCTS IN REVIEW

## NEW AUTO TEF™ SOFTWARE FOR TECHRON'S TEF 12

Techron has introduced a new software for the TEF System 12 computerized acoustic analyzer. Called Auto TEF™, the software reduces the learning time required for operation of the equipment while simplifying re-use of the same program.

With Auto TEF, room analysis test time is reduced from minutes to seconds, and test sequences can now be of almost unlimited length. Acoustic analysis technicians familiar with the original TEF System 12 software need only learn five new keystrokes for Auto TEF.

The software is also applicable in some cases to repetitive production line testing of new audio equipment.

The new software offers full screen text editing, permits modification of existing tests, and can be used for correspondence or creation of new programs.

Circle 4 on Reader Response Card



## HITACHI'S SOLID-STATE, CCD COLOR CAMERA

Hitachi Denshi America, Ltd. has announced its first all solid-state, CCD, color camera, the KPC-100, for use where true color reproduction is necessary.

The KPC-100 consists of a quality imaging device, 330 lines horizontal resolution, that produces clear images with true colors and no geometric distortion, according to Hitachi Denshi. Features such as continuous automatic white balance adjustment, remote adjustment, and automatic lens iris control enable the KPC-100 to operate under adverse and rapidly changing environments.

The KPC-100 can be used for monitoring applications, checking color reproduction, teleconferencing, measurement applications, and system applications.

Hitachi Denshi is also offering the

KPC-100 with an optional genlock feature, enabling several cameras to be operated in synchronization. Both models are available for immediate delivery.

Circle 5 on Reader Response Card



## PORTLAND'S SUBTERRANEAN WEATHER-PROOF SPEAKER

Portland Instrument has announced the availability of the GS3T Omnispeaker, a subterranean loudspeaker system.

The GS3T blends into landscaped areas, solving aesthetic problems, while simultaneously providing background music and paging. It has been used in major theme parks, hotel lobby, pool areas, restaurants, and home patios.

The GS3T is now available in 8 ohm and 25/70 volt versions up to 40 watts.

This all-weatherproof speaker is a Paramount Pictures Corporation product, manufactured under license and sold by Portland Instrument to the commercial market worldwide.

Circle 6 on Reader Response Card

## BOGEN INTRODUCES LINE OF PAGING HORNS

Bogen has introduced a line of horn loudspeakers for paging, telephone



paging, talkback, and related applications. The line includes both conventional and amplified horns.

All models are of weatherproof, all-metal construction and incorporate a universal mounting bracket which permits adjustment in both the vertical and horizontal planes.

Models SPT-15A and SP15-8A are 15-watt re-entrant horns. The SPT-15A incorporates a variable impedance selector for matching the speaker's power requirement to a 25-volt or 70-volt constant-voltage line. The SP15-8A has an impedance of 8 ohms.

Models SPT-30A and SP30-8A are 30-watt re-entrant horns, the former incorporating a variable impedance selector, the latter having an 8-ohm impedance.

Model BDT-30A is a bi-directional 30-watt assembly consisting of two re-entrant horns mounted with a common driver unit and incorporating a variable impedance selector. Models SPT-5A and SP5-8A are 7.5-watt horns with variable impedance selector and 8-ohms impedance, respectively. Model IH-8A is a compact 15-watt horn with 8-ohms impedance, designed for spot coverage.

In the amplified horn line, model AH-5A incorporates a 5-watt amplifier and a volume control. It operates from a 24 VDC source. Input impedance is 600 ohms, balanced, making the AH-5A applicable for telephone paging applications. The integral volume control permits adjustment to the desired level at each speaker location.

Model AH-15A is a similar unit, but rated at 15 watts, designed for effective telephone paging in high noise areas.

Model TB-2H is a 2-watt talkback amplified horn, which permits two-way conversation between a telephone which originates a paging announcement and the loudspeaker which responds.

All models are finished in textured mocha enamel.

Circle 7 on Reader Response Card

## TAPE-ATHON'S MODEL 780 CASSETTE TRANSPORT

Tape-Athon's new 780 cassette transport unit is a single cassette transport in a plug-in drawer that can be rack mounted in individual units, or because of its half rack width design, can be mounted in pairs.

The 780 transport is equipped with automatic reversing allowing an entire





cassette to play continuously in both directions eliminating flipping the cassette over to play reverse tracks.

The 780 will play either 1 7/8 IPS standard cassettes or 1 7/8 four track mono cassettes. When playing a stereo cassette the 780 electronics automatically combines the two stereo channels to mono output, and built-in AGC automatically keeps the output level constant.

Applications for the 780 include recorded narrations, music-on-hold, supermarkets, department stores, theme parks, restaurants, and retail stores.

Circle 1 on Reader Response Card

### TOA ADDS FOREGROUND SPEAKER SYSTEM TO LINE

Toa Electronics' Inc. Commercial Sound Division has added a Foreground Speaker System to its line. The Toa F-Series (F-150 and F-300) consists of two professional speaker systems designed for sound reinforcement in nightclubs, theaters, foreground music applications, as well as monitoring applications in broadcast and A/V production.

The F-150, a full range, bass reflex design with five-inch loudspeaker is rated at 120 watts. The F-300's three-way design with eight-inch woofer, one-inch soft dome tweeter and two-inch dome super tweeter is rated at 150 watts. Both have built-in circuitry to prevent overload.

The F-Series enclosures are constructed of acoustically efficient, scratch-resistant material which is available in three colors: white, gray, and red.

Circle 3 on Reader Response Card

**Introducing a new product? Let us know. Send product information to:**

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# PRODUCTS IN REVIEW

## a closer look by gary d. davis



### Two New Signal Processing Power Amps From BGW

BGW Systems has introduced two new power amplifiers with built-in signal processing capabilities. Each is unusual with regard to the features combined in one 5¼ x 19-inch rack-mountable package.

The SPA-1 is a dual-channel amp intended to drive a sub-woofer system. For this reason, it includes built-in crossover networks to separate the low bass band from the balance of the full-range signal, an all-pass delay section which can be used to compensate for physical offset of the subwoofers with the main cluster, and parametric equalization for fine-tuning the low end. The unit operates by summing the low-frequency signals, delaying them anywhere from 100 microseconds to 4 milliseconds (delay may be bypassed), applying parametric EQ, and then feeding the summed signal to two output amp stages. These stages may be used to drive independent subwoofers, or they may be bridged for twice the power into twice the minimum impedance. Full range (high passed) outputs are provided to drive the balance of the amp/speaker system.

The SPA-1 is rated at 200 W/CH into 8 ohms, 400 W/CH into 4 ohms or 600 W/CH into 2 ohms; in bridged mono mode it delivers 800 W into 8 ohms or 1,200 W into 4 ohms. The input impedance is 15 kohms, whether using the active balanced input or the factory-installed plug-in transformer. The crossover frequency and slope are factory wired per customer request, and may be set at any ISO center, and any slope rate up to four poles. Additionally, the high pass filter may be set

at 10 Hz increments from 10 to 80 Hz. Parametric EQ is sweepable from 50 to 500 Hz, with 6 dB of boost or cut and a Q variable from 0.5 to 2.0. Delay resolution is 100 microseconds. Signal-to-noise ratio is better than 100 dB unweighted (including one step of 2 ms delay).

The SPA-3 is a single-channel *triamplifier*. That is, it handles one channel of audio, but includes a built-in three-way electronic crossover network and three output amps. Like the SPA-1, the filter frequencies and slopes are customer specified, and the high pass filter is adjustable from 10 to 80 Hz. Also, as with the SPA-1, there is a built-in parametric EQ for the low band. Additionally, there is a high frequency contour section that applies boosts to compensate for propagation losses or compression driver roll-off (corner frequency adjustable with a dip-switch, and boost level adjustable with precision digitized control). There are two delay sections; the low band delay is identical to that in the SPA-1. The other delay section may be switched into the mid or high band output, and has 50 microsecond resolution with 2.0 millisecond maximum delay. The low band output is rated at 250 W into 8 ohms or 400 W into 4 ohms, whereas the mid and high bands are each rated at 250 W into 8 ohms or 300 W into 4 ohms (total output power is FTC-rating limited to 850W). Maximum gain is 30 dB per section.

Both models include precision, stepped rotary attenuators, multiple LEDs for power, input and output signal presence, and overload. A front-panel 20 amp magnetic circuit breaker provides over-current protection and doubles as the power switch.

**Comments:** Michael Karagosian, BGW's electronics engineering manager, explained that the SPA-1 and SPA-3 were designed in response to requests from contractors. He also said the SPA-3 was the more popular unit, which is not surprising considering its extra flexibility. The primary advantage of the SPA-3 is that it enables a multi-zone triamplified system to be set up with greater flexibility and

easier installation. Although the unit has three-way capability, it can be configured for a two-way system with dual low or dual high frequency outputs; the delay and high band contour functions also may be "moved around" depending on the desired configuration. Because the signal processing is distributed, if one zone goes down the rest of the audio will continue uninterrupted.

The SPA-1 provides a simple means to add subwoofers to an existing sound system without redesigning and rewiring the entire system. Of course, it also can be designed into a new system.

With both models, the built-in parametric EQ enables the low end response to be tailored to the anomalies of the environment and the drivers. The delay circuitry is provided to permit the acoustic centers of the various drivers in the speaker system to be aligned electronically where physical alignment is not practical (or is impossible, as with subwoofers below the stage and a cluster high above). Of course, with 10 microseconds being equal to about one inch (assuming standard temperature, sea level, dry air), the resolution of the delay is 10 inches (low band) or five inches (mid/high band on the SPA-3) so you still may have to move drivers around to attain perfect alignment.

BGW claims the amp sections utilize all discrete circuitry, including its "Ultra Case" power devices in a low feedback design. I saw only preliminary data, with no distortion, noise or bandwidth specs, and I have not heard the units. On the other hand, these amps now have been out for a while, BGW is an established audio equipment manufacturer, and such unique products certainly deserve your *closer look*.

Circle 15 on Reader Response Card

Gary Davis owns Gary Davis and Associates, a firm which has produced instruction manuals, catalogs, advertisements, and newsletters for the audio field over the last 12 years. Davis has worked as an electronics technician, is a member of the Audio Engineering Society and author of the CAMEO dictionary.



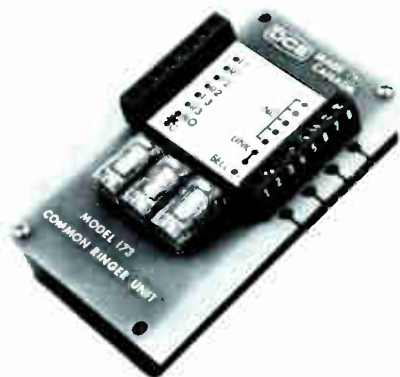
## Telecommunications Techniques' New T-Carrier Analyzer

Telecommunications Techniques Corporation (TTC) has introduced a T-carrier analyzer, the T-BERD 209. The portable test set is designed for both field service and central office testing of T1 and T1C circuits. The T-BERD 209 is used for installation acceptance testing and fault isolation of T-carrier equipment and span lines. The unit may be used for both in-service monitoring and out-of-service testing.

Error measurement and signal analysis functions are based on the simultaneous detection of logic errors, bipolar violations, frame errors (D4 or SLC™ 96) and CRC errors (extended super frame). Associated error rate, errored second, and percent error free second calculations are performed. No CSU is required for span line testing and simplex current, signal level, timing slips and recovered clock frequency measurements are provided. Any two measurements may be displayed simultaneously and all test results may be output to a printer or collected via remote control.

The T-BERD 209 is packaged in a rugged, light-weight, aluminum case and may be rack-mounted.

Circle 8 on Reader Response Card



## New 3 Trunk Common Ringer Selector From DCE

Dees Communications Engineering

has announced a new 3 Trunk Common Ringer Selector, Model 173. The unit provides a means of using central office ringing power on up to three trunks to a common ringer. Units can be tied together if more than three trunks are used.

Circle 9 on Reader Response Card

## Three New Auto Transformer Attenuators from Soundolier

Soundolier has added three new auto-transformer attenuators to its line of communications accessories. The

three "E" Series models in 10 watts, 35 watts, and 75 watts power ratings offer excellent frequency response and minimum insertion loss, according to the company. Attenuation steps are 1.5 dB, and volume control range of 15 dB is provided in 10 positions with positive off.

Switch contacts are silver-plated for noise-free operation. Each auto-transformer is mounted on a stainless steel plate with stamped and filled dial scale and skirted black knob.

Circle 10 on Reader Response Card

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Circle 222 on Reader Response Card

# CONTRACTING CLOSE-UP

Columbus, Ohio

## ESSC OPENS

Contractors met and spoke with manufacturers and their sales representatives at the first ESSC Regional Conference of 1986 in Columbus, OH, on October 2 and 3. Over 150 manufacturers were represented at the seminar in Columbus, according to Bud Rebedeau, NSCA's executive secretary. In addition, Rebedeau said that there were over 300 contractors preregistered for this first conference with total contractor attendance Columbus expected to reach 450 to 500. A figure was not available at press time.

Bob Barba, general manager of the conference, said, "We openly invited contractors to bring their problems—be it design, engineering, whatever—and resolve them by interfacing with the manufacturers."

The conference, which is sponsored by the NSCA and the ERA featured four educational seminars (see seminar schedule). Although the seminars were given by manufacturers, Barba stressed that "they are *not* sales seminars—but technology-oriented presentations. We're giving contractors the chance to hear the manufacturers who developed the technology that the contractors use. The seminars will deal with the latest technology and how it can be applied to some old problems."

Two additional ESSC Regional Conferences are scheduled for December 4 and 5 in Secaucus, NJ, and December 8 and 9 in New Carrollton, MD. For more information on these conferences, call Bob Barba at 312-593-8360.

### 1986 ESSC Seminar Schedule

#### DAY ONE

9 am **Video Advances-New Generation**  
Presented by Bob Klein, Manager, Panasonic Industrial, Secaucus, NJ

12:45 pm **The Tools of Sound and Room Equalization**  
Presented by Emory Strauss, Sales Manager, White Instruments, Austin, TX

#### DAY TWO

9 am **Sight Inspections for Bid Purposes**  
Presented by Vic Hall, San Diego, CA

12:45 pm **Fiber Optics Technology For Contractors**  
Presented by Jim McLaughlin, Vice President, Engineering, American Fibertek, New York, NY

*The seminar schedule is the same for all three ESSC Regional Conferences*

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## Hospital Communications

Communications Systems Inc. of North Providence, RI, recently installed a new communications system in the Women and Infants Hospital in Providence.

Installed were Toa's EXES-6000 intercom and Dukane's nurse call and code blue systems. According to Jerry Neylon, vice president of Communications Systems Inc., "The products were chosen for their reliability. Hospitals need instantaneous service, and nobody enjoys going out on a call at three in the morning. You also can't tell them to wait until next week for a part."

The special attraction with the EXES-6000 is that it allows for hands-free operation at both ends, Neylon added. "At a hospital everyone has their hands full," he said.

Among other equipment that was installed was a simplified doctor's register that eliminated special coding which was built into the TOA installation and a Panasonic CCTV system.

# FACES AND PLACES

## HME Increases Sales Staff With Hughes, Opela, and Otis

HM Electronics has increased its sales staff with the appointments of Michael Hughes as director of marketing, Randy Opela as national sales manager, and Bill Otis as product manager.

Hughes is responsible for coordinating all sales activities and marketing programs. Hughes joined the company in 1975 as production test supervisor. During his 11-year career with HME, he has held the positions of customer service manager and industrial sales manager.

Opela is responsible for overseeing sales of all pro-audio products (wireless microphones, wireless intercom, and cables intercom systems) marketed through HME's nationwide representatives and dealers. Opela was formerly marketing manager for connectors and audio accessories at Switchcraft, Inc.

Otis was previously applications engineer at Sub-Sea Systems, Inc., a manufacturer of underwater television systems. His background includes marketing and sales with prior experience as field service technician in both audio and television.



**TOM  
SEXTON**



**CHUCK  
HAIN**

## Klein Tools' Board Elects Two Vice Presidents

The Klein Tools', Inc. board of directors has elected two new vice presidents. Charles R. Hain was named vice president of finance, and Thomas R. Sexton was appointed vice president of information systems.

Hain joined Klein in 1982 as manufacturing controller and was appointed corporate controller in 1985.

Prior to joining Klein, he worked for Motorola for 13 years, serving most recently as controller of the Display Systems Unit. He holds a BS from the University of Illinois and a MBA degree from Roosevelt University.

Sexton, who attended Loyola University, started with Klein in 1980 as corporate director of management formation systems. Previously, he held data processing management positions with Park View Metal Products and Capitol Foods Industries, both of Chicago.

## Clear-Com Names Tourkow Product/Application Manager

Clear-Com Intercom Systems has appointed Bob Tourkow as its products/applications manager in the company's San Francisco office. He will be involved with new product development and applications engineering.

Tourkow, who has 15 years of experience in broadcast, performing arts, and industrial communications, has worked with Clear-Com in Los Angeles since January 1985. Prior to that, he was sales manager of RTS Systems for three years, after spending six years first as engineering manager for Filmways Audio Services and then for Best Audio in Los Angeles.

In addition to his full-time responsibilities with Clear-Com, Tourkow actively works on television and film productions and other special events. His credits as communications system designer and operation supervisor have included the Academy Awards, Grammy Awards, American Music Awards, Miss America Pageant, Presidential Inaugurations, Closing Ceremonies of the 1984 Los Angeles Olympic Games, and the Closing Ceremonies of the Liberty Weekend.

## REP NEWS

**Toa Electronics, Inc. Security Group**, has appointed the following rep firms to handle its security product line: **Vector, Inc.** of Seattle, WA, will cover Washington, west Montana, Oregon, west Idaho, and Arkansas; **Avwest, Inc.** of Fountain Hills, AZ, will cover Arizona, New Mexico, and El Paso, TX; **CB Electronic Marketing** of Arvada, CO, will cover Colorado, Wyoming, Utah, east Idaho, Montana; **Kodo Associates** of Minneapolis, MN, will cover Minnesota, South Dakota, North Dakota; **Marcus Johnson Associates** of St. Charles, MO, will cover Missouri, Kansas, Iowa, south Illinois, Nebraska; **Peregrine Southwest Reps** of Houston, TX, will cover Texas, Oklahoma, Arkansas, Louisiana; **Ziskind Associates** of Rolling Meadows, IL, will cover north Illinois, east Wisconsin; **Secom Systems, Inc.** of Atlanta, GA, will cover Georgia, Alabama, North Carolina, South Carolina, Mississippi, Tennessee; **LSM Associates** of Latham, NY, will cover upstate New York; **ASR Enterprises, Inc.** Baltimore, MD, will cover Maryland, Virginia, south New

Jersey, east Pennsylvania, Delaware, Washington, D.C.; **Meyer Marketing** of Deerfield Beach, FL, will cover Florida; and **Grace & Hillton Associates**, Marlborough, MA, will cover Massachusetts, Vermont, New Hampshire, Connecticut, Rhode Island.

**Atlas Sound** has announced the appointment of three manufacturers representatives: **Richard S. Pass Associates, Inc.** of Langhorne, PA, and Alexandria, VA, will cover eastern Pennsylvania, southern New Jersey, Maryland, Delaware, Virginia, and Washington, D.C.; **LSM Associates** of Phelps and Albany, NY, will cover upstate New York; **Graham/Davis, Inc.** of Houston and Dallas, TX, will cover Texas, Oklahoma, Louisiana, and Arkansas.

**Furman Sound, Inc.** has announced that **Wane Fuday** of **Future Sales** has been designated the **Furman Rep of the Year**. Future Sales represents Furman in northern California. Furman Sound has also appointed three new rep firms: **Metropolis Marketing** will cover the New York metropolitan area; **Summit**

*(continued on page 49)*



### Insul-Art Acoustics Releases Product Catalog

Insul-Art Acoustics Corporation is offering an eight-page full-color brochure that describes acoustical products.

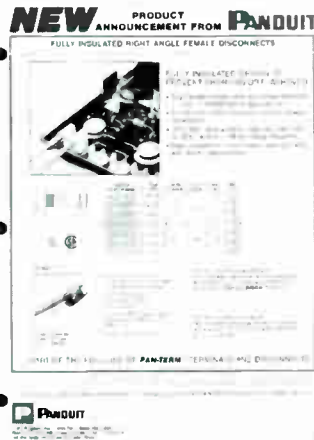
Included are acoustical wall panels, baffles and banners; SCAMP™, Sattellite and Centrallite Sound Masking Systems; and acoustical enclosures for computer printers.

Circle 11 on Reader Response Card

### New Bulletin Describes Panduit® Fully Insulated Female Disconnects

A free product bulletin describing the full line of fully insulated, right angle female disconnects is available from Panduit Corp.

The fully insulated design helps prevent shorting and flashover. The right angle configuration provides design flexibility, permitting use in limited space applications.



The Panduit disconnects have funnel entry with insulation support to speed installation. The .187/.205-inch size accepts male tabs from .187 to .205-inch widths—another feature providing design flexibility.

Circle 12 on Reader Response Card

### Contact East Offers Free One Year Subscription To Its Catalog

Contact East is offering a free, one-year subscription to its toll and instrument catalog. The newest issue introduces 89 new items and over 5,000 products for assembling, installing, testing and repairing electronic equipment.

Circle 13 on Reader Response Card

### Winders & Geist's New Office Products Brochure

A new color brochure from Winders & Geist, Inc. shows the company's full line of office products, including Flexiduct flexible cord covers, power extensions and taps, surge suppressors and static protectors, power back-up equipment, and modular and conversion telephone accessories.

Circle 14 on Reader Response Card

## COMPUTER

(continued from page 15)

error ratio in a digital system corresponds to the analog concept of signal-to-noise ratio, or dynamic range. In an analog system, the *signal-to-noise ratio* is equal to the maximum available signal amplitude divided by the amplitude of the residual noise in the system. In a digital system, the signal-to-quantizing error ratio is directly proportional to the number of bits used to represent the signal samples. Each bit contributes 6 dB to the ratio (Figure 2).

### Analog-to-Digital Conversion System

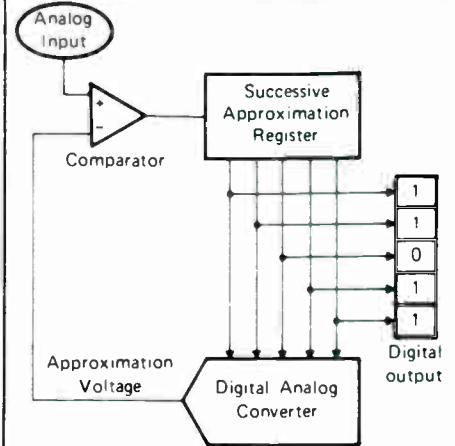
The electronic system to convert signals between analog and digital is comprised of six essential building blocks (Figure 3).

The *input lowpass filter* ensures that no frequency components above one half the sampling rate will enter the conversion system. This filter will have very steep cutoff characteristics, with the cutoff frequency set slightly less than one half the sampling rate. The filter prevents an extremely undesirable phenomenon known as *alias-*

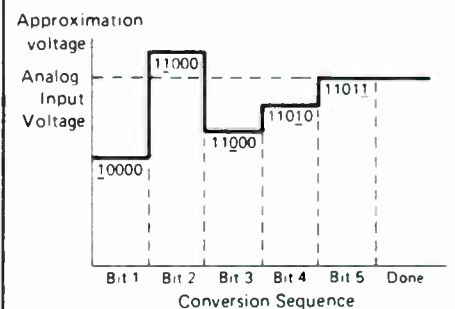
*ing*. Frequencies above one half of the sampling rate, if allowed into the system, produce difference components with the sampling signal, resulting in an objectionable interference signal added to the desired audio signal.

The *input sample-and-hold circuit* measures the analog signal once during each sampling interval and holds its value steady until the next interval. This is necessary to prevent errors which could happen in the next stage if the signal value changed or drifted while the analog-to-digital converter was working on it. Especially in high-accuracy systems like digital audio, the analog-to-digital converter requires an unchanging voltage during the time length of its conversion process.

The *analog-to-digital converter* produces a digital number at its output which corresponds to the analog voltage at its input. A successive approximation converter is the type most often used in today's digital audio systems. The system consists of a digital-to-analog converter (DAC), a comparing circuit, and a successive approximation register (SAR) which stores the digital approximation and makes it available to the digital part of the system (Figure 4).



(A) Successive Approximation A-D Converter



(B) Conversion Sequence Showing Successive Approximation Voltages and Corresponding Digital Numbers

Figure 4 - Successive Approximation ADC and Output.

| DATE           | EVENT/COMMENT   | LOCATION  | CONTACT                         |
|----------------|---|---|---------------------------------|
| October 28-29  | <b>Fiber Optics In Plain English.</b>                               | Atlanta, GA                                     | Clifford Inc.<br>(800) 451-4381 |
| October 28-30  | <b>MAECON</b> Mid-American electronics conference.                  | St. Louis, MO                                   | (313) 254-5310                  |
| November 3-7   | <b>Acoustic and Noise Control.</b>                                  | Seven Springs Convention Center<br>Champion, PA | AVNC<br>(412) 265-4444          |
| November 5-6   | <b>Sound Engineering Seminars</b> In audio & acoustics.             | Atlanta, GA                                     | Syn-Aud-Con<br>(714) 728-0245   |
| November 5-7   | <b>North American Telecommunications Convention and Exhibition.</b> | St. Louis, MO                                   | NATA<br>(202) 296-9800          |
| November 12-16 | <b>81st Audio Engineering Society Convention.</b>                   | Los Angeles, CA                                 | AES<br>(212) 661-8528           |
| November 18-19 | <b>Sound Engineering Seminars</b> In audio & acoustics.             | Orlando, FL                                     | Syn-Aud-Con<br>(714) 728-0245   |
| December 4-5   | <b>ESSC Regional Conference</b> Seminars & products.                | Secaucus, NJ                                    | ESSC<br>(312) 593-8360          |

The *successive approximation converter* actually tries to guess the value of the analog input signal at each sample point by comparing the output of its DAC to the analog input signal in increasingly more accurate steps. The SAR sets the first (most significant) bit of its DAC and compares it to the analog signal. If it is higher than the analog signal, a "0" is stored in the first bit; otherwise, a "1" is stored. Then the next (less significant, more accurate) bit is set and the process is repeated until the system approximates the input signal as accurately as possible. The digital output is then sent out to the digital part of the system and the process is repeated for the next signal sample.

### Digital-to-Analog Conversion System

Once the signal has been digitized and stored or processed, it must be converted back to analog to interface with the audio output system. To produce high quality audio, the following building blocks are used (*Figure 3*).

The *digital-to-analog converter* uses a set of switches and a resistive voltage divider to convert the digital number for each signal sample into its equivalent analog value.

Since the output of the DAC contains glitches caused by transitions in

its internal switching apparatus, an *output sample-and-hold circuit* acquires the DAC voltage only when it has settled to its intended output value, and thus prevents the glitches from distorting the output signal.

The *output lowpass filter* (LPF) smooths the stepped output of the sample-and-hold circuit into a continuous analog output by removing the high-frequency components associated with the sampling process. The resulting output signal is identical to the original audio input within the limits of the parameters of the digitizing process.

### REP NEWS

(continued from page 47)

**Sales** will cover Arkansas, Louisiana, Oklahoma, and Texas; and **Taub Sales** will cover New Jersey, Maryland, Delaware, Virginia, Washington, D.C., and Philadelphia, PA.

**Powertronix** has added five companies to represent its product line: **Design Factors** of Hacienda Heights, CA, will cover southern California and Las Vegas; **Lichtenauer and Associates** of Antioch, CA, will cover northern California and northern Nevada; **Chuck Olson Associates** of Renton, WA, will cover Oregon, Washington, western Idaho and Alaska; **Raleigh**

**Perry and Associates** of Buford, GA, will cover Alabama, Georgia, Tennessee, North Carolina, South Carolina and Mississippi; **R. G. Associates, Inc.** of Stow, MA, will cover Massachusetts, Rhode Island, Connecticut, New Hampshire, Vermont, and Maine.

### CONSULTANTS

(continued from page 12)

with all members of the design team lobbying for their priorities. Several schemes may be discussed and evaluated with respect to program requirements, construction cost, operating costs, and other factors. Eventually, a final design concept evolves which defines the project goal for the design team. Budget estimates are generated, and the construction dollars are allocated among the various specification elements. Preliminary drawings and sketches are submitted by each discipline illustrating their individual design intent. Rarely will the design intent of all parties be in total harmony at this point. So once the schematic design is approved in concept by the owner, the compromises inherent in the design development component of the design phase can begin.

*Next Month: Design development and working drawings.*

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