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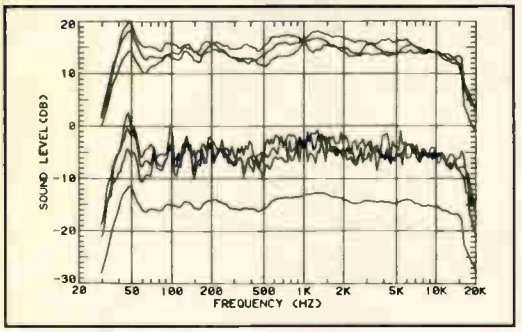
Volume 34 #1
January 1988



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DEPARTMENTS

ON THE COVER

A Panasonic CT1330 color monitor in the Esprit Juniors' Department at Bloomingdale's in Short Hills, New Jersey. The on-screen information—time, date and location—is a reference for the guard at the security console and can be used at a later date as evidence in court for a robbery. *Photo by Mark Egan, MSI Video Systems Inc.*

FEATURES

COLUMNS

IF YOUR PROJECTOR ISN'T THIS FLEXIBLE NOW, IT NEVER WILL BE.

JBL's new Model 6810 Video Projector offers off-the-shelf flexibility the others can't touch.

The Model 6810's 40-function remote control puts sophisticated command in the palm of your hand.

An input panel that's worthy of a blue ribbon panel.

It's just one of the many reasons why JBL's new Model 6810 Video Projector is your most complete choice for a wide range of professional applications.

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...the only video projector with a built-in 178-channel tuner and stereo decoder for Zenith/dbx* stereo and Second Audio Program broadcast signals.

...the only video projector with a wireless 40-function remote control.

*Zenith is a registered trademark of Zenith Electronics Corporation. dbx is a registered trademark of BSR North America Ltd.

If floor space is at a premium, the Model 6810 can be ceiling mounted quickly and easily.

...the only video projector that supports onscreen graphics and lets you superimpose text.

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ERA/NSCA Regionals: Communication is the Key

Although there was a sense of disappointment at the ERA/NSCA Regional Conferences this year, attendees can expect next year's shows to be better. According to Bud Rebedeau, NSCA executive director, inherent problems in this year's shows will be remedied in 1988.

One of the biggest problems this year was poor attendance. While each conference averaged about 175 contractors a day, the floors seemed empty. According to one rep, low attendance was a result of poor communication between ERA/NSCA and the contractor/manufacturer community prior to the shows. Last year a survey was sent to manufacturers asking them how many shows they thought should be held and in what cities. The votes were tallied and "viola" destinations were selected where contrators weren't located, according to Rebedeau. For example, manufacturers didn't know that the bulk of contractors in Missouri are in Kansas City and not St. Louis. In addition, LA was another site selected by manufacturers. What they didn't know was that LA is the highest debt city for sound contractors. The reps are the ones who know where the contractor hotspots are and they weren't even included in the communication loop!

This year, manufacturers and reps will be surveyed on the best locations and number of shows to be held. And instead of using a limited staff of volunteers to communicate with reps, a person from ERA will be hired for the job.

People were also disgruntled over the high cost of exhibit booth space. A Manufacturer's Advisory Committee meeting will be held in February to discuss using plain tables without pipe and drape and less elborate food to keep the costs down. The committee will also discuss the possibility of having only one day of exhibiting instead of two and having a full day of seminars (generally the second day of exhibiting is slower).

Why and how were annual regional shows born? Four years ago ESSC (Electronic Sound & Systems Conferences) set up a joint venture of the ERA and the NSCA on the premise of getting reps more involved in local shows. While the organizations would handle the details for the shows, their goals were to enable reps to put on shows to get more business, to act as a vehicle for manufacturers to see customers such as technicians and sales people who didn't usually go to the national shows, and to act as an educational vehicle for sound contractors, ao they could receive training that they couldn't get anywhere else. Sure the regional shows need some improvement in planning. But the concepts still hold true.

The regionals are important for reps. While each rep may make three or four calls a day on his normal rounds, at each show day he has an opportunity to make 100 calls (if the show is in the heart of contractor land). However, while the organizaitons can provide the tools for the reps, it is really up to the reps to get the contractors out to the shows.

Hopefully, with some changes in 1988 the shows will grow in popularity. But it can't be done unless the right communication is there. Everyone involved—manufacturers, contractors and reps—should get involved because ERA and NSCA need your support to make the shows successful.

Debra A. Pagan

Debra A. Pagan
Managing Editor

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TELEX CORP. TO BE SOLD TO MEMOREX AT $62 PER SHARE

Following a friendly tender offer made in mid-December, Telex Corp. will most likely be sold to Memorex International N.V. on January 19, 1988, at $62 net per share, according to Donald Mereen, director of marketing communications products, Telex Communications, Inc. Division. Memorex's interest in Telex Corp. is essentially with the Telex Computer Products Division and not with the Telex Communications, Inc. Division.

This is not the first tender offer that Telex Corp. has received. Over the past several months, Asher Adleman, a financier, had been attempting to purchase Telex in an unfriendly acquisition. However, Adleman and the organization he had formed for the sole purpose of purchasing outstanding Telex shares had difficulty raising the necessary finances.

"Memorex's buyout would be friendly," said Mereen. "Memorex felt that with their computer products capability and Telex's computer products capability joining the two would produce a good marriage. Although the buyout is going for all Telex stock, it boils down to a merger. I think there will be some consolidation between Memorex and that division—both manufacture IBM compatible peripherals. However, the communications division will remain unchanged. Overall, I believe that a possible buyout is good news for everyone concerned. Telex Corp. and Memorex together will have a stronger, overall capacity."

NEUTRIK USA LAUNCHED TO IMPROVE SERVICE

As announced by Berhard Weingartner, CEO of Neutrik AG, the distribution agreement between Neutrik and Dialight-Kulka-Smith (a unit of North American Philips) has been dissolved. This action was taken to enable Neutrik USA to be formed, "to more efficiently, and more quickly respond to the needs of Neutrik customers in North America." Appointed as general manager of Neutrik USA is James Cowan, who has been associated with the Neutrik product line in the U.S. for a number of years. The location of the company in Millville, NJ, enables the company to be in the most flexible logistic surroundings to serve their OEM and distribution customers.

YAMAHA COMMUNICATION CENTER UNVEILED

Yamaha Communication Center, a newly-formed subsidiary of Yamaha Corp. of America, unveiled its flagship music research and development studio in Metropolitan Tower on West 57th Street, New York City, on December 9.

The facility, which represents the company's first permanent structure to be built in Manhattan, will establish a channel of communication between the company and top recording artists and studio professionals. Over 500 people attended a four-hour presentation at the opening. This included demonstrations by artists and studio professionals of the company's line of musical instruments and professional studio/video equipment in the center's street-level showroom salon. The opening of the Yamaha Communication Center coincides with Yamaha's centennial celebration this fall.

In related news, Yamaha Electronics Corp., USA, and its US parent, Yamaha Corp. of America have broken ground for a new building which will be a major expansion of their facilities in Buena Park, CA. Construction of the 95,000 square foot building began the third week of November and is expected to be completed and ready for occupancy by the end of November, 1988.

FORMER WILKE EMPLOYEES TEAM-UP WITH JOINER-ROSE

The Joiner-Rose Group, consultants in acoustic technologies, has opened a New York office headed by five former employees of the Wilke Organization. Wilke, pioneers in the concept and design of integrated systems for audiovisual communications, disbanded in October, 1987 due to financial difficulties.

According to Arthur Schwartz, vice president, "The branch office will continue in the "Wilke" tradition, which is to offer the design of audiovisual and television systems and the architectural support those systems require. It's like stepping from one moving train to another; we'll keep the same momentum, same clients and same team effort attitude." In addition to Schwartz, other former Wilke members to hook-up with Joiner-Rose in New York are Irving Wood, Jack Dickson, Andy Prager and Norair Asadourian. This group has been associated with Wilke for a combined tenure totaling over 50 years.

ITT NEGOTIATES TO ACQUIRE AMERICAN NETWORK

American Network, Inc. and ITT Corp. have announced that they are negotiating a possible acquisition of American Network by ITT Corp. The companies have reached a preliminary understanding which contemplates that the purchase price for American Network would be approximately $18,500,000 with all of American Network's shareholders receiving cash. The acquisition would be subject to ITT Corp's satisfactory completion of a review of American Network's business and operations as well as legal due diligence, and negotiation and execution of a definite agreement. The acquisition would also require approval by the board of directors of each company, the shareholders of American Network, various regulatory agencies and other third parties. There can be no assurance that an agreement will be achieved or that the acquisition will be consummated.

THE 83RD AES CONVENTION IN NEW YORK BOASTS LARGEST TURNOUT TO DATE

The AES convention held in New York City from October 16 to 19 had the largest turnout in the organization's history. Over 13,000 industry people from 46 states and 40 countries attended the show. There were 476 exhibit booths and 33 demonstration rooms, covering two hotel exhibition areas. According to Donald Plunkett, executive director of AES, a record number of 90 papers were presented at over two dozen sessions at the Hilton, and over a dozen workshops were presented at the Sheraton Centre. Papers and workshops were on the latest technologies from "Acoustics and Intelligibility" to "Creating Sound for Modern Motion Pictures." (See Technically Speaking for further information, page 74).

IBMA CONVENTION PROVES TO BE MOST SUCCESSFUL SHOW OF ITS TIME

The IBMA convention, held at the Mariott Rancho Las Palmas Resort in Southern California from October 14 to 17, was the most successful show in the organization's history. Over 260 industry people attended, including 49 exhibitors. This year's convention, entitled "Problem Solving for the 80s," included a variety of seminars. "The seminar format again proved to be very popular with our membership," said Joe Elum, IBMA president. "People came to see what new things are happening in our industry. The fact that our attendance has increased reinforces my belief that this industry is a stable and growing business."

by Bill Hooper

The Importance of Effective Marketing

At times, the term *marketing* can be terribly abused and/or misused. Growing, smaller firms especially, seem likely to confuse the staff level marketing function with line level positions such as sales, or engineering, or even with advertising. Larger, more formerly structured businesses usually evolve clear definitions for these very different specialties. The owner or president of a less formal firm may feel comfortable as the part time marketing manager, but quite often, this critical function, if for no other reason than by default, falls to the company sales manager. Marketing is a staff function which not only sets the course of a business, but equally establishes how a company is perceived by all of its business community.

Assuming that most larger corporations have indeed identified and separated the unique responsibilities of marketing from those of sales, it is the growing, mid-sized company wherein this confusion can really become troublesome and start danger signals flashing. And, the faster the company growth rate has been, the faster the fall rate can be.

Webster defines salesmanship as—"The ability, skill and technique of selling," and then marketing as—"All business activity involved in the moving of goods from the producer to the consumer, including selling, advertising, packaging, etc." Though Mr. Webster properly defines selling as a sub-function to marketing, his dictionary purpose remains to generally define words, not to detail job titles. However, the key phrases that he uses for marketing are, "*All business activity. . .from producer to consumer. . .*" Therein lies the basic difference between sales and marketing. When the boundary lines of sales and marketing

(continued on page 59)

Hooper has devoted more than 30 years throughout many levels of the sound and communications industry. He has held top managerial and executive posts with contractors, representatives and manufacturers on both coasts and draws from a deep well of organizational, administrative, marketing and technical experience.

If you take us apart, you'll take us on.

When we decided to expand the Quam line to include ceiling baffles, backbox enclosures and assemblies, we wanted to do more than just complement our loudspeaker offerings. We wanted to give the contractor another choice. Judging from the growing list of contractors who have switched to Quam, we did just that, with an unbeatable combination of quality, price and service.

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Take us apart. Then take the competition apart. You'll see that Quam is your best choice. Call or write for your free Quam commercial sound products catalog, and take us on. It's the sound decision.

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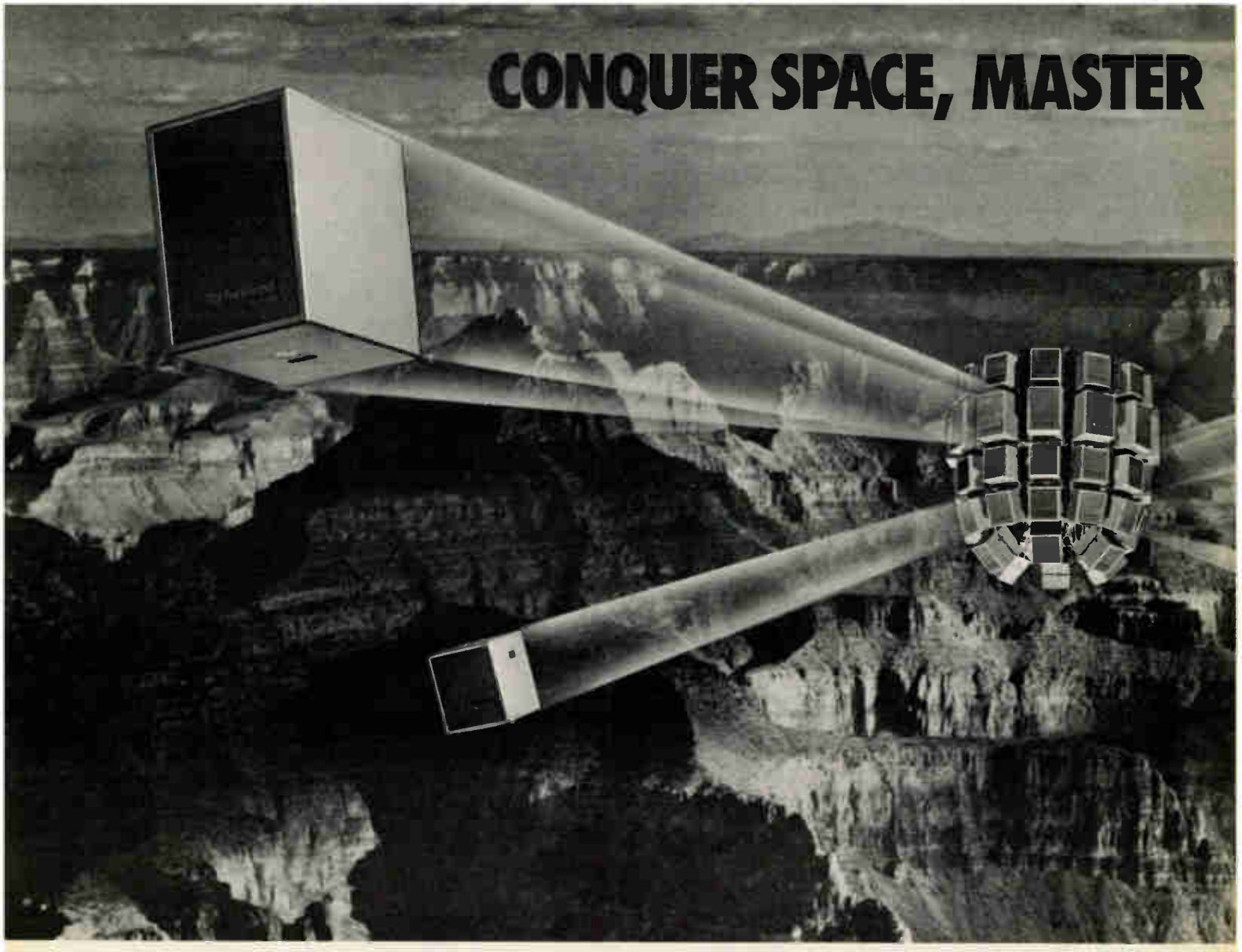

Some speaker systems attempt to conquer the acoustic environment through brute force, deploying massive cabinets and firing horns at everything that moves. Others resort to the sort of electronic trickery that requires delicate and finicky racks of complex gadgetry.

Innovative designs for effective performance

Turbosound Separated Enclosure installation systems achieve their clearly superior performance without excessive bulk or "clever" disguises. Instead, they employ unique, patented design principles that have proven themselves on tours and in fixed installations worldwide.

A true system is more than the sum of its parts

The TSE System focuses Turbosound thinking, outwardly radical yet intrinsically sensible, on the unique problems of fixed installations. The result is more than a collection of cabinets: it's a true system in which all components work together to generate an endless variety of straightforward configurations that produce distinguished sound with unmatched security and reliability.

What goes up must not come down

In large venues, point source clusters often provide the most effective geometry. TSE flying hardware simplifies the design and installation of point source clusters: complete systems have been fully installed and tested in a single day. Each component is load-certified by an independent UK government-approved testing organization. A rather expensive proposition, but we think you should know exactly how your system will perform. Equally rigorous testing substantiates the audio performance of TSE enclosures.

Make full use of your skills

TSE components are made for each other. That makes it easy for you to optimize a TSE system for any installation, large or small. TSE systems, all different, in major venues around the world, are proof that there's no easier way for you to bring your own ideas about sound reinforcement to reality. And while they can't grant you supernatural powers, they will give you superbly natural sound.

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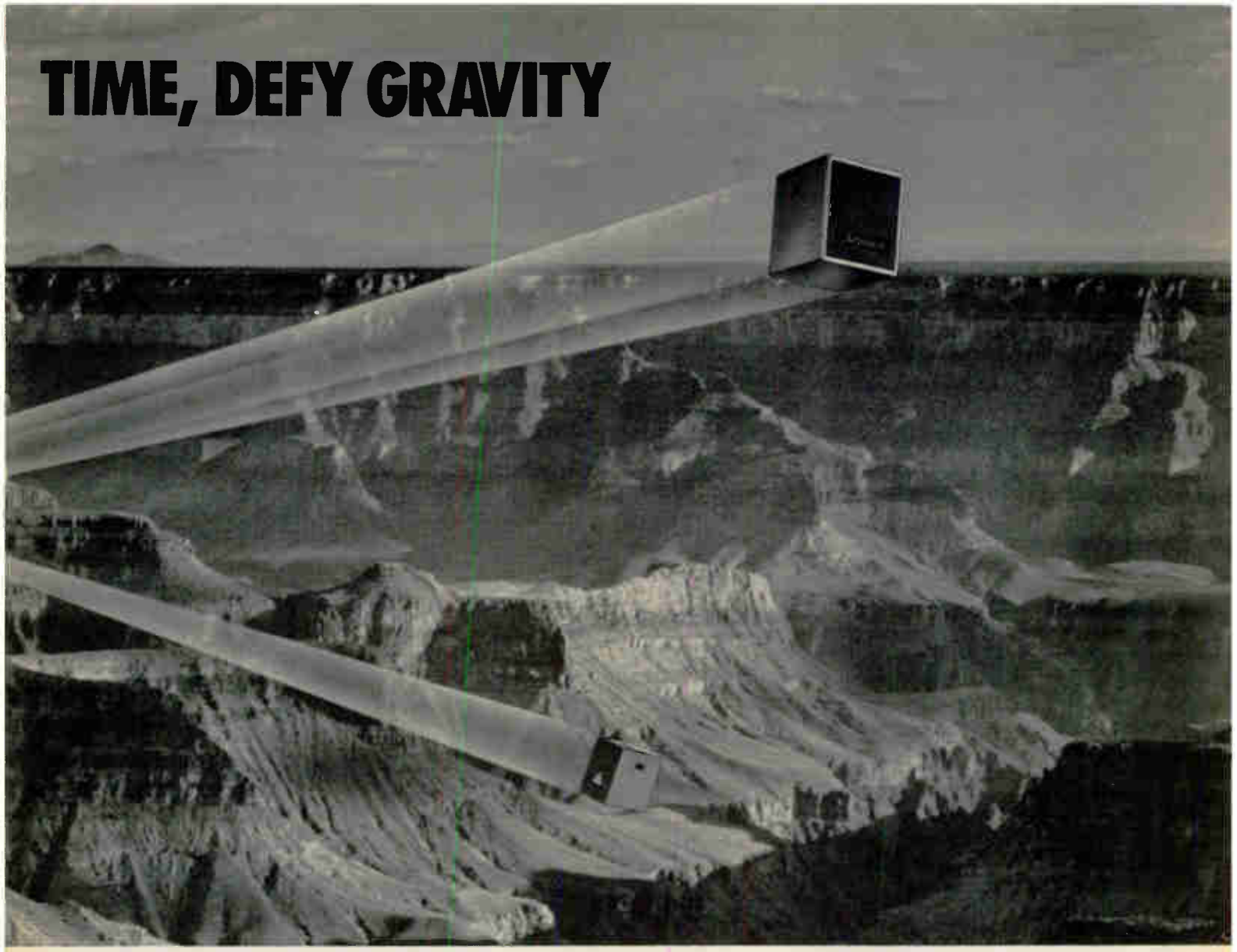
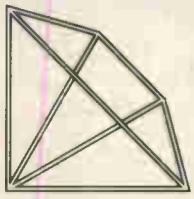


TSE Flying Frames distribute the weight around the enclosure, removing load stress from the cabinet. Connected with Quicklinks, the frames and cabinets pivot vertically to form a smooth coverage arc. The overall angle of vertical dispersion is easily configured with the TS-6 or TS-10 adjustable strap, connected between the bottom flying frame and the suspension quadrant.

TSE-111 — 10" TurboMid™ + HF horn/driver. Fits the FF-111 Flying Frame, designed with a square frontal cross section to let you choose your dispersion pattern by rotating the frame.

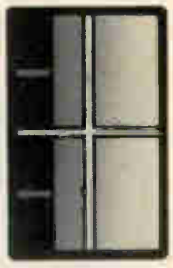
Horizontal dispersion is provided by Suspension Quadrants. Each quadrant will hold any combination of TSE enclosures. Combining quadrants yields arrays with horizontal dispersion of 70° — 360° and vertical dispersion of 50° — 270°.



TSE-211 — 2 x 10" TurboMid + V-2 HF unit. Designed for superior midrange and high frequency projection, with switchable active bi-amped or passive two-way operation. Dual vertically coupled TurboMid devices double the power handling of the TSE-111. The V-2 HF device extends upper octave response.

TSE-260 — V-2 HF unit. Two HF compression drivers are coupled with Turbo loading techniques, minimizing phase cancellation and distortion.

TSE-215 — 2 x 15" TurboBass.™ Balancing the frequency response of a TSE System is easy because LF units are separate from mid/high cabinets. With three bass, two mid/high enclosures and a high enclosure to choose from, generating the proper frequency response and coverage pattern for the venue you're bidding on can be as simple as laying dispersion angles over the blueprints. *Other bass enclosures available: TSE-115, TSE-118.*



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by Ted Uzzle

Recording Techniques: An Artist's Entrée To Technology

Bruce Bartlett, *Introduction to Professional Recording Techniques*, Indianapolis, Howard W. Sams Co., 1987, paper xvi + 397 pp., $18.95.

A book in any audio specialty, if written with enough attention to fundamentals, and if sufficiently free of jargon and specialized but undefined word usage, will be very valuable in other audio specialties. This becomes rarer and rarer as audio industry segments spin off into separate directions, but Bruce Bartlett has done it superbly. He has produced a book that will be useful to beginners or intermediate operators of sound systems for music, whether recording for disk or for film, or broadcasting, or reinforcement.

Such books must serve two purposes. First, they must satisfy the reader with an urgent need. This is done by presenting a large number of explicitly worked out solutions to specific problems (what microphones does one deploy, and how, for a vocalist also playing an acoustic guitar? For a piccolo player?)

Second, they must present and develop the basic principles underlying all techniques shown, so the reader may work out his own solutions to the infinite number of combinations and permutations he will be given by circumstance.

This is an extraordinarily rare combination. *Introduction to Professional Recording Techniques* achieves it handily.

The first chapter deals with recording and reproduction systems, as systems rather than congeries of devices glued together. The reader knows he is onto something special when the first entry in the recording chain is listed as musicians and musical instruments. The entire recording channel is described as a series of changes and transductions from the mechanical actions of the musicians' fingers, applied to the musical instruments to, eventually, the translation of neural spikes into music, in the ultimate listener's head.

There follows 15 pages on equipping the home studio. This is more than a product directory. It shows that in the world of semi-pro recording equipment there are clear levels of flexibility and function, with a variety of equipment choices to make within each. Proceeding up in price level one

(continued on page 52)

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☐ O Other _____

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☐ Final approval/Buyer
☐ Recommend/Specifier
☐ No Direct Authority/User

⑤ Intensity of your product need:
☐ Have salesman call
☐ Need within 3-6 months
☐ Future projects

⑥ Number of employees at your company:
☐ 1-3 ☐ 4-10 ☐ 11-25
☐ 26-100 ☐ over 100

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CCTV SYSTEM SOLUTION

by Tom Miller
Television Systems Marketing

The owners of five new car dealerships in San Jose, California, were faced with the cost of four guards to protect the cars on the lots from being stripped or stolen. A more effective means was sought to provide the same protection at a more reasonable cost. Television Systems Marketing, a manufactuers' representative company, submitted a proposal which includes a rather unusual system design. We now await the go ahead to install the system.

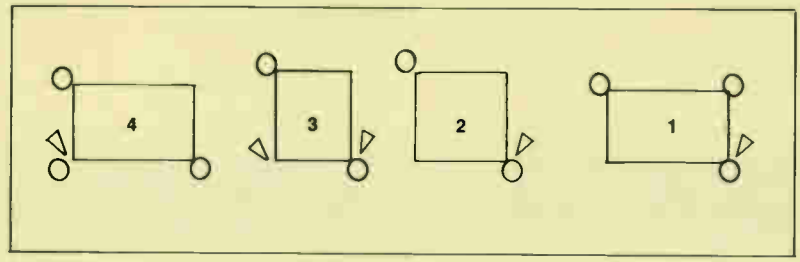
Our solution was to install a CCTV surveillance system that required one guard to monitor the complex and provided a faster overall view of the grounds. While the four-man guard force required almost one hour to cover all the areas to be viewed by the television system, a single guard would have a total visual tour of the area in less than three minutes.

Four of the car dealerships would create little challenge to the system design as they are located on the same side of the street within the same block, and have a 2,500 foot frontage by 800 foot depth. The fifth dealership is on the other side of a six lane street with no way to run cables to the selected monitoring location. This problem will be addressed later in this article.

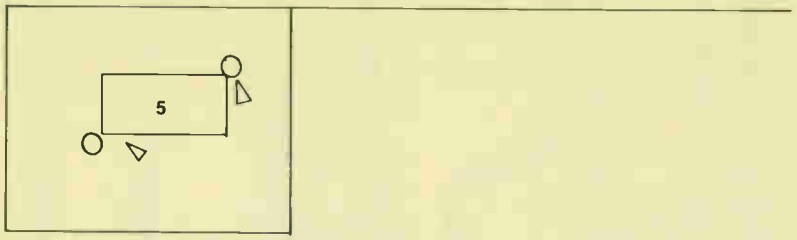
We visited the location twice. One meeting was to find out the customer's needs, the other visit was after dark to check the lighting as this system was to work primarily at night. Three cameras were tested in the darker areas.

A total of 19 camera locations were selected—7 were fixed position and 12 with Pan and Tilt and Zoom Lenses. **(See Figure 1.)** The cameras would be mounted at an equal height to the lights to provide the greatest viewing distance obtainable without having the lights in the cameras' field of view. Corner mounting of the cameras on pan and tilts would provide 270 degrees of pan; wall mounting of the camera to the side of the building would reduce this to 80 degrees, which was not desirable for this system.

FIGURE 1



SIX LANE STREET



○ CAMERA LOCATION PAN/TILT ZOOM LENS

▷ CAMERA LOCATION FIXED POSITION

Equipment List

The next step was to put together a suitable list of equipment, keeping in mind a guard was going to use the system. Simplicity of operation, one button selection of camera and a control function were the targets. Here's a look at each component selected for the system.

The camera selection is based on a semi-low light condition. The choice was between Newvicon and Ultracon tube cameras and the newer chip camera. A chip camera was selected for several reasons, including its sensitivity to meet the lighting requirement. The camera also provided a good picture with no lag under our low light test. The solid state pick up device would outlast the tube cameras by 3 or 4 to 1. This justified the $200 cost difference per camera up front. In addition, the vertical sync is 2 to 1 line locked phase adjustable, which would provide a clean, no roll switching of cameras at our monitoring location.

Motorized zoom lenses would allow for a wide angle field of view for general observation, and telephoto for identification. Lenses selected for this system were 11.5mm - 110mm. We chose this zoom lens because at 11.5mm (wide angle), the field of view is approximately 300 feet wide at a distance of 400 feet in front of the camera. At 110mm (zoomed in), the field of view is reduced to approximately 31 feet. When zoomed in all the way, it is also important to look at the overall height of the picture, approximately 23.5 feet. At this maximum viewing distance, a six-foot man would appear to be 25 percent of the screen height. This may not provide positive identification, but will give the observer a good idea as to what is going on out there. The lens also provides a 400 foot distance which was greater than our maximum target acquisiton distance.

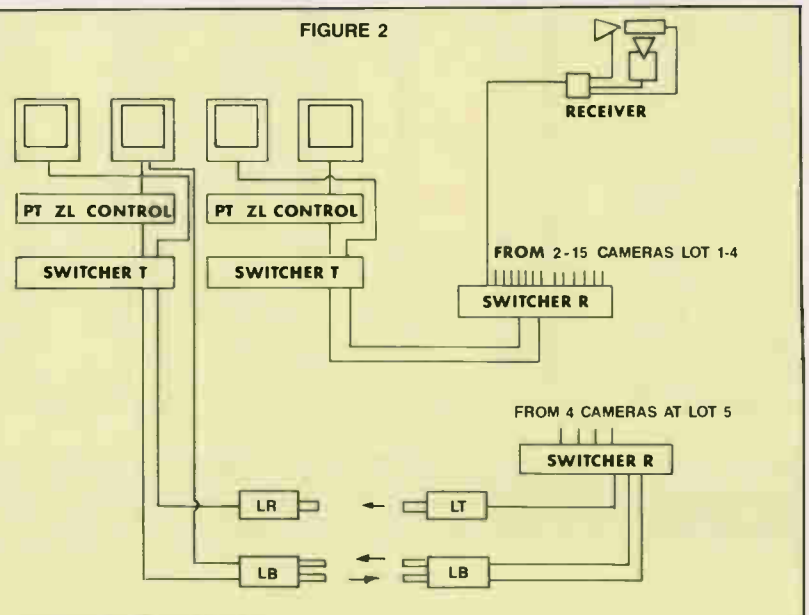
The lens would also need to be equipped with auto iris and spot filters so the camera could operate both day and night.

For the fixed camera locations we selected 8.5mm auto iris and spot filtered lenses. The 56 degrees field of view would cover most of the area between the buildings with a minimum blind spot.

To provide protection from the elements, environmental housings equipped with a heater and blower were selected to enclose the camera and lens combination. Heaters and blowers operate on thermal transistors that turn the heater on automatically at approximately 45 degrees and the blower at approximately 85 degrees. This protection is vital to the proper operation of the camera and lens. The housing size is determined by adding the length of both the camera and lens together remembering to add a couple of inches for the connectors on the back of the camera.

Pan and tilt units provide the ability for camera movement, left to right, up and down from a remote location. Size of the unit is determined by the total weight of the camera, lens and housing. Today, most of these units come as an auto-scan unit. This feature will not be used in this system. We have elected to park the cameras with the field of views overlapping as if they were designed for a fixed camera system. The guard would then have the ability to take control over the cameras on pan and tilts if he observed anyone in the area. This system concept also reduces service problems created by constant movement of the camera such as cable and auto iris wear.

FIGURE 2



LASER TRANSMITTER (LT)
LASER RECEIVER (LR)
LASER BI-DIRECTIONAL (LB)

System Togetherness

After selecting all the cameras and their support equipment we now bring the system together at the monitoring-control center. Lots 1-4 on the same side of the street were tied together as a single system. Lot 5 is still a problem. The selection of an over the coax type control system, with video going one way and the control signals going the other way, would be the most desirable. This would allow us some savings in installation cost and continuity with the control system

behinds" would often remain in a rest room until the facility closed, and then carefully avoid detection by night personnel as he went about his business. Thus, the need for motion detection capabilities became apparent very early in the history of alarm protection, but it wasn't until about 20 years ago that an affordable means of such protection became viable.

The first units relied upon either ultrasonic or microwave energy to detect motion. By blanketing an area with a field of high frequency sound energy (ultrasonics) or electromagnetic radiation (microwaves), movement could be detected by the field disturbances it caused. These early detectors, however, were unsightly, costly, used large amounts of power, and had questionable reliability. In fact, early ultrasonic units could be falsely triggered by air movement through ventilation ducts or by ringing telephones; microwave detectors were often bothered by flourescent lighting and legitimate motion in areas outside the boundaries of what was to be protected. Furthermore, similar units placed too close to each other would cause false alarms and made reliable detection difficult. Although advances in technology made these detectors more stable, they became more costly as a result.

Motion detection technology changed drastically with the introduction of the Passive Infrared (PIR) detector some 10 years ago. PIRs were strictly passive and several could be placed in the same area without any problem. They relied upon the detection of a change in the level of infrared energy (likened to body heat) in an area due to the introduction of an intruder. But early PIRs could be fooled, too. If part of a room was subjected to rapid changes in temperature, a PIR might interpret it as an intrusion.

Today's PIRs have eliminated this problem by using sophisticated circuitry that looks not only for a rapid change in temperature, but for a deliberate movement of that change across its field-of-view, thus representing intruder motion.

The most sophisticated detectors employ dual technology; that is they might combine the attributes of infrared detection with microwave detection.

The most sophisticated detectors employ dual technology; that is, they might combine the attributes of infrared detection with those of microwave detection. Unless both sensing elements were similarly violated at the same time, an alarm could never be processed. Thus, factors that could cause the microwave section of the unit to false alarm do not affect the infrared section and vice versa, but true motion during an intrusion would result in a bona fide alarm condition by affecting the microwave and PIR elements equally.

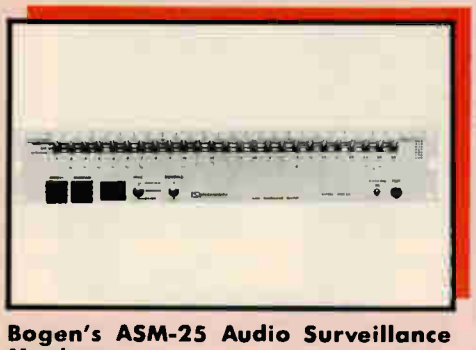
Other technical advances in detection and miniaturization have made the use of foil all but obsolete. Small piezoelectric sensors now stick directly onto glass and respond only to energy produced when glass breaks. Such units each protect over 100 square feet of glass and are often more cost effective than using foil which is labor intensive and requires periodic inspection and preventive maintenance. Additionally in this area, sound discriminators have found widespread use in glass break detection applications. Equipped with a small microphone, the unit continually receives sounds from the area. Those which have the characteristics of glass breaking will be processed; all others will be ignored.

Similarly, shock detection devices are now enjoying widespread use. Today's shock sensor is far different from its predecessor. Early units simply responded to excessive shock and vibration without being able to discriminate as to whether such interference was the result of an attempted break-in or due to extreme ambient conditions. Now, with new digital circuitry, each shock sensor in the system reports to an analyzer which can be preprogrammed to respond only to certain intensities and evaluate them over a period of time. Therefore, random shocks occurring without any specific pattern will be processed, but ignored by the system. Those that appear in a pattern, presumably representing an attempted break-in, are counted and compared to the parameters previously programmed. If the intensity and quantity of shocks meet the established criteria, then an alarm will result.

Wireless Systems

Perhaps the single most important development in the industry of late has been the introduction of wireless systems. Made possible by the microprocessor, wireless alarms do everything that their hardwired counterparts do and sometimes even more. Their value is most appreciated in the residential market where appearance is critical and the concealment of wires is often an arduous task. In such a system, each intrusion sensor is assigned its own transmitter which is quite small and mounted close by. A control panel monitors the transmissions which include all the necessary information relating to the status of any sensor in the system. Without wires, the problem of supervision is most acute.

If we were to depend upon these wireless transmitters only to report intrusions to the panel, there's no way to be absolutely certain that they would always



Bogen's ASM-25 Audio Surveillance Monitor.

VCS' A31000 Surveyor Alorm Control Package.

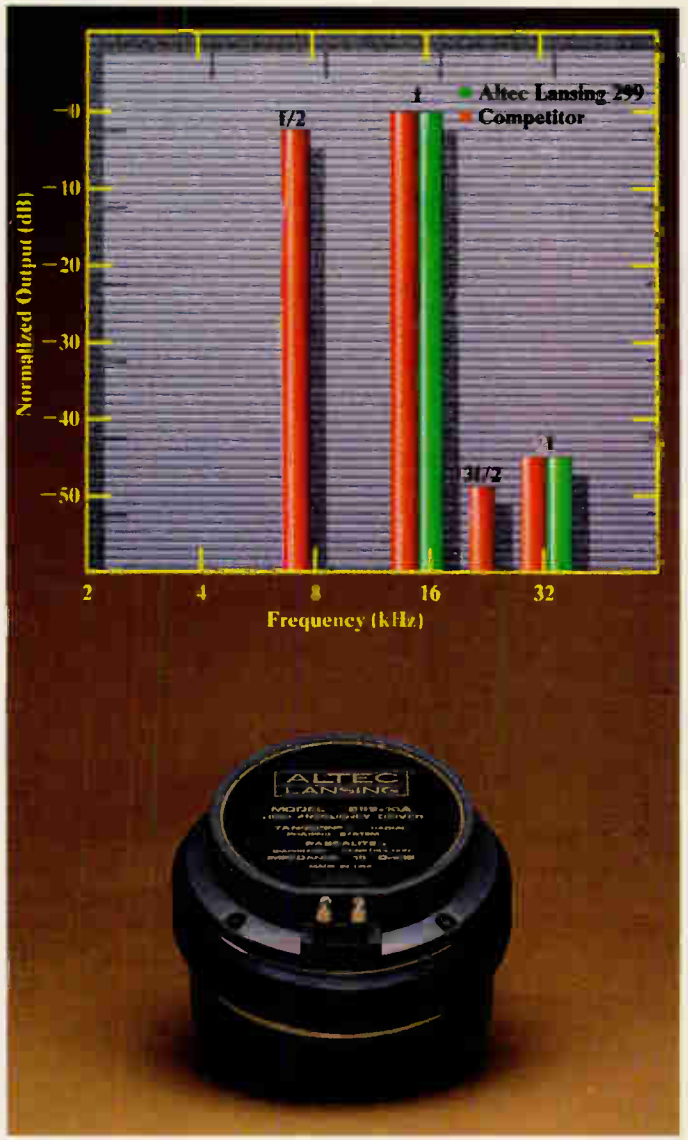
Electro-Voice's PA15B Wide Angle Reentrant Paging Projector used in alarm systems.

In compression drivers, less distortion equals more accurate sound. Theoretically, transducer sound outputs are an exact copy of their electrical inputs. In real-world compression drivers, distortion must be minimized to satisfy the critical listener. Careful design of the magnetic circuit, voice coil and suspension components helps to reduce non-linearities which cause production of upper harmonics, multiples of the fundamental frequency. Manufacturers' data sheets typically show the level of second and third harmonic components relative to the fundamental.

However, other types of distortions can have greater significance in speech and especially in music. Subharmonic distortion components at one half, one third, etc., of the fundamental frequency are of particular concern in the output of a compression driver. Although the second and third harmonics of the frequency range may be outside the audible spectrum, the second or third *subharmonics* are in the middle of the passband where the ear is most sensitive.

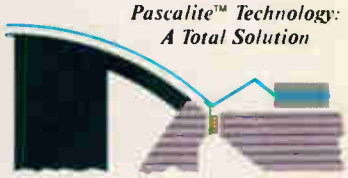
No compression driver diaphragm behaves as an ideal simple piston at all frequencies; some types of "break up" produce subharmonic distortion. At Altec Lansing we solved this problem in the **288 series** of compression drivers. This knowledge was applied in making the careful choices of diaphragm size and material for the Pascalite™ diaphragm assembly in the new model **299** compression driver.

The resulting engineering achievement makes the **299** equal in acoustic output to large format compression drivers using titanium diaphragms, while minimizing the problem of subharmonic distortion.



Fact.

Pascalite™ Technology: A Total Solution



- *High Strength Aluminum Alloy*
- *Aramid Fiber Voice Coil Support*

2.8" Diameter Voice Coil and Diaphragm Assembled with State-Of-The-Art Adhesive in Cutaway One-Half View Mounted in Driver

This graph, based on extensive Altec Lansing research with TEF® analysis, shows the output of a competitor's compression driver with a four-inch diameter titanium diaphragm when driven at 15.5 kHz with a modest input power level of one watt. It also shows the output of the Altec Lansing **299** Pascalite™ diaphragm driver at the same power level. The horizontal axis is frequency, while the vertical axis shows the relative amplitude of the output. At one half the fundamental frequency, the output of the competitor's driver is louder than any of its upper harmonics. This kind of spurious midband tone makes "S" sound like "SHH" and blurs musical definition. *The graph shows the subharmonic content of the Altec Lansing model 299 driver to be virtually unmeasurable.*

The benefit of lower total distortion in a compression driver is more accurate sound, and more satisfied customers and audiences.

In Compression Drivers,
Less Distortion = More Accurate Sound

ALTEC LANSING®

P.O. Box 26105 · Oklahoma City, Oklahoma 73126-0105 USA · 405-324-5311 · Telex 160-369

Circle 207 on Reader Response Card

work. Here's where supervision comes in. Each transmitter, even when sitting idly, will transmit a status report at various intervals. This report will serve to identify the transmitter by number, state its function in the system (burglary, fire, medical, etc.), specify whether the attached sensor is violated or not, and report the condition of its internal battery. If the status report is not received within the appropriate time interval, the control panel issues a trouble signal which may be audible at the premises and may be relayed to the central station where a responsible party (i.e., the installation company) will investigate.

Alarm systems are far more varied and complex than can possibly be explained within the scope of this article. Suffice it to say that more information can be obtained by visiting any of the security trade shows that occur often during the year. Manufacturers of security products may offer introductory seminars providing the uninitiated with much useful information and a chance to expand business opportunities through the use of security products. The security business is an exciting, growing industry which ought not be overlooked when appoaching new markets. ■

Howard Friedman began his career in the security industry as a seminar instructor for a leading equipment manufacturer and has since served as a consultant to many large dealerships throughout the country. He has lectured on various occasions at national trade exhibitions. In 1986, he completed a 32-lesson video-taped installation program for the alarm dealer. Currently, Friedman is serving as field consultant to AT&T.

Setting Standards for the Alarm Industry

The security industry, like other industries, has over the years been interested in increasing its own professionalism, heightening its standards, and regulating itself. There are several organizations which help to achieve this end. Probably the best among them is Underwriters Laboratories (U.L.) which was started in 1894 at the request of insurance companies to test various products for electrical and fire hazards. UL's relationship to the alarm industry was similarly initiated in 1924 by insurance companies who requested that a uniform set of equipment and installation standards be set so that burglar alarm systems installed in banks and certain commercial properties were known to have met acceptable minimum requirements judged to be essential in adequately protecting a mercantile premises. Today, any company which installs and maintains security systems can apply for investigation of their services. While such UL "listing" is optional, it is universally recognized by the industry and the end-user alike to be representative of high quality work under most trying circumstances. Today, there are many commercial applications which require a certifiable UL installation before the proprietor can be granted the insurance coverage he needs.

It is common to find the UL listing on smoke detectors and other fire prevention devices as well. As a result, many municipalities and state fire marshalls have required that such equipment be certified by UL before being legally installed in areas under their jurisdiction.

Perhaps the most impressive organization to take hold of the industry and to further pull it up "by its bootstraps" is S.E.I.A., the Security Equipment Industry Association. Chartered in 1971, SEIA is the only nationwide professional association for manufacturers and distributors of security products and services. Members of SEIA have worked to promote and spread professionalism in the industry and currently the organization enjoys the affiliation of more than 100 member companies throughout the United States.

SEIA sponsors educational programs designed to improve all aspects of conducting business in the area of security. It seeks to establish industry-wide standards to improve the products and services associated with the field. SEIA also makes possible the largest of the security trade shows, the International Security Conference (ISC) which is held four times each year in major cities throughout the country. A highlight of these shows is the College of New Products which is a multi-media presentation reflecting the latest and most significant of the technical advances in the industry.

One outgrowth of the influence that SEIA wields in the alarm industry is the presence of the American Security and Fire Museum, a mobile display of rare and historic equipment found in the colorful history of the security business.

Finally, SEIA's strategy also intends to cast itself as the "voice of the industry" aimed at educating the consumer about the alarm business. SEIA headquarters are in California at: 2800 28 Street, Suite 124, Santa Monica, CA 90405.

Wheelock's Series 40 Strobe Bell.

MG Electronics' SSP-3 Super Siren.

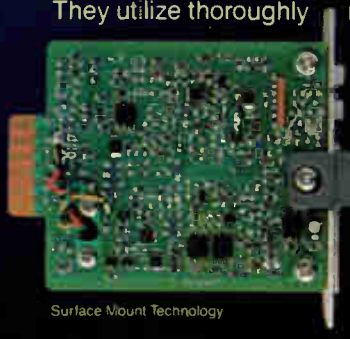
Elenex's Secur-Net System includes a remote alarm and display panel, a computer and printer.

TOA'S WINNING HAND

THE NEW 900 SERIES PLUG-IN MODULES

Toa introduces 7 new fabulous hi-tech modules that perform wonders when incorporated into Sound Reinforcement Systems utilizing 900 Series amplifiers. The new additions to the 900 Series plug-in modules offer Voice Gate, Variable Muting, Mic and Aux Compressor features and allow the sound contractor or specifying engineer to choose from a total of 36 modules in six different categories. These modules have been designed with Toa's "install and forget" philosophy. They utilize thoroughly modern surface mount technology, provide ease of installation and increased reliability.

You can have complete confidence when specifying or installing Toa 900 Series Sound Reinforcement Products.



Surface Mount Technology

TOA's New Modules for The 900 Series

M-51 Voice Gate Module / M-61 Mic Compressor Module / U-12 Variable Mute Module / U-61 Compressor Module / T-02 Music-On-Hold Module / M-11 Precedence Mute Module / U-21 Remote or Remote Master Volume Module

TOA 900 SERIES

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TOA

Circle 216 on Reader Response Card

250 Hz to 4000 Hz, :8 at 40 Hz and moving to .2 at 10 kHz. The speakers are raised and mounted approximately on axis to the listener, volume is adjusted to compensate for different sensitivities, and the listener then rates the speakers by means of a continuum of values, based principally on Gabrielsson's earlier work. (JAES Vol. 35, No. 1 & 2):

Clarity	Softness
Fullness	Brightness
Spaciousness	Presence
Distorsions	Loudness
Pleasantness	Fidelity

The types of recorded music used were predominantly classical, although some jazz and rock music was included. Listeners were chosen based on experience with audio and with critical listening.

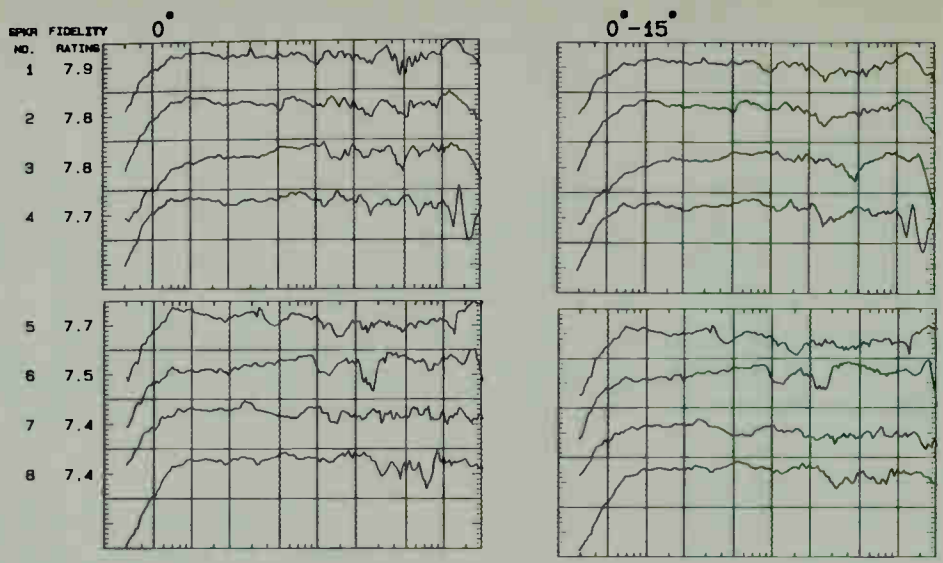


Figure 2
Amplitude Response Comparison and Orientation Response Comparison

Objective Tests

In order to derive the objective data for comparison to his subjective quality tests, Toole has developed a specific test procedure. For his frequency response measurements, a pure tone produced by a programmable oscillator is stepped through 200 frequencies uniformly spaced on the 20-20,000 Hz logrithmic scale. Measurements are made on axis and up to 90 degrees off axis, via the use of an Amber analyzer and a computer.

An attempt has been made to correlate the test data developed with the earlier rating scales developed by the listener tests, based on the assumption that a 5 percent change in scale rating established a significant difference and therefore a group for the basis for sorting loudspeakers. For the purposes of this test, loudspeakers are given "fidelity ratings" from the earlier subjective tests, and a visual correlation to the frequency response data from the objective tests has been attempted. Some of the objective speaker response plots (anechoic) are shown.

Toole concludes his study by noting that there is a very strong correlation between the frequency response information and the subjective testing, in that most of the better speakers in the listening tests had clearly smooth and nominally flat responses, and as the response on and off axis became less flat, the perceived quality of the loudspeaker decreased. While his correlation with the anechoic data seems well established, the correlation between the listening room measurements and the subjective data is less well presented, in that far fewer measurements are taken. **(See Figure 3.)**

Toole summarizes his data in stating: "Listeners, it seems, like the sound of loudspeakers with a flat, smooth wideband on-axis response that is maintained at substantial angles off-axis. If this is achieved, the loudspeakers will exhibit smooth (but not flat) sound power responses and directivity indices. The phase responses will also tend to be smooth, but not of any particular shape." (JAES Vol. 34, No. 5, May 1986-p. 335).

In his summary of this recent work, Toole notes that free field loudspeaker tests are correlated to listening room subjective evaluations; time domain analysis offers further ability to study this correlation; listening room tests are far less precise than anechoic tests; and tests using acoustical manikins may well be more easily applied to listening room measurements.

There are a number of new time-domain measurement systems recently introduced to the market, including the Bruel and Kjaer and Techron time delay spectrometry units, and these will further enhance study of audio quality undertaken here.

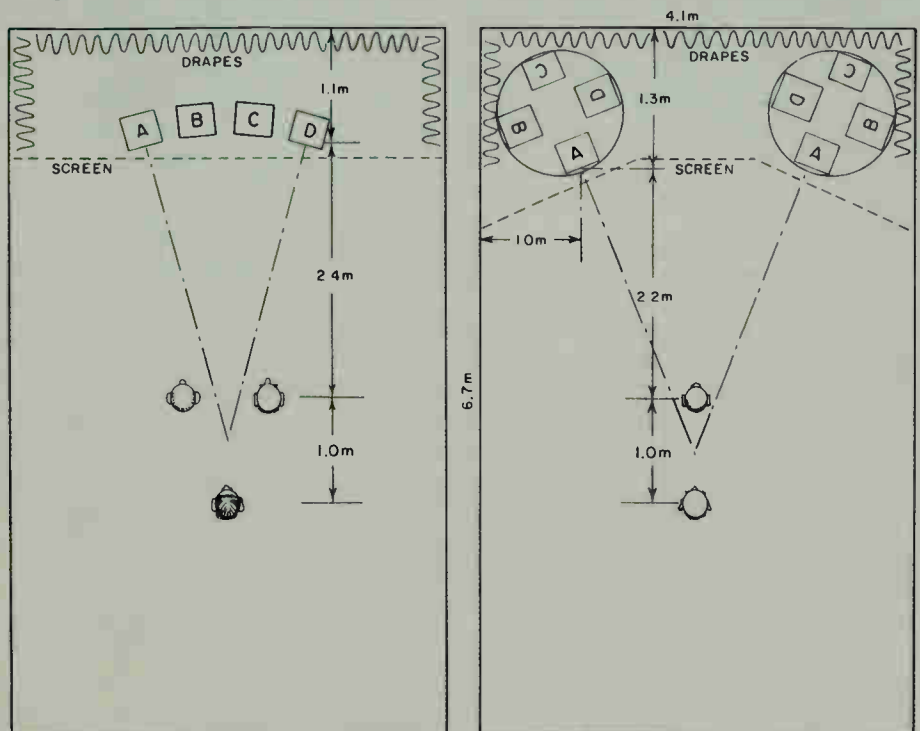


Figure 1a & 1b

Large Room Acoustics

While Toole is interested in small room audio environments, there is a similar question of performance quality in larger rooms, both on-system and without reinforcement. While small rooms create disturbances that are often too subtle for the untrained listener to detect, large

room anomalies can be far more obvious in the evaluation of the quality of speech or music.

Some time ago, Leo Beranek of Bolt Beranek and Newman, Inc. authored a book entitled Music Acoustics and Architecture, which recorded the study of over 50 concert halls for the purpose of establishing acoustical quality comparisons in this type of design. As part of this study, he established a 100 point rating scale that provided points for quality design aspects and subtractions for problematic features. This study established the ongoing controversy over roomshape in acoustical design. Beranek found that among the most highly rated halls, most were in the classical "shoebox" configuration; additionally, he found that only one "shoebox" hall was not highly rated. In his study, Beranek used certain criteria. **(See Figure 4.)**

Since this study, there has been much additional study of the qualities inherent in large room acoustics, but there has been little measurement of psycho-acoustic quality on a broad scale. J.S. Bradley of the National Research Council has been working with an acoustical test equipment company, Norwegian Electronics, on a system for this type of evaluation, based on their dual channel real-time analyzer used to evaluate the impulse response of a pistol shot.

In a number of recent papers in the Journal of the Acoustical Society of America, Bradley discusses the uses of these tests. (JASA July 1986, PP 199-205: JASA December 1986, PP. 837-845.) He further discusses them in three papers given at ASA conventions (Dec 1986, May 1987) and are as yet unpublished. While these standards were not developed by Bradley, he is instrumental in providing a clear explanation of them and in writing a set of software that is the first of its type in providing quick ease of evaluation for rooms. The specific parameters that he incorporates in this software and their intended correlation are:

C 80 Early-to-Late Ratio . . . . . Clarity/Definition

TS Center Time . . . . . Clarity/Definition

G Reference Energy Ration[1] . . . . . Strength of Sound Field

LF Lateral Fraction . . . . . Spatial Impression

U 80 Useful to Detrimental Ratio . . . Speech Intelligibility

EDT Early Decay Time . . . . . Reverberation

([1]author's term)

All of these parameters are measured and calculated in tabular form. **(See Figure 5.)**

The testing is accomplished via the use of a specially calibrated .38 caliber blank pistol which fires black powder cartridges. This is selected in lieu of a loudspeaker due to the omnidirectional characteristic of the pistol in most frequencies. Four pulse responses are ensemble averaged by the analyzer, and the average response is transfered to an MS-DOS computer; the computer then calculates 12 acoustical quantities in 6 octave bands from 125 Hz to 4000 Hz. This calculation takes about seven seconds to complete. With this simple procedure, measurements can be made at various locations throughout the room in question, and these measurements can then be compared with reference standards, can

(continued on page 46)

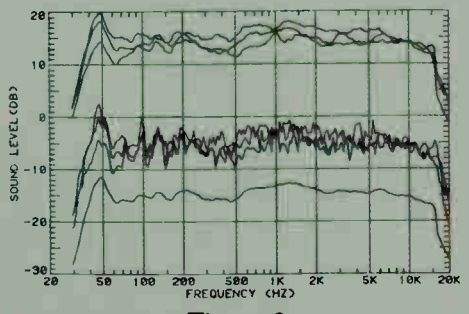


Figure 3
Listening Room Amplitude Response Tests

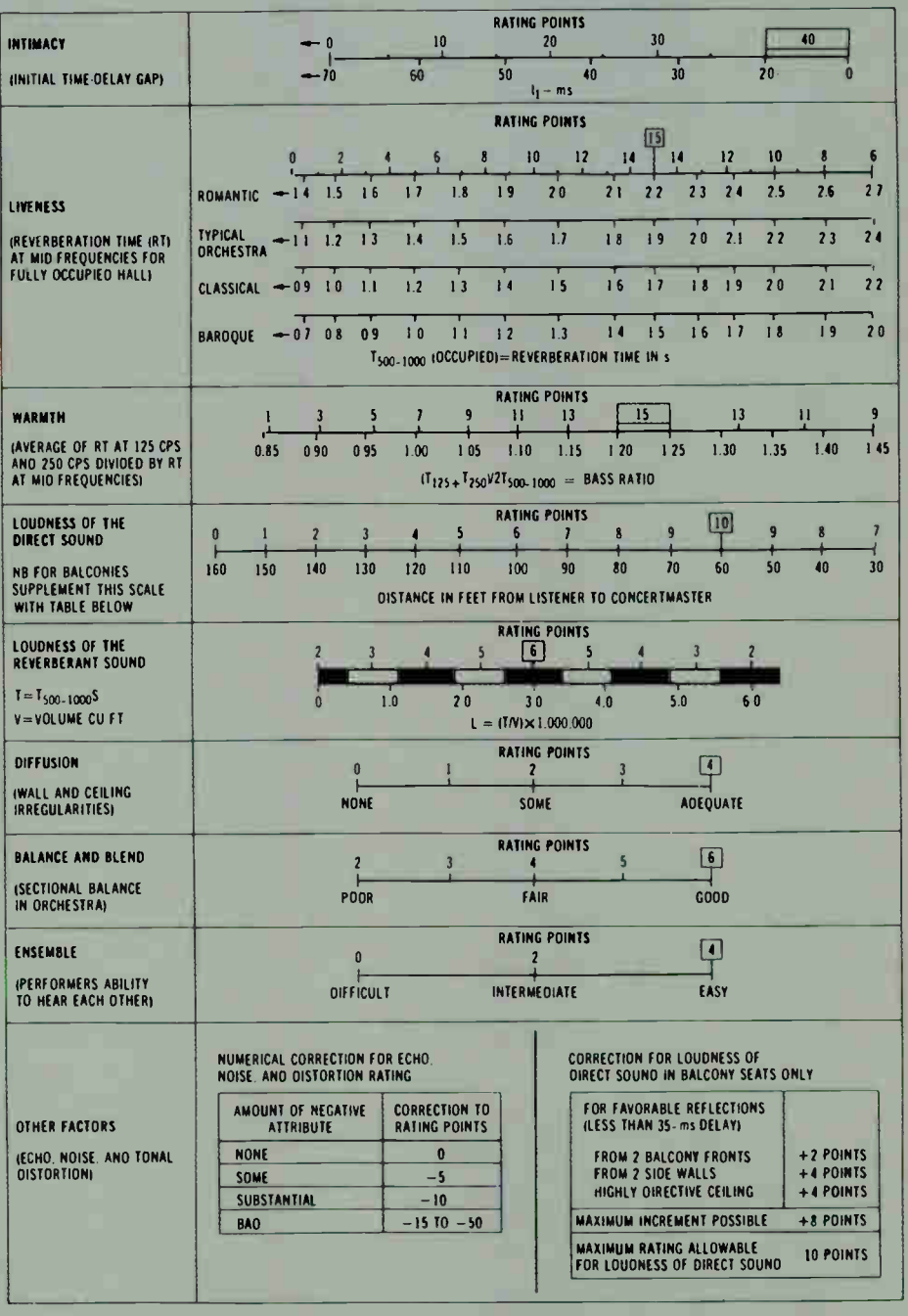


Figure 4
Beranek's Large Room Acoustical Criteria

LOUDSPEAKERS

Part II

Loudspeaker specification is about one of the hardest things to qualify due to subjective factors. Also, standards are not agreed upon across the board—while some do exist. With so many types of loudspeakers on the market, it becomes difficult to select the right one for the job at hand.

Sound & Communications magazine reviewed the many available types and came up with six categories. The first two, **Background/Foreground** and **Integrated & Portable Systems**, were included in the November issue. This month we'll cover **Direct Radiator, Compression Drivers & Tweeters, Horns, & Paging Horns**.

This guide is not intended to be an all inclusive or decisive source. It is, however, intended to be used as a *guide* in selecting an appropriate group from which a final decision can be made. After using this guide, the manufacturers' specifications sheets should be reviewed, and if appropriate should be tested and/or auditioned.

Every attempt was made to make this guide as complete and accurate as possible. However, the editors cannot be held responsible for any errors and/or omissions in the listings.

DIRECT RADIATOR

Model	Size	Axial Sensitivity/ 1 watt-1 meter	Nominal Impedance	Maximum Power	Frequency Range	Recommended Enclosure Volume	Weight	List Price
ALTEC LANSING CORP.								
8124 w/3124	30" x 19" x 14¾"	92	8Ω	250 w	>40	3	60.5	$592.00
8127 w/3127	19" x 16" x 14¾"	97	8Ω	250 w	>70	1.5	42	516.00
8154 w/3154	36" x 30" x 14¾"	94	8Ω	250 w	>40	6	90	744.00
8156 w/3156	30" x 19" x 14¾"	99	8Ω	250 w	>65	3	61.5	612.00
8227 w/3127	19" x 16" x 14¾"	100	4Ω	500 w	>70	1.5	42	828.00
8256 w/3156	36" x 30" x 14¾"	102	4Ω	500 w	>65	6	106	1000.00
BAG END LOUDSPEAKERS								
E-5	5"	95	8Ω	100 w	800-10k	0.2	—	$45.00
E-12	12"	103	8Ω	400 w	45-5.5k	2.5	24	160.00
E-15	15"	101	8Ω	400 w	—	5.2	25	180.00
E-18	18"	100	8Ω	600 w	25-3k	6.4	26	280.00
BOGEN COMMUNICATIONS, INC.								
TB2S	8"cone,3⅛" 2-way Ampl.	93	600Ω	1.5 w	Max intelligibility	—	2	$201.25
AS1	8"cone, 3⅛" 1-way Ampl	92	600Ω	1 w	100-10k	—	2	43.15
S810T725	8"cone,3⅜" plus xformer	96	8Ω	15 w	70-15k	—	50	22.40
S86T725	8"cone,3⅛" plus xformer	95	8Ω	7 w	50-12k	—	48	18.75
S810	8"cone,3⅛"	96	8Ω	15 w	70-15k	—	44	15.90
S86	8"cone,3⅛"	95	8Ω	7 w	50-12k	—	40	12.25
BOZAK, INC								
CM-199	12"	95	8/16Ω	250	16-800	4	9	$159.00
CM-800	8"	92	8/16Ω	200	28-20k	2	8	119.00
CM-209W	6"	89	8/16Ω	100	45-5000	1	7	119.00
CM-209	6"	90	8/16Ω	100	80-10k	2	7	109.00
CM-450	4"	89	16/8/4Ω	50	125-15k	—	2	55.00
CM-200	2"	89	16/8/4Ω	25	1 k-20 k	—	2	45.00
CELESTION INDUSTRIES, INC.								
B18-1000	18"	99	8Ω	1000 w	35-300	—	33	$730.00
B15-600	15"	99	8Ω	600 w	45-500	—	30	600.00
S12-150CE	12"	102	8Ω	150 w	65-6 k	—	11.6	184.00
CETEC GAUSS								
4583B	18"	96	8Ω	800 w	25-800	9	25½	380.00
3880	18"	101	8Ω	400 w	35-1500	4	19¼	295.00
4583A	15"	97	8Ω	800 w	35-800	5	25	295.00
4580	15"	98	8Ω	800 w	40-1200	4	25	295.00
4582	15"	100	8Ω	800 w	45-1200	4	25	295.00
4243	12"	95	8Ω	800 w	40-1500	2	23½	265.00
4280	12"	97	8Ω	800 w	50-1500	3	23½	265.00
3580	15"	101	8Ω	400 w	35-1200	3	18¼	235.00
3280	12"	97	8Ω	300 w	60-2500	2	17¼	215.00
3184B	10"	96	8Ω	150 w	60-3000	1.5	15½	205.00

Model	Size	Axial Sensitivity/ 1 watt-1 meter	Nominal Impedance	Maximum Power	Frequency Range	Recommended Enclosure Volume	Weight	List Price
EASTERN ACOUSTICS WORKS								
L10/561	10"	98	8Ω	250 w	60-4 k	—	—	$115.00
L10/750	10"	101	8Ω	350 w	70-4 k	—	—	160.00
L12/854K	12"	100	8Ω	350 w	45-2 k	—	—	155.00
I12/P11W	12"	101	8Ω	400 w	60-4 k	—	—	225.00
L12/P400	12"	95	8Ω	500 w	30-2 k	—	—	205.00
L15/864K	15"	101	8Ω	450 w	45-2 k	—	—	210.00
L15/542K	15"	98	8Ω	500 w	30-2 k	—	—	208.00
L15/554K	15"	101	8Ω	500 w	40-1.5 k	—	—	255.00
L15/9200K	15"	95	8Ω	800 w	20-1.5 k	—	—	270.00
L18/851K	18"	99	8 or 16Ω	1000 w	25-1 k	—	—	335.00
ELECTRO-VOICE, INC.								
DL10X	10.2" x 5.5"	98	8Ω	300 w	100-2.5 k	0.4-0.8	18	$204.00
DL12X	12.2" x 6"	98	8Ω	300 w	80-2 k	1.3-2.6	18	244.80
DL15X	15.1" x 7"	100	8Ω	400 w	45-1.5 k	3.2-6.4	20	270.00
DL18X	18.1" x 8"	97	8Ω	400 w	40-1 k	7.1-13	21	426.00
DL18W	18.1" x 8"	97	8Ω	400 w	34-3.2 k	7.1-13	21	426.00
DL15W	15.13" x 7"	102	8Ω	400 w	45-3.2 k	3.2-6.4	20	270.00
EVX-150	15.3" x 6.6"	98	8Ω	600 w	40-1 k	3.5-6.5	22	258.00
EVX-156	15.3 x 6.6	98	8Ω	600 w	40-1 k	3.5-6.5	22	258.00
EVX-180	18.1" x 7.8"	96	8Ω	600 w	35-800	8-13	25	438.00
EVX-184	18.1" x 7.8"	96	8Ω	600 w	35-800	8-13	25	438.00
EVX-1500	15.3" x 7.4"	95	8Ω	850 w	30-500	3.5-6.5	30.5	417.60
EVX-1800	18.3" x 8.3"	95	8Ω	850 w	20-200	8-13	31	417.60
EMILAR								
EL-15D	15"	101	4, 8, or 16Ω	600 w	20-1500	3-5	29	$250.00
EL-15B	15"	101	4, 8, or 16Ω	600 w	20-1500	3-5	29	250.00
EL-15J	15"	102	4, 8, or 16Ω	500 w	20-2000	4	29	250.00
EL-15R	15"	102	4, 8, or 16Ω	400 w	20-2200	3-5	23	240.00
EL-12D	12"	100	4, 8, or 16Ω	400 w	20-1500	1.5-2	20	220.00
EL-12B	12"	100	4, 8, or 16Ω	400 w	20-1500	1.5-2	20	220.00
EL-12J	12"	100.5	4, 8, or 16Ω	300 w	20-3000	1.5-2	20	220.00
EL-10J	10"	100.5	4, 8, or 16Ω	300 w	40-5000	0.8-1.5	18	200.00
FOSTEX CORP. OF AMERICA								
L-363	12"	98	8Ω	800 w	55-5 k	1-3.5'	25.3	$285.00
L-467	15"	100	8Ω	600 w	40-3.5 k	7-11'	30.7	210.00
L-469	15"	97	8Ω	800 w	30-7 k	7-11'	20.7	220.00
L-569	18"	99	8Ω	1000 w	30-2k	7-11'	26.8	350.00
L-869	30"	100	8Ω	600 w	15-2 k	21+'	45.1	995.00
FOURJAY INDUSTRIES, INC.								
Q58H10	5" (127 mm)	93	8Ω	10 w	60-18 k	—	10 oz. ceramic	$18.15
Q88D5	8" (203 mm)	96	8Ω	10 w	50-12 k	—	5 oz. ceramic	12.40
Q845D5	8" (203 mm)	96	8Ω	10 w	50-12 k	—	5 oz. ceramic	13.00
JBL PROFESSIONAL								
E145	15"	100	8Ω	300 w	35-2.5 k	—	28.6	$249.00
E155	18"	100	8 or 16Ω	600 w	30-2 k	—	26.2	348.00
G791	—	106	8Ω	400 w	1.5-17 k	—	10	225.00
G125-8	12"	102	8Ω	200 w	60-7 k	—	12.1	165.00
G135A-8	15"	102	8Ω	200 w	40-6 k	—	13	177.00
2118H/J	8"	97	H-8Ω, J-16Ω	200 w	70-7 k	.5-1	8.6	105.00
2123H	10"	101	8Ω	250 w	80-6 k	.25-.5	11.9	159.00

Model	Size	Axial Sensitivity/ 1 watt-1 meter	Nominal Impedance	Maximum Power	Frequency Range	Recommended Enclosure Volume	Weight	List Price
2202H	12"	99	8Ω	300 w	60-4 k	2-4	20.7	198.00
2204H	12"	95	8Ω	350 w	35-4 k	1-4	20.7	198.00
2220H/J	15"	102	H-8Ω, J-16Ω	200 w	40-2 k	3-10	22.9	210.00
2235H	15"	93	8Ω	300 w	20-2 k	3-10	22.2	225.00
2240G/H	18"	98	H-8Ω, G-16Ω	600 w	30-2 k	4.9-12	29.9	348.00
2245H	18"	95	8Ω	600 w	20-2 k	8-16	29.9	348.00
E110	10"	103	8Ω	150 w	60-8 k	—	11.9	159.00
E120	12"	103	8 or 16Ω	300 w	50-6 k	—	20.9	198.00
E130	15"	105	8Ω	300 w	50-6 k	—	22.2	210.00
E140	15"	100	8Ω	400 w	40-2.5 k	—	22.2	210.00
MISCO/MINNEAPOLIS SPEAKER CO.								
PC120PA	12"	99	8Ω	100 w	35-15 k	2-3	7.125	$80.83
LC120PA	12"	99	8Ω	50 w	35-15 k	2-3	5.75	68.25
JC80WP	8"	93	8Ω	30 w	50-18 k	1-2.5	2.125	28.96
JC80F	8"	94	8Ω	30 w	35-18 k	1-2.5	2.125	27.54
JC80PA	8"	97	8Ω	30 w	45-18 k	1-2.5	2.125	26.10
JC8WP	8"	93	8Ω	30 w	50-8 k	1-2.5	2.125	17.92
JC8FD	8"	94	8Ω	30 w	35-14 k	1-2.5	2.125	15.35
JC8PA	8"	97	8Ω	30 w	40-14 k	1-2.5	2.125	13.71
FC8PA	8"	95	8Ω	24 w	55-13 k	1-2.5	1.75	12.15
JC5FD	4"	93	8Ω	30 w	45-12 k	.33-1.25	1.75	13.32
JC5WP	4"	95	8Ω	30	120-8 k	.33-1.25	1.75	11.92
MOTOROLA, INC./CERAMIC PRODUCTS								
KZN1039A	3.75" x .75"	89	275Ω @ 5 k	75 w (8Ω ref)	3 k-20 k	N/A	1.1 oz.	at 1 k $2.50
KSN1036A	3.75" x .75"	89	275Ω @ 5 k	75 w (8Ω ref)	3 k-20 k	N/A	1 oz.	2.35
KSN1023A	2" dia. stud	89	300Ω @ 5 k	50 w (8Ω ref)	4 k-50 k	N/A	.4 oz.	1.51
KSN1020A	2" dia. x .725"	89	300Ω @ 5 k	50 w (8Ω ref)	4 k-50 k	N/A	.4 oz.	1.43
KSN1076A	1.5" stud	88	300Ω @ 2 k	50 w (8Ω ref)	6 k-50 k	N/A	.4 oz	1.36
KSN1101A	1.5"/.50"	88	300Ω @ 5 k	50 w (8Ω ref)	6 k-50 k	N/A	.2 oz.	1.36
PEAVEY ELECTRONICS CORP.								
1505-8 BW	15"	103.5	8Ω	500 w	60-5 k	—	21	$155.00
1201-8 BW	12"	103	8Ω	500 w	130-6 k	—	20	145.00
SP-15825	15"	100	8Ω	300 w	40-5 k	—	15	99.98
POLY-PLANAR INC.								
P40	12" x 15"	85	8Ω	25 w	40-20 k	—	1.2	$34.95
RP8	8" Diameter	90	8Ω	20 w	60-18 k	—	.69	24.95
RP6	5¼" Diameter	85	8Ω	20 w	85-20 k	—	.5	24.95
P5	4½" x 9½"	80	8Ω	20 w	60-20 k	—	.6	26.95
PROFESSIONAL AUDIO SYSTEMS (PAS)								
ER1880C	18"	102	8Ω	200 w	40-3.5 k	—	31	$288.00
ER1580C	15"	103	8Ω	200 w	35-5 k	—	27	197.00
G1280C	12"	102	8Ω	200 w	60-5 k	—	26	184.00
MB1080C	10"	99	8Ω	150 w	80-5 k	—	26	174.00
CX1580C	15"/1" Co-ax	103	8Ω	200 w	30-20 k	—	27	228.00
CX1280C	12"/1" Co-ax	102	8Ω	200 w	40-20 k	—	26	210.00
RENKUS-HEINZ, INC.								
SSL18-1P	18"	102	8Ω	300 w	35-3.5 k	—	33	$360.00
SSL15-1	15"	104	8Ω	200 w	40-4 k	—	21	252.00
SSL12-1	12"	103	8Ω	200 w	50-5 k	—	14	232.00

Model	Size	Axial Sensitivity/ 1 watt-1 meter	Nominal Impedance	Maximum Power	Frequency Range	Recommended Enclosure Volume	Weight	List Price
ROSS SYSTEMS-DIVISION OF INTERNATIONAL MUSIC CO.								
LF18-8	18"	97	8Ω	250 w	30-1.2 k	4	—	$218.72
LF18-4	18"	99	4Ω	250 w	30-1.2 k	4	—	224.64
LF15	15"	99	8Ω	250 w	40-3 k	3	—	150.08
MF08	8"	100	4Ω	100 w	200-4 k	.25	—	52.64
PRO15	15"	98	8Ω	150 w	50-3 k	3	—	85.68
PRO12	12"	97	8Ω	100 w	55-4 k	2	—	60.56
SOUND PRODUCTS/3M								
S8-CX70	8"	91	70 v	10 w	70-10k	—	2.5	$21.00
TECHNICAL AUDIO DEVICES (TAD) DIVISION OF PIONEER ELECTRONICS (USA), INC.								
TL-1601A	15¾" x 6½"	97	8Ω	300 w	28-1 k	22-Sealed	24.25	$400.00
TL-1602	15¾" x 6½"	100	8Ω	300 w	21-2 k	22-Sealed	24.25	400.00
TL-1603	15¾" x 5¾"	97	8Ω	500 w	28-1 k	22-Sea;ed	20.94	360.00
TM-1201	12½" x 4¼"	100	8Ω	300 w	200-3 k	22-Sealed	23.75	350.00
UNIVERSITY SOUND								
30 W	30" Woofer	103	8Ω	60 w	15-100	>22	51	$540.00
5P12C	12"	100	8Ω	35 w	37-10 k	5.5	12	72.00
SP8C	8"	95	8Ω	25 w	41-12 k	1.2	8	64.00
MC12A	12"	97	8Ω	20 w	32-11 k	6	6	53.00
MC8A	8"	97	8Ω	12 w	43-20 k	2.4	5	76.00
CS810	8"	94	8Ω	10 w	80-15 k	>1	3	12.25
CS410	4"	91	8Ω	10 w	90-18 k	>1	2.5	11.90

COMPRESSION DRIVERS & TWEETERS

Model	Throat Size	Axial Sens./1w-1m on 90x40 horn	Nominal Impedance	Maximum Power	Frequency Range	Recommended Crossover Point	Dimensions	Weight	List Price
ALTEC LANSING CORP.									
288-8/16L	1.4"	112	8/16Ω	20 w	500-15 k	500	7⅝" x 5⅞"	30.5	$664.00
290-8L/16L	1.4"	110	8/16Ω	120 w	300-9 k	300	7¾" x 8½"	32	692.00
291-8L/16L	1.4"	111	8/16Ω	50 w	500-13 k	500	7¾" x 5⅞"	30.4	620.00
902-8B	1"	106	3Ω	15 w	500-20 k	500	5½" x 2⅝"	6.4	292.00
906-8A	1.4"	111	8Ω	40 w	500-13 k	500	7½" x 3½"	14.8	376.00
908-8B	1"	106	8Ω	30 w	500-20 k	500	5½" x 2⅝"	6.4	292.00
ATLAS/SOUNDOLIER									
PD-60T	1⅜"/18	—	70 v	60 w	70-12,000	—	6⅜" x 6⅞"	9.0	$184.93
PD-5VT	1⅜"/18	—	70 v	40 w	80-12,000	—	6⅜" x 6⅞"	7.0	167.38
PD-60	1⅜"/18	—	16Ω	60 w	70-12,000	—	6⅜" x 6⅞"	7.0	150.15
PD-30	1⅜"/18	—	8Ω	30 w	120-14,000	—	4½" x 4½"	3.5	91.05
PD-20	1⅜"/18	—	16Ω	20 w	120-7000	—	3½" x 2⅞"	2.5	79.83
PD-MR	1⅜"/18	—	16Ω	40 w	400-6000	—	4⅝" x 2⅜"	5.0	65.95
BAG END LOUDSPEAKERS									
E-350	—	103	8Ω	60 w	3.5k-19k	3.5k	6 x 4"	3	$100.00

Model	Throat-Size	Axial Sens./1w-1m on 90x40 horn	Nominal Impedance	Maximum Power	Frequency Range	Recommended Crossover Point	Dimensions	Weight	List Price
BOGEN COMMUNICATIONS, INC.									
DR30TA	1⅜"	—			120-14K	—	4⅝" x 5¼"	5	$118.90
CELESTION INDUSTRIES, INC.									
HF-50	—	102	8Ω	25 w	2 k-16 k	3 k	—	2.6	$72.00
CETEC GAUSS									
4080	2"	113	8Ω	80 w	500-15 k	500	9¼" x 5¾"	34	$455.00
4081	2"	113	8Ω	200 w	300-12 k	500	9¼" x 5¾"	34	455.00
2080	1"	112	8Ω	50 w	800-18 k	800	6⅞" x 3⅞"	15.5	300.00
2081	1"	112	8Ω	80 w	500-15 k	500	6⅞" x 3⅞"	15.5	300.00
1502	—	111	8Ω	60 w	3 k-20 k	3000	6" x 5"	8	245.00
COMMUNITY LIGHT & SOUND, INC.									
M4	4"	109.5	8Ω	500 w	200-4 k	200, 2 k	13" x 9⅜"	41	$1164.00
M200	2"	108.5	8Ω	200 w	400-4 k	350	5.54" x 2.23"	7.25	145.00
EASTERN ACOUSTICS WORKS									
N980	2"	110	8Ω	250 w	500-18 k	500	—	—	$385.00
N681	1"	108	8Ω	150 w	800-20 k	800	—	—	208.00
N482	1"	107	8Ω	150 w	800-19 k	1000	—	—	170.00
N481	1"	106	8Ω	150 w	800-17 k	800	—	—	135.00
N280	Screw-on	105	8Ω	120 w	1000-15 k	1000	—	—	75.00
TW101	Screw-on	107	8Ω	160 w	800-12 k	500	—	—	105.00
N252	Tweeter	104	8Ω	150 w	2.5-20 k	3000	—	—	75.00
ELECTRO-VOICE, INC.									
DH1A	2"	110	8Ω	75 w	500-20 k	500	8.9" x 5.5"	23.5	$444.00
DH2	2"	110	8Ω	60 w	800-20 k	800	6.75" x 7.38"	14	349.20
DH2012	1.3"	111	8Ω	50 w	500-15 k	500	—	16	386.40
DH1506	1"	110	8Ω	30 w	500-20 k	800	6.125" x 3.875"	13	285.00
DH3	1"	112	8Ω	30 w	1.5-20 k	5 k	4.8" x 3.5"	4.2	132.00
DH1A-16	2"	110	16Ω	75 w	500-20 k	500	8.9" x 505"	23.5	444.00
DH2MT	1.375"	111	8Ω	60 w	500-20 k	800	3.5" x 6.75"	11	288.00
DH2/4MT	2"	111	8Ω	240 w	500-20 k	800	11.5" x 9.4"	47.5	1152.00
DH3/4MT	2"	110	8Ω	120 w	1.5-20 k	5k	10" x 6.6"	21.5	528.00
ST350B	—	101	8Ω	5 w	3-16 k	3 k	6" x 5" x 4.6"	2.63	129.60
T35A	—	104	8Ω	5 w	3.5-16 k	3.5 k	2" x 5.25" x 2.35"	1.89	94.80
EMILAR									
EC-600	3.2"	113	4 or 8Ω	500 w	150-8 k	150-200	10.2" x 3.31"	26.5	$1300.00
EC-320B	2"	112	8 or 16Ω	120 w	500-25 k	500-800	6.875" x 2.625"	12	420.00
EC-320A	2"	112	8 or 16Ω	120 w	500-15 k	500-800	6.875" x 2.625"	12	420.00
EC-314B	1.4"	112	8 or 16Ω	120 w	500-25 k	500-800	6.875" x 2.625"	12.5	440.00
EC-314A	1.4"	112	8 or 16Ω	120 w	500-15 k	500-800	6.875" x 2.625"	12.5	440.00
EA-175B	1.0"	110	8 or 16Ω	100 w	500-15 k	500-800	5.0" x 4.0"	12..01	380.00
EK-175M	1.0"	109	8 or 16Ω	100 w	800-25 k	800	4.56" x 2.15"	6.0	220.00
FOSTEX CORP. OF AMERICA									
D-262	1"	104	8Ω	60 w	800-15 k	800	4.72" x 3.23"	5.1	$160.00
D-272	1"	106	8Ω	60 w	800-15 k	800	4.72" x 4.74"	9.6	275.00
D-502	2"	108	8Ω	80 w	500-10 k	500	7.1" x 5.6"	28.6	535.00
D-582	2"	107.5	8Ω	80 w	500-10 k	500	7.87" x 4.2"	20.3	350.00
T-845	1.5"	106	8Ω	40 w	2.5 k-18 k	3000	5" x 4.7"	4.4	145.00
T-945	1.57"	110	8 or 16Ω	40 w	2 k-18 k	3000	3.2" x 4.7"	4.4	145.00

Model	Throat Size	Axial Sens./1w-1m on 90x40 horn	Nominal Impedance	Maximum Power	Frequency Range	Recommended Crossover Point	Dimensions	Weight	List Price
JBL PROFESSIONAL									
2402H	3.1	110	8Ω	40 w	205-15 k	>2.5 k	4.8" x 3.9"	5	$165.00
2404H	—	105	7.2Ω	40 w	4-19 k	>3 k	5.1" x 5.1"	24.2	165.00
2405H	—	105	8Ω	40 w	6.5-21.5 k	>7 k	4 3/4" x 3 3/4"	5	165.00
2426H/J	1"/1 3/8" x 18	110	H-8Ω,J-16Ω	100 w	500-20 k	>800	5.9" x 4.1"	9.5	198.00
2427H/J	1"	110	H-8Ω,J-16Ω	100 w	500-20 k	>800	5.9" x 4.1"	9.5	249.00
2445J	2"	111	16Ω	150 w	500-20 k	>500	9.25" x 5.16"	30.4	375.00
2485J	2"	111	16Ω	120 w	300-6 k	>300	9.25" x 13"	30.4	399.00
2450H/J	2"	119	H-8Ω,J-16Ω	100 w	500-20 k	>500	6.5" x 5.125"	10.5	—
MOTOROLA, INC./CERAMIC PRODUCTS									
KSN1086A	1 3/8"/18	93	125Ω @ 1 k	50 w [1]	800-20 k	N/A	4" dia. x 3.5"	10 oz.	at 1k $15.34
KSN1087	1 3/8"/18	92	200Ω @ 1 k	75 w [1]	2 k-30 k	N/A	2.52" dia. x 2.79"	3.2 oz.	6.07
KSN1025	Contact Factory	92	200Ω @ 2 k	75 w [1]	2 k-30 k	N/A	7.38" x 3.16" x 4.25"	—	5.10
KSN1016	"	92	300Ω @ 5 k	75 w [1]	3 k-40 k	N/A	5.7" x 2.63" x 2.25"	—	3.90
KSN134A	Contact Factory	92	300Ω @ 5 k	75 w [1]	4 k-25 k	N/A	3.75" x 3.5" x 2.415"	2.4 oz.	8.45
KSN1056A	Contact Factory	92	300Ω @ 5 k	75 w [1]	4 k-27 k	N/A	3.75" x 2.375" x .375"	2.3 oz	3.00
[1] Referenced to 8Ω									
MTX LOUDSPEAKERS - THE MITEK GROUP									
CD60N8	1"	106	8Ω	100	—	2.5k-7.5k	—	—	129.95
EU714	1"	100	8Ω	100	2k-20 k	2.5k-7.5k	—	—	59.95
RFL410	1"	100	8Ω	50	800-16 k	—	—	4	59.95
RFL-T1	1.5"	107	8Ω	125	5k-20 k	—	—	4	119.95
OREVOX CORP.									
TD1001	.4"	92	6Ω	40 w	4-22 k	4 k	3.3" x .75"	.2	—
TD2004	.5"	92	8Ω	40 w	4-20 k	4 k	3.3" x .8"	.26	—
TH2004	.8"	94	8Ω	50 w	3-23 k	3 k	3.5" x 1.26"	.7	—
SDT2510	1"	94	8Ω	60 w	4-25 k	4 k	3.7" x 1.26"	1.2	—
M15011	1.5"	93	8Ω	50 w	.5-10 k	750 k	5.2" x 1.4"	2	—
	3"	94	8Ω	100 w	.5-10 k	500	6" x 2"	1.5	—
PASO SOUND PRODUCTS									
DU-20	1 3/18"	—	16Ω	20 w	100-12 k	—	3 3/4" x 2 3/14"	2	$72.00
DU-20T	1 3/18"	—	25/70 v	20 w	100-12 k	—	3 3/4" x 6"	3	116.00
DU-30	1 3/18"	—	16Ω	30 w	85-12 k	—	4 1/2" x 3"	3	94.00
DU-30T	1 3/18"	—	25/70 v	30 w	85-12k	—	4 1/2" x 5 1/4"	4	136.00
DU-60	1 3/18"	—	16Ω	60 w	70-12 k	—	4 3/4" x 3 1/4"	4	122.00
DU-60T	1 3/18"	—	25/70 v	60 w	70-12 k	—	4 3/4" x 6 1/2"	5	163.00
PEAVEY ELECTRONICS CORP.									
IIT-94 Super Tweeter	—	108	8Ω	60 w	5 k-20 k	>5 k	6" x 6" x 7 1/2"	6	129.50
22A	1"	116	8Ω	80 w	500-16 k	>500	5 1/4" x 3 1/4"	6.5	99.50
RENKUS-HEINZ, INC.									
SSD5600	2.4"	112	8Ω	400 w	250-4 k	—	10.4" x 4"	47	$1100.00
SSD3301	2"	110	8/16Ω	200 w	500-17 k	—	66.69" x 2.44"	8.5	460.00
SSD1801	1"	108	8/16Ω	90 w	500-2.2 k	—	5" x 1.875"	4.5	360.00
SSD1800	1"	108	8/16Ω	100 w	500-16 kl	—	5" x 1.875"	4.5	260.00

Model	Throat-Size	Axial Sens./1w-1m on 90x40 horn	Nominal Impedance	Maximum Power	Frequency Range	Recommended Crossover Point	Dimensions	Weight	List Price
ROSS SYSTEMS-DIVISION OF INTERNATIONAL MUSIC CO.									
HF44	¾"	100	8Ω	20 w	3 k-16 K	3 k	4" x 4" x 3"	—	12.20
SAN MING SOUND CO.									
S-50	—	110	16Ω	50 w	125-8 k	—	4¾" x 4½"	4.7	$54.17
S-30T	—	110	25/70 v	30 w	225-14 k	—	4¼' x 4¼'	4.3	66.15
S-40T	—	109	70/100 v	40 w	150-11 k	—	6⅜" x 6⅞"	6.7	89.45
S-60T	—	110	70/100 v	60 w	150-11 k	—	6⅜" x 6⅞"	7.2	97.90
S-60A	—	110	16Ω	60 w	125-805 k	—	4¾" x 4½"	4.4	88.15
S-75A	—	110	16Ω	75 w	125-8.5 k	—	4¾" x 4½"	5.1	112.40
TECHNICAL AUDIO DEVICES (TAD) DIVISION OF PIONEER ELECTRONICS (USA), INC.									
TD-4001	2"	110	16Ω	60 w	600-20 k	>600	7" x 6⅛"	29.75	$870.00
ET-703	—	107	8Ω	30 w	5 k-45 k	5 k	3.16" x 2.94"	2.4	450.00
TD-2001	1"	109	8Ω	30 w	500-22 k	>800	5.56" x 4.19"	14.13	420.00
TOA ELECTRONICS, INC.									
HFD-353	1"	107	8Ω	60 w	500-18 k	500	152mm x 110mm	9.2	
HFD-651-8	1.4"	109	8Ω	180 w	500-16 k	500	204mm x 136mm	22.05	
HFD-651-16	1.4"	109	16Ω	180 w	500-16 k	500	204mm x 136mm	22.05	
HT-371-8	—	105	8Ω	60 w	7 k-20 k	5 k	95mm x 102mm	4.41	
HT-371-16	—	105	16Ω	60 w	7 k-20 k	7 k	95mm x 102mm	4.41	
UNIVERSITY SOUND									
7110XC	1"	110	8Ω	30 w	300-4.5 k	Explosion Proof	7⅞" x 7⅞" x	14	$215.00
1D75	1"	112	16Ω	75 w	150-7 k	—	4¼" x 3¾"	6	195.00
1D60C8	1"	113	8Ω	60 w	300-5 k	—	5⅝" x 6⅜"	7	97.00
1821S	.88"	108	8Ω	75 w	350-8 k	—	5½" x 3½"	5	111.00
1824M	.88"	104	8Ω	60 w	400-6 k	3.5 k	5½" x 3½"	6	110.00
1D30C8	1"	112	8Ω	30 w	300-5 k	—	4¼" x 5¼"	4	62.00
1828C	.88"	107	8Ω	30 w	150-10 k	—	4" x 3¼"	3.5	57.00
ST350B	Tweeter	101	8Ω	5 w	3 k-15 k	3 k	6" x 5" x 4½"	3	108.00
T35A	Tweeter	104	8Ω	5 w	3.5 k-15 k	3.5 k	2" x 5¼" x 2¼"	3	82.00

HORNS

Model	Type	Throat-Size	Dispersion	Q @ 2 kHz octave-board	Frequency Range	Recommended X-Over	Dimensions	Weight	List Price
ALTEC LANSING CORP.									
MRII 542	Mantaray® CD	1.4"	40 x 20	45	500-16 k	500	14½" x 21" x 29"	11.4	$272.00
MRII564	Mantaray® CD	1.4"	60 x 40	20	500-16 k	500	11" x 11" x 13"	4.6	232.00
MRII594A	Mantaray® CD	1.4"	90 x 40	11	500-16 k	500	11" x 21" x 13"	4.6	212.00
MRII5124	Mantaray® CD	1.4"	120 x 40	5	500-16 k	500	11" x 22" x 13"	5	244.00
MR42A	Mantaray® CD	1.4"	40 x 20	60	300-16 k	300	24" x 34" x 60"	5.5	640.00
31B	Sectoral	.8"	120 x 40	5	300-20 k	300	17¾" x 23" x 14"	15	472.00
	Directivity								
FOSTEX CORP. OF AMERICA									
H-251	Sectorial	25.4	90	—	250	—	—	—	$270.00
H-351	Radial	25.4	90	—	350	—	—		175.00
JBL PROFESSIONAL									
2365A	Bi-Radial™	2"	60 x 40	19.8	300 +	350	31.3" x 31.3" x 32.1"	25	$405.00
2386A	Bi-Radial™	2"	40 x 20	44.9	350 +	400	11" x 17.5" x 14.1"	12	198.00
2366A	Bi-Radial™	2"	40 x 20	45.9	200 +	300	31.3" x 31.3" x 55"	36	627.00
2344	Bi-Radial™	1"	100 x 100	9	800 +	1 k	12.5" x 12.5" x 7"	4	198.00
2370A	Bi-Radial™	1"	90 x 40	12.2	800 +	800	6.8" x 17.5" x 6.9"	3	117.00
2380A	Bi-Radial™	2"	90 x 40	10.7	500 +	>500	11" x 17.5" x 9.3"	10	153.00
2360A	Bi-Radial™	2"	90 x 40	10.8	300 +	>350	31.3" x 31.3" x 32.1"	27	408.00
2382A	Bi-Radial™	2"	120 x 40	7.9	500 +	>500	11" x 17.5" x 9.3"	10	198.00
2385A	Bi-Radial™	2"	60 x 40	19	500 +	>500	11" x 17.5" x 9.3"	10	153.00
MOTOROLA, INC./CERAMIC PRODUCTS									
KSN6125	Diffraction	1⅜"/18	—	N/A	—	N/A	15" x 4.5" x 10.5"	10 oz.	$14.06
MTX LOUDSPEAKERS - THE MITEK GROUP									
18-8-120	—	1"	18' x 8' x 120'	—	—	—	18" x 8"	4	$144.95
14-4-100	—	1"	14' x 4' x 100'	—	—	—	14" x 4"	2	49.95
PASO SOUND PRODUCTS									
TR-1	Round	—	—	—	—	—	9¾" x 13"	4	$42.00
TR-2	Rectangle	—	—	—	—	—	13" x 7"	4	50.00
TR-3	Rectangle	—	—	—	—	—	20" x 11"	8	95.00
TR-4	Round	—	—	—	—	—	17¾" x 18"	8	95.00

Model	Type	Throat-Size	Dispersion	Q @ 2 kHz octave-board	Frequency Range	Recommended X-Over	Dimensions	Weight	List Price
ATLAS/SOUNDOLIER									
DR-72	Directional Reflex	1⅜"/18	65	—	—	—	31" x 28"	30	$285.28
DR-54	Directional Reflex	1⅜"/18	75	—	—	—	26" x 19"	23	200.70
CJ-46	Wide Angle	1⅜"/18	120 x 60	—	—	—	22" x 12" x 17"	15.5	167.85
BIA-100	Biaxial	1⅜"/18	130 x 60	—	—	—	21" x 10¼" x 19¼"	10	160.65
DR-42	Directional Reflex	1⅜"/18	85	—	—	—	21" x 16"	14	141.03
DR-32	Directional Reflex	1⅜"/18	95	—	—	—	16½" x 12½"	10	126.73
BOGEN COMMUNICATIONS, INC.									
BAH	Bi-axial	—	130 x 60	—	200	—	21" x 10¼" x 10¾"	10	$179.75
WAH	Wide Angle Trumpet	—	120 x 60	—	115	—	23" x 13" x 17"	14.5	179.75
MH	Reflex Trumpet	—	85	—	140	—	21" x 16"	13	153.15
CETEC GAUSS									
8222	CD	2"	60 x 40						

Model	Type	Throat-Size	Dispersion	Q @ 2 kHz octave-board	Frequency Range	Recommended X-Over	Dimensions	Weight	List Price
PEAVEY ELECTRONICS CORP.									
CH-1	CD	1"	90 x 45	—	500-16 k	>500	23⅜" x 14¼" x 17⅞"	—	$80.00
CH-4	CD	1"	60 x 30	—	800-16 k	>800	23⅞" x 10¾" x 23⅞"	—	70.00
CH-2	CD	1"	90 x 45	—	800-16 k	>800	19" x 10" x 12"	—	50.00
CH-3	Exponential	1"	90 x 45	—	800-16 k	>800	14⅜" x 4⅞" x 5½"	—	35.00
ROSS SYSTEMS-DIVISION OF INTERNATIONAL MUSIC CO.									
CDM	Constant Directivity	2" x 7"	90 x 40	—	250-4 k	300	22" x 14" x 10¾"	—	$94.60
CAT	Constant Directivity	1"	90 x 40	—	2 k-20 k	>3 k	—	—	31.08
SAN MING SOUND CO.									
SCA	w/Driver	—	125	—	350-13.5 k	—	6.1" x 5.9"	2.4	$33.15
SC-15A	w/Driver	—	120	—	350-13.5 k	—	8¼" x 8¼"	2.7	41.32
SK-30F	w/Driver	—	105 x 72	—	250-13 k	—	11" x 6⅝" x 9"	5.4	49.60
H-16	Reflex	—	95	—	>220	—	16" x 12¾"	6	65.38
H-20	Reflex	—	75	—	>150	—	24" x 20"	12	94.63
TOA ELECTRONICS, INC.									
HRH-651	Radial	1"	90 x 40	—	500-3 k	500	170mm x 570mm x 395mm	9.92	
HRH-851	Radial	1.4"	90 x 40	—	500-3 k	500	220mm x 772mm x 580mm	24.03	
UNIVERSITY SOUND									
Cobra III	Folded	1"	96 x 55	8.5	250-10 k	250	14½" x 27½" x 15"	19	$110.00
Cobra IIB	Reflex	1"	120 x 60	20.5	200-10 k	200	18⅛" x 9¼" x 10¼"	10	88.00
FC100	Compound	1"	130 x 110	5.3	200-14 k	200	20½" x 10½" x 20"	13	110.00
PH	Reflex	1"	70	34.5	300-10 k	300	20⅜" x 15¾"	3	90.00
ZWP	Bi-Directional	1"	70 bi-directional	—	400-10 k	400	8½" x 20⅞"	4.5	85.00
SMH	Reflex	1"	70	34.5	300-10 k	300	16¼" x 12"	3	81.00
SH	Reflex	1"	70	12.5	300-10 k	300	—	3	81.00
HC400	Re-Entrant	1"	70	19.5	450-10 k	450	10" x 5¼"	6	39.00

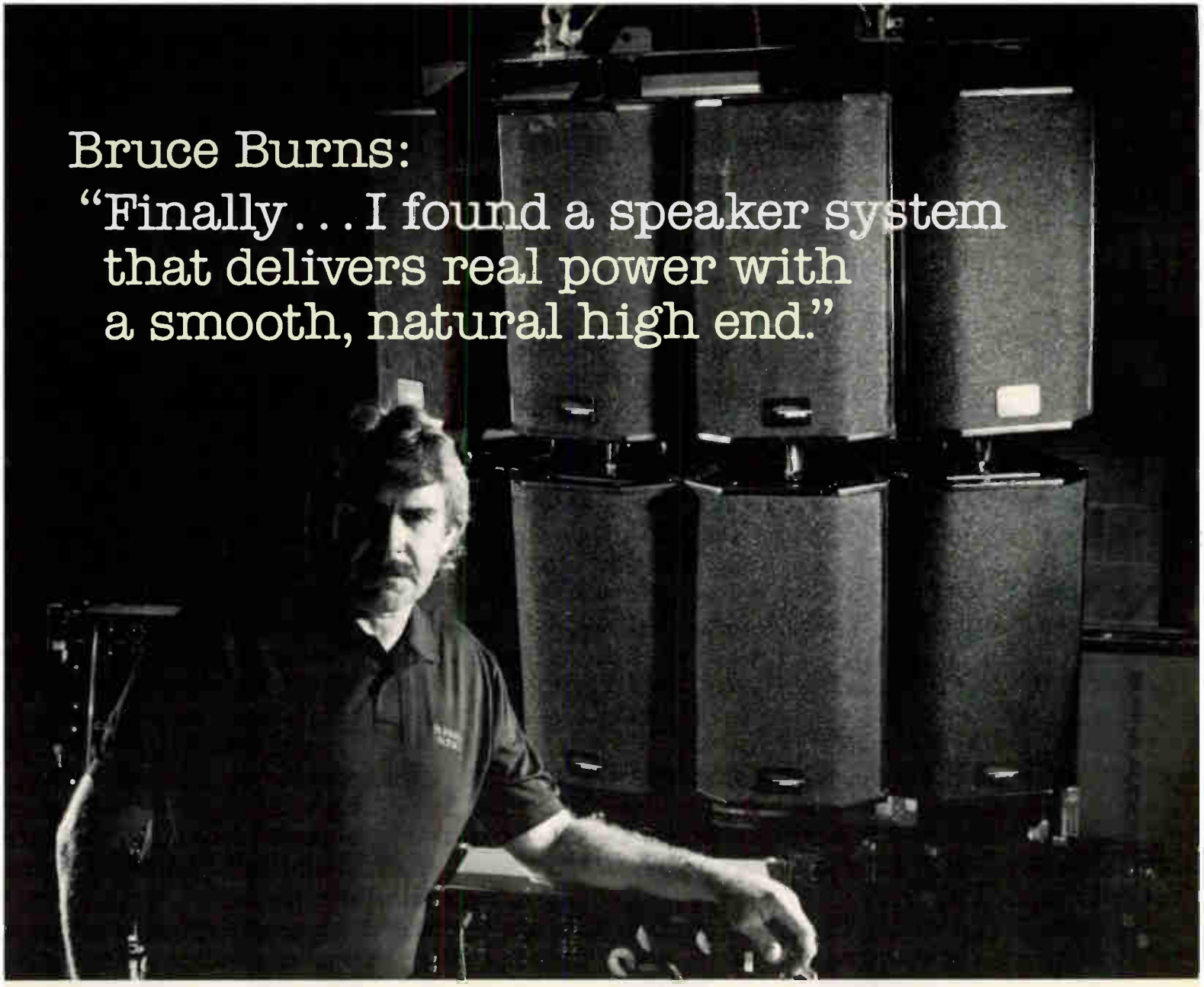
PAGING HORNS

PAGING HORNS

Model	Type	Mounting	Size	Nominal Impedance	Axial Sens./ 1w-1 meter	Maximum Power	Dispersion	Frequency Range	Accessories	Weight	List Price
ATLAS/SOUNDOLIER											
WT-15	2-way Reflex	Surface	13¼" x 10¾" x 10"	8Ω	99	15 w	130 x 110	150-15000	—	9.5	201.45
APR-30T	Radial Reflex	Ceiling	11¾" x 13"	25/70 v	105	30 w	360	300-14000	cable/conduit, adaptor	10	182.98
APW-30T	Wide Angle Re-entrant	Surface	12" x 8¾" x 10⅜"	25/70 v	104	30 w	130 x 90	275-14000	pipe thread/cable/ conduit/adaptor	5.3	138.47
AP-15	Omni Purpose Re-entrant	Surface	8" x 8" x 9"	8Ω	104	15 w	110	275-14000	pipe thread/cable/ conduit/adaptor	3.5	80.03
CA-12T	Re-entrant	Surface	10"round x 11"	25/70 v	—	12 w	90	500-9000	—	8.3	67.94
SC-15	Circular Reflex	Surface	6½" x 6⅝"	4, 8,45Ω	97	15 w	130	350-12000	line matching transformer	2.5	64.45

Model	Type	Mounting	Size	Nominal Impedance	Axial Sens./ 1w-1 meter	Maximum Power	Dispersion	Frequency Range	Accessories	Weight	List Price
BOGEN COMMUNICATIONS, INC.											
TB2H	Re-entrant horn,2-way Ampl.	Remountable brackets	8" x 8" x 9"	600Ω	109	1.5 w	110	—	—	4.5	$284.65
HFS2	Reflex,2-way	Remount/brack	13¼" x 10⅜" x 10"	8Ω	117	15 w	130 x 110	150-15k	—	10	216.65
AH15A	1-way Ampl.	Remount/brack	8" x 8" x 9"	600Ω	121	15 w	110	275-14k	—	5	201.25
BDT30A	Re-entrant Bi-directional	Remount/brack	16½" x 9¾"	25/70 v	121	30 w	100	225-14k	—	8	187.65
AH5A	1-way Ampl.	Remount/brack	8" x 8" x 9"	600Ω	116	5 w	110	275-14k	—	4.5	172.50
SPT30A	Re-entrant 1 or 2 way	Remount/brack	10" x 9½" x 10½"	25,70 v	125	30 w	100	225-14k	—	6	131.00
SP30-8A	Re-entrant 1 or 2 way	Remount/brack	10" x 9½" x 10½"	8Ω	25	30 w	100	225-14k	—	5.5	106.50
SPT15A	Re-entrant 1 or 2-way	Remount/brack	8" x 8" x 9"	25,70.v	121	15 w	110	275-14k	—	4.5	107.90
SP15-8A	Re-entrant 1 or 2-way	Remount/brack	8" x 8" x 9"	8Ω	121	15 w	110	275-14k	—	4	84.15
SPT5A	Reflex horn 1 or 2-way	Remount/brack	6" x 4"	25,70 v	105	7.5 w	120	250-14k	—	2	77.40
SP5-8A	Reflex horn 1 or 2-way	Remount/brack	6" x 4"	8Ω	105	7.5 w	120	250-14k	—	1.25	52.15
IH8A	Double	Remount/brack	6½" x 6⅝"	8Ω	120	15 w	130	350-12k	—	2.5	64.15
CELESTION INDUSTRIES, INC.											
R13/13T	Compact Reflex Re-Entrant	Bracket	6½" x 7¾"	3Ω	—	7 w	—	325-8 k	100 v transformer	2.2	—
R40/54	Compact Reflex Re-Entrant	Bracket	15" x 16⅜"	3Ω	—	—	—	—	—	7.1	—
SD24/24T	Junior Reflex	Bracket	10⅝" x 9½"	4Ω	116	10 w	—	300-8 k	—	8	
CLARITY											
S-600	ABS	Fully Adjustable	10" x 9.5" x 10.5"	8Ω	121	16 w	120 x 90	300-10 k	—	3.5	—
S-615	Metal	Fully Adjustable	8" x 8" x 9"	25/70 v	121	15 w	110	275-14 k	—	4	—
S-616	ABS	Fully Adjustable	10" x 9.5" x 10.5"	25/70 v	121	16 w	120 x 90	300-10 k	—	4	—
S-630	Metal	Fully Adjustable	10.5" x 10" x 7.5"	25/70 v	125	30 w	100	275-14 k	—	6.5	—
S-632	ABS	Fully Adjustable	11.5" x 12.25" x 7.5"	25/70 v	125	32 w	120 x 90	250-10 k	—	4.5	—
S-650	Bi-Axial	Fully Adjustable	21" x 10" x 19"	25/70 v	127	30 w	130 x 60	120-14 k	—	13	—
FOURJAY INDUSTRIES, INC.											
132-8D	Re-Entrant	Adjustable	12" x 7⅝"	8Ω	11.7	32 w	120 x90	250-10 k	—	6	95.50
216-8D	Re-Entrant	Adjustable	10" x 7⅜"	8Ω	10.7	16 w	120 x 90	300-10 k	—	5	76.25
306-8	Re-Entrant	Adjustable	5"	8Ω	98.7	6 w	100	300-11 k	—	2	42.50
312-8	Reflex	Adjustable	9"	8Ω	100.7	12 w	100	150-11 k	—	4	69.75
440-8	Re-Entrant	Adjustable	5"	8Ω	106.7	40 w	100	500-7 k	—	3	53.75
HARRIS CORPORATION, DRACON DIVISION											
22001-001	Re-entrant	Multi-purpose	8" x 8" x 9"	70 v	121	15 w	110	225-14 k	—	4	—
22001-002	Re-entrant	—	—	70 v	115	4 w	110	225-14 k	—	4	—
22001-003	Re-entrant	—	—	70 v	121	4/15 w	110	225-14 k	—	4	—
22002-001	Re-entrant	—	10" x 10" x 11"	70 v	125	30 w	100	225-14 k	—	6	—
22060-110	Re-entrant	—	6" x 6" x 6"	8Ω	119	15 w	130	350-12 k	—	2.5	—
LEN FINKLER COMPANY											
HDC-15T	Reflex	swivel base	8" diameter	25/70 v	106	15 w	110	350-14 k	—	4.65	$57.00
HDC-30T	Reflex	swivel base	10" diameter	25/70 v	106	30 w	105	350-14 k	—	6.8	75.00
HDA-30T	Reflex	swivel base	12" dia.	25/70 v	111	30 w	100	300-14 k	—	5.75	80.00

Model	Type	Mounting	Size	Nominal Impedance	Axial Sens./ 1w-1 meter	Maximum Power	Dispersion	Frequency Range	Accessories	Weight	List Price
PASO SOUND PRODUCTS											
TR-19	Reflex	Surface	10¼" x 6¼" x 11"	8Ω	122	20 w	60 x 120	275-14 k	5	—	
TR-20T	Reflex	Surface	10¼" x 6¼" x 8"	25/70 v	122	20 w	120 x 60	275-14 k	6	—	
TR7/8	Reflex	Surface	10¼" x 6¼" x 8"	8Ω	122	20 w	120 x 60	275-14 k	5	—	
TR-12	Reflex	Surface	5" x 4"	8Ω	106	8 w	120	357-10 k	1.5	—	50.00
C51T	Projector	Surface	8" x 11"	25/70 v	103	20 w	120	120-16 k	8	—	129.00
SPECO DIV., COMPONENTS SPECIALTIES, INC.											
SPC-SP	ABS	Triangle Base	5" x 5"	8Ω	105	12 w	—	300-15 k	—	—	$18.95
SPC-6P	ABS	Triangle Base	5¼" x 5"	8Ω	105	15 w	—	300-15 k	—	—	18.15
SPC-8	Aluminum	Triangle Base	5" x 5"	8Ω	105	15 w	—	300-15 k	—	—	19.95
SPC-10	Aluminum	U-Bracket	6" x 6"	8Ω	105	15 w	—	250-15 k	—	—	37.95
SPC-15	Aluminum	U-Bracket	8" x 8"	8Ω	110	25 w	—	200-15 k	—	—	42.80
SPC-15B	Aluminum	U-Bracket	5" x 8"	8Ω	110	25 w	—	200-15 k	—	—	45.95
SPC-15RP	ABS	90° Swivel	5" x 8"	8Ω	105	30 w	—	200-15 k	—	—	47.50
SPC-40XP	ABS	180° Swivel	6½' x 11" x 9"	8Ω	120	40 w	—	200-15 k	—	—	55.00
SPC-60RP	ABS	90° Swivel	5" x 8" x 9"	8Ω	120	60 w	—	200-15 k	—	—	61.95
SPC-20	Aluminum	U-Bracket	12" x 12"	8Ω	115	65 w	—	150-15 k	—	—	95.95
SPC-20R	Aluminum	U-Bracket	8" x 12" x 12"	8Ω	115	65 w	—	150-15 k	—	—	97.95
SPC-30	Aluminum	U-Bracket	15" x 13"	8Ω	120	75 w	—	130-15 k	—	—	108.95
SPC-10T	ABS	U-Bracket	6"	70 v	—	30 w	360°	—	—	—	75.95
SPC-15T	ABS	U-Bracket	8"	70 v	—	30 w	360°	—	—	—	99.95
SPC-13RT	ABS	U-Bracket	5" x 8"	70 v	—	30 w	180°	—	—	—	101.95
SPC-40RT	ABS	U-Bracket	6½" x 11"	70 v	—	40 w	180°	—	—	—	139.95
TOA ELECTRONICS, INC.											
TC-101A	—	U-Bracket	5.83" x 7.13"	8Ω	—	10 w	188 x 190	315-12.5 k	—	1.76	
TC-101TA	—	U-Bracket	5.83" x 7.13"	63Ω	—	10 w	188° x 190	315-12.5 k	—	2.2	
TC-151A	—	U-Bracket	7.64" x 8.98"	8Ω	—	15 w	135 x 150	280-12.5 k	—	2.2	
TC-151TA	—	Swivel Bracket	7.64" x 8.98"	42Ω	—	15 w	135 x 150	280-12.5 k	—	3.53	
TC-301A	—	U-Bracket	8.62"	8Ω	—	30 w	100 x 130	250-16 k	—	3.09	
TC-301TA	—	Swivel bracket	8.62"	21Ω	—	30 w	100 x 130	250-16 k	—	4.19	
UNIVERSITY SOUND											
CF1D 32-8	Rectangular Reflex Exp	Swivel Mount	7⅛" x 14⅞" x 12¼"	8Ω	108	32 w	120 x 80	350-4.2 k	25/70 v transformer	8	$74.50
PA60	Re-Entrant	Swivel Mount	11" x 6½" x 8½"	8Ω	112	60 w	60 x 50	580-6.4 k	25/70 v transformer	4	66.00
CFD15-8	Rectangular Reflex Exp	Swivel Mount	6⅞" x 11⅞" x 17⅜"	8Ω	110	15 w	120 x 80	500-8 k	25/70 v transformer	5	59.25
PA30A	Re-Entrant	Swivel Mount	11" x 6½" x 8½"	8Ω	113	30 w	66 x 66	580-6.4 k	25,70v traansformer	5	62.00
PA15B	Re-Entrant	Swivel Mount	6¼" x 10¾" x 9¼"	8Ω	108	15 w	75 x 75	530-6.2 k	25/70v transformer	5	55.00
PA12	Re-Entrant	Swivel Mount	7½" x 7"	8Ω	110	12 w	72	840-5.6 k	25/70v transformer	3	38.50
PA34T	Bi-Directional Re-Entrant	Dual Swivel	8¾" x 16½" x 7½"	25/70 v	107	30 w	—	840-5.6 k	—	4.5	109.00
VALCOM INC.											
V-1050B	Self Amplified Bi-Directional	Surface	—	600Ω	—	5 w	120 x 90	350-8 k	includes mounting	6.75	$139.00
V-1036B	Self Amplified Bi-Directional	Surface	—	600Ω	—	30 w	120 x 90	350-8 k	includes mounting	6	139.00
V-1030B	Self Amplified	Surface	—	600Ω	—	5 w	120 x 90	350-8 k	includes mounting	5.5	67.00
WHEELOCK, INC.											
SA-H15	Amplified Re-Entrant	Wall or Pole	8" x8" 10½"	600Ω	110	15 w	110	275-14 k	24VDC Supply	6.25	$115.00



Burns Audio won the 1987 ProSound News "Sound Reinforcement Award, Festival Category," for Liberty Island ceremonies. Other credits include: "We the People..." the Barbra Streisand HBO Special, Happy Birthday Hollywood and the Emmies.

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PSYCHOACOUSTICS

(continued from page 31)

be used to consider changes in the room, or can be used for final room evaluation. Bradley does not provide prediction calculations that are used for design of halls or for their analysis, and thus, these must be derived from other sources.

Bradley does, in an ASA presentation, compare two auditoriums based on these metrics, and the results are very interesting. One of the halls is rectangular and the other is fan shaped. His measurements show very clearly that the fan shaped hall has measurable problems that correlate well with complaints with regard to temporal and spatial diffusion, especially in the rear of the hall.

There is no question that these measurements can be of great benefit in the evaluation of halls and in the diagnosis of problems and solutions. Their prediction can increase the quality of design of many more halls that are all too often the unfortunate result of no precise predictions.

RASTI Intelligibility Testing

Although both of the above test systems are quite beneficial for their respective applications, Toole's procedures are complex and expensive, requiring a listening room and a test system, and Bradley's system is also out of the range of many practioners ($\pm$$30,000). For the evaluation of the results of room performance with regard to intelligibility, the Bruel and Kjaer RASTI system falls a bit more in range of serious users (about $10,000). This system is based on the Modulation Transfer Function, used by Steeneken and Houtgast in Denmark to develop a simple time and frequency based system for evaluation of intelligibility. (See *Sound & Communications* October & November, 1986.)

The system includes a transmitter with a built-in speaker and a receiver with a microphone, and it can be used either through a sound system or as its own unreinforced source. The system produces a modulating signal which is analyzed by the receiver for modulation reduction at 500 Hz and 2000 Hz, based on nine modulation rates. The background sound level is measured, as well as early decay time, and a calculation is made in about a second, with both that calculation and its underlying data available for inspection.

The system is quick to use, requires little skill or theoretical knowledge, and it requires little interpretation. It clearly shows the relationship between early

DATE: 86 11 24 TIME: 16 12 34

SITE IDENTIFICATION: Mallet Theatre
SOURCE POSITION : centre hangings removed
RECEIVER POSITION : f6

ACOUSTICAL MEASURE	OCTAVE BAND 125	250	500	1000	2000	4000	
BACKGROUND	39.71	31.53	28.41	26.78	26.77	27.04	dB
C36	-5.41	-4.11	-1.82	-0.39	-1.81	-0.37	dB
C50	-3.49	-2.22	-0.56	0.90	-0.68	0.88	dB
C80	3.44	1.27	1.78	2.82	2.45	3.60	dB
TS	0.095	0.096	0.084	0.078	0.082	0.070	sec
G	10.76	9.50	10.24	8.93	7.81	6.65	dB
EDT	1.29	1.32	1.25	1.33	1.21	1.04	sec
RT	1.38	1.25	1.27	1.26	1.19	1.74	sec
U50	-12.97	-3.81	-0.98	0.57	-1.93	-4.20	dB
U80	-9.21	-0.90	1.23	2.40	0.69	-2.72	dB
LF	0.47	0.46	0.34	0.32	0.30	0.53	
LFS	0.45	0.41	0.34	0.32	0.30	0.53	

SPEECH INTELLIGIBILITY : 98.5% at a speech level of 55.0 dBA

LEGEND:

Early/Late sound ratios
C36 - with 36 ms as early limit
C50 - with 50 ms as early limit
C80 - with 80 ms as early limit

TS - Centre time
G - strength of signal

Decay times
EDT - early decay time (0 dB to 10 dB)
RT - reverberation time (5 dB to 30 dB)

Useful/Detrimental ratios
U50 - with 50 ms early time limit
U80 - with 80 ms early time limit

Lateral fractions
LF - 0 to 80 ms as early lateral fraction
LFS - 5 to 80 ms as early lateral fraction

EXAMPLE OUTPUT PRINT-OUT

Figure 5

reverberation (EDT) and background noise level, and it is the most portable of the above systems. (I used the RASTI system recently on a problem church that I was also evaluating with the TEF analyzer and with a CEL reverberation test system. Interestingly, as each cluster loudspeaker was turned off, the intelligilibilty increased, until finally it peaked when the entire system was turned off. While the TEF demonstrated this problem in detail, the RASTI allowed a quick test of the entire space and correlated well with the TEF and the ⅓ octave reverberation data.)

The RASTI system is limited in that it assumes Linear transmission; pure tones are not considered; constant noise floor is assumed; and reverberation time is assumed to not be strongly dependent upon frequency. *(continued on page 71)*

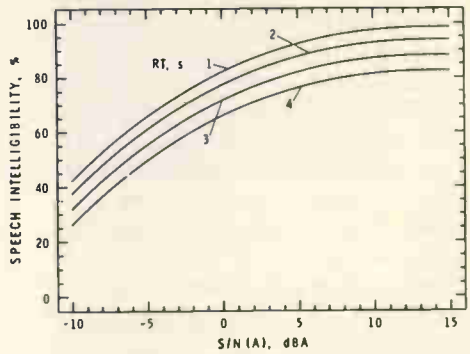


Figure 6

BOOK REVIEW

(continued from page 14)

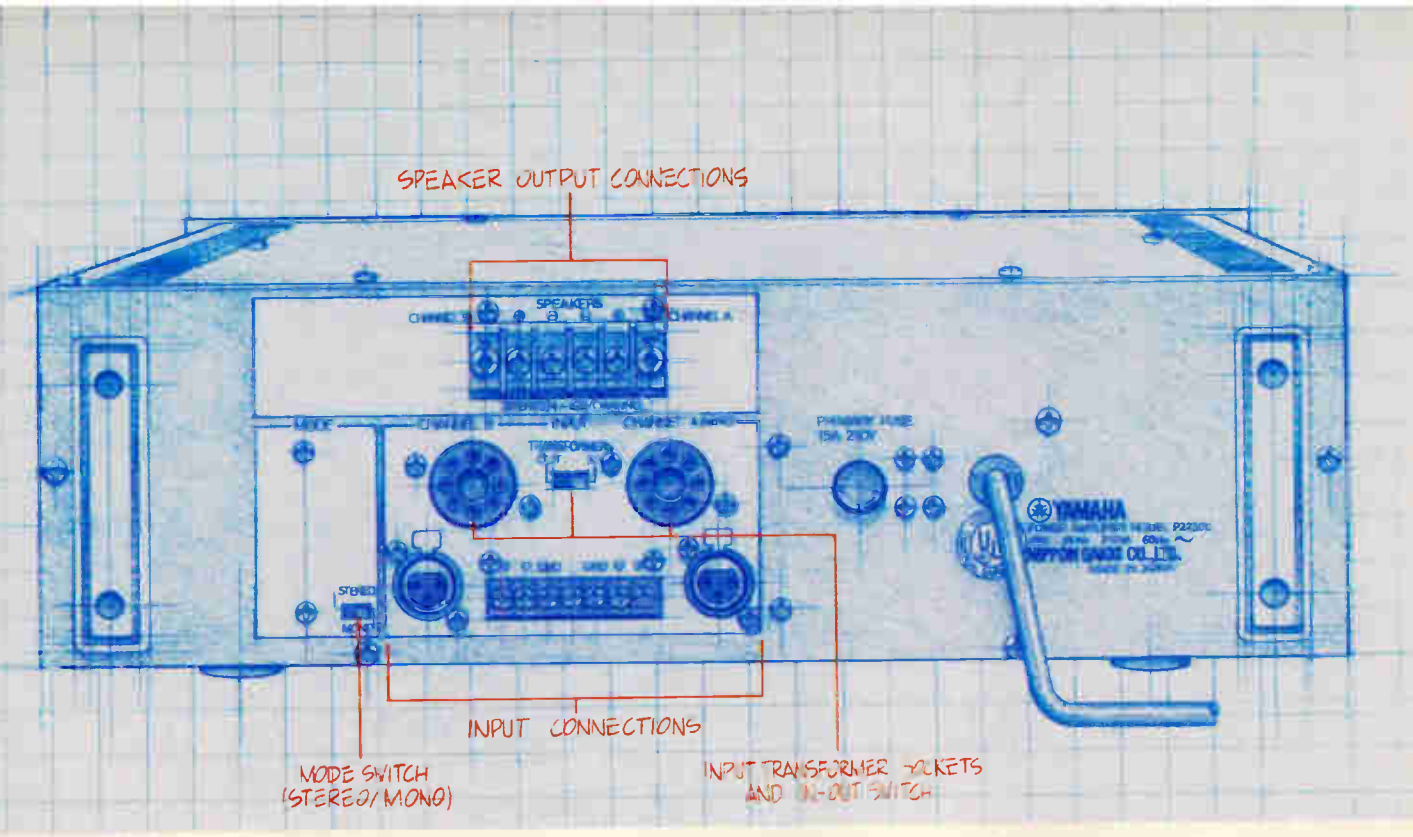
sees only very small changes in sound quality. . .low priced sound equipment sounds *very* good today. . .but large changes in user control and complexity. There are more and more knobs for each channel, more and more channels.

The discussion of studio acoustics gets down to basics: time, amplitude, and frequency, and the way they combine for phase behaviors, for example, control of sound in recording rooms is discussed succinctly, but without theory. One can quibble with the discussion of reverberation and of noise control, but it's hard to prescribe how a 16-page discussion of these thorny subjects ought to be written. One feels the need of subject-specific references at the close of each chapter, to send the reader forward to more detailed treatments of such subjects; after all, F. Alton Everest has written entire books on the matters covered in a single chapter here.

Your reviewer must protest the chapter on hum prevention, because of its numerous suggestions of making electrical connections to water pipes (to achieve an earth ground). First, this is expressly forbidden by many local electrical codes, and the prohibition will probably be universal in a few years. Secondly, many local water utilities are routinely using sections of vinyl pipe where the water service enters a building, in order to make these shenanigans useless. Thirdly, and most importantly, utility workers can be (and sometimes are) electrocuted when repairing water pipes that also serve as part of the electrical system. Don't do it! You keep those wires *off* that water pipe!

Fifty pages on microphones form the heart of this book. Microphone characteristics are described schematically, and the types are illustrated, with performance notes for the intelligent beginner. Basic and more advanced techniques are shown, for the varieties of stereo placement, and the unique microphone tricks required for various kinds of musical instruments and ensembles. Any reader who needs a quick reference for setting up microphones to pick up musical performance, whether for recording or reinforcement or broadcast, will find these pages invaluable.

(continued on page 70)



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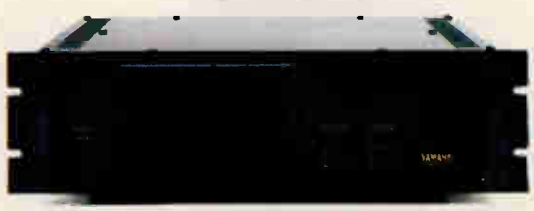


Circle 204 on Reader Response Card

Automatic Operation of a Cathedral Sound System

(Left)
A Bozak loudspeaker enclosure is located behind a structure at the bottom of the cupola's stained glass Greek cross.
(Right)
Exterior, St. Mary's Cathedral

by Charles F. Swisher, FAES

On September 17 and 18, 1987, during his journey to the United States, Pope John Paul II visited St. Mary's Cathedral in San Francisco for two special dialogs, one with 3,000 members of Bay Area clergy and one with 3,000 members of the laity. This occasion marked the inauguration of an entirely new automatic sound system and a completely renovated fully automatic programmable lighting system installed in the Cathedral.

St. Mary's Cathedral is a modern architectural wonder which challenges the imagination. Dedicated in 1971, the Cathedral was designed by McSweeney, Ryan, and Lee of San Francisco in collaboration with Pietro Belluschi of Boston and Pier Luigi Nervi of Rome. A hyperbolic paraboloid cupola of more than two million cubic feet with walls which rise nearly 200 feet rests on four giant pylons which extend 94 feet into the ground, each carrying a weight of nine million pounds. Four elegant vertical stained glass windows rise the height of the cupola and are capped by a dazzling horizontal stained glass Greek cross at the 200 foot level. The interior is highlighted by a remarkable baldachino of anodized aluminum rods which shimmer dramatically from constant air movements in the vast space.

News of the Papal visit gave impetus to the Archdiocese of San Francisco to implement long standing plans to renovate the sound and lighting systems in the cathedral. In December, 1986, Jaffe Acoustics, Inc. was retained to conduct a study and provide design recommendations for appropriate sound system modifications. Following approval of this report, authorization was granted in June, 1987, to proceed with formal specification preparation, contracting, and installation of a new sound system.

MAIN REQUIREMENTS

The main requirements set forth by the pastor and the Cathedral staff were as follows; improve overall intelligibility

and distribution of the spoken word in the Cathedral; provide automatic control of microphones and sound levels; provide inconspicuous microphones and do away with standard chrome plated microphone stands; provide wireless hand-held and lavalier microphone systems; provide a wireless listening system for the hearing impaired; provide a means to reinforce the choir and music ensemble without sounding "amplified;" provide facilities for hands-on mixing in the sanctuary for special events; provide the means for continuous reproduction of recorded sacred music during morning and afternoon hours when many thousands of tourists and visitors enter the Cathedral which is open every day of the year; and not to intrude upon the existing architecture with any exposed speaker arrays or visible elements of the sound system.

The interior of the Cathedral involves massive areas of concrete surfaces, a brick floor, enormous glass windows in all four corner areas, wood fret-work on all four sides, with the concrete lattice-work cupola rising upward over the sanctuary. The original acoustical consultant, Dariel Fitzroy, brought the space under control with absorption behind all the side wall wood fret-work and custom-made triangular shaped sound absorption panels located in every section of the lattice-work cupola. The reverberation time in the empty space is four seconds.

SOUND SYSTEM DESIGN

The original sound system design began in March, 1967, and was installed in time for the Cathedral opening in 1971. It consisted of three horn speakers and three bass boxes mounted in a central array 56 feet above the main altar. Cleverly designed into an area at the bottom of the south cupola vertical stained glass windows, the array area is concealed with beige grill cloth on a steel frame. This site is approximately 78 feet from the closest center pews, and 134 feet from the rear pews. A full 180 degrees of coverage is required from the array to reach the entire surround seating area.

Two additional eight inch speakers were mounted behind wooden grillwork in the left and right side altar areas. An amplifier/control rack room located adjacent to the sacristy provides a convenient location for electronic equipment. In addition, an original all-condenser microphone system was replaced several years ago with an automatic microphone system, but problems with microphone quality and switching time bothered the staff.

Following the Jaffe Acoustics report and discussions with the pastor and Cathedral staff, authorization was given to proceed with complete replacement of the system with contemporary technology.

It was decided to create a new system using Bozak columnar loudspeaker systems with Industrial Research Products automatic microphone mixers, power amplifiers, and transversal equalizers as primary components. The sound column, with its wide horizontal dispersion, controlled vertical dispersion, and natural-sounding voice reproduction abilities gave it preference as a speaker system of choice.

In an effort to avoid the expense (and potential risk to the baldachino) of designing and installing a new grill cloth and frame assembly, it was decided to fit Bozak CM-209-18 sound columns with bass supplement in the existing array area. Space limitations and angulation of the existing grillwork required local construction of cabinets similar to the CM-209-18, but with tapered backs. Two such columns were constructed for the central part of the array, each having a vertical line of six six-inch Bozak drivers with double magnet assemblies and twelve two-inch drivers. Similar, but shorter cabinets, were fabricated for the near left and near right coverage, each using four six-inch drivers, and eight two-inch drivers. Extreme left and right coverage is provided by two Bozak CM-450-6 column speakers each having six four-inch drivers.

Two Bozak CM-199-2 bass supplement speakers were fitted in the rear of the array area. The four main sound columns were wired for bi-amplification. All hard surfaces in the array area were lined with Sonex sound absorbtion material, and all parts of the steel grill frame were lined with black felt to minimize internal reflections and back waves.

Sufficient space remained in the array area for a small rack containing six dual 100 watt/channel Industrial Research Products DH-4020 power amplifiers and a Brooke Siren FDS-360 four-way electronic crossover network. The IRP amplifiers have very low heat dissipation and occupy 1¾ inch of rack space. In this case, 1200 watts of power and the electronic filter were fitted into 12¼ inches of rack space. A Topaz Line 2 power conditioner stabilizes ac power to the amplifier rack. The crossover frequency for the main columns is 2500 Hz with a 100 Hz high pass filter to prevent cone flutter from pipe organ pedal tone. The far side columns are fed a full range signal with a 100 Hz high pass filter, and the bass supplement speakers are fed from a 150 Hz low pass filter on the electronic crossover. Individual peak limiting available on each channel of the Brooke Siren crossover is available for system protection. Short (six foot) 14 AWG speaker cables were used.

Ten microphone lines run from the control room to the top of the kiosk.

Two JBL 4301 two-way speaker systems are used in the side altar areas and are fed via an Audio Digital, Inc. Add-1 signal delay unit to provide time coincidence with the main array.

A sacristy monitor speaker with a wall-mounted level control permits priests in the sacristy to monitor activities in the sanctuary at all times.

Existing microphone lines from the main altar to the control room were fitted with new receptacles and hinged bronze cover plates. Ten microphone lines run from the control room to the top of a kiosk at the rear of the Cathedral. These lines were terminated at the kiosk with a receptacle panel and provide a convenient location for a portable mixer when required for special events, such as the Papal visit. An additional four microphone lines terminate adjacent to the organ console and provide connections for choir, soloist, and musical ensemble microphones.

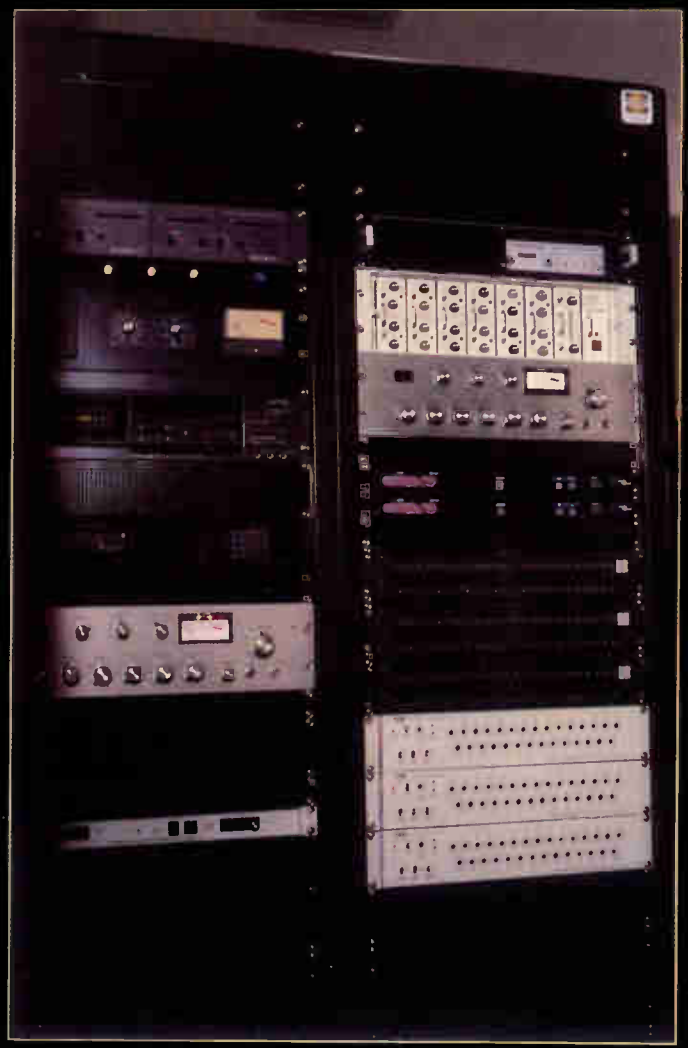
Countryman Associates' Isomax IV hypercardioid electret microphones with 12 inch goosenecks were chosen for the pulpit, presidor, and cantor microphones, the latter on black Atlas stands. Choir microphones are Isomax III cardioid electret microphones with 12 inch goosenecks mounted on black Atlas stands with boom extensions. A special Isomax III omnidirectional electret microphone with an 18 inch gooseneck in a linen white finish, a matching white stand, white mic cord and white windscreen were used by the Pope and remains for use by the Archbishop. A Countryman Associates' EMW-S electret lavalier microphone is used with the lavalier wireless microphone.

A Crown PCCR-160 surface mounted cardioid boundary microphone was chosen for use on the main altar. An AKG

C-535 condenser microphone was provided as a general purpose hand-held/stand soloist/announce microphone. A Telex WT-200 belt-pack wireless transmitter, HT-500 wireless hand-held condenser microphone, and two FMR-2 receivers complete the microphone package.

The control room equipment is fitted into two racks. These racks house the voice mixing system, the choir mixing system, the music mixing system, time delays, equalizers, wireless microphone receivers, wireless headset transmitter, patch bays, summing/distribution amplifiers, and power amplifier for the sacristy monitor and side altar speakers.

The heart of the voice mixing system is an Industrial Research Products DE-4013 Voice-Matic automatic microphone mixer fitted with a DE-206 Level-Matic automatic output level control unit. This mixer automatically attenuates microphone channels that do not have active inputs, and its dynamic threshold sensing avoids the fixed threshold common to gated mixers. The Level-Matic module senses signal variations between soft and loud voices and automatically adjusts the master gain to maintain uniform output. This mixer also has 12 buffered outputs under non-automatic control which appear on the patch bay for use in outside broadcast or recording as required.



St. Mary's control room racks include (left side) two Telex FMR-2 wireless receivers, a custom fabricated power indicator panel, a Soundolier MVX A195 monitor panel, a Teac 112R cassette deck, a JVC XCM-700B compact disc changer, a Bozak CMA-6-1 music mixer, and an IRP RR4020 power amp; (right side) a Sennheiser SH013 infrared transmitter, an IRP DE4013 automatic mic mixer, a Bozak CMA-6-1 choir mixer, two Audio Digital AAD-1 time delay units, three IRP DG4021 equalizers and three ADC Products' PPA5-14-MK11 patch panels.

A six-channel Bozak CMA-6-1 mixer is used for choir microphone mixing and is fed to the system via an Audio Digital ADD-1 signal delay unit. Normally three microphones are used for the choir and a fourth soloist microphone is available. Use of a small amount of signal (time) delay and appropriate level settings take advantage of the Haas precedence effect, and the listener senses the choir/soloist as the source of the sound without the sense of amplification.

A novel background recorded music system is included, perhaps marking the first time a compact disc changer has been employed in a cathedral sound system. A JVC XLM-700B compact disc changer mechanism is rack mounted along with a Teac 112-R rack-mounted reversing cassette deck. A Bozak CMA-6-1 mixer is used to balance this system. The compact disc changer manages magazines, each containing six separate compact discs. In addition, the unit has a conventional single play drawer which makes it very convenient to insert single discs at any time for special occasions. During the day, a set of six compact discs are set into automatic playback operation, one at a time. Initially a set of three magazines have been assembled with a variety of carefully chosen sacred music including Gregorian chants, hymns, masses, motets and organ music. Played at fairly low levels in the main sanctuary, the effect of the music greatly enhances the esthetic feelings of the extraordinary architecture and heightens the level of inspiration offered to the thousands who visit the Cathedral every year.

A Sennheiser wireless infrared hard-of-hearing system is installed using a pair of infrared radiators mounted on the left and right sacristy wall. Users have a choice of standard stethoscope dual ear headsets, plus induction loop lanyards, or direct induction ear clips for those with any type of hearing aid.

Summing and distribution of signals is provided by an Innovative Electronics Designs, Inc. Model 5000 series audio processing system. Three Industrial Research Products DG-4021 Transversal Equalizers are used to separately equalize the main array, side altar speakers, and hard of hearing system.

SYSTEM OPERATIONS

Complete operation of the entire system is by means of three illuminated push-buttons conveniently located on a panel in the sacristy. One button marked SOUND activates the entire system. Microphones can be plugged in as required and the system is fully operational under automatic control.

A second button marked MUSIC when pressed starts the compact disc changer (in its 'timer' mode) and six compact discs are automatically played in sequence. Prior to masses or other services, pressing the MUSIC button de-activates the compact disc changer. (The compact disc magazines are rotated regularly and re-arranged by the Cathedral music staff to avoid constant sequence repetition.)

A third illuminated push button is used to mute the wireless microphone system. In the off or un-illuminated mode, the outputs from both wireless microphone receivers are separately muted. This prevents any spurious signals from entering the sound system and allows the priests to switch their wireless microphones on and off while in the sacristy. When pressed, the RF MIC MUTE button illuminates and signals the priests that their wireless microphones are active. It also serves as an illuminated caution to de-activate the wireless system upon returning to the sacristy.

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The *Sound & Communications* panel was hosted by technical editor Jesse Klapholz. Held before a live audience, well-known guest panelists were Daniel Queen, president of Daniel Queen Associates; David Klepper, co-founder of Klepper Marshall King Associates, Ltd.; Donald Davis, president and co-founder of Synergetic Audio Concepts (Syn-Aud-Con); and Clifford Henrickson, consulting engineer for U.S. Sound Company. A lively discussion was followed by a question and answer segment by the studio audience.

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The time constraints imposed by the Papal visit on system design, fabrication, and installation became an extraordinary challenge. It is a minor miracle that such an expensive system was able to be completely operational in a remarkably short period of time. Very close cooperation between Jaffe Acoustics and the general contractor, Lloyd F. McKinney Associates, Inc. of Hayward, California, proved most successful in meeting a seemingly impossible deadline.

The support and encouragement from Archbishop John R. Quinn, Reverend P.J. McGrath and the entire Cathedral staff were very welcome and important factors in the development and timely installation of this new system.

SYSTEM SUCCESS

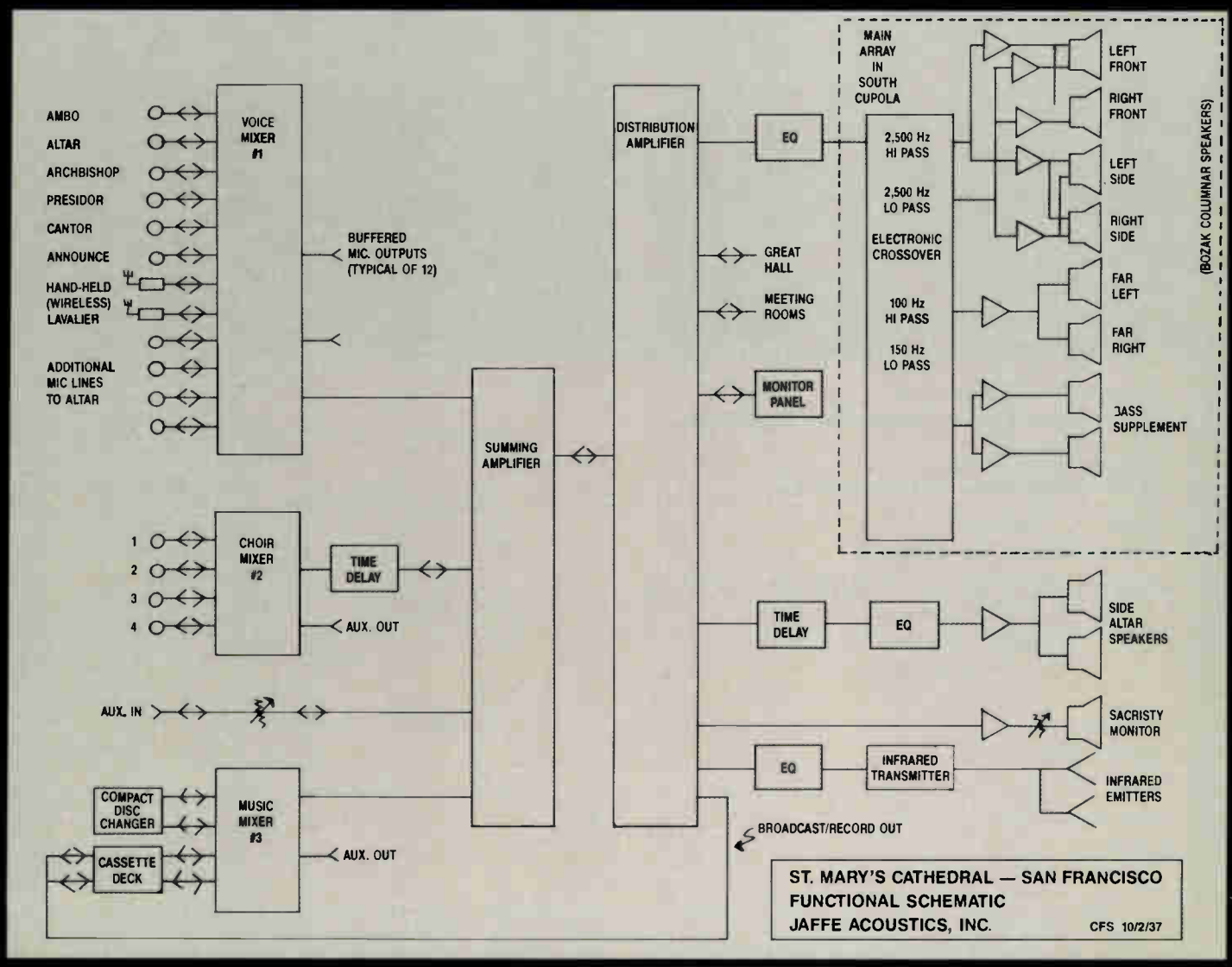
In a two million cubic foot room with a mid-frequency reverberation time of four seconds when empty (2.7 seconds when full), a sound system design is challenging under any circumstances. The new St. Mary's Cathedral sound system has fulfilled the design goals, and is providing articulate, natural sounding, well distributed voice reinforcement throughout this very large space.

The microphone system has proven very successful. The miniature microphones on their built-in goosenecks not only provide excellent sound quality, but also are minimally visible, especially on their black microphone stands. The internal vibration isolation on the microphones has proved very effective in minimizing mechanical coupling through the stands, floor, and pulpit. A substantial improvement in gain before feedback has been achieved over the old system.

The hypercardioid shock-mounted microphones, automatic microphone mixer, columnar speaker design, and minimal use of processing equipment have been combined to permit simultaneous use of 11 microphones, including two wireless systems, without approaching feedback difficulties while providing more than adequate sound pressure levels throughout the listening area.

Fully automatic operation of the system has proven extremely manageable and has yielded consistent and predictable results. Choir reinforement can now be achieved in a natural sounding and musical manner. Ambience enhancement with recorded music via compact disc technology has been successful and contributes to the experience of being present in this unique example of contemporary American church architecture. ■

Charles F. Swisher received his Bachelor of Science Degree in Electrical Engineering from the University of Illinois in 1956. He is a Member and Fellow of the Audio Engineering Society. A colleague of Christopher Jaffe, Jaffe Acoustics, Inc. since 1968, he includes among his sound design projects the San Francisco Opera, the New York Philharmonic/Metropolitan Opera Summer Parks Concerts, the Concord Pavilion, and the Hollywood Bowl. He has created sound designs and special effects for a host of operas, theatrical productions, musicals, and ballet performances.



SALES & MARKETING

(continued from page 10)

become obscured, the company will internally suffer and externally project chaos and confusion.

By its very nature, sales is a high energy visibility and a highly individualistic—or ego driven professsion. In an industry such as ours, it requires a great amount of technical skill as well as the ability to persuasively present products to satisfy any number of given applications. Selling becomes a highly developed, professional art form that is a curious mixture of skill, instinct and desire. Like many other art forms, it has no prescribed methodology and to a great extent is subject to individual interpretation. Although successful sales styles may radically vary—from Van Gogh to Picasso—it remains the individual perception of achievement which drives most sales people.

With few exceptions, sales managers are compensated via some type of bonus or commission arrangement which is predicated upon *gross sales.* Therefore, to a considerable degree, sales persons can control their own output and reward, without bearing any direct responsibility for the company's *net income.*

Marketing is entirely another matter. Whether you are at General Motors, a twenty person contracting firm or a manufacturer with one hundred employees, size does not alter functional requirements. Each job function within a large corporation proportionately reflects itself into the smaller, whether or not actual departments exist. In growing businesses, marketing is usually one of the presidential functions, at least until such time as budget constraints will permit otherwise. As the company continues to grow, more and more of his time is consumed by financial and other executive activity. He must begin to delegate—he must begin to formally plan. Clear achievable goals must be defined, along with a clear achievable procedure. The company may only have reached 20 employees, but if 19 don't know its planned objectives—or if those objectives change daily—the company simply cannot succeed.

Time has now become the enemy. Various key employees get less of his time and what were once reflective, considered communications have become quick-fix answers. Dumping marketing or operations into sales and engineering are really poor choices. The president may consider promoting some bright employee as his helper, with say, a 10 to 15 percent pay hike—then train the person. That might reasonably satisfy the payroll budget, but it will actually *increase* the president's work load. Training does not happen by osmosis. In a fast-paced, mid-size company it takes more time to train and supervise, than it does to simply do it yourself. Training, especially of mid-management personnel for higher level staff positions is probably the most gnawing problem for growing companies—and one of the highest priorities of large organizations. It takes years of concentrated effort and a considerable capital investment to accomplish even the most modest back-up of well trained people.

The 'Contractor's Speak Out' section of a recent *Sound & Communications* issue (May, 1987) bears on the perception angle of marketing. A New Yorker complained, "I want to convey to manufacturers that we, the contractors, are not the enemy. We must have maximum information." From Indiana came, "major. . .companies treat the dealer/contractor as the end user, rather than as part of a two way pipe line. . ." Then, at a recent trade show, a manufacturer's staff was lamenting about the lack of contractor loyalty to their brand. No doubt each of these comments have validity—and no doubt all *could* have been avoided. Be it contractor or producer, rep, consultant or even end-user, this kind of breakdown is preventable when clearly stated marketing objectives and procedures are effectively communicated and understood by all parties.

When visiting the bank or venture capital people, there is no better persuasive tool than a clearly defined marketing plan; one that indicates where the company stands today—where it intends to go—and how it intends to get there. This same tool will also work wonders with customers, suppliers consultants—and most especially—with your own company employees. When ways and means for accomplishing realistic objectives are clearly communicated, almost everyone is willing to grab an oar and row in the same direction. ■

MAY

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Starr Bros. Gives Art Sound

The challenge Starr Bros. Audio Inc. faced at the Vorpal Galleries in Soho, NY, was to install a sound system that would provide good sound that would compliment artwork by such masters as Picasso, Hamaguchi, Echer and others.

The equipment Starr Bros. found that were up to the task were 24 ADS L300cc two way miniature speakers, a Sony programmable CD player that holds 10 CDs per magazine, a custom SBA VOL-01 and an SBA custom mixer rack mounting and three Crown PS400s that power the system.

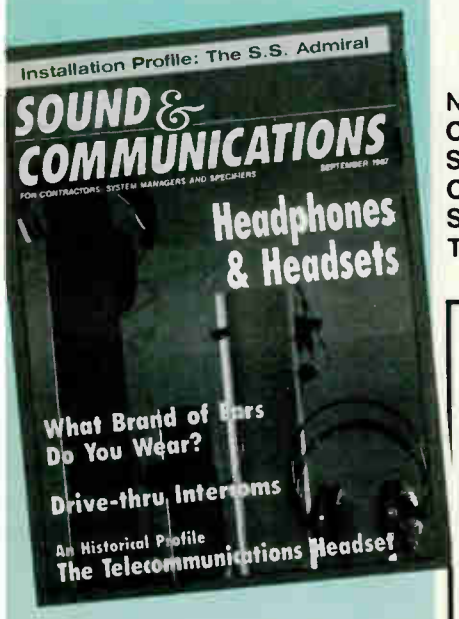
One of the problems both installer and equipment faced was the random nature of traffic flow through the gallery and the main viewing areas. In these places the system would be monaural. According to Peter Starr, president of

Starr Bros., "The alternative would have been to allow viewers to pass from left program, to stereo picture, to right program and so on as they moved about the large rooms, an effect that I find very unpleasant." Each floor has a private viewing room that is smaller, and gives the viewer a fixed seating area. These rooms were given a stereo picture. "The stereo image in the smaller, private viewing areas, with speakers distributed around the room, creates a dramatic effect that enchances any work being displayed," said Starr.

The equipment rack was located in the lower level, built into a wall. The central rack controls the overall volume level, equalization, program material, etc. Vorpal's owner, Muldoon Elder, insisted upon localized wall mounted volume controls for all areas, from audio full off to audio full on. The speakers would have to be out of sight, so as not to be a distraction.

SOUND & COMMUNICATIONS

QUICK PRODUCT INFORMATION GUIDE



SOUND & COMMUNICATIONS — JANUARY 1988

QUICK PRODUCT INFORMATION CARD

NAME: _____ TITLE: _____

COMPANY: _____

STREET: _____

CITY: _____

STATE: _____ ZIP: _____

TELEPHONE: ( ) _____

1 Are you a subscriber to Sound & Communications?
☐ Yes ☐ No

2 Primary Job Function (only one:)
☐ A Management/Owner
☐ B Engineering/Technical Mgt
☐ C Sales/Marketing
☐ D In-House Maintenance/Service
☐ E Field Installation/Maintenance
☐ F Consultant
☐ G Advertising/Promotion
☐ H Other _____

3 Primary business of company (only one):
☐ 1 Contractor—Engineered Sound/Acoustical
☐ 2 Contractor—Interconnect/Intercom
☐ 3 Contractor—Fire/Alarm/Safety
☐ 4 Electrical Contractor
☐ 5 Pro Audio/Studio/Reinforcement
☐ 6 Architect/Designer
☐ 7 Engineering/Acoustical Consulting
☐ 8 Maintenance/Service
☐ 9 Dealer/Distributor/Rep
☐ M Manufacturer
☐ O Other _____

4 Your purchasing authority:
☐ A Final approval/Buyer
☐ B Recommend/Specifier
☐ C No Direct Authority/User

5 Intensity of your product need:
☐ 1 Have salesman call
☐ 2 Need within 3-6 months
☐ 3 Future projects

6 Number of employees at your company:
☐ A 1-3 ☐ B 4-10 ☐ C 11-25 ☐ D 26-100
☐ E over 100

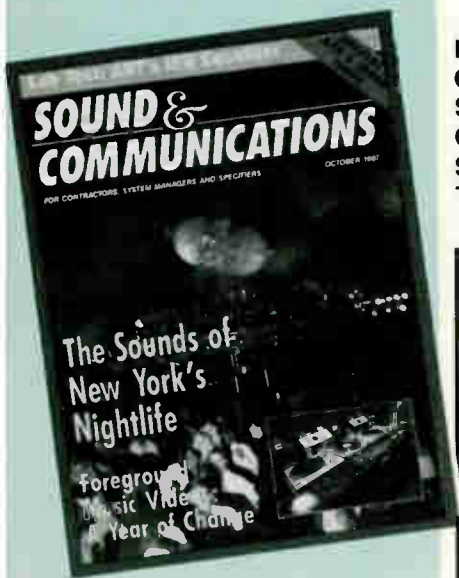
EXPIRES 5/1/88

NEW PRODUCTS: (Please Circle)

			43	60	77
			44	61	78
			45	62	79
1	15	29	46	63	80
2	16	30	47	64	81
3	17	31	48	65	82
4	18	32	49	66	83
5	19	33	50	67	84
6	20	34	51	68	85
7	21	35	52	69	86
8	22	36	53	70	87
9	23	37	54	71	88
10	24	38	55	72	89
11	25	39	56	73	90
12	26	40	57	74	91
13	27	41	58	75	92
14	28	42	59	76	93

ADVERTISING PRODUCTS: (Please Circle)

			243	260	277
			244	261	278
			245	262	279
201	215	229	246	263	280
202	216	230	247	264	281
203	217	231	248	265	282
204	218	232	249	266	283
205	219	233	250	267	284
206	220	234	251	268	285
207	221	235	252	269	286
208	222	236	253	270	287
209	223	237	254	271	288
210	224	238	255	272	289
211	225	239	256	273	290
212	226	240	257	274	291
213	227	241	258	275	292
214	228	242	259	276	293



SOUND & COMMUNICATIONS — JANUARY 1988

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COMPANY: _____

STREET: _____

CITY: _____

STATE: _____ ZIP: _____

TELEPHONE: ( ) _____

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☐ A Management/Owner
☐ B Engineering/Technical Mgt
☐ C Sales/Marketing
☐ D In-House Maintenance/Service
☐ E Field Installation/Maintenance
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☐ G Advertising/Promotion
☐ H Other _____

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☐ 2 Contractor—Interconnect/Intercom
☐ 3 Contractor—Fire/Alarm/Safety
☐ 4 Electrical Contractor
☐ 5 Pro Audio/Studio/Reinforcement
☐ 6 Architect/Designer
☐ 7 Engineering/Acoustical Consulting
☐ 8 Maintenance/Service
☐ 9 Dealer/Distributor/Rep
☐ M Manufacturer
☐ O Other _____

4 Your purchasing authority:
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8	22	36	53	70	87
9	23	37	54	71	88
10	24	38	55	72	89
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12	26	40	57	74	91
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207	221	235	252	269	286
208	222	236	253	270	287
209	223	237	254	271	288
210	224	238	255	272	289
211	225	239	256	273	290
212	226	240	257	274	291
213	227	241	258	275	292
214	228	242	259	276	293

EXPIRES 5/1/88

SOUND & COMMUNICATIONS

IT'S NOT JUST A MAGAZINE...
IT'S AN INDUSTRY

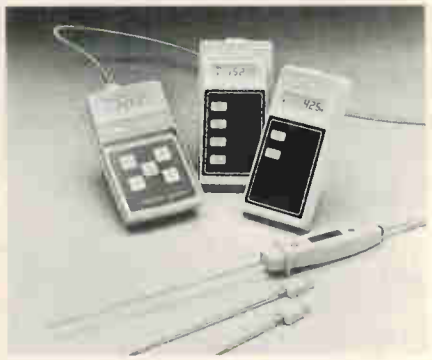
Place Stamp Here

TESTA COMMUNICATIONS
SOUND & COMMUNICATIONS
25 Willowdale Avenue
Port Washington, NY 11050

Place Stamp Here

TESTA COMMUNICATIONS
SOUND & COMMUNICATIONS
25 Willowdale Avenue
Port Washington, NY 11050

SUPPLIES



Beckman Introduces Hand Held Thermometers

Beckman Industrial Corp.'s Instrumentation Products Division has added three digital thermometers to the company's product line. These units will be available through Beckman Industrial's network of over 800 distributors and dealers nationwide.

Models 440, 445 and 450 hand-held thermometers all offer a number of features for use in the field or laboratory. They include an LCD display that is easily read in all lighting conditions; auto-off to extend battery life; the ability to switch from °F to °C; and a splash proof "touch-type" keyboard which ensures the models' profitability to field locations without the risk of weather damage.

Model 440 lists for $99, the 445 lists for $169 and the 450 lists for $295.

Circle 10 on Reader Response Card

Rush Wire Strippers' Hand Held Wire Stripper

Rush Wire Strippers has announced the availability of its Model MH-1, hand-held thermal wire stripper. The Model MH-1 is a lightweight stripper designed for stripping thermo-plastic insulation from solid or stranded wire from 12-43 AWG. The tool is useful for stripping problem insulations such as Teflon and P.T.F.E. A positive tweezer action strips wires and eliminates any risk of damage or nicking to wire conductors.

A self-contained, continously rated power unit is connected to the handpiece to provide variable temperature at the stripping elements, up to 1,400°F. A handheld cradle is attached to the power unit to act as a holder when the handpiece is not in use.

Circle 11 on Reader Response Card

Introducing Dear Dr. Wokka

This month marks the beginning of a new era in highly technical audio journalism. Dr. Wilhelm Wokka himself has graciously consented to author a new column, "Dear Dr. Wokka", which will address the crucial issues facing the sound industry today.

Many of you more technically astute readers are no doubt astounded by the good fortune presented here to the industry. Although this magazine has agreed to pay an unprecedented sum of money for this landmark event (thereby severely damaging its profit structure) the benefit to the readership is felt to be well worth the risk of going out of business. Yes, you heard it right; Dr. Wokka himself. A name mentioned in scientific circles in the same breath as Edison, Fermi, Michaelangelo, Funkenstein. For those of you more pedestrian and uninformed readers, and for the feeding of Dr. Wokka's ever-growing appetite for praise and publicity, here is a brief rundown on his stunning history to date.

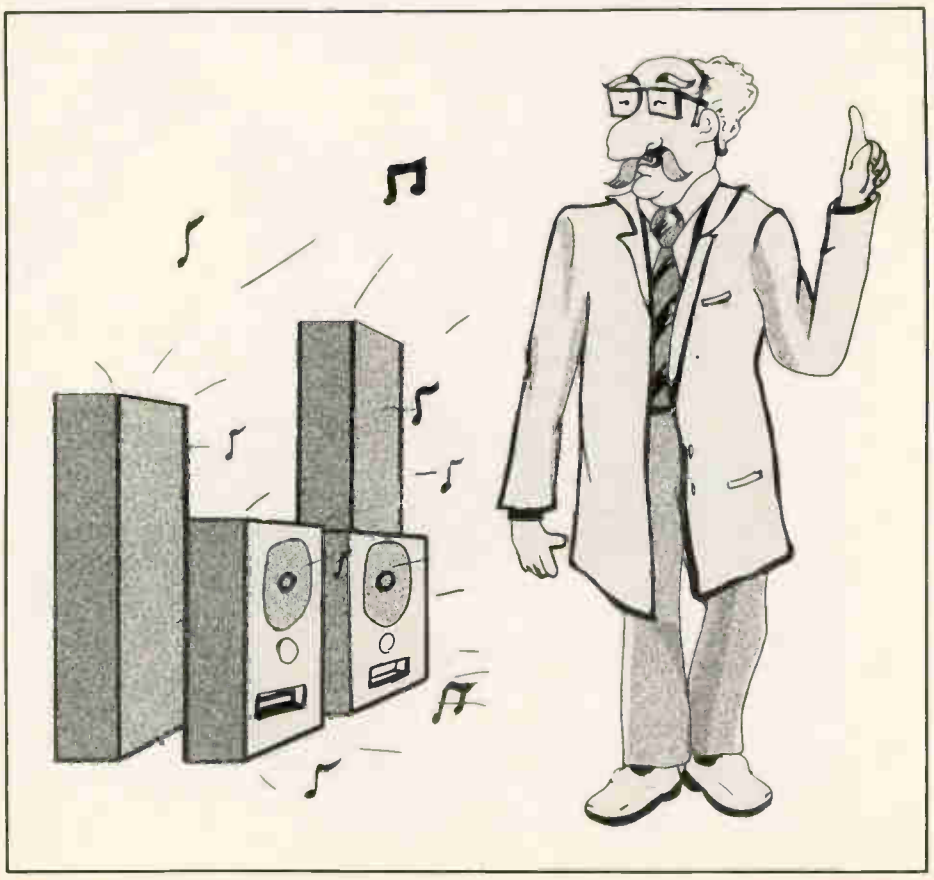
Wilhelm Wokka was born in 1943 in Dresden, Germany. In the period of 1955-1959, his lifeforces took a power-drift turn. He saw three movies; Blackboard Jungle, High School Confidential and Rock Around the Clock; attended an Elvis concert in London, consumed a bottle of Coca-Cola and saw a 1957 Chevrolet Bel Air convertible, powder blue with a white top, in a Life magazine advertisement.

As a result of these profound, sledgehammer-like experiences he convinced his father, then a ruined heavy-industry magnate, to "sell the shop", pack the Wokka family off to Los Angeles and open a Rexall drugstore/soda shop on Vine Street in Hollywood. Young Wilhelm immediately began work on "hopping up" the Wokka Rexall's Rock-Old Grand Prix jukebox, aiming for the impressive low end concussion he experienced as a young man in wartime Germany.

Using brilliant intuition and and a glowing vision of the "Monster Sound" as he called it he became immediately successful in his quest. His fame quickly spread outside of Hollywood as the Wokka soda fountain was featured in a major motion picture on the local pop culture, and the pleasure-bent as well as the curious were drawn from far and wide to sample the wondrous sounds. Soon, young Wokka had a monopoly on all jukebox service contracts for Wurlitzer, Seeburg, and of course, Rock-Ola. His famous mods on the latter prompted a collaboration and, of course, the now-classic Wokk-Ola was born, still a standard for high-impact jukebox design.

Dissatisfied with the limitations of his knowledge on his work, Wokka enrolled in the graduate program in acoustics at UCLA. He bypassed the undergraduate program by testing out all course requirements in a period of six weeks, scoring an above 90 percentile. Unfortunately, his radical new ideas on music, sound and acoustics were met with instant rejection by fellow colleagues and professors. Taunts of "fraud" and "quack" nearly broke his heart and he finally left to seek a more progressive channel for his work.

He found it at the Philadelphia Medical College of Musical Knowledge, long known for its quest of the cure for Musical Dystrophy, isolated in 1961 and then sweeping the country. Dr. Wokka received his PhD and Nobel Prize in 1965 for his discovery of the cure for M.D. and, of course went on to make audio history, armed with the wisdom gained in his research. Author of thousands of U.S. and foreign patents and countless articles in the Journal of Musical Medicine, he was also president of the American Musical Medicine Association (AMMA) for a decade. His most famous and important inventions are, of course, the molecular-resonance synthesizer, the Energized Ion-Cloud Loudspeaker, the self-coiling XLR microphone cable, the loudest guitar amplifier in the world and non-residual mucus gaffer's (duct) tape.



Dr. Wokka will be answering only the most profound questions on audio technology in his upcoming *Sound & Communications*' column, "Dear Dr. Wokka."

Please don't write in lame questions and offend this Great Man of Science. If you're real intelligent, prepare to be dazzled (yes, overwhelmed) by the jewels of wisdom to appear here every month. The Doctor's column will range from Musical Dystrophy in Remission to The Pompetous of Love to The Number of Acoustical Consultants it Takes to Change a Light Bulb.

Next Month: A popular subject: Video Games for Audio Engineers.

PRODUCTS IN REVIEW

Frazier's Cat's Out of the Bag

Frazier's CAT 60 is a high output system that extends Frazier's presence into applications calling for larger full-range systems. Intended applications for the CAT60 include theatres (behind the screen), convention halls, arenas, auditoriums, larger churches, night clubs, and discos among others. The CAT 60 will also function as a studio monitor. This loudspeaker is a two-way, high output, controlled directivity system. It features two heavy-duty 12 inch woofers. Transducer placement and crossover characteristics result in point source alignment. Frequency response is 45-15Khz ±3 dB, sensitivity—96dB/1W/1M, power handling—250 watts (AES standard); impedance is 8 ohms.

Circle 5 on Reader Response Card

Tannoy Introduces Professional Monitor

Tannoy North America has introduced a new member to its professional line of monitors called the PBM 6.5. The PBM 6.5 is a small play-back monitor with a diverse character. It can be employed on stage, or be used as part of a background music system. The PBM 6.5 is priced at $298 per pair.

Circle 6 on Reader Response Card

Siedle's Intercom System Camera Unit

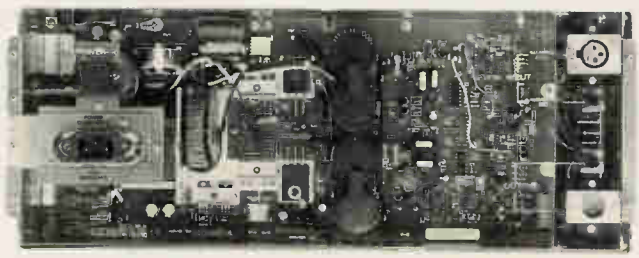
Siedle Intercom/USA has introduced its outside camera voice unit for the flat screen video intercom. It features a low light camera with an auto iris and wide angle lens.

The camera is not powered until the picture is needed. No preheat is necessary and the camera turns on in one second. In addition, the unit can accommodate up to 275 apartments and up to 20 entrances.

Circle 7 on Reader Response Card

a closer look

by gary d. davis



Bose Acoustimass Professional Powered Speaker System

A high performance professional powered speaker system, offering full-range frequency response at high SPL in a small enclosure, has been introduced by Bose Corp.

The Bose Acoustimass professional powered speaker system is a two-way seven-driver amplified and equalized system in an injection-molded enclosure. It achieves 122 dB SPL at one meter, operates between 50 Hz and 18 kHz ±3 dB, and requires no external power amplification. The unit measures 16 by 22 by 23 inches, takes up less than 5 cubic feet in volume and weighs 70 pounds.

The Bose Acoustimass professional powered speaker system incorporates several patented technologies developed at Bose Corp. Led by M.I.T. professor Dr. Amar G. Bose, the Bose engineers have incorporated six critical technologies into this new product: The *Acoustimass bass reproduction system* in which sound is launched into the room via two air masses rather than by a vibrating surface. The benefit is clarity at all power levels; a digital mode high power amplifier which utilizes *Two State Modulation switching amplifier technology*. It is lightweight, creates little heat, and, being 90 percent efficient, minimizes electrical power requirements.

The third critical technology is an ultra powerful low frequency transducer (woofer) with *electromagnetic braking system* which combines very high power output with clarity; *Wide-range HVC drivers* which combine ruggedness with clarity for mid-range and high frequency reproduction; an *articulated array* arrangement of drivers that provides nearly optimum dispersion over the audio range for clarity and consistent volume for all listeners; and a *reaction injection molded enclosure* offering ruggedness, ease of transport, mounting and installation, and lighter weight.

The Acoustimass Professional is a system solution for a large number of sound reinforcement applications. It is stand mountable for portable sound reinforcement and also has molded-in handles for ease of transportation. For installed sound applications, the enclosure has integral molded-in hang points, which, when used with Bose accessory hardware, allow a variety of wide array configurations. Its ¼-inch phone jacks and XLR (Cannon) connectors allow it to be used to amplify virtually any line-level source signal—with no external amplifiers or equalizers to complicate a quick set-up and tear down.

The Acoustimass Professional Speaker System will be available in early March 1988 at a suggested retail price of $2,500 per unit.

Comments: The Acoustimass is an impressive speaker system. One can gain some sense of this from reading the press release, and from the accompanying literature Bose provided to us. However, we have another basis for our statement, a live demo and factory tour in Farmingham, Massachusetts.

Bose invited approximately 60 journalists to a press conference/product unveiling just two weeks after the October AES convention (where the Acoustimass Pro could have been unveiled at a relatively minor cost). However, Bose Corp. wanted to make a big splash—to have the spotlight on their products, and to provide a complete background to the press which could not have been accomplished in the typical one hour press conference.

During the tour, we met many of their 160 staff engineers, and were shown the component technologies that go into the Acoustimass product. The demo included the setup of two different systems as we watched (very fast and simple), and a live performance by a local rock band.

Why do I share this with you as part of the commentary? While press events of this type are common in other industries, they are not in pro audio. Bose made a big splash, and they deserve credit for an absolutely first class presentation. Beyond that, you'll probably be seeing quite a few commentaries in other magazines on this new product, and you should know where that is all coming from. Still, this should not take away from the product itself.

The Acoustimass is an impressive system, as I have stated. It sounds good. It puts out a lot of level—more, in fact, than the literature or press release would suggest. The 122 dB SPL/1 meter maximum is based on a continuous output. Peak levels, one

(continued on page 72)

FACES AND PLACES

HME Relocates to San Diego

HM Electronics, Inc. has moved to a 40,000 square foot facility in the newly developed Sorrento Mesa area of San Diego. The new facility, located at 6675 Mesa Ridge Rd, San Diego, CA 92121, telephone (619) 535-6060, enables the company to increase its engineering and manufacturing departments.

Altec Names Phillips Director of Sales

F. Davis Merrey, Jr., president of Altec Lansing Corp. has named Larry Phillips director of sales. In his new post, Phillips will be responsible for management of the company's employed sales force.

As a technical representative with Edwards Co. and as a sales engineer for a sound contractor, he has worked with architects and contractors alike, resulting in an understanding of the industrial/professional audio market. He joined JBL in 1968 where he held a variety of positions, including sales manager and marketing manager during his six year tenure. Later as the director of marketing at TEAC, he helped develop a second generation line of multi-track recorders and consoles. Phillips also worked in the international arena for Harman International for four years.

Lexicon Appoints Broadcast Sales Manager

Joel Silverman, director of sales for Lexicon has announced the appointment of Steve Barbar to the position of broadcast sales manager. In his new position, Barbar will manage broadcast manufacturer's representatives, train new representatives and dealers and oversee the development, marketing and sales of broadcast products. Also, he will assist in promoting sales of Lexicon Advanced Products and OPUS, Lexicon's random access digital audio production system.

Prior to joining Lexicon, Barbar spent three and one half years at Systems Wireless Ltd. as applications manager. His work history combines rep and sales work at Sphere Associates and Veneman Professional.

REP NEWS

HM Electronics has appointed **R.L. Graham Associates** as rep for all pro audio products in Iowa, eastern Nebraska, Kansas, Missouri and Southern Illinois. Also **A/V Marketing,** HME's rep for Indiana and Kentucky, has expanded its territory to include Ohio, Western Pennsylvania, and West Virginia. **Kurt Gish** will cover the western region and Denny Gattuso will handle the eastern region.

At the A.E.S. convention in New York City **Michael Chafee,** independent sales representative and president of **Michael Chafee Enterprises,** was named **Turbosound** Rep of the Year by company president Alan C. Wick.

S&C's Job Report

Format
STATE
city: Name of Job, $ Total of Construction, Phase of Project. Contact: Name, Company, City, State; Telephone Number.

TOTAL CONSTRUCTION
1—up to $1 million
2—$1 million to $9 million
3—$9 million to $17 million
4—$17 million to $25 million
5—$25 million and up
NA—Not Available

PHASE OF PROJECT
A—Planning = Consultant is designing system
B—Pre-Bid = Final plans near completion
C—Bidding = Bid date set
D—Starting = Electrical Contractor/ General Contractor/ Owner buying now

The following jobs are in various phases leading up to bid. If you are interested in any of the projects, please contact only the names printed below.

ALASKA
Aleutian Islands: Shemya AFB, NA, A. Contact: Craig E. Park, Paoletti/Lewitz Associates, San Francisco, CA; (415) 391-7610.

ARIZONA
Tuscon: Temple of Art and Music, 2,A. Contact: Robert Lorelli, Brannigan-Lorelli Associates, Inc., New York, NY; (212) 420-8787.

CALIFORNIA
Concord: Automatic Data Processing, 1,D. Contact: Craig E. Park, Paoletti/Lewitz/ Associates, San Francisco, CA; (415) 391-7610.
Fresno: John Wright Theatre, California State University, Fresno, NA,A. Contact: Craig E. Park, Paoletti/Lewitz/Associates, San Francisco, CA (415) 391-7610.
Los Angeles: Ketchum Communications, 1,D. Contact: Craig E. Park, Paoletti/ Lewitz/Associates, San Francisco, CA; (415) 391-7610.
Los Angeles: Simon Wisenthal Center, 3, B. Contact: Neil A. Shaw, Paul S. Veneklasen & Associates, Inc., Santa Monica, CA; (213) 450-1733.
Menlo Park: Raychem Corp, 1,A. Contact: Craig E. Park, Paoletti/Lewitz/Associates, San Francisco, CA; (415) 391-7610.
Milpitas: Sun Microsystems, 1, A. Contact: Craig E. Park, Paoletti/Lewitz/Associates, San Francisco, CA; (415) 391-7610.
Modesto: Trinity Presbyterian Church, 1,D. Contact: Craig E. Park, Paoletti/ Lewitz/Associates, San Francisco, CA; (415) 391-7610.
Oakland: East Bay Municipal Utility District, 1,A. Contact: Craig E. Park, Paoletti/Lewitz/Associates, San Francisco, CA; (415) 391-7610.
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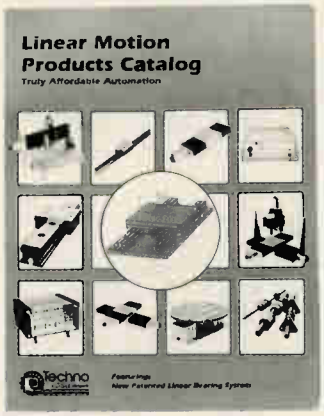

Techno Describes Linear Bearing System

A 64 page Linear Motion Products catalog from Techno contains over 500 low cost modular off-the-shelf components for building dozens of automated testing, measurement, assembly or production machines.

Highlighted in the catalog, identified as TI-830, is a recently patented recirculating linear bearing assembly.

The catalog is organized into a dozen major product groups.

Circle 8 on Reader Response Card

Dialight's Applications Oriented Light Guide

Dialight has published a 184 page indicator light catalog that provides product information as well as step-by-step guidelines for selecting the proper indicator for specific applications.

The catalog, "The Complete Guide to Dialight Indicator Lights," provides information on a million-and-a-half neon, incandescent and LED indicators, including physical and electrical characteristics. The catalog contains drawings, labeled with dimensions that show the indicators from several aspects.

Circle 9 on Reader Response Card

BOOK REVIEW

(continued from page 52)

A chapter on tape recording covers the basics of machine functions, operation, and everyday maintenance, as well as noise reduction systems.

Signal processing is described in some detail, as it applies to recording. For example, the discussion of equalization centers around the EQ controls one is apt to find on a recording console, and not the boxes with the dozens of slider knobs many of us are more used to in reinforcement. Compressing, limiting, flanging, delay, reverberators, doubling and chorus, they're all here, viewed as recording effects devices.

Here we find a table that ought to be the constant study of every audio engineer who must deal with those lacking trained ears. Technical characteristics of sound, carefully defined, are listed with the everyday terms often used to describe them. Unlike other similar compilations, no presumption of desirability or undesirability is made, and both positive and negative terms are given for each technical characteristic.

For example, consider a high frequency boost, about 7 kHz. Those words, "high frequency boost, about 7 kHz" are a technical description of something that might sound quite pleasing or quite irritating to two different people. Someone who likes it uses the term "crisp" (among seven words listed), while someone who dislikes it might call it "edgy" or "glassy."

What's mellow to one listener is dull to another, and we're ill served by technical books that pretend to define the difference in engineering terms.

Several chapters describe recording procedures, in the studio and on location, for various types of music and speech. Specific suggestions are made for judging sound quality under different conditions, and there is page after page of ideas for correcting audible faults. Move the microphones. Try microphones with a different coverage pattern. Add signal processing. Bypass signal processing. This part of the book can make an important contribution to the beginning or inexperienced recordist, who will do well to keep it near his hand during recording.

The discussion of monitoring covers some basic ideas in monitor loudspeakers and power amplifiers for them. Viewed by itself, this chapter contains some statements that could result in ungentlemanly arguments. We are told, for example, that we may expect a loudspeaker to play 10 dB louder than its 1 watt sine-wave sensitivity, plus 10 times the logarithm of its sine-wave power handling. The extra 10 dB is for peaks, we are told. Actually, the peak-to-average ratio of a sine wave is only 2 dB. In much the same way, we are told that a 100 watt amplifier and a 25 watt amplifier in a biamplification configuration produce the same peak power as a 225 W amplifier with a passive cross-over. In much the same way, we are given a table of wire gauges to use in connecting the amplifier to the loudspeaker, so as to avoid power loss in heating the wire. One would suppose that in the most critical listening applications the effect of wire resistance on frequency response and damping factor would be much more significant than simple power loss.

The chapter on monitoring brings one to realize that this book is not about the engineering part of audio, but rather about the music part, a part we impoverish our lives by ignoring. Bartlett concludes his book with a

chapter titled, "Why Do We Record?" Why indeed?

When Thoreau was told the states of Maine and Texas were connected by a telegraph wire, instead of marvelling at the technology, he retorted, "But what have Maine and Texas to say to each other?"

Recorded music is an art, a business, and a technology. Bruce Bartlett's *Introduction to Professional Recording Techniques* is addressed to the artist who wants an entrée to the technology. It also reminds the business and the engineer that he also serves a more demanding and more rewarding master than the balance sheets or the dBs. ■

PSYCHOACOUSTICS

(continued from page 47)

Other Options

Since most audio engineers and technicians do not have access to one of the above instruments, they might consider the acqusition of the NE or the RASTI analyzer or they might consider the purchase of a TEF analyzer, the portable analyzer with the most potential; the TEF is limited by the need for understanding of its function and skill in its use, and this is being somewhat resolved by new software, but I am not aware of any psychoacoustic software currently in the works for the TEF.

Another option is the use of existing equipment, such as 1/1 octave and ⅓ octave real time analyzers, for example, the IVIE 30A-17A and 40 PL. While these don't have much time domain control, they can perform reverberation calculations and evaluate background noise levels, and some architectural software can be developed by the user for the new 40 PL.

In the interim, a semi-anechoic listening room can be set up inexpensively to evaluate the quality of loudspeakers, and the guidelines provided by Bradley can be used for considering intelligibility for rooms with up to four seconds of reverberation, remembering that the two most often problematic variables in room and sound system design are local reverberation and background noise levels. **(See Figure 6.)**

At this point, subjective room quality evaluations are best left to those equipped to measure them via one or another of the above methods and who perform these measures frequently, as they have great potential to provide useless or detrimental data, if used incorrectly. Remember that the ear is the best instrument for final verification and is the final arbiter of all psychoacoustic quality parameters, but it ranks far lower for complex analysis of the source of room acoustics and audio problems. ■

Steven J. Orfield, a Minneapolis consultant, has been involved with architectural technology consulting for 15 years and practices in the fields of acoustics, audio, lighting, daylighting and thermal environment. He is a member of ASA, AES, ANSI, ASTM, IES and IFMA, and is on the ASTM E-33 Committee on Environmental Acoustics.

Bibliography

Figure 1: *JAES*, January, 1986, pg. 6.

Figure 2: *JAES*, May 1986, pg. 332.

Figure 3: *JAES*, May 1986, pg. 338,

Figure 4: Ballou, Glen (Editor), *Handbook for Sound Engineers, The New Audio Cyclopedia*, pg. 170. Indiana: Howard W. Sams & Co., 1987.

Figure 5: Norwegian Electronics Literature, Tranby, Norway.

Figure 6: *JASA*, Sept. 1986, pg. 843.

CCTV SYSTEM

(continued from page 20)

of view, all he would have to do is push the same number button on the switcher under that monitor. The video from the selected camera would then be presented to him on the second (bridged) monitor connected to that switcher. He now would have the camera isolated to the second monitor and also have control of the pan and tilt and zoom lens functions, if available. Video Motion Detectors were recommended as an option to the system; they sense any motion in the cameras, field of view and sound a warning. The motion detector would automatically switch the proper camera and control to the bridged output of the switcher for the guard to take instant action on. Although not incorporated in the initial system, they can be easily added at a later date.

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CLOSER LOOK

(continued from page 66)

Bose engineer told us, are between 130 and 140 dB SPL. Based on what we heard, we believe that is probably true. There was a bit of hype regarding Bose being the first to offer an integrated (powered) full range pro speaker (Altec did so years ago), but it certainly is a unique package. As you can see from the cutaway view, the molded package is compact and full of goodies. What you cannot see is how the unit works.

The Acoustimass principle relies upon two chambers of different volume, one on either side of the 12-inch long-throw (1½-inch) woofer. Each chamber has a ducted port (the slots that both come out of the front of the enclosure). The ports act as separate pistons, coupling the sound energy from the chamber to the environment. The chambers provide a high acoustic pressure against which the woofer diaphragm can work, which (according to Dr. Bose's excellent presentation on acoustics) increases the efficiency of the driver considerably. Because each chamber is tuned to a different resonant frequency, the woofer maintains a reasonably flat response throughout the range of about 50 to 200 Hz, above which it falls off like a brick. However, the array of smaller drivers takes over there (assisted by a built-in high-level passive network). The real purpose of the Acoustimass loading is to allow the woofer to operate in its resonance range, thus minimizing diaphragm motion, which, in turn, minimizes distortion. Why, then, does it have such a long excursion? To allow it to generate a lot of SPL! And the driver is specially designed with built-in magnetic braking (a kind of physical peak limiter using the magnetic structure) so that even at very high power inputs and the lowest frequencies, it does not slam the coil former against the back plate.

The high frequencies are reproduced by Bose's now well-known 4½ inch HVC (helical voice coil) drivers. They do the job, and with six of them in a custom-aimed array, the dispersion is very wide and even (we walked in an arc from center stage to the edge of the stage during the live band performance, and noticed no lobing and minimal changes in response until we were about 60 degrees off-axis—then a gradual high frequency loss).

The power amp is a 450 Watt switching amp. Actually, Bose distinguishes their "two-state modulation" amplifier technology from typical Class D or PWM (pulse width modulated) switching amps because there is no clock frequency for the switching; it is signal controlled. The amp is very compact, and because it is part of a closed system (which includes EQ for the drivers), it has been optimized as a separately packaged amp. The physical resonance of the amplifier package is about the highest frequency the woofer handles.

Not only does the molded enclosure allow for each stacking and stand mounting, metal through-rods can be unscrewed, longer rods inserted, and thus multiple enclosures (up to three) can be securely stacked, slung, and hung very easily. While the unit is compact, it puts out as much SPL (including the low frequencies) as enclosures three to four times its size. The price per unit does seem high at first blush (about $2500), but it compares favorably with the price of a separate 450 Watt amp, full range drivers, and the accompanying cabinet and crossover. All in all, we think the Bose Acoustimass Professional powered speaker system deserves your *Closer Look*, too.

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Don't miss the February issue of *Sound & Communications* magazine

The AES Technical Meeting

Once again the audio community has brought together the greatest minds in audio today at the Audio Engineering Society Convention in New York City. The cavalcade of stars ranged from vacuum-tube experts to theorists on the cutting edge of anti-gravity technology. From around the world inventors, tinkerers, technicians, engineers, designers, and pro-audio buffs, congregated enmasse, in hithertofore unprecedented numbers, throughout the spacious quarters of the New York Hilton and the Sheraton Centre.

Once again volunteers vied for the envious and thankless jobs of organizing a technical forum for the onslaught of every consummate audio engineer with the solution to the missing bit, dB, and .0001 percent—a job left only for real men and women of audio. Whether it was supplying a sound system for those of the academic world and succumbing to the taunts of laughter over the "invalid third-order crossover," or squeezing in an elevator of lost 47th-St. (music store row) kids fighting to get to the best live demo of a synthesizer they'll never buy—it sure was the Big Apple at its finest.

Does this sound sarcastic or fatalistic you ask? Does waking up at 6:30 AM to the tune of screaming cabbies, jack-hammers, and traffic, rushing to a $15 plate of cold eggs and hard toast, to make it in time for a two-hour session on graduate-level transform theory—which was smashed by a recognized authority in the field at its conclusion—sound like a weekend of fun in the Big City? To all the audio masochists in attendance it was sheer bliss. To those non-Pee Wee Herman types there was a fair share of tilted glasses at the bar remorsing over the state-of-the-art of the business. Of course, as in tradition in New York (and in many other locales I'm told), it is the hotel lobby bar where the greatest of deals are made.

To this end many hours were spent in temporary emergency offices set up by the Hilton Hotel, commiserating with the all-time greats in audio including Hiram Levity, and the celebrated Dr. Wokka. Conversation, ensuing battles, arguments and fist fights were akin to scenes from Clockwork Orange. Explicity, the underlying theme of our "Audio Summit" was socially oriented. The meeting of over 14,000 audio experts in two buildings was truly a story almost impossible to reduce to words. The importance of these social interludes is rather lucid when considering the nature of our industry.

Simple ideas are what most of our industry is based on; the invention of the telephone—a simple electromechanical invention that stirred the world, for example. More significant is when an engineer with a great idea leaves his roost for a new home than the introduction of a revolutionary way of telling time. Ingenuity, opportunity, and technology cross-pollinate to produce the possibilities not afforded by academic prowess alone.

Minimization of academic importance is not stressed here, but more than that its 'perspective' in this crazy entrepreneurial and musical business we call sound and communications. In our bar-room conversations we observed how well we listen to the needs of others to freely communicate without the obstacles of stress and poor environment. Our role, in at least one respect, can be reduced to the concept of providing efficient and ergonomic means for channels of communication and personal expression.

With the 83rd Technical Meeting theme of "Audio Or Video: Analog Present, Digital Future," we are sure to follow in the footsteps of our forefathers who started audio for film. We start the new year with overcoming the challenges of the new computer, communications, and entertainment age. Supplanted by the technical support afforded us by the abundance of technical documents carried home on the sore shoulders of all our greater audio buffs, we look forward to a new year of technical audio milestones.

Jesse Klapholz
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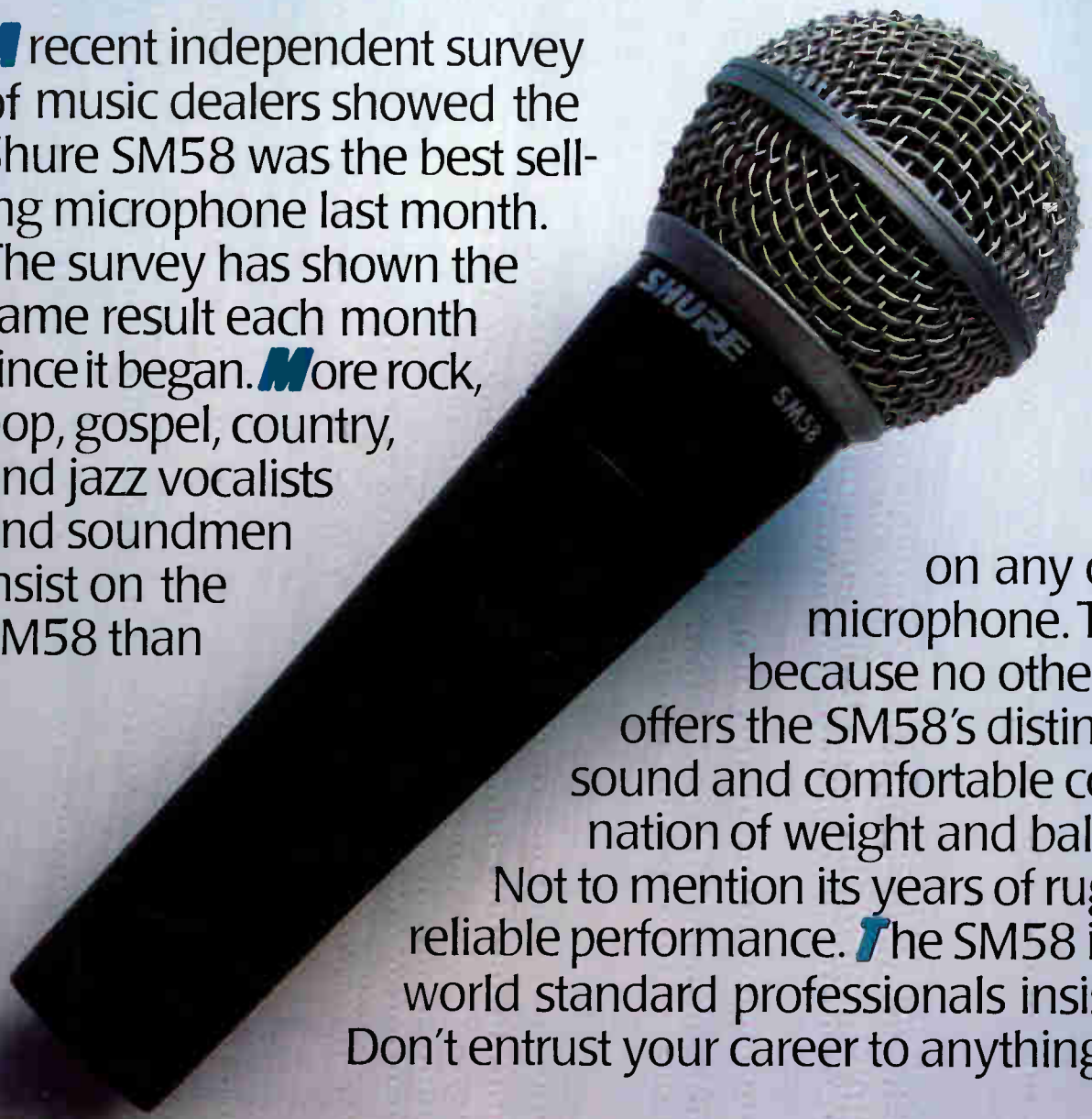

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