NSCA Wrap-up — What an Expo!

SOUND & COMMUNICATIONS

FOR CONTRACTORS, SYSTEM MANAGERS AND SPECIFIERS

JUNE 1987

A Historical Perspective: Stereophonic Sound Systems

Assistive Listening Devices: An Overview

SPECIAL PULL-OUT SECTION
THE CONTRACTOR'S GUIDE TO MIXING CONSOLES

Large scale concert sound reinforcement has a smaller future.

MT-4

Concert Sound System

50,000-Watt Array

Manifold Technology™ delivers...twice the output in half the space!

Concert sound is getting smaller. System size, that is, not tour dollars! In fact, the high-level sound market is stronger than ever. But high transportation and setup costs are forcing lighter, smaller and more efficient speaker systems. While audiences demand better fidelity.

That's why we've made Manifold Technology *systems twice as loud in half the spuce.* The two-box, 4-way active MT-4 uses 4 (four!) drivers in each bandpass for unequaled acoustic output. Now, your system can be one quarter the size or four times as loud compared to other designs.

The MTA-42 Manifold Technology adapter combines four compression drivers without added distortion. And without the phase cancellations of Y-adapters! That's 4 supertweeter and 4 upper-midrange compression drivers on identical 60° × 40° constant-directivity horns. To complete the MTH-4 "high" box, four DL10X woofers use proprietary phase plugs to provide seamless vocals from 160-1600 Hz. The result is flawless 138-dB midbass at 1 meter!

The MTL-4 "low" box combines four 18-inch woofers in an ultra compact 36″ × 36″ × 30″ cabinet. More efficient than horn-loaded subwoofers, Manifold Technology design prevents woofer "bottoming" even at 40 Hz with 1,600 watts input!

High output plus high fidelity

To produce high-level sound, most concert systems aim many horns at the same seating area. Unfortunately, this approach causes peaky frequency response, decreased sensitivity and ragged coverage patterns. With four drivers on each horn, a large-scale MT-4 system has fewer independent sources. For fewer phase-cancellation problems. Frequency response is smoother, sensitivity increased, and coverage perfectly constant.

A flying system that's second to none

MT-4 cabinets are optionally equipped with a unique two-point flying system that allows true point-source arrays. Tilt angle adjustment is easy because track positions are pre-engineered for popular array configurations. Trial-and-error guesswork is a thing of the past. Nothing is as easy as an MT-4.

You don't have to wait for the system of the future. It's here now! For a free MT-4 brochure, see your EV Professional Audio Dealer or write: Electro-Voice, Inc., Dept. SC-4, 600 Cecil St., Buchanan, MI 49107.

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AKG... IT'S OBVIOUS.

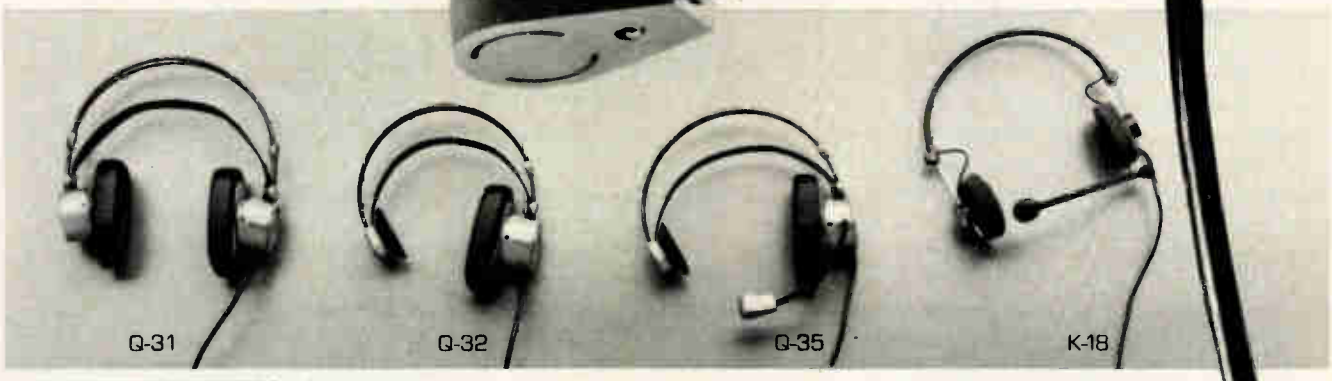
Some things are just obvious. For any number of applications, headset mics are the only way to go . . . but they also can be a big headache. Many on the market sound bad and feel — after only a few minutes — even worse.

Not the AKG Q-series. Whatever your need in an intercom or broadcast communications application, we've got a headset ready to meet it with unparalleled comfort, audio quality, and reliability. Features like close-talking, noise-cancelling microphones, removable/washable ear cushions, self-adjusting headband and options providing squelch circuit, carbon equivalency, in-line mic preamp and PTT switching.

It takes the best sound and best feel to make the best headsets.

With AKG, some things after all, are just obvious.

Q-34



AKG acoustics

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Stamford, CT 06902

SOUND & COMMUNICATIONS

Volume 33 #6
June 1987

16

DEPARTMENTS

ON THE COVER

The Des Moines Symphony, Yuri Krasnopolski, conductor, performs Beethoven's Ninth Symphony in the Des Moines Civic Auditorium. The auditorium features an eight-channel stereophonic sound reinforcement system which is not used during classical performances. The loudspeakers for direct reinforcement are mounted in a canopy above the proscenium. Photo by Paul S. Veneklasen and Associates.

FEATURES

COLUMNS

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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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EDITORIAL

It Happened... People Talked... Word Got Around

There is absolutely no doubt in anyone's mind that the NSCA Expo in New Orleans was a smash hit of a show. The attendance, the attitude, the interest and the overall results and benefits to both exhibitor and attendee were overwhelming. Congrats to the entire committee and Bud Rebedeau and staff for a job very well done.

In this issue we tried to capture some of the excitement of the gathering while at the same time give you an overview of the seminars and some of the new product introductions that took place during those three days. We at *Sound & Communications* think that one of the most significant things to come out of this show was the overall feeling of maturity, sophistication and dedication by all to being more "professional." We are an industry that may be over 30 years old, but we're just beginning to take ourselves seriously—and that's great.

The lead feature in this issue is on Stereophonic Sound Systems. It discusses the fundamental theory underlying stereophonic sound as it was developed at the Bell Telephone laboratories in the 1930s and the article should prove extremely informative and helpful to all. In this month's installation profile, the legendary Beverly Hill Hotel gets a going over. The "tinsel-town" landmark is now equipped to serve the professional sound needs of its film and TV guests.

In addition to the regular departments like Lab Test, Rep News and Contracting Close-up, we are very pleased to present a special pull out/center supplement entitled THE CONTRACTORS' GUIDE TO...MIXING CONSOLES. In this special supplement, you will find all the pertinent information about all the mixer products available to you by today's manufacturers. It includes model numbers, specs and prices to help you find the right product for your client's needs. We are proud to say that this is a first for this market...and something that we intend to continue on a regular basis. *Sound & Communications* will cover every product category you do business in...Amps, Speakers, Microphones...etc.

I was very serious when I said that the oldest magazine in the business is now the best. This special pull-out supplement is another sign of the commitment by Debra Pagan, Jessie Klapholz, Cliff Capone, and all at *Sound & Communications* to help you succeed and prosper in this market.

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EditorialDirector/Publisher

SOUND & COMMUNICATIONS

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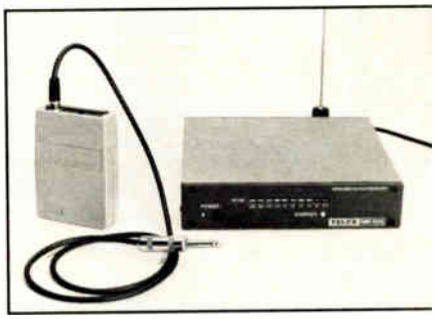
Why do you suppose one company seems to introduce the most new wireless systems?

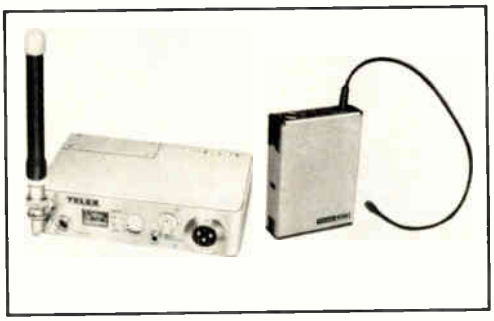
1984: FMR-2 Pos-i-Phase Diversity systems

1985: FMR-50 Economic Non-diversity systems



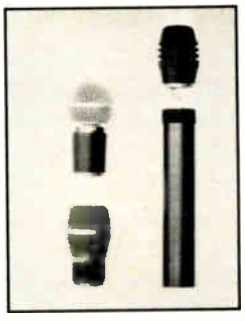
1985-'86: FMR-50G (pictured) Non-diversity and FMR-2G Diversity Guitar systems

1986: Sound Enhancement, Personal Audio system



1986: ENG-4/WT400 Compact, Multi-Channel system

1987: FMR-4 Multi-Channel, Rack Mountable Receiver



1987: HT-400 2-Channel Mic/Transmitter with interchangeable heads

Because they do.

For a long time now, Telex has been successfully introducing new wireless systems each year. They seem to have the knack for recognizing a market need and satisfying it. As a result, the popular Telex line of wireless products has grown to be the envy of the industry. Each time a new Telex wireless product is developed, an eager market is willing to give it a try based on past experience or the recommendation of trusted colleagues. Next time your situation calls for wireless, choose from the growing Telex family. We're running fast to keep up...with you.

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NOKIA BUYS CUE NATIONWIDE PAGING COMPANY

The DiversiCom nationwide paging service company, formerly a subsidiary of ADCC in Costa Mesa, CA, is now a wholly-owned subsidiary of Nokia-Mobira, the Finnish industrial conglomerate. The company is now operating under the name Cue Paging Corporation. Cue operates the first nationwide paging network in the nation, with instant service offered in more than 80 metropolitan areas and over 2,000 smaller towns. Message retrieval is available throughout the country. "Nokia-Mobira was seeking a way to participate in American telecommunications, and they believe that nationwide paging will be a good starting point," said Gene Swanzy, president of Cue. Cue is also affiliated with Century Telephone, one of the largest telephone companies in the U.S.

SECOND PHASE OF NORTHERN TELECOM/APPLE ALLIANCE IMPLEMENTED

The second phase of the Northern Telecom and Apple Computer strategic alliance program was implemented with the announcement of four new networking capabilities that further extend the ability of the Apple Macintosh personal computer family to communicate over Northern Telecom's Meridian SL-1 integrated services network. The new capabilities include linking separate AppleTalk networks, "dial-up" remote use of LaserWriter printers, "one-step" file transfer and conversion, and Memorybank 485, a new 485-megabyte storage subsystem for use with the Apple Macintosh personal computer family. The first phase of the alliance took place in the fall of 1986 and expanded Macintosh users' networking capabilities by providing users with the tools to communicate with a variety of computers. In other news from Northern Telecom, the company has announced that it shipped to Japan the first digital central office switching system the company has sold to Nippon Telegraph and Telephone (NTT) under the terms of a $250 million supply agreement. The Northern Telecom DMS-10 is the first manufactured digital central office switching system that will be installed by the Japanese public telephone network. Northern Telecom and NTT officials initially worked together in 1983 to develop the KS2 switch, an emergency switch to restore telephone service damaged by earthquakes in Japan.

MTN SERVICES AND UCS AGREE ON JOINT EFFORT TO MARKET SHARED REVENUE

MTN Services, Inc. a member of the Marmon Group of Companies, has entered into an agreement with Universal Communications Systems, Inc., to jointly provide telephone systems on a shared-revenue basis nationwide. "The typical revenue sharing arrangement involves a large facility, such as a hotel, hospital, university or office complex, in which the phone service is made available by the management for use by guests, patients, students or tenants," said Don Akerberg, president of MTN Services, "Rather than making the major investment required to buy the needed telephone system, the organization managing the facility often prefers to have the system owned, supplied and maintained by a telecommunications company. The revenues generated by third party users are then divided between the managing organization and the equipment owner/supplier."

SONY MEDICAL ELECTRONICS APPOINTS PEIRCE-PHELPS' A/V DIVISION AS SUPPLIER

The Audio/Video Systems Division of Peirce-Phelps, Inc. has been named a supplier of medical systems and equipment for the Sony Medical Electronics Company, a division of Sony Corporation of America. Michael Dillon, Video Systems' sales manager, said effective immediately, Peirce-Phelps will offer Sony medical video systems primarily to clients in Pennsylvania, New Jersey, Maryland, Delaware, and the District of Columbia. The Sony medical line will be available through Peirce-Phelps' Philadelphia headquarters locations, as well as its offices in Rockville, MD; Camp Hill, PA; and Jersey City, NJ. Dillon reports Sony's medical systems can fulfill numerous applications including video systems for operating rooms, endoscopy, surgical microscopes and microscopy; VTR's for x-ray TV camera and ultrasound diagnostic equipment; hospital audio and video centers; and medical monitoring systems.

MARATECH COMMUNICATIONS ACQUIRED BY MOUNTAIN VIEW

Maratech Communications Companies, Inc. of Minneapolis (Golden Valley), Minn., a voice, text and video electronic messaging firm, has been acquired by Mountain View Investment Corp., a Phoenix, AZ based publicly owned corporation. Under the terms of the acquisition, the present directors of Mountain View have resigned and have elected directors of Maratech Communications as new directors of Mountain View. Other terms of the transaction were not disclosed.

FSR FORMS A METAL PRODUCTS DIVISION

A new division has been formed by FSR, Inc. to handle the metal fabrication needs of the electronic sound and video industry. FSR Metal Products will specialize in small metal enclosures, panels, brackets, and custom metal fabrication for large and small production runs.

ARINC FILES TO CONSTRUCT SATELLITES DEDICATED TO AVIATION

Aeronautical Radio Inc. (ARINC) recently filed an application with the Federal Communications Commission for authority to construct the world's first satellites dedicated to providing services to aviation. The program will consist of six AvStar space stations providing L-Band and C-band communications at 22°W, 58°W, 114°W, 173°E, 132°E and 63°E in the geostationary orbit, along with an in-orbit spare positioned at 58°W. Each AvStar satellite will have nominal 400 voice equivalent channel capacity and will employ seven spot beams and two global coverage beams. The system is designed to improve aviation safety and promote regularity of flight and will provide air traffic control, air traffic services, aircraft operational control communications, aeronautical administrative communications.

FIBERCOM INSTALLS WORLD'S LARGEST FIBER OPTIC LAN

Fibercom Inc. has announced a $3.5 million contract to supply 6000 transceivers to Computer Connection A/AS of Mjoendalen, Norway, for what will be the world's largest fiber optic data communication network. Under the terms of the agreement, Computer Connection A/S will install FiberCom's WhisperNet, a fiber optic extended-distance Ethernet Local Area Network, in approximately 125 of Norway's largest banking cooperations. When the project is completed, a total of 850 bank branches will be networked using WhisperNet in a nationwide automated banking system. In each bank, WhisperNet will interconnect self-service terminals (ATM,EFT/POS) based on NCR worksaver master workstations to an NCR multiuser computer. The tower computer in turn will function as a network file server and X.25 gateway into the central on-line system.

DIGITECH RECORDS BIRDS FOR A SONG

Scientists studying animal behavior at the Rockefeller University, Millbrook, New York, are using DigiTech digital delays in recording bird calls for their study of learning and behavior in birds and their similarities to humans. One of the Field Research Center's laboratories, headed by Dr. Peter Marler, uses the DigiTech digital delays along with an array of other analog and digital electronics in their studies of animal sounds, especially birdsong. Dr. Stephen Nowicki, one of the professors studying animal behaviors at the center, stated, "It is usually impossible to tell when a bird will sing, so the normal technique to record birds is to leave a tape recorder running for a long time and then edit out the dead spaces between the bird songs. It can be a very tedious job." Rockefeller University scientists use a tape machine with a voice actuated recording device that starts when the bird sings. The digital delay delays the sound long enough for the tape machine to come up to speed and still not miss the beginning of the bird's song. The result is an automatic editing of the recording which is more suitable for study.

The AES Music and Digital Technology Conference

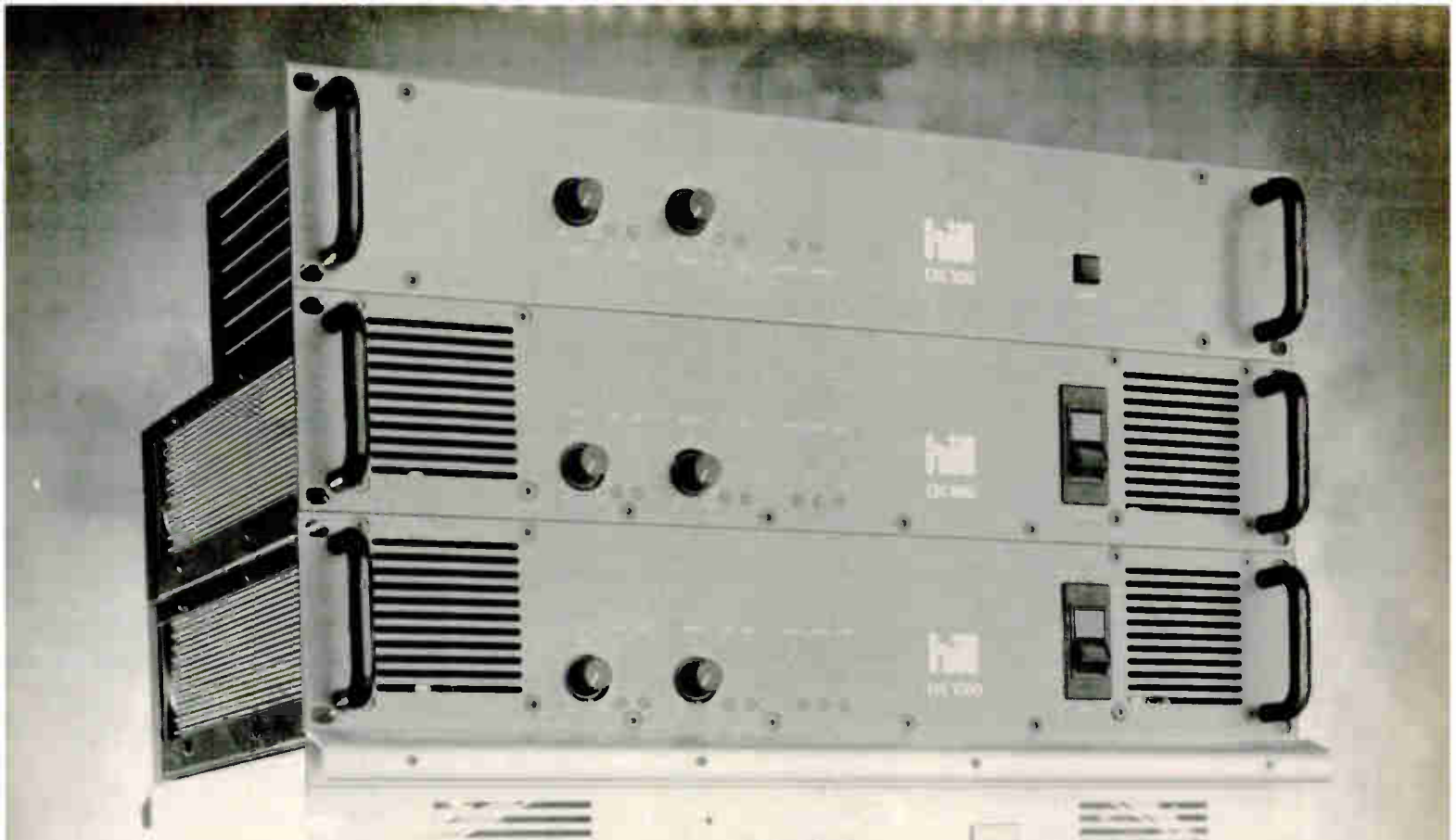
by Jesse Klapholz

This conference, the fifth such international event of the Audio Engineering Society, was the AES' first successful attempt at bringing together the music and digital/audio-engineering worlds. Because many of us are involved in reproducing music in one form or another, we should agree that scientifically-speaking music is information, though more complex in comparison to the written or even the spoken word. We can simply state that the sound and communications industry is based around the distribution of information. The role of digital audio in sound contracting is no longer an issue of hype with some esoteric mathematical engineering exercise lurking in the background. It is a reality rapidly falling upon our doorsteps, loading docks, and workbenches.

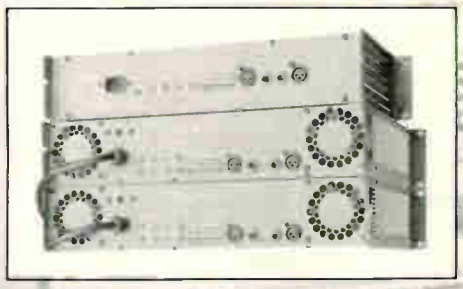
Digital is an overly used word when it comes to describing a particular piece of gear, "digital-ready loudspeaker system," for example. We have covered the basic concepts of converting an analog audio signal into a digital stream of information, as well as introducing the concepts of DSP (Digital Signal Prcessing) in past issues. One thing is clear when viewing audio events in the digital domain—digitally encoded information can be manipulated to almost any degree in a computer/software environment. This brings us to the underlying theme of the conference—the audio workstation. Mike Klasco used this term when describing systems used to design and analyze sound systems and acoustic environments.

Throughout every presentation the terms digital and computer were often interchanged or would infer the other. Retrospectively speaking, when references were made to digitally-generated music work in the '50s and '60s the term "computer generated" was used exclusively. Music and computers can mix freely, information and computers can mix freely,and audio can mix freely with computer, too. Whether it is the composition, documentaton, performance, recording, or manipulations of sounds, computers are rapidly becoming the audio workstation. Ven-

(continued on page 47)



introducing the DX300, DX800 and DX1500 power amplifiers



The DX300, DX800 and DX1500 amplifiers all feature balanced XLR inputs, balanced and unbalanced ¼" inputs, banana outputs, ground lift switch and a terminal block with access to all inputs and outputs.

DX300 **output power:** **200** watts into 8Ω (per channel, both channels driven, 20Hz -20kHz, -0.5dB) **400** watts into 8Ω, **450** watts into 4Ω (burst power*) **distortion** (250mW to rated power at 8Ω): IMD SMPTE: < 0.01%. THD (1kHz): < 0.01%. THD (20kHz DIN): < 0.02% **size:** 2 rack spaces, 8½" behind front panel **weight:** 7Kgs, 16 lbs. **cooling:** 2 passive heatsinks.

DX800 **output power:** **250** watts into 8Ω, **400** watts into 4Ω (per channel, both channels driven, 20Hz - 20kHz, -0.5dB), **800** watts into 8Ω (bridged mono), **800** watts into 4Ω, **900** watts into 2Ω (burst power*) **distortion** (250mW to rated power at 8Ω): IMD SMPTE: < 0.01%. THD (1kHz): < 0.01%. THD (20Hz-20kHz DIN): < 0.02% **size:** 2 rack spaces, 13" behind front panel **weight:** 13Kgs, 29 lbs. **cooling:** 1 servo controlled DC fan.

DX1500 **output power:** **300** watts into 8Ω, **500** watts into 4Ω, **750** watts into 2Ω (per channel, both channels driven, 20Hz - 20kHz, -0.5dB), **1000** watts into 8Ω, **1500** watts into 4Ω (bridged mono) **1500** watts into 2Ω, **1600** watts into 1Ω (burst power*) **distortion** (250mW to rated power at 8Ω): IMD SMPTE: < 0.01%. THD (1kHz): < 0.01%. THD (20Hz-20kHz DIN): < 0.02% **size:** 2 rack spaces, 13" behind front panel **weight:** 15Kgs, 34 lbs. **cooling:** 2 servo controlled DC fans.

*Burst power is a 1kHz tone for 10ms every 100ms, single channel (an indication of the amplifiers ability to handle music transients and tolerate deviations in nominal speaker impedance)

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Hill Audio

by Marc L. Beningson
Jaffe Acoustics Inc.

Working Under Section 11

Last month's column discussed the problems associated with installing a sound system as a subcontractor to an electrical contractor. This month we will discuss one alternative to lumping the sound system into Division 16, Electrical Work, and that is Section 11.

Section 11 of the standard A.I.A. specification package is designed for the supply of equipment. Typically, contracts under this section are for the supply and delivery of equipment directly from a manufacturer. Generally, instead of a contractor purchasing devices, engineering a system, and interfacing or installing it in the building, the manufacturer supplies and coordinates the complete installation. Section 11 equipment can include theatre rigging, draperies, seating, projection screens, food service and waste equipment, theatre lighting and controls or A/V equipment.

"(An) Advantage to the Section 11 solution (is) the sound contractor is not subcontracted to the electrical contractor..."

Some of these systems may require electrical work that must be performed by an electrical contractor, but a specification can be structured so that the installation of AC power distribution, conduit, and wiring for the special system is performed by the electrical contractor, while the supply and installation of equipment is performed by the manufacturer of that equipment. The trick in such an arrangement is to make sure that the workscope is cleanly and clearly defined so that each contractor knows where his work begins and ends.

One system frequently placed in Section 11 that has some similarities to sound system installation is theatre lighting. To over-simplify a bit, a theatre lighting system consists of a main control console, one or more remote control positions, rack of dimmers, and a bunch of lights. (Of course, this is somewhat like saying a sound system consists of a mixer, a rack of amps, and a bunch of speakers, but the parallel is there.)

The AC power to the dimmer racks and control positions, the wiring from the dimmers to the light receptacles, the low voltage control wiring, and the conduit for all the wiring is placed in Section 16 to be installed by the electrical contractor. The control console, remote controls, dimmers, and lighting devices can be supplied and installed by the lighting manufacturer under Section 11. (Often the lights themselves may be installed by stagehands.)

The key element is that the installation of the critical devices be performed by a specialist, and this specialist is not subcontracted to the electrical. Rather, the manufacturer and electrical contractor are on equal terms with the general contractor or construction manager, and this is the situation that we would like to establish for sound system installation.

A major difference, though, between theatre lighting systems and sound systems is that lighting systems generally consist of devices that are sole sourced. That is, all of the lighting devices, dimmers, and consoles are all from a single manufacturer, and there are only a handful of major manufacturers.

While there are several large conglomerates who can supply most of the components of a sound system, it is rare that a sound system design will incorporate equipment from less than a dozen different manufacturers. Further, these manufacturers are not set up to do any kind of installation work. Because sound systems use so much equipment from different sources, they require engineering by an additional party—the sound contractor—to integrate the various mixers, processors, amplifiers and speakers into a complete system.

Despite these differences between sound and lighting equipment, the sound contractor can be considered the "manufacturer" of the complete system, that is, he assembles the amplifier racks in the same way that the lighting manufacturer assembles the dimmer rack. The center array and other speakers are treated as lighting devices. Therefore, the sound contractor can install the special equipment under Section 11, and the electrical contractor installs power, conduit and wiring under Section 16.

"...the sound contractor can be considered the 'manufacturer' of the complete system."

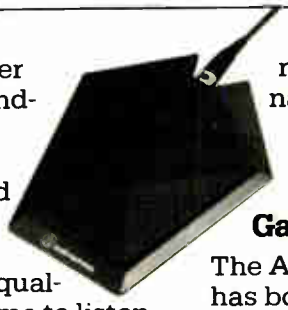
Advantages to the Section 11 solution are: the sound contractor is not subcontracted to the electrical contractor; there are fewer levels of coordination between the sound contractor and the designer; the sound system package is bid directly to qualified contractors and not influenced by middlemen—bidding is therefore more competitive; the workscope of both contractors is clearly defined by the designer, not by the prime contractor.

Disadvantages to placing sound systems in Section 11 includes: no one contractor has full responsibility for the entire system, which can result in finger pointing or even lawsuits if the system does not perform as expected; the electrical contractor may not pay close enough attention to special sound system requirements such as isolated grounding, conduit spacing, and separation of wiring; a high level of coordination is required between the sound system designer and the electrical engineer to ensure that there are no gaps or overlaps in the workscopes of both contractors.

Who would believe a microphone this flat...

Model AT871 UniPlate™
Condenser Cardioid

could have a curve to match!



If you've tried other hemicardioid boundary microphones, you may have been disappointed in the sound... thin, peaky, and requiring lots of equalization. If so, it's time to listen to ours: the new AT871 UniPlate Condenser Cardioid.

UniPoint Technology at Work

Our experience pioneering UniPoint miniature condensers permitted us to take a new approach to boundary microphone design. We optimized the basic UniPoint cardioid element for boundary use, creating remarkable reach and presence, yet retaining extended high and low-frequency response so vital to natural sound reinforcement.

Outstanding Gain-Before-Feedback

The AT871 UniPlate Cardioid has both the polar pattern and response curve to provide higher gain-before-feedback than you may have thought possible. But better gain-before-feedback and a great sounding element are only a part of the story.

Less Noise Two Ways

By using a very low-mass diaphragm and a case heavier than the others, we sharply reduced sensitivity to mechanical noise. The electronics are audibly quieter as well – a tremendous advantage in typical boundary microphone applications. We also include a low-cut switch to help control acoustic room noise. The AT871 can be powered by an internal battery or from 9-52VDC phantom power.

Effective Problem Solver

The AT871 is solving problems in stage sound reinforcement, church sound, teleconferencing, boardroom applications... even TV and film locations. Wherever great sound is needed...unobtrusively. We urge you to test the AT871 side-by-side with any of the rest. Choose your most critical sound problems. The difference you hear will prove our point.

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Computer Based Systems

by Dale R. Patrick

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Part two of this article focused on computer memory. This final installation will take an in-depth look at a programming example.

In order to demonstrate the potential capabilities of a computer-based system, we will discuss its ability to solve a straight line computation problem. In this problem, the system will be used to simply add two numbers and then indicate the resulting sum. This type of problem is obviously quite simple and could be easily solved without the help of a microcomputer system. It is, of course, used in this situation to demonstrate a principle of operation and to show a plan of procedure more so than for its problem solving capability.

In practice, a microcomputer system could not solve even the simplest type of problem without the help of a well defined program that works out everything right down to the smallest detail. After the program has been developed, the system simply follows this procedure to accomplish the task. Programming is an essential part of nearly all computer system applications.

Before a program can be effectively prepared for a microcomputer system, the programmer must be fully aware of the specific instructions that can be performed by the system. In general, each microcomputer system has a unique list of instructions that are used to control its operation. The "instruction set" of a microcomputer is the basis of all program construction.

Assume now that the programmer is familiar with the instruction set of the system being used to solve our straight-line computation problem. The next step in this procedure is to decide upon what specific instructions are needed to solve the problem. A limited number of operations to perform can generally be developed without the aid of a diagrammed plan of procedure. Complex problems, by comparison, usually require a specific plan in order to reduce confusion or to avoid the loss of an important operational step. Flowcharts are commonly used to aid the programmer in this type of planning. Fig. 7-9 shows some of the flowchart symbols that are commonly used in program planning.

The first step in preparing a pro-

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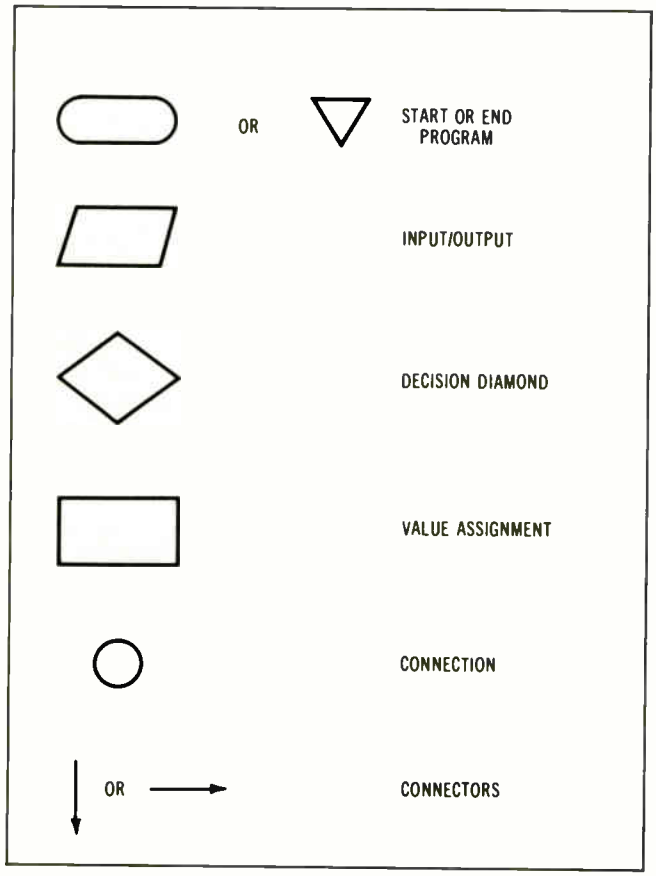
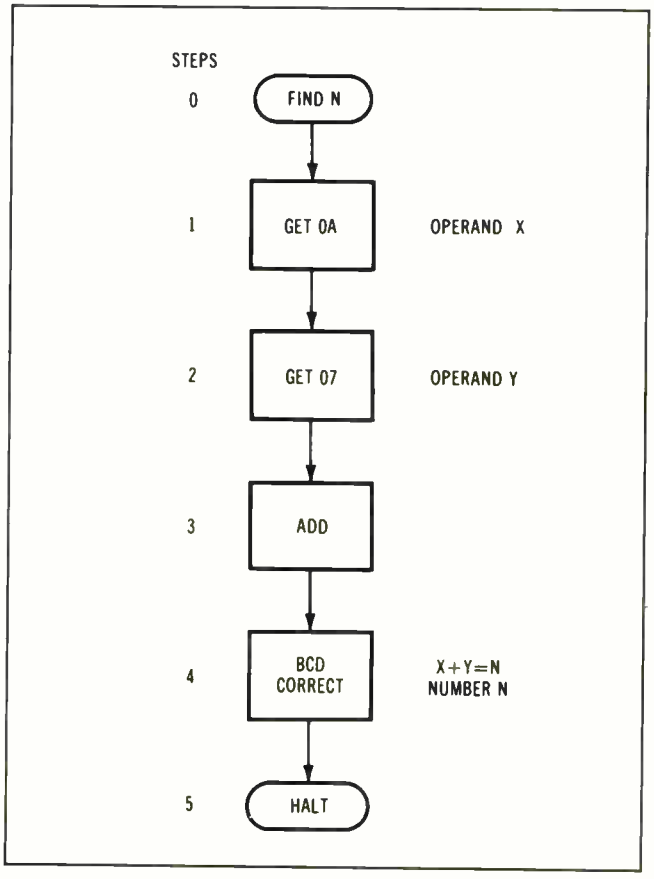
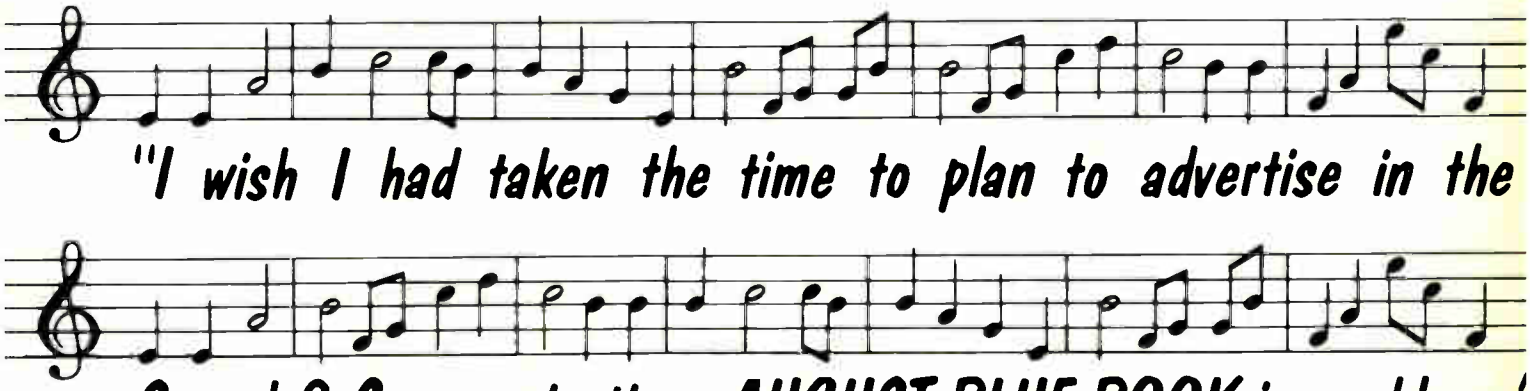


Flowchart symbols
FIGURE 7-9



Flowchart for problem solving.
FIGURE 7-10

Now is the time to start preparing so that you don't find yourself singing those...



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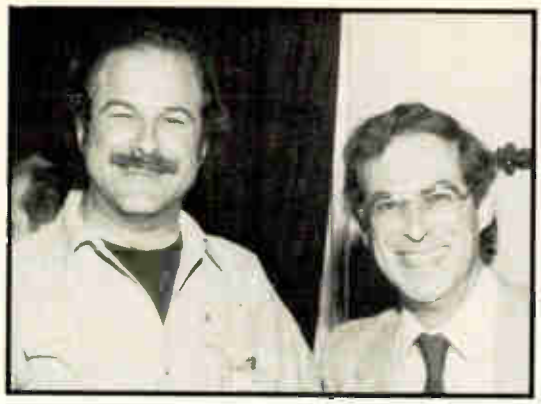


Oh! What a show!

The Sixth Annual National Sound and Communications Contractor's Expo had record-breaking attendance at its convention in New Orleans, LA, from April 5 to 8. Over 4,000 industry people were at the show, up 900 from last year—a sure sign that the sound and communications business is growing.

The event was held at the Fairmont Hotel, built in the 19th century with the grandiose charm of the old south. About 211 exhibitors filled the exhibit floor, with 1,800 bona fide contractors looking and/or buying. Unfortunately, there was no space available for 70 additional manufacturers. Bud Rebedeau, NSCA executive director, is surveying next year's expo site at the Bally Grand Hotel in Reno, NV, for additional space. Next year's booth size will remain the same, 8 × 10 feet. So far, 239 exhibitors are scheduled for the 1988 Contractor's Expo from May 18-20.

In addition, according to Rebedeau, exhibit hours will be lengthened by 30 minutes to an hour everyday at Expo '88. Contractors could not get to all the booths due to an increase of manufacturers this year. Rebedeau also noted that the average ratio of contractor per booth was eight to one, compared to the ususal average of four to one.

Rebedeau said he attributes the huge increase in attendance to several factors. "The large turnout was due to the show's excellent educational programs, and excellent promotional support from exhibitors, sales reps and the trade press."

"We're absolutely thrilled with the response to the Expo '87," said Harold George, NSCA president. "And the big surprise was the first minute response to the show! We had nearly 500 contractors register on-site! I think it's just great that all of us NSCA members, our manufacturers and reps and the trade press were able to generate so much excitement for the show. It's a great feeling of accomplishment to see so much business taking place, and also to see so many share so much."

Mel Wierenga, NSCA vice president and Expo '87 chairman, said, "Many people from all areas of the electronic contracting industry put a lot of time and effort into the planning of Contractor's Expo '87. The press worked together to present the Expo as a place to learn about new theories, better ways to do things and new products. The feedback has

been very positive and I'm proud of what all of us were able to accomplish."

The feedback has also been very positive about NSCA-TV News. For the second year at the NSCA Expo, attendees watched NSCA-TV News for up-to-date news and information about the events, seminars and the people at the show. The news program, which was written, edited and produced by the editors and publisher of *Sound & Communications*, aired on television on the convention floor and in each and every hotel room at the Fairmont, Monteleone, Le Pavillon, and Howard Johnsons via closed circuit broadcast. All three days of NSCA-TV News are available on one VHS cassette for $29.95 through Sound & Communication.

SEMINARS

The buzz phrase at this year's Expo was "very good seminars." NSCA introduced its educational program with three tracks: audio, special/management and CCTV that involved nearly 60 faculty and 600 attendees a day. Topics covered at the seminars included From the Drawing Board to the Catwalk With Computer Aided Design; Pan, Tilt, Zoom, Switchons—A Hi-Tech CCTV Overview; Making More, Then the Most of Your Market; Electronic Spreadsheet in Sound System Design; Job Survey Technology—How to Do it Right; and Making Effective Advertising and Promotion Work For You.

Clockwise (starting top left:) • Contractors look over reading material at the Schell Electronics booth. • Enjoying the Expo are Neil Shaw of Paul S. Veneklasen and Associates (L) and Brian Wachner of BGW. • Harold George, NSCA President, welcomes attendees at the NSCA Expo '87 Keynote by Larry Estrin. • Larry Doran, president of Professional Audio Systems (L), and Mark Engerbretson, consultant for Electro-acoustic Technology, were pleased with the show's huge success this year. • The seminar "From the Drawing Board to the Catwalk and Back Again," sponsored by *Sound & Communications*, included panelists (L-R) Mike Klasco of Menlo Scientific, Steve Romeo of Bose, Marc L. Beningson of Jaffe Acoustics, William Parry of Maryland Sound, Jim Long of Electro-Voice, John Wiggins of Community Light & Sound, and John Lanphere of Altec Lansing. • Bill Little of Quam talks with some customers. • Contractors packed into exhibitors' booths with table-top displays. • The NSCA Expo '87 Keynote session was packed. The presentation took a behind the scenes look at the extensive electronics involved in "Liberty Weekend," and other extensive programs such as the Olympics. • The seminar "Making Effective Advertising & Promotion Work For You" included (L-R) moderator Vinny Testa, publisher of *Sound & Communications*, and panelists Bob Davis of Yamaha, John Strand of Community Light & Sound, Emory Strauss of White Instruments, John Karamon of Sonic Systems, and Stan Kohagen of Aiphone. • The seminar "Making More, Then the Most of Your Market" included (L-R) moderator Debra Pagan, managing editor of *Sound & Communications*, and panelists W.G. Palmer of Audio Systems, Bud England of Carver Sound, Bob Davis of Yamaha, Richard Feld of Tekcom Corp., Barry Glick of Glicktronix, and Chris Foreman of Panasonic/Ramsa. • Larry Spalla of Conquest Electronics discusses his new products with several contractors. • The 1987 National Sound and Communications Contractor's Expo had the largest turnout ever: 4,000 attendees! • C. F. Boyd of Telex answers contractors' questions.

For further information and fees for audio and video cassettes of the seminars, write to: NSCA, 501 W. Algonquin Rd., Arlington Heights, IL 61005-4410, or call (312) 593-8360.

Rebedeau discussed what's planned for Expo '88 seminars. "Due to the overwhelming response to the seminars this year with standing room only, we made sure we found a hotel with bigger rooms.

"This higher than average attendance at the workshops indicates that people want to become more educated about their industry. There was a particularly larger turnout at the "How to . . . technical help seminars," said Rebedeau. He also pointed out that the NSCA committee will be asking suppliers to volunteer state-of-the-art audio equipment for the seminar rooms, which will alleviate the problems associated with house audio.

"Also due to the success of the Introduction of Design and Estimating Course held this year, we'll be adding an intermediate course at Expo '88," Rebedeau indicated. "These will be held prior to the opening of the convention on May 16 and 17."

According to Mary Beth Rebedeau, director of Member Services, the association will poll its members as to what seminars they would like to attend at EXPO '88.

NEW AT THE EXPO

As with all trade shows, there were many exciting new products introduced at this year's Contractor's Expo, many of which we will be discussing in this and future issues of Sound & Communications.

BGW debuted its most powerful amplifier to date—the Grand Touring Amplifier. It delivers more than 1.2 horse power per channel, which is the equivalent of 900 watts per channel of continuous power. The GTA's welded steel chassis is 5½ inches high allowing for high power density in touring sound systems.

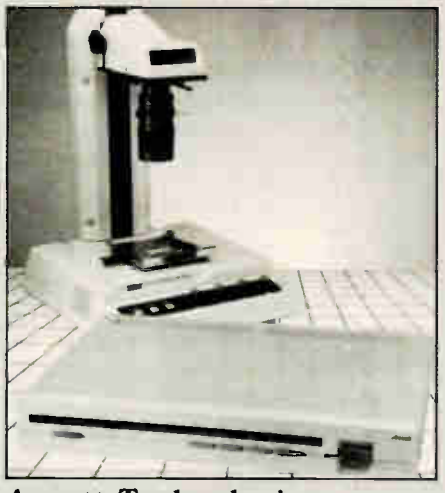
Orban displayed its new Model 464A Co-Operator™, a stereo Gated Leveler/Compressor/HF Limiter/Peak Clipper. It automatically rides gain, controls excessive high frequency levels (with selectable pre-emphasis). It is switchable for stereo-stacking or independent dual channel operation.

Genter announced its new Easy-Term™ rack-mounted wiring termination panel at this year's NSCA Expo. Cables are run from inside the rack, eliminating clutter; the termination panel is hung so users can get at their equipment inside the rack; and one of the blocks (Flexiblock) is designed for standard wire use. Genter also introduced its Digital Hybrid™ telephone system, using Digital Signal Processing for two way

NSCA Products in Review

Rokustics

When our **NSCA TV** camera crew arrived at the Rokustic booth the crew asked, "Where's the speaker?" They couldn't have stated Rokustic's case any better. The booth looked like anybody's backyard—nicely trimmed shrubs, grass, plants, rocks, etc. The speakers—in the form of naturally shaped rock—fit in perfectly with any outdoor setting. They sound like good hi-fi speakers and come in two- or three-way configurations. Also, the "rock's" composition may be changed to match various landscapes.



Ansett Technologies

With many companies advertising various modes of both voice and data communication, the transmission of high-quality color graphics is unusual. Both color and B&W are easily transmitted by the VF-3000 video FAX system through its NTSC input. Ansett also showed its PV-500 camera which converts slides, negatives, transparencies, flat art, and 3-D objects to color video images for viewing, recording and transmission.

Telex

Because many of us are gearing up for computer presentations to large groups, we often find the need to project a large computer-generated image. Traditionally, we have used large and expensive video projectors. An alternative, shown by Telex, is its MAGNABYTE™ computer-to-overhead-projector adaptor. This system uses a card and software (available for both the Apple II® and IBM® series), and a transparent LCD-type display that is placed on a standard overhead projector. The computer can use its own graphics package, or can be operated by the Telex software. A remote control is also proved to emulate slide projector operation.

Bose

The last few years have shown renewed interest in VLF (very-low-frequency) reproduction. Bose introduced its Acoustic Wave® Cannon System (AWCS) to the contracting market at the **NSCA EXPO**. In simple terms, the AWCS works on a tuned-resonance principle, and uses a dynamic loudspeaker element mounted in a long tube. The position of the loudspeaker in the tube is such that two resonant frequency tunings are achieved. This accounts for the relatively high efficiency of the system. The unit is lightweight, due to its PVC con-

(continued on page 41)

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conversation between the caller and the moderator.

Intersonics Incorporated exhibited two new subwoofers at the show. The SDL-4 subwoofer is suitable for installation or sound company use and features a first in the speaker industry: power cooling. The SDL speakers are run by a servo-motor, replacing the traditional voice coil and magnet configuration. Intersonics also displayed a prototype: the 4-15, which has a flat response to 16Hz and has a usable frequency range of 13Hz to 125Hz. It will be available for distribution in the fall.

Sentex introduced its new line of telephone-style entry security systems at NSCA Expo '87. This included the VISTA telephone entry system which has an integral, lighted directory that handles up to 115 names. Sentex also introduced its new line of card access and key pad entry systems. This includes the PROcard™ programmable card access system. According to the company, it is the first truly stand-alone programmable system to use EEPROM memory. The EEPROM memory does not lose its contents when there is a power outage.

Siedle exhibited its new Multi Common Wire Switchboard System for residential complexes, multi-family apartment buildings and schools. It's a fully electronic, micro-processor controlled communication and information system. Calls can be logged with the date and time in the system by using a V.24/RS 232 interface printer.

For the first time, SCA Data Systems introduced its FM Plus SCA Receiver. This receiver is frequency and subcarrier agile and has an adjustable EQ two position cut-off filter with a built-in bandpass amplifier utilizing a GaAsfet preamplifier.

Altec Lansing debuted its new 299-8A and 299-16A high frequency compression drivers at NSCA Expo '87. These are based on existing proven modes and feature a new Pascalite™ diaphragm construction that has the power handling and output capabilities of 2-inch drivers, while maintaining high frequency power bandwidth. The company also displayed its new factory assembled loudspeaker systems. The 9872-8A and 9872-8F series loudspeakers are two-way full range loudspeakers featuring high acoustic output from a compact enclosure.

Carver featured its new PM-2.OT power amplifier, with 8 ohms, 465 channel 20-20 kHz—both channels driven with no more than 0.5% THD. IM distortion is less than 0.1% SMPTE and is compatible with 70 V systems.

HME introduced its new line of DJ mixers, a power amplifier, and two new cabled microphones. The mixers range from a four channel stereo mixer to the top of the line six channel. The PA120 two channel stereo Power Amplifier is used for church, lounge and theater applications and the new HM58 Unidirectional Dynamic Handheld Microphone has a non-glare finish, and mic-mute switch.

Following five years of development, Celestion unveiled its new SR Series, a full-range sound reinforcement system capable of reproducing music at high-volume levels with full audio fidelity and deep low frequency impact. The system also features an electronic controller for total protection from thermal or mechanical breakdown. The new series is targeted for movie theaters, MIs, and sound contractors; 25 models will be shipped to the U.S. from England for demonstration during the middle of this month.

Crown debuted its MT 10,000 amplifier for touring systems and sound applications where large amounts of continuous power or lots of headroom is needed. The first fixed installation of this amplifier was at the Indianapolis Motor Speedway, where four of the MT-10,000 amps power a system that provides voice coverage at levels exceeding that of the race cars for over 400,000 people. The amps operate on 208V AC, 3-phase, 20 amperes, 50/60 Hz, and have multiple levels of protection to prevent failure.

University Sound introduced its two full-range ceiling speakers for use in high quality distributed sound systems: the CS410 4-inch, 8 ohm loudseaker and the CS810 8-inch, 8 ohm loudspeaker. Both the loudspeakers feature a centrally mounted, free-edge cone for extended high-frequency sound and an acoustically transparent dust dome that protects both the free edge cone and the voice coil. Long-term average power capacity for each model is 10 watts, per EIA Standard RS-426A.

Part II of How to Prepare a Winning Bid, a seminar sponsored by *Sound & Communications* at the NSCA Expo this April, will appear in the July issue and will cover how to estimate costs for a winning bid. In the May issue, Part I discussed what a winning bid is.

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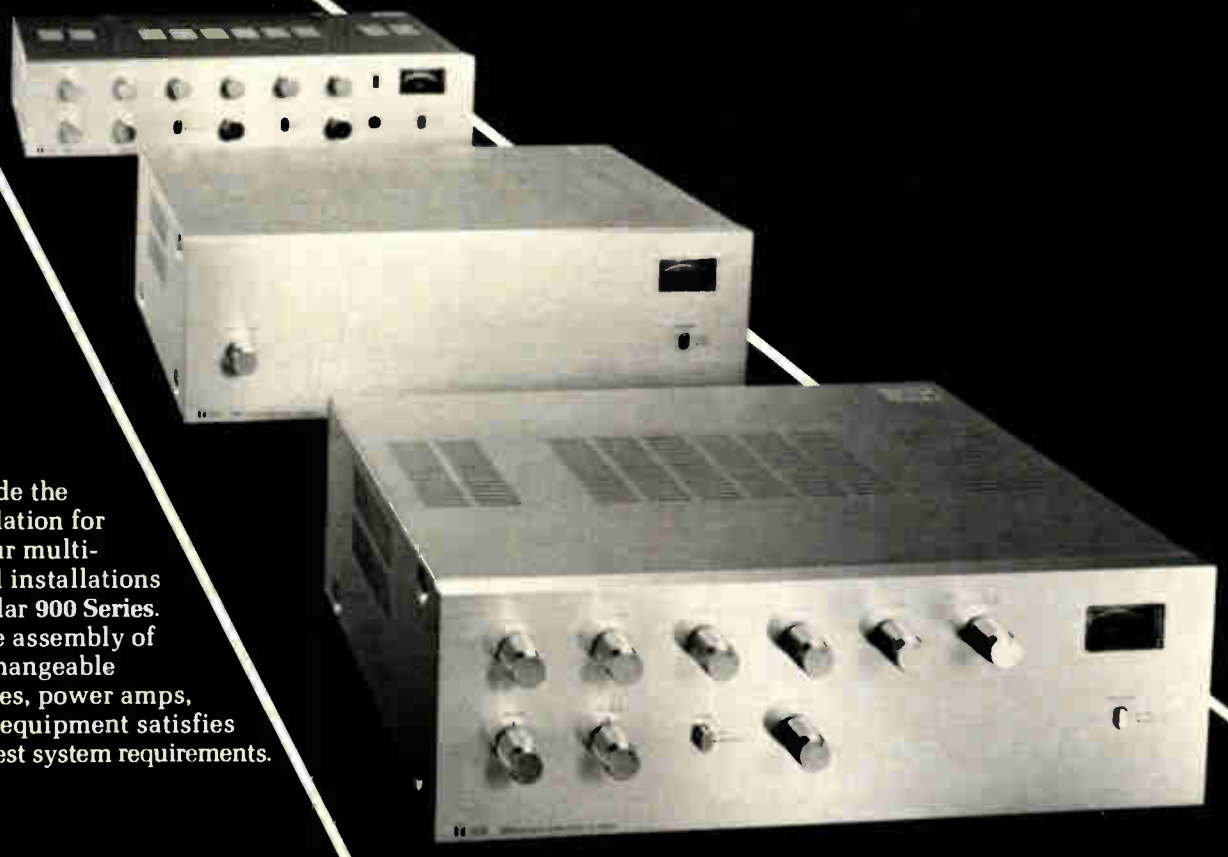

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STEREOPHONIC SOUND SYSTEMS

a historical perspective

by Neil Shaw

Stereophonic sound has become commonplace in today's world. The subject has been studied over the years, but the principles from which it has evolved have been overlooked in contemporary installations of theater sound reinforcement systems and in home entertainment systems. This article will discuss the fundamental theory underlying stereophonic sound as it was developed by Fletcher, Snow, et. al. at the Bell Telephone Laboratories in the 1930's. The differences between binaural listening and stereophony will also be discussed along with their similaries.

Fletcher's Basic Requirements

From Fletcher's classic paper on the basic requirements for auditory perspective, we learn that the sound system must accommodate the limitations of the human hearing mechanism, as well as the sounds to be reproduced.

Auditory perspective was first developed as a transfer device—a program was transferred from one hall to another, or recorded in one hall to be reproduced in another. The requirements necessary for any reinforcement or reproduction system, before a listener will be aware of any degradation from the orginial sound, must be defined. We know that when a sound starts or stops suddenly, the frequency range needed to faithfully recreate the sound must be infinitely wide. Due to the limitations of hearing, this is not necessary. If the level of sound for some of the frequency components in the original sound is below the level of audibility, their elimination will not be detected by the normal ear. As a result, we see that for high quality reproduction of sound, except in some very special cases, the range of frequencies that a system must transmit is determined by the range of hearing, rather than the kind of sound that is being reproduced.

For people with normal hearing, pure tones ranging in frequency from 20 Hz to 20,000 Hz can be detected. To sense the sounds at the extremes of this range the sounds must have very high intensity (Figure 1). In music these frequencies usually are at such low intensities that if we eliminate those frequencies below 40 Hz and those above 15,000 Hz there is no detectable difference in the reproduction of symphonic music (Figure 2). However, eliminating sounds below 40 Hz produces detectable changes in the reproduced sounds of the bass viola, the bass tuba and particulary the pipe organ.

In regards to the frequency response of the system, we want the system to reproduce the range of frequencies with the same efficiency. Fletcher notes: "Such a general statement sounds correct, but a careful analysis of it would reveal that when anyone tried to build such a system or tried to meet such a requirement he would have great difficulty in understanding what it meant."

The system must also be capable of handling sound powers that vary through a wide range. If we limit ourselves to symphonic music that is produced by a large orchestra, this range would be about 10,000,000 to 1, or 70 dB. To faithfully reproduce such music, the system must be capable of reproducing the faintest sounds without introducing any extraneous noise approaching it in intensity, and also reproduce the loudest sounds without overloading any part of the system. The obvious limits to the desirable requirements for the intensity range and the frequency range are determined by the ear rather than the physical characteristic of any sound. An ideal system should be capable of reproducing a sound as faintly as the ear can hear and as loudly as the ear can tolerate, without introducing any audible extraneous sound.

From the above, if T is the reverberation time of a hall in seconds, W the power of the sound source in watts, E the maximum energy density in joules per cubic meter and V the volume of the hall in cubic meters, then

$$E = \frac{1}{6 \log_e 10} \times \frac{WT}{V} \qquad (1)$$

Again referring to Figure 1, we see that the upper safe limit for sound is reached when the sound intensity field reaches about 120 dB or 10 watts/meter^2. This intensity corresponds to an energy density E of 3×10^{-3} joules/meter^3. Using this as an upper limit to be tolerated by the human ear, we see from equation 1 that

$$W = 4.1 \times 10^{-2} (V/T) \qquad (2)$$

For halls like the Academy of Music in Philadelphia and Carnegie Hall in New York, in which the volume V is approximately 2×10^4 cubic meters and the reverberation time is about two seconds, W, the acoustical power of the sound source, from equation 2, is approximate-

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y 400 acoustic watts.

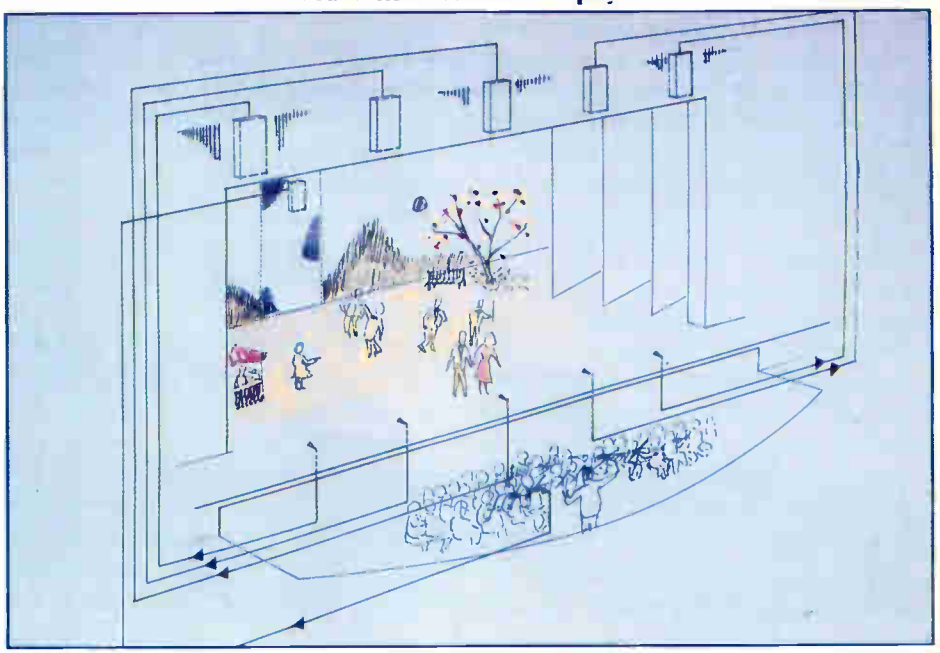
Auditory Perspective Physical Factors

As defined in Steinberg and Snow's paper, Auditory Perspective is reproduction that preserves the spatial relationships of the original sounds. The ability to localize the direction and to form some judgement of both the direction and the distance from a sound source in ordinary listening conditions is a common experience. This ability to localize enables an audience to appreciate the spatial character of the sounds of an orchestra, i.e., the first violins are heard at stage left, the brass and woodwinds are at stage center, etc. However, in ordinary methods of reproduction and reinforcement, where only one loudspeaker system is used, the spatial characteristics of the original sound are lost. Some of the depth properties of the sound may be preserved by such a system, but all directional properties are lost because the audience tends to localize the sound as coming from the direction of the single loudspeaker.

There are two ways of reproducing sounds in true auditory perspective. One is binaural reproduction, in which headphones are used to reproduce in a listener's ears an exact copy of the sound vibrations that would exist if he were listening directly. The other method uses loudspeakers, and aims to reproduce in a distant hall an exact copy of the pattern of sound vibration in the original hall, or to reinforce a performance. This is done so that the directional characteristics of the original sounds are preserved, although at a higher level, and that the listener is unaware of the reinforcement.

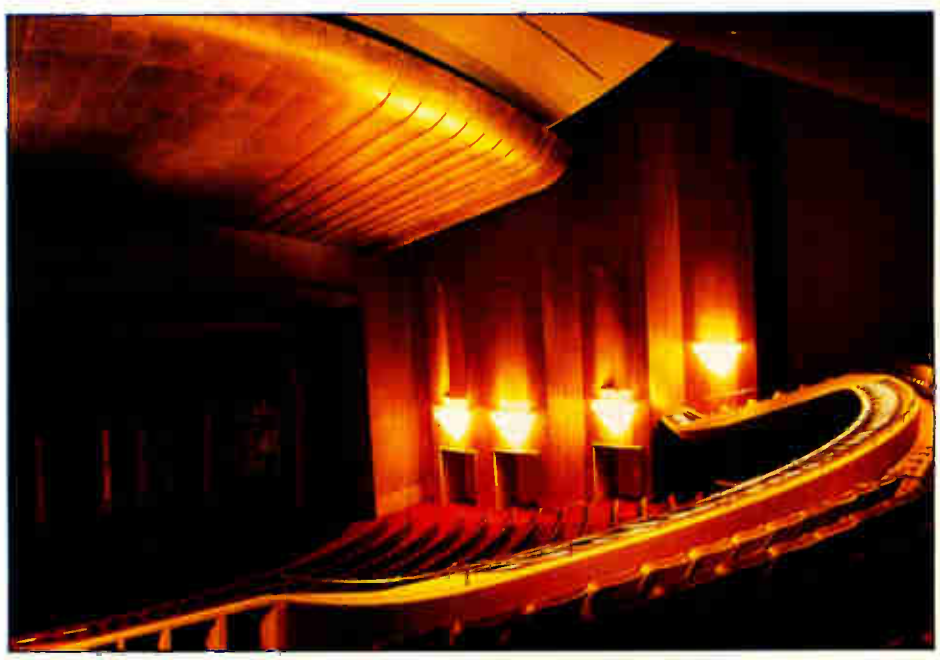
Figure 3 shows the experimental set-up used by Bell Laboratories in the early 1930's to investigate what physical properties of the sound waves must be preserved, and how these properties are preserved by various arrangements of two- and three-channel loudspeaker reproducing systems. In the limit, an infinite number of channels (microphones, loudspeakers and associated circuitry) of infinitesimal dimensions would seem to be needed. For a stage width of about 40 feet, Steinberg and Snow found that as few as two channels were able to give fair auditory perspective. However, in 1953, Snow reported that three channels are preferable. In Figure 3, microphones LM, CM and RM were set on a "pick-up" stage that was marked out on the floor of an acoustically treated room. The loudspeakers LS, CM and RS were placed in the front end of the auditorium at the Bell Telephone Laboratories and were concealed from view by a guaze curtain.

Sound Reinforcement for plays.



The object of the tests was to determine how a caller's position on the pick-up stage compared with his apparent position as judged by a group of observers in the auditorium listening to the reproduced speech. Words were spoken from 15 positions on the pick-up stage in a random order. The nine positions shown in Figure 3 were always included in the 15, the remaining positions were introduced to minimize memory effects. The reproducing system was switched off when a caller moved from one position to another. The results of these tests are shown in Figure 3 along with the type of reproduction system.

With three-channel reproduction there is a reasonably good correspondence between a caller's actual position on the pick-up stage and his apparent position on the virtual stage. The system gave good lateral or "angular" localization, i.e., apparent positions to the left or right corresponded to actual positions to the left or right. The system also gave good fore and aft or "depth" localization, for which the apparent front and rear positions corresponded to actual front and rear positions. For comparison, the localization afforded by direct listening is shown. The crosses indicate the caller's position in back of the gauze curtain and the circles indicate his apparent location as judged by the observers listening to the speech directly. In both cases, as the caller moved back in a straight line on the



The Dorothy Chandler Pavilion in Los Angeles.

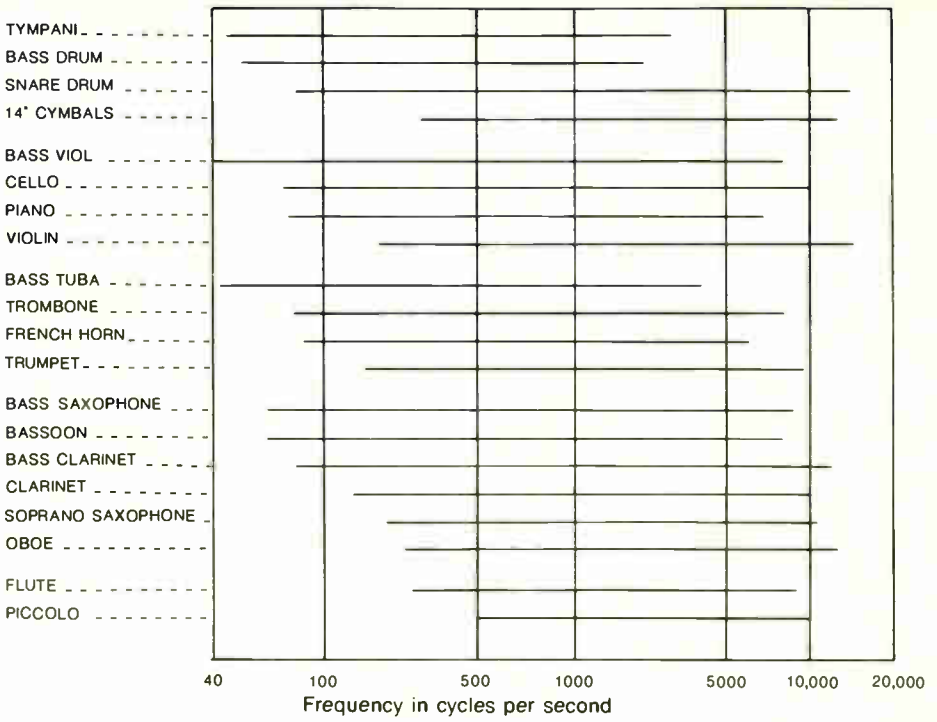
left or right of the stage, he appeared to follow a curved path pulling in toward the right center. Compare the caller position one, two, three with apparent position one, two, three. Note that this "distortion" was greater with the three-channel reproduction than for direct listening.

The results for the two-channel system showed two marked differences from those obtained with the three-channel system. Positions on the center line of the stage (i.e., four, five, six) all appear in the rear center of the virtual stage, and the virtual stage depth for all positions is reduced. However, the virtual stage width is somewhat greater than that obtained with the three-channel reproduction.

Bridging a third microphone across the two-channel system had the effect of pulling the center line positions four, five, and six forward, but the virtual stage depth essentially remained the same while the virtual stage width decreased somewhat. Please note that in this and the other bridged circuit arrangements, the speech currents were as indicated by the arrows in the type of reproduction diagrams.

Bridging a third loudspeaker across the two-channel system had the effect of increasing the virtual stage depth and decreasing the virtual stage width, with the positions on the center line of the pick-up stage appearing in the rear center of the virtual stage as in the two-channel reproduction.

Bridging a third microphone and a third loudspeaker across a two-channel system had the effect of greatly reducing the virtual stage width. The width could be restored by reducing the bridging gains, but fading out the bridged microphone, caused the front line of the virtual stage to recede at the center, and fading out the bridged loudspeaker reduced the virtual stage depth. No set of bridged gains were able to create the virtual stage of the three-channel system.



Frequency transmission range required to produce no noticeable distortion for orchestral instruments.

FIGURE 2

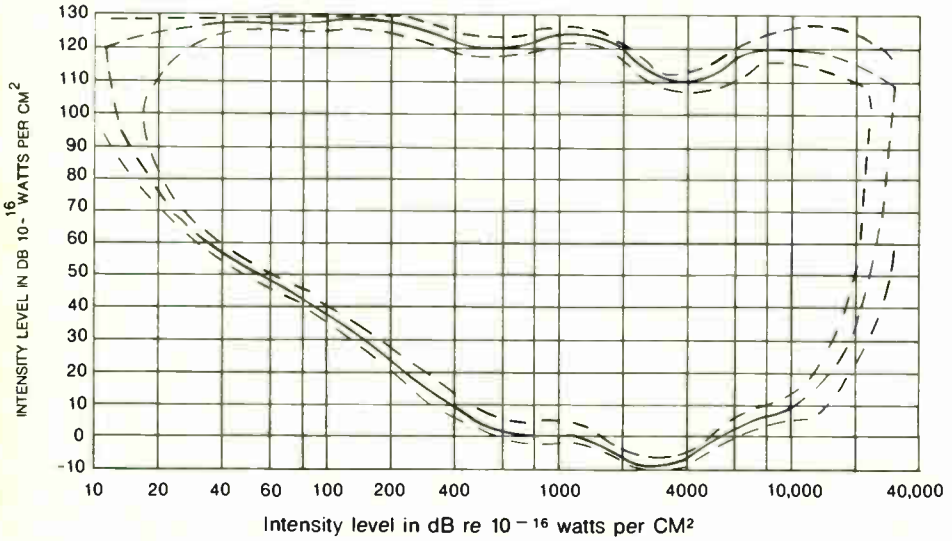
Depth Localization

To investigate the factors that affect depth localization the following three tests were performed by Steinberg and Snow:

1. The caller remained stationary on the pick-up stage and close to the microphone, but the loudness of the sound received by the observer was reduced by gain control. This was loudness change without a change in the direct to reverberent sound intensity ratio.
2. The caller moved back from the microphone, but the gain was increased to keep constant the loudness of the sound received by the observer. This was a change in the ratio of direct to reverberent sound intensity without a loudness change.
3. The caller moved back from the microphone, but no changes were made in the gain of the reproducing system. This changed both the ratio and the loudness.

All of the observers agreed that the caller appeared to recede in all three cases. Either a reduction in loudness or a decrease in the ratio of the direct to reverberent sound intensity, or both, caused the sound to appear to move away from the observer. Tests on a stage with variable reverberation showed that increasing the reverberation moved the front line of the virtual stage to the rear, but had little effect upon the rear line. When the microphone was moved outdoors to eliminate the effect of reverbation, either changing circuit gains or changing the distance between the caller and the microphone moved the virtual stage farther away. It is because of these effects that all center line positions appeared at the rear of the virtual stage for two-channel reproduction.

A quantitative description for these relationships has not been found. It is possible that a given loudness change, or a given in the ratio of the direct to reverber-



Limits of hearing.

FIGURE 1

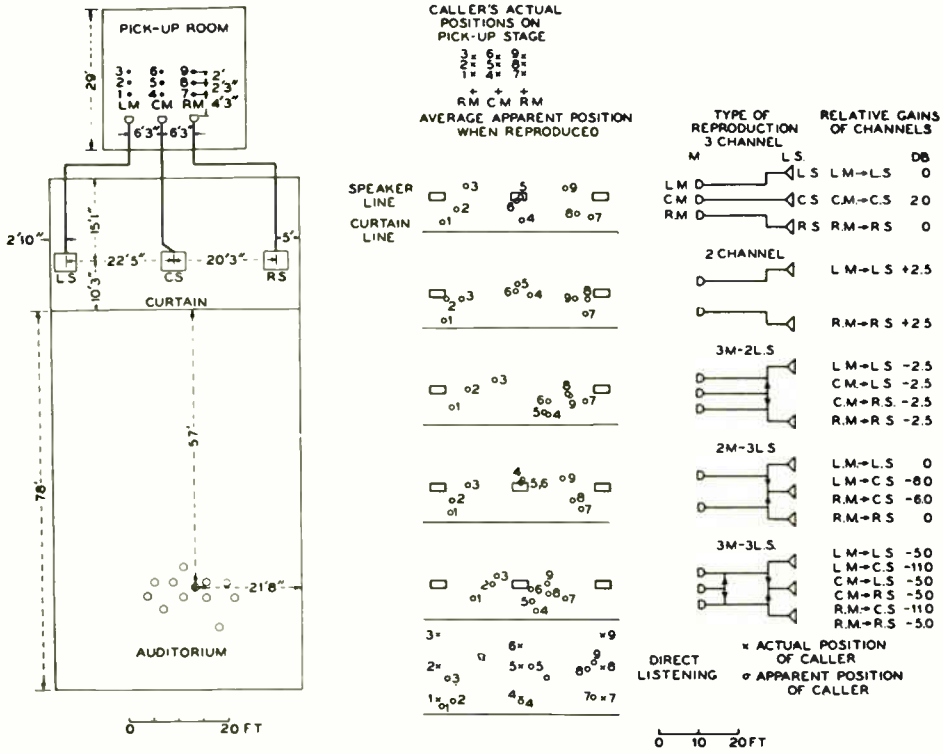


Diagram of arrangement (left) for sound localization tests & (right) the results obtained.

FIGURE 3

ent sound intensities, or both, causes different perceptions of depth that depend on the character of the reproduced sound and upon the observer's familiarity with the acoustic conditions surrounding the reproduction. Depth localization is inaccurate even under direct listening conditions. It is hard to obtain data for depth localization of sufficient accuracy for use in a quantitative manner. As such, good auditory perspective may be obtained with reproduced sounds even though the properties controlling depth localization may depart markedly from those of the original sound, i.e., the virtual width and angular localization are more apparent, while the virtual depth localizations seem more shallow.

Angular Localization

The properties entering into lateral or angular localization permit more quantitative treatment. For the case of a plane progressive wave from a single sound source, and where the observer's head is held in a fixed position, there are apparently only three factors that can assist in angular localization: the loudness difference, the quality difference, and time difference (as Snow later suggests) between the two sounds received by the two ears. In applying these factors to localization of sounds from more than one source, which is usually the case for musical performances, the effects of phase difference can be neglected. The two remaining factors, loudness and quality differences, both arise from the directivity of hearing, i.e., diffraction around the head. Snow later identifies time arrival as an additional important function. Measurements of the directivity with a source of pure tone located in various positions around the head had been reported in 1933 by Sivian and White. From these measurements the loudness level differences between near and far ears have been determined for various frequencies. These are shown in Figure 4. Using the pure tone data given in Figure 4 we can calculate similar loudness levels for complex tones, which are shown in Figure 5.

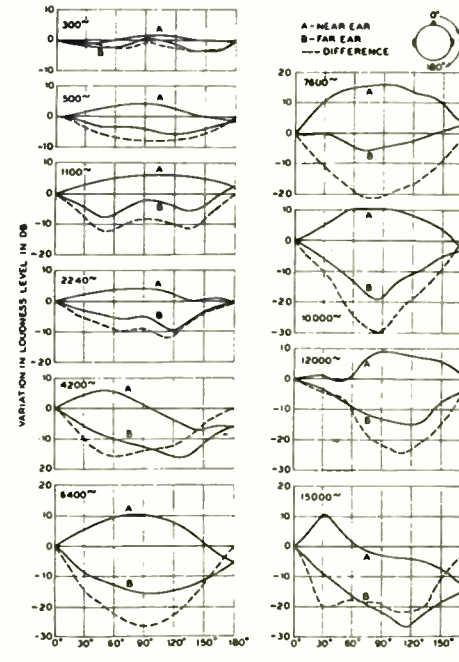
We can see from Figure 4 that the directive effects of hearing introduce a frequency distortion that is a characteristic of the direction from which the sound comes, i.e., the character or quality of a sound varies with the angle of the source. There are quality differences at each ear for various angles of the source, and quality differences between the two ears for a given angle of the source. Figure 6 shows the frequency distortion at the right ear when a source of sound is moved from a position on the right to one on the left of the observer. Figure 6 is a graph of the 'difference' values for an angle of 90 degrees taken from Figure 4.

We see from Figure 5, when the right ear hears speech three dB louder than the left, the observer localizes the sound as coming from a position 20 degrees or 167 degrees to the right, depending on the quality of the speech. If we assume this to be true, even though the difference is caused by the combination of sounds of similar quality from several sources, the apparent angle of the source as a function of the difference in decibels between the speech levels emitted by the loudspeakers of two- and three-channel systems can be calculated. For each loudspeaker, its contribution of direct sound loudness to each ear, which depends upon its distance from and angular position to the observer, is combined on a power basis to give the direct sound at each ear.

From this the difference in loudness between each ear is calculated and the apparent angle determined. The calculated results for two- and three-channel systems are shown by the solid lines in Figure 7. The y-axis shows the apparent angle, positive angle being in a clockwise direction. The x-axis shows the difference in decibels between the speech levels from the right and left loudspeaker. The points are observed apparent angles taken from Figure 4.

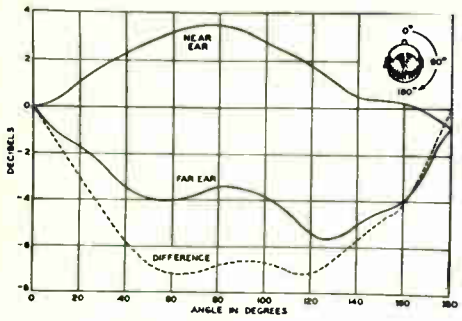
The principle conclusions to be drawn from the early Bell Laboratory investigations are:

1. Of the factors influencing angular localization, loudness difference of direct sound seems to play the most important part. These effects can be predicted for most observer positions reasonably well.



Variation in loudness level as a sound source is rotated in a horizontal plane around the head.

FIGURE 4

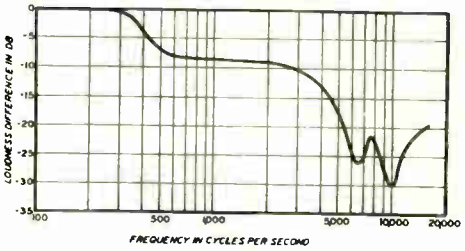


Variation of loudness of tone at both ears as sound source is rotated around head.

FIGURE 5

2. Depth localization was found to vary with changes in loudness, the ratio of direct to reverberent sound, or both. The effects are not subject to a computational treatment. The actual ratio of the direct to reverberent sound, and the change in the ratio, both appeared to play a part in an observer's judgement of stage depth.
3. Observers in different parts of the auditorium localize a given source at different virtual positions, as is predicted using loudness computations. As an observer moves to one side of an auditorium, the virtual source shifts toward the same side of the stage. Moving backward and forward in the auditorium appears to have only a small effect on the virtual position.
4. Because of these factors, point-to-point correlation between pick-up stage and virtual stage positions is not obtained in two- and three-channel systems.
5. The three-channel system proved clearly superior to the two-channel by eliminating the recession of the center-stage positions and in reducing the differences in localization for various observing positions. For musical performance reinforcement, the center channel can also be used for independent control of soloist renditions.
6. The application of acoustic perspective to orchestral reproduction in large auditoriums gives more satisfactory performance than would probably be suggested by the foregoing discussions. The instruments near the front are localized by everyone near their correct positions. In the ordinary orchestral arrangement, the rear instruments will be displaced in the reproduction depending upon the listener's position, but the impor-

(continued on page 54)



Loudness difference at right ear as sound source is moved from left to right of head.

FIGURE 6

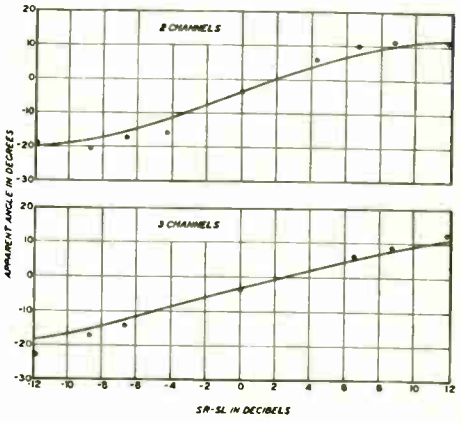


Illustration of angular location of sound source by loudness difference at ears for 2- and 3-channel systems.

FIGURE 7

Each RAMSA product can stand on its own individual merits. That's why our mixers, amps and speakers perform *together* beautifully. These modular, expandable *systems* deliver impressive performance with flexibility, wide bandwidth and minimum distortion. Each component is designed with integrity, manufactured with care and conservatively rated for longevity. Audition these components in concert at your nearest RAMSA dealer today.

RAMSA

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You're looking at the

In developing our newest console, we invited the engineers, consultants and contractors you see here to be a vital part of the mix. We asked them what works and what doesn't. What they like and don't like. What they want. And what they don't want.

We took this input and combined it with our own experience that includes nothing less than the development of the well-known PM1000 and PM2000. The result is an extraordinarily responsive, reliable, versatile mixing console, the PM3000. A console able to meet the demands of concert tours, fixed installations and broadcast applications by combining new technologies and ideas with proven Yamaha reliability.

MIX Magazine 1986 TEC Award for technical achievement.

In designing the PM3000, we considered not only where it will be used but also how it will be used. That's why the overall size and weight of the PM3000 are less than its predecessor's. Why the meter bridge height has been lowered. And why the 40-channel model has a center master configuration.

Greater control over equalization was another important consideration. Each input channel has a four-band parametric equalizer with a variable frequency high pass filter. The 12dB/octave high pass filter has its own in/out switch and its -3dB cutoff frequency is sweepable from 20Hz to 400Hz. This range makes it useful in minimizing the effects of low frequency stage rumble, vocal pops or wind noise. This high pass filter is also useful when micing high-hats or cymbals, to reduce the unwanted pick-up of nearby drums. Each of

Pictured (rear, l. to r.) Jay Kingery, Recording Consultants, Inc.; Herb Swartz, Harrah's-Tahoe; John Windt, Windt Audio; Rick Southern, Southern Star Engineering; Gary Davis, Wales, Smics Assoc.; Al Siniscal and Bobby Ross, A-1 Audio; Craig Olsen, Product Mgr./Yamaha. Not pictured: Chris "Smoother" Smyth and Steve Venezia, Delicate Audio;

PM3000's input channels.

the four stereo AUX returns also has its own two-band sweep-type EQ.

The PM3000's transparent sound quality is achieved by utilizing matched components in its electronic differential input stages. Yet it still retains a high degree of stability and common mode rejection. For those situations where the extra common mode rejection of a transformer is needed or where total grounding isolation is necessary, the optional IT3000 input transformers can be installed on a channel-by-channel basis.

To help accommodate the increased number of effects used in the real world today, the PM3000 provides eight AUX sends, each with level control and pre/off/post switch.

There are also eight VCA groups. We designed and built our own VCAs to insure that they would be stable enough to withstand the effects of constantly changing environmental conditions.

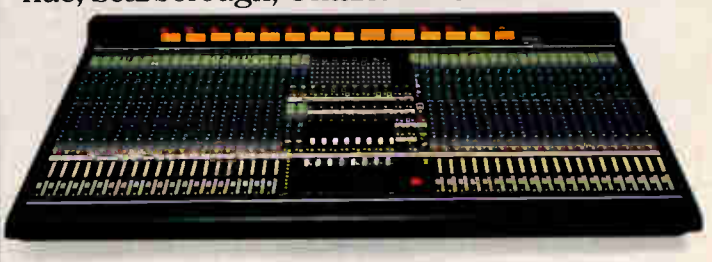
We also incorporated extensive and flexible muting capabilities into the PM3000. Each input channel has eight mute assign switches that permit the channel's on/off function to be controlled by the eight master mute switches. That means multiple channels can be muted or turned on at once, making scene changes or punch-ins quick and convenient. The mute-safe switch on each channel guards against inadvertent channel muting, if desired.

While the VCAs allow tremendous level control flexibility, conventional group busses and faders are provided for routing and signal processing purposes. These master faders are assignable to our unique mix matrix feature, the stereo buss and to the rear panel XLR connectors.

You'll appreciate the convenience of the PM3000's extensive cue and solo capability. Especially during sound checks. The ability to solo one channel while muting all inputs except the one being monitored makes sound checks a lot easier.

As previously stated, it was input from professionals like the ones you see here that enabled us to design a console as impressive and versatile as the PM3000. The result of all this can be heard at your Yamaha Professional Audio Dealer. More complete technical information is available from Yamaha Music Corporation, Professional Audio Division, P.O. Box 6600, Buena Park, CA 90622. In Canada, Yamaha Canada Music Ltd., 135 Milner Avenue, Scarborough, Ontario M1S 3R1.

Gary Davis & Assoc. (frnt, l. to r.) Bill Schuermann, Antech Labs; Lynn McCrosky and Alvis Michael Wickow and John Henderson, Little River Band; Ken Fause, Smith, Fause & Assoc.



YAMAHA®
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MIXING CONSOLES

When motion pictures first acquired a voice, balancing the characteristics of a sound source meant the introduction of equalizers and variable-gain microphone preamps. Since then, the marketplace has grown tremendously and the varying degrees of sophistication offer the sound contractor a variety of choices.

This special, comprehensive *Sound & Communications* Mixing Console pull-out section provides the sound contractor with a diverse selection of mixing consoles to choose from to suit his particular needs.

MIXING CONSOLES

Model	No. of Mic Input/Type	Phantom Power (Yes/No)	No. of Line Input/Type	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Channel Patching (Yes/No)	Modular Construction (Yes/No)	External Power Supply (Yes/No)	No. of EQ Bands	Input EQ Type	No. of Outputs/ Matrix/Stereo	Special Features	VCA	List Price
ALLEN AND HEATH BRENELL																
SR-16	16/B	Yes	16/B 2/U	LED	7 LED	up to 4	up to 4	Yes	Yes	Yes	4	Fixed	S/M	Yes	No	n/a
SR-416	16/B	Yes	16/B 6/U	LED	11 LED	up to 4	up to 4	Yes	Yes	Yes	4	Fixed	S/M / Subs	Yes	No	n/a
SR-424	24/B	Yes	24/B 6/U	LED	11 LED	up to 4	up to 4	Yes	Yes	Yes	4	Fixed	S/M / Subs	Yes	No	n/a
SR-432	32/B	Yes	32/B 10/U	LED	11 LED	up to 4	up to 4	Yes	Yes	Yes	4	Fixed	S/M / Subs	Yes	No	n/a
SRM-186	18/B	No	18/B 2/U	LED	7 LED	—	—	Yes	Yes	Yes	3	Fix / Mid-Sweep	6	Yes	No	n/a
SRM-248	24/B	No	24/B 2/U	LED	9 LED	—	—	Yes	Yes	Yes	3	Fixed	8	Yes	No	n/a
Studio 12	6/B	Yes	6/B 24/U	VU	3 VU	2	1	Yes	Yes	Yes	4 3	Fixed Fixed	S M	Yes	No	n/a
System 8 1616	16/B	Yes	16/B 18/U	VU / Peak LED	14 VU	2	2	Yes	Yes	Yes	3	Switch / Sweep	8/Stereo	MIDI	No	n/a
System 8 2416	24/B	Yes	24/B 18/U	VU / Peak LED	14 VU	2	2	Yes	Yes	Yes	3	Switch / Sweep	8/Stereo	MIDI	No	n/a
CMC-24 MK II	16/B	Yes	40/U	Peak LED	22 LED	up to 6	up to 6	Yes	Yes	Yes	3	Sweep	16/Stereo	MIDI SMPTE Opt.	No	n/a
CMC-32 MK II	24/B	Yes	56/U	Peak LED	30 LED	up to 6	up to 6	Yes	Yes	Yes	3	Sweep	16/Stereo split to 24	MIDI SMPTE Opt.	No	n/a
Sigma Series	8/B Up	Yes	10/U Up	Peak LED	2 up to 58	6 to 32	2 Stereo / 2 Mono	Yes	Yes	Yes	4 or 5	Sweep	S/M	MIDI	Opt.	n/a
ALTEC LANSING																
231A	12/B	Yes	12/U	LED	10/VU	1	2	Yes	No	No	3	2 Fix 1 Var	Stereo	—	No	$4,828.00
231 EM Extender	8/B	Yes	8/U	LED	—	—	—	Yes	No	No	3	2 Fix 1 Var	—	—	No	2,516.00
API AUDIO PRODUCTS																
Custom	to 56	Yes	32	Opt.	32	12	6	Yes	Yes	Yes	4	API 550A 560A 5502	Stereo	Opt.	No	n/a
AUDIO CENTRON																
AC 116	16/B	No	18/U	LED	4 LED	1	1	Yes	Yes	No	3	Fixed	Stereo/ Mono	Reverb	No	$1,300.00
AC 112	12/B	No	14/U	LED	4 LED	1	1	Yes	Yes	No	3	Fixed	Stereo/ Mono	Reverb	No	1,100.00
AC 108	8/B	No	10/U	LED	4 LED	1	1	Yes	Yes	No	3	Fixed	Stereo/ Mono	Reverb	No	900.00

BIAMP SYSTEMS

Model	No. of Mic Input/Type	Phantom Power (Yes/No)	No. of Line Input/Type	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Channel Patching (Yes/No)	Modular Construction (Yes/No)	External Power Supply (Yes/No)	No. of EQ Bands	Input EQ Type	No. of Outputs/ Matrix/Stereo	Special Features	VCA	List Price
3224 Bimix	32/B	Yes	32/B-36/U	LED meter	3 LED meters	up to 4	up to 4	Yes	Yes	Yes	3	Sweep	24/Stereo	Control room and studio outputs	No	$12,599.00
2016 Bimix	20/B	Yes	20/B-24/U	LED meter	23 LED meters	up to 4	up to 4	Yes	Yes	Yes	3	Sweep	16/Stereo	Control room and studio outputs	No	7,899.00
1280 Bimix	12/B	Yes	12/B-16/U	LED meter	15 LED meters	up to 4	up to 4	Yes	Yes	Yes	3	Sweep	8/Stereo	Control room and studio outputs	No	5,299.00
3228	32/B	Yes	32/B-36/U	2 LED	11 Florescent bar graph meters	up to 4	up to 4	Yes	No	Yes	3	Mid-Sweep	8/Stereo	Switch-able signal routing	No	6,699.00
2428	24/B	Yes	24/B-28/U	2 LED	11 Florescent bar graph meters	up to 4	up to 4	Yes	No	Yes	3	Mid-Sweep	8/Stereo	Switch-able signal routing	No	4,699.00
1628	16/B	Yes	16/B-20/U	2 LED	11 Florescent bar graph meters	up to 4	up to 4	Yes	No	No	3	Mid-Sweep	8/Stereo	Switch-able signal routing	No	3,449.00
2424	24/B	Yes	24/B-28/U	2 LED	7 Florescent bar graph meters	up to 4	up to 4	Yes	No	Yes	3	Mid-Sweep	4/Stereo	Switch-able signal routing	No	4,374.00
1624	16/B	Yes	16/B-20/U	2 LED	7 Florescent bar graph meters	up to 4	up to 4	Yes	No	No	3	Mid-Sweep	4/Stereo	Switch-able signal routing	No	3,099.00
1224	12/B	Yes	12/B-16/U	2 LED	7 Florescent bar graph meters	up to 4	up to 4	Yes	No	No	3	Mid-Sweep	4/Stereo	Switch-able signal routing	No	2,349.00
1683CX	16/B	Opt.	16/B-U	2 LED	3 LED meters	1	1	Yes	No	No	3	Fixed	Stereo/ Mono	Digital reverb (opt.)	No	1,599.00
1283CX	12/B	Opt.	12/B-U	2 LED	3 LED meters	1	1	Yes	No	No	3	Fixed	Stereo/ Mono	Digital reverb (opt.)	No	1,319.00

CARVIN

MX-2488	24/8	Yes	24/Mic line input	Peak	8/VU	2	2	Yes	Yes	Yes	3	Para-metric	8 Output 4 Matrix	No	No	$3,995.00
MX-1622	161	Yes	16/Mic line	Peak	21/VU	2	1	Yes	Yes	No	3	3 Band	—	No	No	1,395.00

DDA — DIVISION OF KLARK-TEKNIK

S-32/4/2	32/B	Yes	36/B	LED	7/VU	up to 4	up to 4	Yes	Yes	Yes	4	2/F-2/V	4/Stereo Mono	4/FX Ret	No	$11,500.00
S-24/4/2	24/B	Yes	28/B	LED	7/VU	up to 4	up to 4	Yes	Yes	Yes	4	2/F-2/V	4/Stereo Mono	4/FX Ret	No	8,250.00
S-16/4/2	16/B	Yes	20/B	LED	7/VU	up to 4	up to 4	Yes	Yes	Yes	4	2/F-2/V	4/Stereo Mono	4/FX Ret	No	6,250.00
S-8/4/2	8/B	Yes	12/B	LED	7/VU	up to 4	up to 4	Yes	Yes	Yes	4	2/F-2/V	4/Stereo Mono	4/FX Ret	No	4,500.00
SPA-32/4/2 Also in 24 & 16 input frame sizes	32/B	Yes	34/B	LED	10/VU	up to 8	up to 8	Yes	Yes	Yes	4	2/F-2/V	4/4/2/1	3 Band eq on aux sends	No	13,500.00

Model	No. of Mic Input/Type	Phantom Power (Yes/No)	No. of Line Input/Type	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Channel Patching (Yes/No)	Modular Construction (Yes/No)	External Power Supply (Yes/No)	No. of EQ Bands	Input EQ Type	No. of Outputs/ Matrix/Stereo	Special Features	VCA	List Price
S-Monitor 32/8/2 Also in 24 & 16 input frame sizes	32/B	Yes	34/B	LED	10/VU	up to 4	up to 4	Yes	Yes	Yes	4	2/F-2/V	8/2/1	4/FX return	No	$13,500.00
D-PA 40/8/2 Also in 32, 24 & 16 input frame sizes	80/B	Yes	44/B	LED	12/VU	up to 8	up to 8	Yes	Yes	Yes	4	2/F-2/V	8/2	A/B mic per input	No	25,050.00
D-Monitor 40/8/2 Also in 32, 24 & 16 input frame sizes	80/B	Yes	44/B	LED	12/VU	up to 8	up to 8	Yes	Yes	Yes	4	2/F-2/V	8/2	3 Band eq on aux sends	No	25,050.00
D-Theatre 40/8/2 Also in 32, 24 & 16 input frame sizes	40/B	Yes	44/B	LED	12/VU	up to 8	up to 8	Yes	Yes	Yes	4	2/F-2/V	8/2	3 Band eq on aux sends	No	28,330.00
D-Recording 40/8/2. Also in 32, 24 & 16	80/B	Yes	60/B	LED	12/VU	up to 8	up to 8	Yes	Yes	Yes	4	2/F-2/V	8/2	16 Tape return	No	24,930.00
AMR-24-110	24/B	Yes	54/B	LED	31/VU	up to 8	up to 8	Yes	Yes	Yes	5	3/V-2/S	24/2	Master switching	No	57,650.00
DORROUGH ELECTRONICS																
700	3/B	No	15/B	VU	2/VU	—	7	No	No	No	3	—	Mono cue for broadcast	Self-contain cue speaker	No	$2,250.00
ELECTRO-VOICE																
8432	32/B	Yes	41/U	LED/PK	6, Flor	2	1	Yes	No	No	3	Mid-Sweep	6/S	—	—	$770.00
8424	24/B	Yes	33/U	LED/PK	6, Flor	2	1	Yes	No	No	3	Mid-Sweep	6/S	—	—	6,160.00
8416	16/B	Yes	25/U	LED/PK	6, Flor	2	1	Yes	No	No	3	Mid-Sweep	6/S	—	—	4,185.00
8408	8/B	Yes	17/U	LED/PK	6, Flor	2	1	Yes	No	No	3	Mid-Sweep	6/S	—	—	3,210.00
8216	16/B	Yes	21/U	LED/PK	6, VU	2	1	Yes	No	No	3	Mid-Sweep	6/S	—	—	3,165.00
8212	12/B	Yes	17/U	LED/PK	6, VU	2	1	Yes	No	No	3	Mid-Sweep	6/S	—	—	2,580.00
8208	8/B	Yes	13/U	LED/PK	6, VU	2	1	Yes	No	No	3	Mid-Sweep	6/S	—	—	2,140.00
8108	8/B	Yes	6/U	LED/PK	4,10 LED	0	0	—	No	No	2	Fixed	4/M	—	—	1,275.00
EVT 5216 II	16/B	Yes	16/B-3/U	LED/PK	5,10 LED	1	1	Yes	No	No	3	Fixed	5/S	—	—	1,530.00
EVT 5212 II	12/B	Yes	12/B-3/U	LED/PK	5,10 LED	1	1	Yes	No	No	3	Fixed	5/S	—	—	1,195.00
EVT 5208 II	8/B	Yes	8/B-3/U	LED/PK	5,10 LED	1	1	Yes	No	No	3	Fixed	5/S	—	—	990.00
BK1632	16/B	Yes	16/B-3/U	LED/PK	5,10 LED	2	1	Yes	No	No	3	Fixed	6/S	—	—	1,498.00
HILL AUDIO																
Soundmix 16	16/B	Yes	16/U	LED	23 LED	4	4	Yes	No	Yes	4	Fixed	Stereo / Mono	—	—	$2,850.00
Soundmix 24	24/B	Yes	24/U	LED	31 LED	4	4	Yes	No	Yes	4	Fixed	Stereo / Mono	—	—	3,680.00
KUSTOM MUSIC																
KS-16R	16/B	Yes	16	LED	6 LED	2	1	Yes	No	No	3	Mid-Sweep	Stereo	—	No	$1,848.00
KS-12R	12/B	Yes	12	LED	6 LED	2	1	Yes	No	No	3	Mid-Sweep	Stereo	—	No	1,498.00
LOGITEK																
Perfectionist -12	4-12/B	No	48/B	No	2/VU	0	2	Yes	Yes	No	0	0	Stereo	DAS	No	$11,575.00
Perfectionist -8	4-12/B	No	32/B	No	2/VU	0	2	Yes	Yes	No	0	0	Stereo	DAS	No	8,995.00

Model	No. of Mic Input/Type	Phantom Power (Yes/No)	No. of Line Input/Type	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Channel Patching (Yes/No)	Modular Construction (Yes/No)	External Power Supply (Yes/No)	No. of EQ Bands	Input EQ Type	No. of Outputs/ Matrix/Stereo	Special Features	VCA	List Price
MIDAS AUDIO SYSTEMS																
AS6	48/PR 40A	Yes	16/PR41/B	8 LED	13 LED	8	—	Opt.	Yes	Yes	4	Sweep	12/4 + 4	—	No	L 66,821.00
AS5	40/PR 40A	Yes	12/PR41/B	8 LED	13 LED	8	—	Opt.	Yes	Yes	4	Sweep	12/4 + 4	—	No	58,103.00
AS4	32/PR 40A	Yes	8/PR41/B	8 LED	13 LED	8	—	Opt.	Yes	Yes	4	Sweep	12/4 + 4	—	No	44,808.00
AS3	36/PR 40A	Yes	4/PR41/A	8 LED	13 LED	4	—	Opt.	Yes	Yes	4	Sweep	12/4 + 2	—	No	35,707.00
AS2	30/PR 40A	Yes	4/PR41/A	8 LED	13 LED	4	—	Opt.	Yes	Yes	4	Sweep	12/4 + 2	—	No	32,042.00
AS1	24/PR 40A	Yes	4/PR41/A	8 LED	13 LED	4	—	Opt.	Yes	Yes	4	Sweep	12/4 + 2	—	No	28,377.00
XL 40	40/XL 01A	Yes	8/XL10A	LED	11 LED	8	—	Opt.	Yes	Yes	4	Sweep	8/2 + 2	—	No	31,806.00
XL 32	32/XL 01A	Yes	8/XL10A	LED	11 LED	8	—	Opt.	Yes	Yes	4	Sweep	8/2 + 2	—	No	27,135.00
XL 24	24/XL 01A	Yes	8/XL10A	LED	11 LED	8	—	Opt.	Yes	Yes	4	Sweep	8/2 + 2	—	No	22,680.00
NEOTEK																
Elite	up to 64/B	Yes	up to 64	LED	26 LED	6	6	Yes	Yes	Yes	4	State Variable	26 Stereo	MIDI	Yes	n/a
Elan	up to 36	Yes	up to 36	LED	24 LED	6	6	Yes	Yes	Yes	4	State Variable	24 Stereo	MIDI	Yes	n/a
Series I	up to 24	Yes	up to 84	LED	8 LED	4	4	Yes	Yes	Yes	4	State Variable	8 Stereo	Auto-mation	Yes	n/a
Theatre	up to 24	Yes	up to 74	LED	12 LED	4	4	Yes	Yes	Yes	3	Variable	12 Stereo	Quad	Yes	n/a
PANASONIC/RAMSA																
WR-8428	up to 28	Yes	up to 28	LED	12/VU	2	2	No	Yes	Yes	3	Variable	Stereo 4 matrix 4 group mono	24 Tape input	No	$20,000.00
WR-8616	up to 16	Yes	Up to 16	LED	7/VU	2	2	No	Yes	Yes	3	Variable	Stereo 4 group mono	No	No	8,000.00
WR-T820	20	Yes	20	LED	10/VU	2	2	No	Semi	No	3	Variable	8 group	No	No	6,900.00
PEAVEY ELECTRONICS																
MDII-16	16/B	Yes	16/U	LED	2 LED	1	1	Yes	No	No	3	Fixed Vari	Stereo	Mid-Eq	No	$1,149.50
MDII-12	12/B	Yes	12/U	LED	2 LED	1	1	Yes	No	No	3	Fixed Vari	Stereo	Mid-Eq	No	949.50
MDII-8	8/B	Yes	8/U	LED	2 LED	1	1	Yes	No	No	3	Fixed Vari	Stereo	Mid-Eq	No	749.50
Mark III-24	24/B	Yes	24/U	LED	2 LED	2	2	Yes	No	No	4	Fixed	Stereo	Case	No	2,458.50
Mark III-16	16/B	Yes	16/U	LED	2 LED	2	2	Yes	No	No	4	Fixed	Stereo	Case	No	1,858.50
MS-2421	24/B	Yes	24/U	LED	2 LED	2	2	Yes	No	No	3	Fixed Vari	Stereo	EQ	No	2,734.00
MS-1621	16/B	Yes	16/U	LED	2 LED	2	2	Yes	No	No	3	Fixed Vari	Stereo	EQ	No	2,099.50
MS-1221	12/B	Yes	12/U	LED	2 LED	2	2	Yes	No	No	3	Fixed Vari	Stereo	EQ	No	1,834.00
Mark IV-24	24/B	Yes	24/U	LED	4 LED	1	2	Yes	No	No	4	Fixed	Quad	Com.	No	3,058.00
Mark IV-16	16/B	Yes	16/U	LED	4 LED	1	2	Yes	No	No	4	Fixed	Quad	Com.	No	2,558.00
RANDALL																
RM12-4A	12/B	Yes	12/U	LED	10 LED	to 4	to 4	Yes	Yes	No	3	—	4	—	No	$1,294.50(B)
RM16-4A	16/B	Yes	16/U	LED	10 LED	to 4	to 4	Yes	Yes	No	3	—	4	—	No	1,625.00(B)

Model	No. of Mic Input/Type	Phantom Power (Yes/No)	No. of Line Input/Type	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Channel Patching (Yes/No)	Modular Construction (Yes/No)	External Power Supply (Yes/No)	No. of EQ Bands	Input EQ Type	No. of Outputs/ Matrix/Stereo	Special Features	VCA	List Price
RUPERT NEVE																
V Series	36-60+	Yes	36-60+	LED	48 Plasma	8	n/a	Yes	Yes	Yes	4	Parameter	48	Necam	Opt.	$180-300K
8232	32/48	Yes	32/48	LED	32/VU	6	n/a	Yes	Yes	Yes	4	Sweep	32	Necam	Opt.	115-175K
51 Series	12-48+	Yes	12-48+	LED	4-8/VU	4/8	n/a	Yes	Yes	Yes	4	Sweep	4/8	Necam	n/a	70-150K
542 Series	8-16	Yes	8-16	n/a	2-4/VU	2	n/a	No	Yes	Yes	3	Fixed	4/2	Direct Outs	n/a	10-30K
SECK distributed by CONNECTRONICS																
Seck 1882	18/B	Yes	18/B	No	8+Stereo LED	up to 4	up to 2	Yes	No	Yes	3	2 Fixed 1 Sweep	8+Stereo	Port-able	No	$4,794.00
Seck 1282	12/B	Yes	12/B	No	8+Stereo LED	up to 4	up to 2	Yes	No	Yes	3	2 Fixed 1 Sweep	8+Stereo	Port-able	No	4,140.00
Seck 242	24/B	Yes	24/B	No	2 LED	up to 2	up to 2	Yes	No	Yes	3	2 Fixed 1 Sweep	2	Port-able	No	4,140.00
Seck 122	12/B	Yes	12/B	No	2 LED	up to 2	up to 2	Yes	No	Yes	3	2 Fixed 1 Sweep	2	Port-able	No	1,995.00
SONY																
MXP-2016	1-2	Yes	1-2	5 LED	6 Me-chanical 5 LED	4	6	Yes	Yes	Yes	3	Fixed	up to 20 Mono 5 Stereo	Editor Inter-face	Yes	$17,640.00
MXP-2036	1-2	Yes	1-2	5 LED	6 Me-chanical 11 LED	4	6	Yes	Yes	Yes	3	Fixed	Mono version 40 Mono 5 Stereo Stereo Version 36 Mono 5 Stereo	Editor Inter-face	Yes	34,000.00
SOUNDTECH																
SL16	16/B	No	16/U	LED	5 LED	2	2	Yes	Yes	Yes	3	Fixed	Stereo	—	—	$1,999.00
SL24	24/B	No	24/U	LED	5 LED	2	2	Yes	Yes	Yes	3	Fixed	Stereo	—	—	2,599.00
ST164	16/B	Yes	16/U	LED	8 LED	4	2	Yes	Yes	Yes	3	Fixed	4 Sub	—	—	2,599.00
ST244	24/B	Yes	24/U	LED	8 LED	4	2	Yes	Yes	Yes	3	Fixed All units have mid-sweep	4 Sub	—	—	2,999.00
SOUNDTRACS																
CP6800 40-12-24-2 + 2	40/B	Yes	40	Peak	10 LED	up to 6	up to 6	Yes	Yes	Yes	6	Mid-Sweep /Shelving	Stereo	Patch auto-mation	Yes	$57,995.00
CP6800 32-12-24-2 + 2	32/B	Yes	32/B	Peak	10 LED	up to 6	up to 6	Yes	Yes	Yes	6	Mid-Sweep /Shelving	Stereo	Patch auto-mation	Yes	52,995.00
CM4400 W/PB 32-12-24-2 + 2	32/B	Yes	32/B	Peak	10/VU	up to 6	up to 6	Yes	Yes	Yes	4	Mid-Sweep /Shelving	Stereo	Digital routing	Yes	34,655.00
CM4400 32-12-24-2 + 2	32/B	Yes	32/B	Peak	10/VU	up to 6	up to 6	Yes	Yes	Yes	4	Mid-Sweep /Shelving	Stereo	Digital routing	Yes	30,655.00
CM4400 W/PB 24-8-16-2 + 2	24/B	Yes	24/B	Peak	10/VU	up to 6	up to 6	Yes	Yes	Yes	4	Mid-Sweep /Shelving	Stereo	Digital routing	Yes	29,475.00
CM4400 24-8-16-2 + 2	24/B	Yes	24/B	Peak	10/VU	up to 6	up to 6	Yes	Yes	Yes	4	Mid-Sweep /Shelving	Stereo	Digital routing	Yes	24,275.00
CM4400 W/PB 16-8-16-2 + 2	16/B	Yes	16/B	Peak	10/VU	up to 6	up to 6	Yes	Yes	Yes	4	Mid-Sweep /Shelving	Stereo	Digital routing	Yes	24,455.00
CM4400 16-8-16-2 + 2	16/B	Yes	16/B	Peak	10/VU	up to 6	up to 6	Yes	Yes	Yes	4	Mid-Sweep /Shelving	Stereo	Digital routing	Yes	19,255.00

Model	No. of Mic Input/Type	Phantom Power (Yes/No)	No. of Line Input/Type	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Channel Patching (Yes/No)	Modular Construction (Yes/No)	External Power Supply (Yes/No)	No. of EQ Bands	Input EQ Type	No. of Outputs/ Matrix/Stereo	Special Features	VCA	List Price
M SERIES																
32-8-2 Also in 24 & 16 input frame sizes.	32/B	Yes	32/U	Peak	10 LED	up to 6	up to 6	Yes	Yes	Yes	4	Mid-Sweep /Shelving	Stereo	4 Matrix	Yes	$13,995.00
ML SERIES																
32-12 Also in 24 & 16 input frame sizes.	32/B	Yes	32/B	Peak	13 LED	2	10	No	Yes	Yes	4	Mid-Sweep /Shelving	Mono	Inter-face	Yes	16,595.00
MR SERIES																
32-8-16-2. Also in 24 & 16 input frame sizes.	32/B	Yes	32/U	Peak	10 LED	up to 6	up to 6	Yes	Yes	Yes	4	Mid-Sweep /Shelving	Stereo	Norm-alized	Yes	14,995.00
PC SERIES																
24-16-2. Also in a 16 input frame size.	24/B	Yes	up to 56/U	Peak	8 LED	up to 4	up to 4	Yes	Yes	Yes	4	Mid-Sweep /Shelving	Stereo	MIDI	Yes	11,995.00
FME SERIES																
24-4-8-2	24/B	Yes	24/B	Peak	8 LED	up to 4	up to 4	Yes	Yes	Yes	4	Mid-Sweep /Shelving	Stereo	Stereo opt.	Yes	9,595.00
16-4-8-2	16/B	Yes	16/B	Peak	8 LED	up to 4	up to 4	Yes	Yes	Yes	4	Mid-Sweep /Shelving	Stereo	Stereo opt.	Yes	7,495.00
24-10 Mono	24/B	Yes	24/B	Peak	4 LED	up to 10	up to 10	No	Yes	Yes	3	Mid-Sweep /Shelving	Stereo	Stereo opt.	Yes	10,425.00
16-10 Mono	16/B	Yes	16/B	Peak	4 LED	up to 10	up to 10	Yes	Yes	Yes	3	Mid-Sweep /Shelving	Stereo	Stereo opt.	Yes	7,495.00
T SERIES																
16-4-2	16/B	Yes	16/B	Peak	8 LED	4	4	Yes	No	Yes	3	Mid-Sweep /Shelving	Stereo	Expand-able	Yes	3,995.00
With expanders (32-8-2)	32/B	Yes	32/B	Peak	8 LED	4	4	Yes	No	Yes	3	Mid-Sweep /Shelving	Stereo	—	Yes	995.00 each module.
SPECTRA SONICS																
1032-32	32	Yes	32	n/a	VU	12	4/24	Yes	Yes	Yes	3	ADJ	32/2/1	Yes	No	$74,710.00
1026-26	26	Yes	26	n/a	VU	12	4/24	Yes	Yes	Yes	3	ADJ	26/2/1	Yes	No	51,750.00
1024B-24	24	Yes	24	n/a	VU	12	4/24	Yes	Yes	Yes	3	ADJ	24/2/2	Yes	No	42,005.00
STUDER REVOX AMERICA																
961/962	to 16/B	Yes	to 4 16/B	VU or PPM	to 4 VU	2	2	Yes	Yes	No	3	Variable	2 to 4	Comp./ limiter modules	—	from $12,500.00
TASCAM / TEAC PROFESSIONAL DIVISION																
M512	12/B	Yes	12/B/U	VU	8/VU	4	8	Yes	No	No	3	Param.	8	—	Yes	$4,395.00
M520	20/B	Yes	20/B/U	VU	8/VU	4	8	Yes	No	Yes	3	Param.	8	—	Yes	5,995.00
M600	32/B	Yes	32/B	VU	16/VU	8	16	Yes	Yes	Yes	4	Param.	16	—	Yes	14,250.00
M216	16/B	No	16/B	VU	VU	1	4	Yes	No	No	2	Param.	Stereo	—	No	1,695.00
M308B	8/B	Yes	8/6/U	VU	VU	3	4	Yes	No	No	3	Param.	Stereo	—	No	1,995.00
M312B	12B	Yes	12/6/U	VU	VU	5	4	Yes	No	No	3	Param.	Stereo	—	No	2,945.00
M320B	20/B	Yes	20/6/U	VU	VU	5	4	Yes	No	No	3	Param.	Stereo	—	No	3,495.00
3RD GENERATION																
G162	16	Yes	16	LED	2/VU	4	4	Yes	No	Yes	3	Variable	Stereo	—	—	$1,599.00
G102	10	Yes	10	LED	2/VU	4	4	Yes	No	Yes	3	Variable	Stereo	—	—	1,199.00

Model	No. of Mic Input/Type	Phantom Power (Yes/No)	No. of Line Input/Type	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Channel Patching (Yes/No)	Modular Construction (Yes/No)	External Power Supply (Yes/No)	No. of EQ Bands	Input EQ Type	No. of Outputs/ Matrix/Stereo	Special Features	VCA	List Price
TOA ELECTRONICS																
RX-208	8/B	Yes	8/B	LED	Flor-escent	1	1	Yes	No	No	6	V	2	No	No	n/a
RX-212	12/B	Yes	12/B	LED	Flor-escent	1	1	Yes	No	No	6	V	2	No	No	n/a
RX-216	16/B	Yes	16/B	LED	Flor-escent	1	1	Yes	No	No	6	V	2	No	No	n/a
RX-7-164	16/B	Yes	16/B	LED	4/VU	4	4	Yes	Yes	Yes	4	Shelving	Matrix	No	No	n/a
RX-7-248	24/B	Yes	24/B	LED	4/VU	4	4	Yes	Yes	Yes	4	Shelving	Matrix	No	No	n/a
RX-7-328	32/B	Yes	32/B	LED	4/VU	4	4	Yes	Yes	Yes	4	Shelving	Matrix	No	No	n/a
TOTAL AUDIO CONCEPTS																
TAC Scorpion Fold Back	18-40/B in 3 frame sizes	Opt.	18-40/B	LED	8 or 12 LED or VU	n/a	8 or 12	Yes	Yes	Yes	4	Switched Hi/Low sweep mids	12 Mixes and listen output	Com-prehensive output EQ	No	$8,250.00 to 21,750.00
TAC Scorpion/ Sr.	16-40/B in 3 frame sizes	Yes	16-40/B	LED	18 LED or VU	4 or 8	4 or 8	Yes	Yes	Yes	4	Switched Hi/Low sweep mids	8 Groups 8x8 matrix stereo	Steel chassis with mother-board	No	5,950.00 to 23,850.00
TAC SR9000 Super Console	80 in-puts into 40 chan-nels/ DB	Yes	40/DB	8 seg-ment LED in 3 DB steps	26/30 segment LEDS VU option	16	16/ switch-able pre/ post	Yes	Yes	Yes	4	Full parametric	16/8 matrix, stereo, aux st. mono sum, 16 groups	Stereo input avail. VCA groups 8 mute groups	In place solo patch-bay ex-tender avail.	50,000.00 to 80,000.00
TAC Scorpion for Recording	3 frame sizes 16-40/B	Yes	16-40/B	LED	18 meter-ing LED or VU	4 or 8	8-16-24-32	Yes	Yes	Yes	4	Switched Hi/Low sweep mids	8-12-16 busses stereo	Steel chassis w/ mother-board	No	5,950.00 to 23,850.00
TOUCH TECHNOLOGIES																
MAX Theatre Console	n/a	n/a	24	n/a	24 Alpha Numeric	24	n/a	Yes	Yes	Yes	n/a	n/a	24	IBM PC pro-gram-mable	Yes	$41,000.00 to 67,000.00
TRIDENT																
Series 24 28-24-24 Also in 36, 44 & 52 input frame sizes.	28/B	Yes	28/B	LED/VU	24 LED	8	8	Yes	Yes	Yes	4	Sweep	Stereo	Fader reverse stereo inplace solo	No	$19,500.00
Series 65-8 24-8-2 Also in 24, 32, 40, 48 & 56 input frame sizes.	24/B	Yes	24/B	LED/VU	8 LED	8	8	Yes	Yes	Yes	4	Sweep	Stereo	n/a	No	13,800.00
Series 80/B 30-24-24 Also in 40 & 50 input frame sizes.	30/B	Yes	30/B	LED/VU	24/LED	5	5	Yes	Yes	Yes	4	Sweep	Stereo	Fader reverse stereo inplace solo	No	52,950.00

Model	No. of Mic Input/Type	Phantom Power (Yes/No)	No. of Line Input/Type	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Channel Patching (Yes/No)	Modular Construction (Yes/No)	External Power Supply (Yes/No)	No. of EQ Bands	Input EQ Type	No. of Outputs/ Matrix/Stereo	Special Features	VCA	List Price
WARD BECK SYSTEMS																
T1202A	12/B	Yes	12/B	—	2/VU	1	2	No	Yes	No	3	Para-metric	2	—	—	$14,500.00
WHEATSTONE																
MTX-1080	32-52/B	Yes	32-52/B	LED	18/VU	8	—	Yes	Yes	Yes	4	V	26	8 Mutes	No	$32,000.00
MTX-88	32-52/B	Yes	32-52/B	LED	10/VU	8	—	Yes	Yes	Yes	3	V	25		No	27,000.00
MTX-40	24/B	Yes	24/B	LED	7/VU	4	—	Yes	Yes	Yes	3	V	17		No	11,350.00
M-16	16-52/B	Yes	16-52/B	LED	17/VU	—	16	Yes	Yes	Yes	4	V	17	4 Mutes	No	16,000.00
M-8	12-52/B	Yes	12-52/B	LED	9/VU	—	8	Yes	Yes	Yes	3	1-F,1-V, 1-S	9		No	10,000.00
MTX-80	12-52/B	Yes	8-52/B	LED	10/VU	4	—	Yes	Yes	Yes	3	V	21		No	9,000.00
3208	12-48/ B	Yes	12-48	LED	12-48/ VU	4	—	Yes	Yes	Yes	3	V	—	—	No	10,000.00 and up
3224	12-48/ B	Yes	12-48	LED	12-48/ VU	4	—	Yes	Yes	Yes	3	V	—	—	No	10,000.00 and up
YAMAHA																
RM804	8/B	No	8/B	LED	5/VU	1	2	Yes	No	No	3	Fixed	Stereo	C/R monitor	No	$1,345.00
RM1608	16/B	Yes	16/B	LED	14/VU	2	2	Yes	Yes	Yes	3	Sweep	Stereo	Patch Bay	No	7,795.00
RM2408	24/B	Yes	24/B	LED	14/VU	2	2	Yes	Yes	Yes	3	Sweep	Stereo	Patch Bay	No	12,195.00
MC802	8/B	Yes	8/B	LED	5/VU	up to 3	up to 3	Yes	No	No	3	Mid-Sweep	Stereo	Stereo returns	No	n/a
MC1202	12/B	Yes	12/B	LED	5/VU	up to 3	up to 3	Yes	No	No	3	Mid-Sweep	Stereo	Stereo returns	No	n/a
MC1602	16/B	Yes	16/B	LED	5/VU	up to 3	up to 3	Yes	No	No	3	Mid-Sweep	Stereo	Stereo returns	No	n/a
PM3000-24	24/B	Yes	24/B	LED	26/VU	up to 8	up to 8	Yes	Yes	Yes	4	Para-metric	Stereo/ Matrix	Pgm. Mute	Yes	31,500.00
PM3000-32	32/B	Yes	32/B	LED	26/VU	up to 8	up to 8	Yes	Yes	Yes	4	Para-metric	Stereo/ Matrix	Pgm. Mute	Yes	36,500.00
PM3000-40C	40/B	Yes	40/B	LED	26/VU	up to 8	up to 8	Yes	Yes	Yes	4	Para-metric	Stereo/ Matrix	Pgm. Mute	Yes	42,500.00
MC1204	12/B	Yes	12/B	LED	10/VU	2	2	Yes	Yes	No	3	Mid-Sweep	4 x 2	Talk Back	No	2,445.00
MC1604	16/B	Yes	16/B	LED	10/VU	2	2	Yes	Yes	No	3	Mid-Sweep	4 x 2	Talk Back	No	2,995.00
MC2404	24/B	Yes	24/B	LED	10/VU	2	2	Yes	Yes	No	3	Mid-Sweep	4 x 2	Talk Back	No	3,995.00
MC2408M	24/B	Yes	24/B	LED	10/VU	2	2	Yes	Yes	No	3	Mid-Sweep	10 Mon. mix	Stage mon. cons.	No	3,995.00
M508	8/B	Yes	8/B	LED	4/VU	1	1	No	No	No	3	Fixed	Stereo	Trans-formers	No	1,850.00
M512	12/B	Yes	12/B	LED	4/VU	1	1	No	No	No	3	Fixed	Stereo	Trans-formers	No	2,550.00
M916	16/B	Yes	16/B	LED	6/VU	2	2	Yes	No	No	3	Switch	Stereo/ Matrix	Trans-former	No	5,995.00
PM1800-16	16/B	Yes	16/B	LED	20/VU	up to 6	up to 6	Yes	Yes	Yes	4	Sweep	Stereo/ Matrix	Trans-former Opt.	No	13,500.00
PM1800-24	24/B	Yes	24/B	LED	20/VU	up to 6	up to 6	Yes	Yes	Yes	4	Sweep	Stereo/ Matrix	Trans-former Opt.	No	16,500.00
PM1800-32	32/B	Yes	32/B	LED	20/VU	up to 6	up to 6	Yes	Yes	Yes	4	Sweep	Stereo/ Matrix	Trans-former Opt.	No	19,500.00
PM1800-40	40/B	Yes	40/B	LED	20/VU	up to 6	up to 6	Yes	Yes	Yes	4	Sweep	Stereo/ Matrix	Trans-former	No	23,500.00

SELF-POWERED MIXING CONSOLES

Model	Output @ 4/8 Ohms	Phantom Power (Yes/No)	No. of Mic Inputs/Type (B = Balanced U = Unbalanced)	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Reverb (Yes/No)	No. of EQ Bands (P = Passive A = Active)	Input EQ Type (F = fixed V = variable S = switchable)	Main EQ Type & No.	Stereo or Mono (S/M)	Weight in Lbs.	List Price
AUDIO CENTRON														
AC108P	125W/4 190W/2	No	8/B	LED	4 LED	1	1	Yes	—	V	9 Graphic	S	n/a	$1,350.00
BIAMP SYSTEMS														
1229	290W/175W	Opt.	12/B	LED	3 LED Meters	1	1	Yes (Digital Opt.)	3-A	F	9 Graphic X2	S/M	52	$1,899.00
829	290W/175W	Opt.	8/B	LED	3 LED Meters	1	1	Yes (Digital Opt.)	3-A	F	9 Graphic X2	S/M	49	1,599.00
Mixpak 7 +	250W/150W	No	7/B	—	1 LED Meter	1	1	Yes	2-A	F	9 Graphic	M	25	699.00
Mixpak 6 +	250W/150W	No	6/B	—	1 LED Meter	1	1	Yes	2-A	F	9 Graphic	M	25	649.00
Mixpak 5 +	250W/150W	No	6/B	—	1 LED Meter	1	1	Yes	2-A	F	9 Graphic	M	25	599.00
CARVIN														
MX122P	400W/250W	Yes	12/B	Peak	1 Stereo 1/VU	1	2	Yes	3-A	3-V	2 Graphic 10 Band	S	64	$1,299.00
MX822P	400W/250W	Yes	12/B	Peak	1 Stereo 1/VU	1	2	Yes	3-A	3-V	2 Graphic 10 Band	S	53	999.00
ELECTRO-VOICE														
100M	100W/8	Yes	8/B-11/U	LED	2 Flor	1	1	Yes	3-A	F	Dual 8-Band Graphic	S	36	$1,914.00
HM ELECTRONICS														
MX56	100W/60W	NO	1	n/a	2 Meter	1	n/a	n/a	n/a	V	n/a	S	18	$860.00
KUSTOM MUSIC														
KPC-16	200W/150W (X 2)	Yes	16/B-U	Peak/Signal	6/VU	2	1	Yes	3	V	9 Graphic X 2	S	—	$2,448.00
KPC-12	200W/150W (X 2)	Yes	16/B-U	Peak/Signal	6/VU	2	1	Yes	3	V	9 Graphic X 2	S	—	2,148.00
KBC-1	160W/100W (X 2)	Yes	8/B-U	LED	2 LED	1	1	Yes	3	F	7 Graphic X 2	S	—	1,478.00
K8300	200W/100W (X 2)	Yes	8/B-U	—	3 LED	1	1	Yes	2-A	F	7 Graphic X 2	M	—	1,268.00
K6300	200W/100W (X 2)	Yes	6/B-U	—	3 LED	1	1	Yes	2-A	F	7 Graphic X 2	M	—	1,168.00
K6160	150W/90W	No	6/B-U	—	3	1	1	Yes	2-A	F	5 Graphic	M	—	598.00
K4100	100W/70W	No	4/B-U	—	3	1	1	Yes	2-A	F	5 Graphic	M	—	458.00
NUMARK														
PM200	140W/100W per Ch.	No	2/U	No	2 LED	1	1	No	0	—	5 Graphic	S	25	$899.00

Model	Output @ 4/8 Ohms	Phantom Power (Yes/No)	No. of Mic Inputs/Type (B = Balanced U = Unbalanced)	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Reverb (Yes/No)	No. of EQ Bands (P = Passive A = Active)	Input EQ Type (F = fixed V = variable S = switchable)	Main EQ Type & No.	Stereo or Mono (S/M)	Weight in Lbs.	List Price
PEAVEY ELECTRONICS														
XR-700C	150W/83W	Yes	7/B-U	No	2 LED	1	1	Yes	3-A	F	9 Graphic	M	40	n/a
XR-800C	150W/83W	Yes	8/B-U	LED	2 LED	1	2	Yes	3-A	F-V	9 Graphic	S	50	n/a
XR-1200C	250W/138W	Yes	12/B-U	LED	2 LED	1	2	Yes	3-A	F-V	9 Graphic	S	80	n/a
XR-1600C	250W/138W	Yes	16/B-U	LED	2 LED	1	2	Yes	3-A	F-V	9 Graphic	S	90	n/a
PROFESSIONAL SOUND														
SX-6,8,10	—	Yes	6, 8, 10/B	LED	2 LED	1	2	No	3-A	F	3 Mid-parametric	S	14	n/a
SXPR	—	Yes	2, 4, 6/B	LED	2 LED	—	1	No	1-A	F	Lo-Cut	S	2.5	n/a
RANDALL														
RPA-2	100W/8	No	4/U	No	2	—	1	Yes	1	F	—	M	28	$479.50
RPA-601	120W/4	No	6XLR	—	2 LED	1	1	Yes	5-A	S	5-A	M	24	699.50
RPA-801	120W/4	No	8XLR	—	2 LED	1	1	Yes	5-A	S	5-A	M	24	849.50
ROLAND														
CPM-120	120/8	No	8/U	LED	2 LED	1	1	No	2-A	V	—	S	15	$775.00
SHURE BROTHERS														
Audio-Master1200	200W/4	Yes	6, 8, or 10 (B)	LED	1 LED	n/a	1	Yes	2-A	V	n/a	M	37 w/case	$1,000.00 UL Listed
SOUNDTECH														
4150	150W/100W	No	4/B	No	1	1	1	Yes	2-A	F	5 Graphic	M	29	$399.00
6150	150W/100W	No	6/B	No	1	1	1	Yes	2-A	F	9 Graphic	M	35	549.00
6300	300W/200W	No	6/B	No	1	1	1	Yes	2-A	F	9 Graphic	M	36	649.00
8300	300W/220W	No	8/B	No	1	1	1	Yes	2-A	F	9 Graphic	M	27	799.00
310SE	150W/100W	No	10/B	LED	2 LED	2	2	Yes	3-A	F	7 Graphic	S	44	1,899.00
512SE	250W/200W	No	12/B	LED	2 LED	2	2	Yes	3-A	F	7 Graphic	S	69	2,199.00
SOUNDTRACS														
Clubmixer	n/a	No	2/U	LED	2 LED	up to 2	up to 2	No	3	F	Graphic	S/M	10	$1,295.00
STELLAVOX														
AMI48	Line bal. float.	Yes + all other supply	5/B	1X VU	2/2 VU	—	—	—	10	V	—	S/M	10	$5,000.00
3RD GENERATION														
G62S	200W/128W	No	6/B-U	LED	2/VU	1	1	No	3-A	V	n/a	S	30	$1,259.00

Model	Output @ 4/8 Ohms	Phantom Power (Yes/No)	No. of Mic Inputs/Type (B = Balanced U = Unbalanced)	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Reverb (Yes/No)	No. of EQ Bands (P = Passive A = Active)	Input EQ Type (F = fixed V = variable S = switchable)	Main EQ Type & No.	Stereo or Mono (S/M)	Weight in Lbs.	List Price
TOA ELECTRONICS														
RXA-212	120W	No	12/B	LED	2 Florescent	2	2	Yes	—	3-V	9 Graphic	S	64	n/a
RXA-216	120W	No	16/B	LED	2 Florescent	2	2	Yes	—	3-V	9 Graphic	S	88	n/a
YAMAHA														
EM-1400	150W/100W	No	4/B	LED	3/VU	2	—	Yes	3-A	F	6 Graphic	M	n/a	n/a
EM-1600	150W/100W	No	6/B	LED	3/VU	2	—	Yes	3-A	F	6 Graphic	M	n/a	n/a
EM1800	150W/100W	No	8/B	LED	3/VU	2	—	Yes	3-A	F	6 Graphic	M	n/a	n/a
EMX-200	250W/170W	No	8/B	LED	5/VU	1	2	Yes	3-A	Mid V	9 Graphic	S	68	$1,995.00
EMX-300	250W/170W	No	12/B	LED	5/VU	1	2	Yes	3-A	Mid V	9 Graphic	S	77	2,295.00

MIXERS: RACK-MOUNT, PORTABLE

Model	No. of Mic Input/Type	Phantom Power (Yes/No)	No. of Line Input/Type	Limiter (Yes/No)	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Channel Patching (Yes/No)	Hi-Pass Filter (Yes/No)	Reverb (Yes/No)	No. of EQ Bands	Input EQ Type	Main EQ Type & No.	Special Features	VCA	Stereo or Mono (S/M)	List Price
ALTEC LANSING																		
1689A	2/B	Yes	2/B	No	—	1 None	—	—	No	No	No	—	—	2 Band Fixed	—	No	M	$700.00
1699A	6/B	Yes	2/B	No	—	1 None	—	—	No	No	No	—	—	2 Band Fixed	—	No	M	1,184.00
1692A	6/B	Yes	2/B	No	—	2 LED	—	—	No	Yes	No	—	—	2 Band Fixed	—	No	2M	1,588.00
API AUDIO PRODUCTS																		
3124M	4/B	Yes	4/U	No	LED	4 x 2 LED	4	2	Yes	No	No	n/a	n/a	n/a	—	No	S	n/a
AUDIO MEDIA RESEARCH (AMR)																		
AMR-64	6/B	No	10/U	No	Limit LED	6 LED	1	—	Yes	No	No	3	Mid-Sweep	n/a	Re-cording Mixer	No	S	$599.50
AMR-42	4/U	No	4/U	No	Limit LED	2 LED	1	—	No	No	No	2	Fixed	7 Band Graphic	Re-cording Mixer	No	S	349.50

Model	No. of Mic Input/Type	Phantom Power (Yes/No)	No. of Line Input/Type	Limiter (Yes/No)	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Channel Patching (Yes/No)	Hi-Pass Filter (Yes/No)	Reverb (Yes/No)	No. of EQ Bands	Input EQ Type	Main EQ Type & No.	Special Features	VCA	Stereo or Mono (S/M)	List Price
BIAMP SYSTEMS																		
Rackmax	16/B	Yes	16/B-U	No	2 LED	6 LED	up to 3	up to 3	No	Yes	Yes	3	Fixed	n/a	Digital Reverb (opt.)	No	S/M	$1,899.00
883RX	8/B	Opt.	8/B-U	No	2 LED	5 LED	1	1	Yes	Yes	Yes	3	Fixed	n/a	Digital Reverb (opt.)	No	S/M	974.00
683RX	6/B	Opt.	6/B-U	No	2 LED	5 LED	1	1	Yes	Yes	Yes	3	Fixed	n/a	Digital Reverb (opt.)	No	S/M	819.00
CETEC IVIE																		
2503	4/B	Yes	4/B-3/U	No	—	1	—	—	—	Yes	No	—	—	—	Auto-matic gating MXR	6 CH	M	$1,734.00
2502	4/B	Yes	4/B-3/U	No	—	1	—	—	—	Yes	No	—	—	—	Auto-matic gating MXR	1 CH	M	1,575.00
DDA - Division of KLARK-TEKNIK																		
8/2RM	8/B	Yes	10/B	No	LED	4/VU	up to 4	up to 4	Yes	Yes	No	4	2 Shelv-ing 2 Peak w/sweep freq.	—	−90 Xtalk Modu-lar	No	S/M	$4,500.00
ELECTRO-VOICE																		
ELX-1	4/B	Yes	4/B-1/U	Yes	LED & Peak	1 LED	—	—	—	Yes	No	—	—	—	—	—	—	$532.00
EVT-5208 II rack mount	8/B	Yes	8/B-3/U	No	LED	5, 10 LED	1	1	Yes	No	Yes	—	3-Band F	—	—	—	S	990.00
HILL AUDIO																		
Multimix	16/B	Yes	20/U	No	LED	19 LED	up to 12	up to 12	Yes	No	No	3	Fixed	n/a	RIAA	No	S/M	$2,199.00
Rackmix	8/B	Yes	8/U	No	LED	7 LED	4	4	Yes	No	No	4	Fixed	n/a	—	No	S/M	1,980.00
HM ELECTRONICS																		
MX-55	4/U	n/a	4/U	No	n/a	2 LED	1	—	No	No	No	—	Fixed	n/a	n/a	n/a	S	$384.00
MX-77	4/U	n/a	1/B-4/U	No	n/a	2 LED	1	—	No	No	No	—	Fixed	3 Graphic	n/a	n/a	S	494.00
MX-99	4/U	n/a	1/B-5/U	No	n/a	4 LED	1	—	No	No	No	—	Fixed	5 Graphic	n/a	n/a	S	534.00
MX-1	6/U	n/a	9/U	No	n/a	6 LED	—	—	No	No	No	—	Fixed	5 Graphic	n/a	n/a	S	749.00
MX-10	6/U	n/a	11/U	No	n/a	2 Meter	2	—	No	Yes	No	2	Variable	n/a	n/a	n/a	S	950.00
MX-81	6/U	n/a	11/U	No	n/a	2 Meter	1	—	No	No	No	—	Fixed	7 Graphic	n/a	n/a	S	899.00

Model	No. of Mic Input/Type	Phantom Power (Yes/No)	No. of Line Input/Type	Limiter (Yes/No)	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Channel Patching (Yes/No)	Hi-Pass Filter (Yes/No)	Reverb (Yes/No)	No. of EQ Bands	Input EQ Type	Main EQ Type & No.	Special Features	VCA	Stereo or Mono (S/M)	List Price
IED																		
4000	1 to 100	Yes	1 to 100	Opt.	—	2	—	—	—	—	—	—	—	—	—	—	—	n/a
INDUSTRIAL RESEARCH PRODUCTS																		
DE-4018	up to 10	Opt.	up to 10	Opt.	LED	Main/ Aux	No	No	No	Yes	No	9	Fixed	n/a	n/a	No	M	n/a
DE-4013	up to 12	Opt.	up to 12	Opt.	LED	Main/ Aux	No	No	No	Yes	No	—	n/a	n/a	n/a	No	M	n/a
DE-4014	4	Opt.	1	No	LED	Main/ Aux	No	No	No	No	No	—	n/a	n/a	n/a	No	M	n/a
DE-4016	4	Opt.	1	No	LED	Main/ Aux	No	No	No	No	No	—	n/a	n/a	Re-mote	No	M	n/a
JBL																		
7510-A	to 24	Yes	to 24	No	LED	1/VU	—	—	—	—	—	—	—	—	Auto-mixer	Yes	M	$1,698.00
7510-02							4-INPUT MODULE FOR 7510A											675.00
5330	6 M/L	Yes	6	Yes	No	1 LED	1	1	No	Yes	No	—	—	2/Bass Treble	—	Yes	M	876.00
5336							6-VCA PLUG-IN CARD FOR 5330											180.00
KUSTOM MUSIC																		
BC-1	8/B	Yes	8/B-4/U	No	LED	5/LED	1	1	Yes	No	Yes	3	Fixed	7 Band X 2	—	No	S	$1,478.00
LOGITEK																		
Stereorack	7/B	No	11/B	No	No	2/VU	—	4	—	—	—	—	—	—	Talk-back DAs	Yes	S	$4,250.00
Audiorack	6/B	No	5/B	No	No	2/VU	—	4	—	—	—	—	—	—	Talk-back DAs	No	M	2,995.00
RUPERT NEVE																		
5442	8/B	Yes	8/B	No	n/a	2/VU	2	1	No	Yes	No	3	Fixed	n/a	Direct Outs	No	S	$10,960.00
PANASONIC/RAMSA																		
WR-S208	8/B	Yes	8/B	No	LED	6 LED	2	1	No	No	No	3	H/L Fixed Variable Mid	n/a	No	No	S/M	$1,275.00
WR-S212	12/B	Yes	12/B	No	LED	6 LED	2	1	No	No	No	3	H/L Fixed Variable Mid	n/a	No	No	S/M	1,955.00
WR-S216	16/B	Yes	16/B	No	LED	6 LED	2	1	No	No	No	3	H/L Fixed Variable Mid	n/a	No	No	S/M	2,195.00
WR-M10	4 Mono In	No	6 Stereo In	Yes	LED	4	1	—	No	No	No	4	Fixed	n/a	Mono In pri-ority	No	S/M	795.00
WR-133	8 Mic Line	No	—	No	LED	2/VU	1	1	No	No	No	2	Fixed	n/a	—	—	S/M	1,100.00

Model	No. of Mic Input/Type	Phantom Power (Yes/No)	No. of Line Input/Type	Limiter (Yes/No)	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Channel Patching (Yes/No)	Hi-Pass Filter (Yes/No)	Reverb (Yes/No)	No. of EQ Bands	Input EQ Type	Main EQ Type & No.	Special Features	VCA	Stereo or Mono (S/M)	List Price
PEAVEY ELECTRONICS																		
701R	8/B	No	8/U	No	LED	2 LED	1	1	Yes	No	Yes	4	Fixed	n/a	RIAA	No	S/M	$649.50
PPD BY NUMARK																		
MMX-2000	4/B	No	10/U	No	No	6 LED	1	1	Yes	No	No	3	Fixed	2 Fixed	3 Phono Inputs with Cross-fader	No	S	$1,799.00
MMX-1000	4/B	No	5/U	No	No	6 LED	1	1	No	No	No	—	—	2 Fixed	3 Phono Inputs with Cross-fader	No	S	1,399.00
DM-1950	2/B	No	4/U	No	No	4 LED	1	1	No	No	No	—	—	2 Fixed 2 Sweep	3 Phono Inputs with Cross-fader	No	S	999.00
DM-1900	1/B 1/U	No	5/U	No	No	4 LED	1	1	No	No	No	—	—	6 Graphic	3 Phono Inputs with Cross-fader	No	S	799.00
DM-1775	2/U	No	4/U	No	No	3 LED	1	1	No	No	Yes	—	—	6 Graphic	2 Phono Inputs with Cross-fader	No	S	849.00
DM-1700T	2/U	No	4/U	No	No	2 LED	1	1	No	No	Yes	—	—	6 Graphic	2 Phono Inputs with Cross-fader	No	S	589.00
DM-1750	2/U	No	4/U	No	No	2 LED	—	1	No	No	No	—	—	6 Graphic	2 Phono Inputs with Cross-fader	No	S	489.00
RANE																		
SM-26	—	No	8/B/U	No	—	8	n/a	n/a	No	Yes	No	—	—	n/a	Mix/ Pan	No	S	$349.00
MP-24	2	Yes	18/U	No	LED	13 LED	8	—	No	Yes	No	4	—	4/BP	Many	No	S	1,099.00
ROLAND																		
BX-800	8/U	No	8/U	No	LED	2 LED	1	1	No	No	No	2	V	—	—	No	S	$460.00
BX-600	6/U	No	6/U	No	LED	2 LED	1	1	No	No	No	2	V	—	—	No	S	260.00
BX-400	4/U	No	4/U	No	LED	1 LED	1	1	No	No	No	1	V	—	—	No	M	190.00
SECK distributed by CONNECTRONICS																		
SECK 62	6/B	Yes	6/B	No	n/a	2 LED	2	2	Yes	No	No	3	2 Fixed 1 Sweep	n/a	2" Thick	No	S/M	$1,345.00

SHURE BROTHERS

Model	No. of Mic Input/Type	Phantom Power (Yes/No)	No. of Line Input/Type	Limiter (Yes/No)	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Channel Patching (Yes/No)	Hi-Pass Filter (Yes/No)	Reverb (Yes/No)	No. of EQ Bands	Input EQ Type	Main EQ Type & No	Special Features	VCA	Stereo or Mono (S/M)	List Price
FP-51	4/B	Yes	4/B	No	—	1/VU	—	—	No	Yes	No	—	—	—	Compressor	No	M	$951.00
FP-42	4/B	Yes	4/B	Yes	—	2/VU	—	—	No	Yes	No	—	—	—	Cue	No	S	750.00
M-267	4/B	Yes	4/B	Yes	—	1/VU	—	—	No	Yes	No	—	—	—	Classic	No	M	475.00
M-268	4/B	Yes	1/U	No	—	3	—	—	No	No	No	—	—	—	UL List	No	M	257.00
M-68FCA	4/B	No	1/U	No	—	2	—	—	No	No	No	—	—	—	UL List	No	M	205.00

SONY

Model	No. of Mic Input/Type	Phantom Power (Yes/No)	No. of Line Input/Type	Limiter (Yes/No)	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Channel Patching (Yes/No)	Hi-Pass Filter (Yes/No)	Reverb (Yes/No)	No. of EQ Bands	Input EQ Type	Main EQ Type & No	Special Features	VCA	Stereo or Mono (S/M)	List Price
MXP-21	8/B	Yes	8/U	No	LED Peak	2/B 2/U LED	2	4	No	Yes	No	3	Fixed	n/a	Fader remote	No	S	$1,695.00
MXP-29	8/B	Yes	6/U	No	LED Peak	2/B 2/U LED	2	2	No	Yes	No	3	Fixed	n/a	Video Editor Interface	Yes	S	3,300.00
MXP-6/VU	12/B	Yes	12/B	Yes	LED Peak	4/B VU	3	2	No	Yes	No	3	Variable (MID)	n/a	Cascade connect	No	S	9,500.00

SOUNDCRAFT

Model	No. of Mic Input/Type	Phantom Power (Yes/No)	No. of Line Input/Type	Limiter (Yes/No)	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Channel Patching (Yes/No)	Hi-Pass Filter (Yes/No)	Reverb (Yes/No)	No. of EQ Bands	Input EQ Type	Main EQ Type & No	Special Features	VCA	Stereo or Mono (S/M)	List Price
Series 4	40/B	Yes	40/B	No	LED	8 LED	8	n/a	Yes	Yes	No	4	Parametric	n/a	*	Yes	S	$58,750.00
Series 4 (Monitor Version)	40/B	Yes	40/B	No	LED	16 LED	8	16	Yes	Yes	No	4	Parametric	n/a	*	Yes	S	50,250.00
8000	40/B	Yes	40/B	No	VU	8/VU	8	n/a	Yes	Yes	No	4	Sweep	n/a	*	Yes	S	32,500.00
8000	32/B	Yes	32/B	No	VU	8 LED	8	n/a	Yes	Yes	No	4	Sweep	n/a	*	Yes	S	27,950.00
8000	24/B	Yes	24/B	No	VU	8 LED	8	n/a	Yes	Yes	No	4	Sweep	n/a	*	Yes	S	23,500.00
600	32/B	Yes	32/B	No	LED	8 LED	8	n/a	Yes	Yes	No	4	Sweep	n/a	*	Yes	S	14,500.00
500	32/B	Yes	32/B	No	VU	8 LED	8	n/a	Yes	Yes	No	4	Sweep	n/a	*	Yes	S	13,225.00
600	24/B	Yes	24/B	No	LED	8 LED	8	n/a	Yes	Yes	No	4	Sweep	n/a	*	Yes	S	11,500.00
500	24/B	Yes	24/B	No	VU	8 LED	8	n/a	Yes	Yes	No	4	Sweep	n/a	*	Yes	S	10,300.00
600	16/B	Yes	16/B	No	LED	8 LED	8	n/a	Yes	Yes	No	4	Sweep	n/a	*	Yes	S	9,150.00
500	16/B	Yes	16/B	No	VU	8 LED	6	n/a	Yes	Yes	No	4	Sweep	n/a	*	Yes	S	8,350.00
200SR	24/B	Yes	24/B	No	VU	4 LED	4	n/a	Yes	Yes	No	4	Fixed	n/a	*	Yes	S	5,175.00
200SR	16/B	Yes	16/B	No	VU	4 LED	4	n/a	Yes	Yes	No	4	Fixed	n/a	*	Yes	S	3,750.00
200SR	8/B	Yes	8/B	No	VU	4 LED	4	n/a	Yes	Yes	No	4	Fixed	n/a	*	Yes	S	2,295.00

* ALL HAVE MODULAR CONSTRUCTION, EXTERNAL POWER SUPPLY.

SOUNDTRACS

Model	No. of Mic Input/Type	Phantom Power (Yes/No)	No. of Line Input/Type	Limiter (Yes/No)	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Channel Patching (Yes/No)	Hi-Pass Filter (Yes/No)	Reverb (Yes/No)	No. of EQ Bands	Input EQ Type	Main EQ Type & No	Special Features	VCA	Stereo or Mono (S/M)	List Price
FMX-4-4-4	8/B	Yes	8	No	LED	5 LED	up to 4	up to 4	No	No	No	3	Mid-Sweep/Shelving	Parametric	Opt.	Yes	Stereo	$7,495.00
FMX-8-10-Mon	8/B	Yes	8	No	LED	5 LED	up to 4	up to 4	No	No	No	3	Mid-Sweep/Shelving	Parametric	Stereo Opt.	Yes	Stereo	5,065.00
FMX-8-4-82	8/B	Yes	8	No	Peak	8 LED	up to 4	up to 4	Yes	No	No	3	Mid-Sweep/Shelving	Parametric	Stereo Opt.	Yes	Stereo	4,835.00
FMX-12-2	12/B	Yes	12	No	LED	4 LED	up to 4	up to 4	No	No	No	3	Mid-Sweep/Shelving	Parametric	Stereo Opt.	Yes	Stereo	4,775.00
FM-8-4-2	8/B	Yes	8	No	Peak	8 LED	up to 4	up to 4	Yes	No	No	3	Mid-Sweep/Shelving	Parametric	No Opt.	Yes	Stereo	3,995.00

Model	No. of Mic Input/Type	Phantom Power (Yes/No)	No. of Line Input/Type	Limiter (Yes/No)	Input Level Indicator Type (LED/VU)	No. of Outputs & Level Indicator Type	No. of Effects Sends	No. of Monitor Sends	Channel Patching (Yes/No)	Hi-Pass Filter (Yes/No)	Reverb (Yes/No)	No. of EQ Bands	Input EQ Type	Main EQ Type & No.	Special Features	VCA	Stereo or Mono (S/M)	List Price
SPECTRA SONICS																		
1100-04	6/B	No	6/B	No	n/a	1/VU	1	1	No	No	No	2	n/a	1/ADJ	Yes	No	M	$910.00
1100-03	6/B	No	6/B	No	n/a	1/VU	1	1	No	No	No	2	n/a	1/ADJ	Yes	No	M	910.00
1100	6/B	No	6/B	No	n/a	1/VU	1	1	No	No	No	2	n/a	1/ADJ	Yes	No	M	815.00
STUDER REVOX																		
C279	6/BU	Yes	6/U Stereo	No	—	2 LED	1	—	No	Yes	No	2	Fixed	n/a	PFL Meter	No	S/M	$2,699.00
TASCAM — TEAC PROFESSIONAL DIVISION																		
MX-80	8/B	Yes	8	Yes	LED	2	—	—	No	No	No	—	—	—	—	No	M	$575.00
M-06	6/B	No	6	Yes	VU	2/VU	1	4	No	No	No	2	Fixed	—	—	No	M	295.00
M-106	6/B	No	6	Yes	VU	2/VU	1	4	Yes	No	No	2	Fixed	—	—	No	M	594.00
M-208	8/B	No	8	Yes	VU	4/VU	1	4	Yes	No	No	2	Fixed	—	—	No	M	1,095.00
3RD GENERATION																		
G-62	6	No	6	No	LED	2/VU	2	2	Yes	No	No	3	V	n/a	—	—	—	$659.00
TOA ELECTRONICS																		
RX-31C	8/B	Yes	8/B	No	LED	12 LED	—	—	No	Yes	No	5	Peaking	n/a	No	No	Mono	n/a
MX-106	6/B	No	1/B	Yes	LED	2 Florescent	2	2	Yes	No	Yes	3	V	9	No	No	M	n/a
TRIDENT																		
Aries 10 x 4 x 2	10/B	Yes	18/B	No	LED	4 LED	4	4	Yes	No	No	3	Sweep	n/a	Monitors 8 returns	No	S	$2,995.00
UREI																		
1620	4/XL (Bal.)	No	20/RCA Unb.	No	No	8	2	2	No	No	No	2	Fixed	2/Bass Treble	No	No	S/M	$996.00
YAMAHA																		
KM-602	1/U	No	6/U	No	No	3 LED	1	—	No	No	Yes	n/a	n/a	n/a	Chorus	No	S	$225.00
KM-802	2/U	No	8/U	No	2 LED	5 LED	3	—	No	No	Yes	2	Fixed	n/a	Stereo returns	No	S	325.00
M-406	6/B	Yes	6/B	No	n/a	3/VU	1	—	No	No	No	3	Fixed	n/a	Transformer	No	S	1,250.00
MV-802	8/B	No	8/U	No	LED	4 LED	2	—	No	No	No	n/a	n/a	n/a	Master VCA	Yes	S	445.00
PM-180	6/B	No	6/B	No	n/a	2/VU	n/a	n/a	n/a	Yes	No	2	Fixed	n/a	Transformer	Yes	S	725.00
WARD BECK SYSTEMS																		
T1201A	12/B	Yes	12/B	—	—	2/VU	1	2	—	—	—	3	Parametric	—	—	—	S/M	$14,500.00

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The Series 500 offers 6 auxiliary sends (switchable pre or post fader; selectable pre or post EQ), 8 sub groups and balanced inputs and outputs. And an incredible 28 db of operating headroom.

The Series 8000 carries on the tradition of Soundcraft flexibility with features like 4 band parametric EQ, direct routing to sub groups, and an 8 X 8 matrix or effects return option.

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Assistive Listening Systems

an overview

by Paul Ingebrigtsen

It has been known for many years that hearing impaired people have difficulty understanding speech and music when listening with a group of people in a large room. Houses of worship, theaters, and auditoriums are common problem areas. Most sound system designers will agree that the hearing impaired have special needs and are aware that there is equipment available to help them. The questions remaining are whether the expense of an Assistive Listening System (ALS) can be justified to help a minority of listeners, and which system is the right one to use.

It is currently estimated that almost 10 percent of the population is classified as hearing impaired. It may seem like a lot of trouble to provide special equipment for a minority of users. However, hearing impaired people have the right to hear and understand the program or service when they attend a house of worship, theater or class. People with normal hearing have the ability to discriminate between wanted and unwanted sonic information. The solution lies in using specialized equipment that can meet the specific needs of the hearing impaired.

Paul Ingebrigtsen is the director of marketing for Williams Sound Corp. He is a graduate of the University of Minnesota and joined Williams Sound in 1981.

The Signal-to-Noise Ratio

Desired sounds must be significantly louder than undesired sounds in order to be understood. The sounds that occur closest to the listener, like shuffling feet, rattling papers, and conversation, are the loudest. A personal hearing aid cannot solve this problem because it cannot discriminate for the listener.

Multiple sound sources from loudspeakers and room reverberation often make matters worse. A solution is to put the hearing aid microphone closer to the sound source.

How an ALS Works

An ALS makes use of the existing microphones and mixer in the facility to pick up speech or music. Since the microphone is close to the sound source, the desired sound is louder than background noises, establishing an optimal signal-to-noise ratio. The mixed audio is then distributed directly to the listeners, either by wired headphones, or more preferably, by a wireless system.

Wired Systems

An early approach to ALS design was to install earphone jacks in selected seats, hard-wired directly to the sound system. The advantages of a hard-wired system are low equipment cost, immunity to electromagnetic interference, and good sound quality, depending on the headsets and amplifier chosen. Since portable receivers are not used, there are no concerns about receiver or battery management.

However, there may be a limitation on the number of users and reluctance of people to use the system. People do not like to call attention to themselves by sitting in the "deaf row." Any type of ALS is of little value if people are unwilling to use it.

Wireless Systems

Wireless systems allow the listener to use a portable receiver unit to pick up a transmission anywhere within a facility and any number of receivers can be used. There are four types of wireless systems available, Induction Loop, AM, FM, and Infrared. These systems all provide a wireless link between the listener and the sound system and differ mainly in the method of transmitting the signal.

Induction Loop Systems

Induction loops are one of the oldest technologies. An audio amplifier is connected to a loop of wire that is placed around the perimeter of a listening area. The amplifier is fed from the sound system mix and drives current at audio

frequency through the loop, creating a magnetic field around the loop wire. The magnetic field can induce an identical audio signal into a pick-up coil contained within loop receiver or hearing aid.

The primary advantage of loop technology is that a listener who has a hearing aid equipped with a telephone pick-up coil (T-switch) can hear the loop signal without any further equipment. Unfortunately, this encompasses only about 10 percent of the hearing impaired population and this number is decreasing with the trend towards smaller, in-the-ear hearing aids. Pick-up coil orientation and sensitivity also vary from hearing aid to hearing aid so favorable reception is not assured.

HEARING IMPAIRED POPULATION IN NORTH AMERICA
(People in 000's)

	Have Hearing Impairment	Admit Hearing Impairment	Own Hearing Aids
United States	17,250	13,800	3.700
Canada	1,875	1,500	400
TOTAL	19,125	15,300	4,100

Source: Most current data available — extroapolated figures from the Hearing Industries Association (HIA) Market Study 1984.

AM Radio Systems

The next development in wireless ALS was the AM radio system. These systems use an AM radio transmitter, operating below the AM broadcast band (455 - 480 kHz), or at the extremes of the AM broadcast band (510 - 1600 kHz). This allows the use of inexpensive AM pocket radios to pick up the broadcast.

AM systems offered freedom of seating and better sound quality than induction loop systems. However, AM system performance is highly dependent on building construction and interference sources in the building. Installation difficulty depends on antenna design, which is limited by FCC rules and AM transmission requirements. With the availability of FM and infrared systems, the use of AM systems has diminished dramatically.

In 1982, the FCC opened the FM auditory assistance band (72 - 76 MHz) to use in all places of public gathering. FM systems overcome virtually all of the limitations of AM systems and have become the dominant ALS technology. FM systems use an FM transmitter to broadcast the sound system signal to listeners, who use pocket-sized FM receivers and an earphone. FM system installation is generally very simple, so installation costs are low.

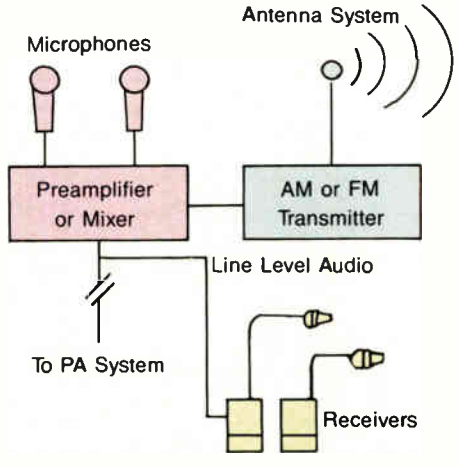
Whip antennas are commonly used, with simple remote antennas available for rack-mounted transmitters. FM systems are not vulnerable to interference from dimmers or flourescent lights, and sound quality is considerably better than AM systems or induction loop systems. Due to better signal propagation at the higher frequencies used, FM systems can be used to cover very large auditoriums, including adjacent rooms.

FM systems have some inherent limitations; there are a finite number of channels available. The auditory assistance band is divided into 32 narrow-band channels, 50 kHz wide, or eight wide-band channels, 200 kHz wide. Narrow-band operation uses 20 kHz maximum deviation, while wide-band operation permits 75 kHz deviation. Most ALS use wide-band operation because more than eight channels is seldom required, and greater deviation allows wider audio bandwidth and a better signal-to-noise ratio than narrow-band operation. Interference from other radio sources is a possibility. In most cases, an alternate frequency can be selected to solve the problem. Multiple-channel operation is possible if multiple transmitters are used, limited by the number of available channels.

Most of these potential problems are easily remedied and are rarely over-riding concerns that preclude the use of FM systems. Given the ease of installation, relatively low equipment cost, and excellent RF and audio performance, FM systems are the most common ALS's sold and in use today.

Infrared Systems

The infrared ALS' are the newest technology. They use invisible infrared beams of light that are frequency and amplitude modulated to transmit the program from the sound system to the listeners. The transmission is produced by an array of infrared light-emitting diodes (LED's) configured in an emitter panel. Receiver units use an infrared detector to pick up the transmission. In most cases, infrared systems use standardized transmission characteristics, so compatibility from installation to installation is likely.



An RF listening system

Infrared light behaves much like visible light, so infrared transmissions can be confined by opaque objects like walls. This characteristic makes infrared ideal when security from eavesdropping is a major concern, or when a large number of adjacent rooms must have independent systems. They are also an excellent choice when adverse RF conditions exist, since they are not affected by radio transmissions.

Depending on the application, some of these virtues can be a drawback. Due to their relative inefficiency, several emitter panels are needed in most auditoriums, with interconnecting cables between them. If adjacent rooms are to be covered, emitter panels must be installed in each room. Because the system uses light waves, the emitter panels cannot be concealed by opaque materials, making them difficult to conceal. Infrared systems are typically three to four times more costly in terms of installation and equipment costs than FM systems.

Choosing the Right System

Of the four technologies available, FM and Infrared are clearly superior technologies. As with any type of equipment, the system designer must choose the ALS that best fits the performance and price needs of the customer. FM and Infrared systems both provide excellent audio performance. Some infrared systems are capable of stereo operation for musical performances. If stereo is used, the infrared receiver should have a balance control, since hearing loss is rarely identical in both ears.

In general, FM installation is simpler and requires less time and wiring than infrared. Infrared equipment is more costly than FM equipment, especially when

(continued on page 47)

Installation Profile

Photos by Ronald Stone

When the Crystal Ballroom of the Beverly Hills Hotel in Beverly Hills, CA, recently hosted a private party by Johnny Carson for the production team that taped his 24th anniversary show, it was the first time the newly renovated Ballroom was used. The entire hotel is being renovated and designed by the Cattaffo/Northcutt Design Collaborative of Los Angeles, CA.

Vortec Environmental Audio/Visual Design of Los Angeles was contracted to design the sound reinforcement and video presentation systems for the hotel. The Crystal Ballroom was the first room to be completed. Other scheduled work includes the Cinema Room, the Coterie Restaurant, the Polo Lounge, the Pool and Cabanas, a business center, the Bungalows, the hotel lobby and the Presidential Suites. The Ballroom's interior was designed by Dennis Reedy of the Design Collaborative. Vortec worked closely with Reedy to ensure that all panels, speaker enclosures and wall-jacks would not detract from the elegant design.

Originally contracted as audio/visual consultants, Vortec submitted a bid to act as contractor on the Crystal Ballroom installation and was chosen by the hotel management for the job. Working from information gathered from the hotel management and catering staff, Vortec supplied the client with a "wish list" of the audio and visual systems that would support fashion shows, wedding receptions, conventions, banquets, speaker system, fund-raising events and live entertainment shows.

Vortec found that the audio system would have to provide speech reinforcement, background music, sound reinforcement and foreground music. The audio system needed to amplify and distribute sound from a cartridge tape system, a cassette deck, 1/2-inch and 3/4-inch VCR formats and wired and wireless microphones, as well as live music from the stage and a disc jockey.

THE AUDIO

There were two specific applications for the speakers—the first being ceiling speakers. The 7,500 square feet of the ballroom is divided into six zones that facilitate maximum banquet and function seating. Vortec used 34 Tannoy NFM-8's interspersed over the six zones. Each zone received independent equalization and gain controls. The Tannoys are actually professional near field monitors which Vortec specially adapted for ceiling applications. Vortec chose the Tannoys for their broad dispersion, low distortion and high output capabilities. Using the cubic inches required for the best sound as specified by the manufacturer, Vortec instructed the carpenters to build and install the speaker enclosures into the ceiling.

The second speaker system was for the main speakers on either side of the stage. Using a bi-amped system, Vortec circuited the lows to two twin 15-inch Gauss 4583 A drivers with active crossovers. Vortec custom-built two 12 cubic-foot enclosures, each use two 15-inch Gauss

Thomas Babbitt is the account executive for Vortec Design.

The Crystal Ballroom of the Beverly Hills Hotel

by Thomas Babbit

4583A drivers with active crossovers. The mid-range speakers are two Gauss 10-inch 3184 D's, and each Gauss 2081 wide-dispersion compression tweeter uses passive crossovers. Seven Soundcraftsmen PM 860's and two PR 1800's were used with a total wattage of 6,600.

The speech reinforcement and background music had to provide even coverage throughout the Crystal Room, but it had to be zoned to allow for the ability to have two events running simultaneously. The system also had to provide multiple input/output ports for flexibility in room layout according to need.

For the mixer, Vortec chose a Yamaha MQ 1602 which is also known for its mellow sound quality. Vortec stresses that there is no such phenomenon as a neutral sound; every system has its own flavor and Vortec designs systems for a certain coloration. In the restrained and stately element of the Crystal Ballroom, Vortec wanted a sound that did not reach out and grab a listener, so components were used that were considered as proven, producing a warm, smooth sound.

The Ballroom also has two kinds of microphone systems. One is used by the catering staff to facilitate banquets and functions. This required a turn-key type of operation that also negated any variable feedback dynamics. Vortec used Shure SM-58's and lavolier SM-11's through a Gatex compressor/limiter. The Gatex is very fast and there is no discernable speech lapse. Vortec put that into the first four channels of the Yamaha board, where the settings stay pretty much the same so the hotel staff doesn't have to bother with them. In addition, the mikes can be plugged into wall-jacks at 20 different locations around the ballroom for maximum versatility.

The second microphone system is for the stage. Presently, the Crystal Room does not make extensive use of sound reinforcement for the many wedding bands that play there. The management wants that to change, but for now Vortec went with Shure SM-58's.

Foreground Music

The sound reinforcement and foreground music system had to provide high level, high quality sound originating from both sides of the stage, as well as the bar area.

The Ballroom currently makes extensive use of background music. Vortec upgraded that to foreground music with the EMS/Music system because of the selection it provides. Vortec used the EMS 2000 which lists their programs by energy levels, for example, High Energy, Medium Energy and Mellow. The play list is current with a variety of music styles.

Visual Formats

The visual formats needed included video projection system, slide projection system and 16 mm projector. The video projection system had to display images from a ½-inch VHS video cassette recorder, a ¾-inch video cassette recorder and a closed circuit camera system. All visual images had to be projected on three electronically operated screens, one located on the stage and one on either side of the stage. The video projector had to be recessed and ceiling mounted, with electronic controls. Vortec also recommended making the necessary wiring for the inclusion of satellite transmissions.

The electronic controls had to be centrally located to provide remote control to the projection screens, video projector raise and lower functions, audio level control, audio and video functions, drapery open and close control, electronic room divider control and lighting level.

For the overhead projection system, Vortec used the French-made Thompson projector. They are comparatively small and have a variable focal length. They are set up on Draper retracting ceiling mounts that are operated from the main equipment rack. For the screens, Vortec went with Draper electronic screens for either side of the stage and a Screenworks floor mount screen that comes up out of the center of the stage.

As a video source, Vortec used a Mitsubishi HS 430 UR and a Sony U-matic

deck. On all the wall-jacks there are video inputs and outputs. That way a function group can access the overhead projection system from anywhere in the ballroom or just pop their tape into

Twelve-cubic foot enclosure includes an EMS 2000 foreground system, a Sony U-matic video deck, Soundcraftsmen PM860 amplifiers and TG344 R equalizers.

Yamaha's NQ 1602 Mixing Console, with fold-down brackets for closure into the closet.

the decks in the main equipment rack.

The ambiance created by excellent sound reproduction equipment may not elicit kudos from hotel guests, but strong feelings of an extra pleasant environment will certainly help them decide which hotel to choose next time they are in town.

The Electro-Voice PRO-8A Coaxial Loudspeaker

by Farrel M. Becker

The PRO-8A from Electro-Voice is a two-way, 8-inch, coaxial loudspeaker intended for distributed sound systems. It consists of an 8-inch woofer with a coaxially mounted 1.5-inch piezoelectric tweeter and integral crossover. The tweeter is mounted directly to the pole piece of the woofer and behind an acoustically transparent dust cap, placing it closer to the woofer's acoustical center than in most other designs. This provides for "improved" alignment in time but, as will be seen, not "good" alignment. The loudspeaker is 8.6 inches in diameter and 3.15 inches deep and provides holes for standard mountings.

The PRO-8A carries a 30 watt power handling rating (EIA) and is available in an 8 ohm version or with 5 or 30 watt, 70 volt transformers installed (the 8 ohm version is reviewed here). Connections are made via solder or "quick disconnect" crimp connectors. A red paint dot indicates the positive terminal (applying a positive voltage will result in forward cone movement.)

All measurements for this review were made with the loudspeaker mounted in a standard 1 cubic foot enclosure and the enclosure mounted in a standard 2 feet x 4 feet ceiling tile. No grill was used unless otherwise noted.

The magnitude of the PRO-8A's impedance is shown in figure 1. The impedance is 8.74 ohms at 1 kHz and drops off to 6.2 ohms at 20 Hz.

Figure 2 is an Energy Time Curve (ETC) taken on axis. The first peak is the tweeter followed 276 microseconds later by the woofer. This time difference corresponds to a distance of about 4 inches. The acoustical center of most large cone loudspeakers (large with respect to the tweeter in this case) is located well behind the dust cap. The tweeter's mounting immediately behind the dust cap accounts for this difference in arrival times.

The anechoic on-axis frequency response is shown in figure 3. The 1 watt/4 foot sensitivity at 1 kHz is 91.4 dB. The EIA rating is 43.9 dB. Figure 4 is a nearfield measurement of the loudspeaker's low frequency response. The 3 dB down point (relative to 1 kHz) is 100 Hz. Output drops rapidly from there on down.

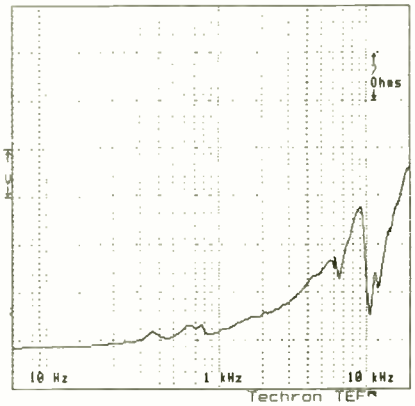


Figure 1. Magnitude of PRO-8A impedance, 0-20 kHz, 7 Hz resolution.

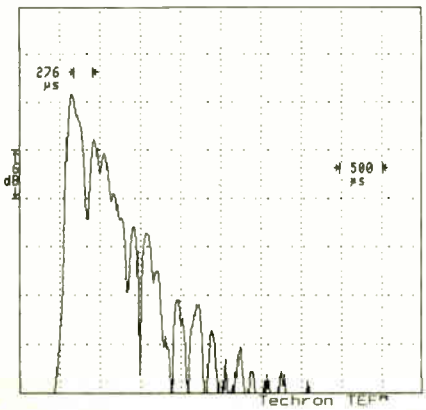


Figure 2. On axis ETC.

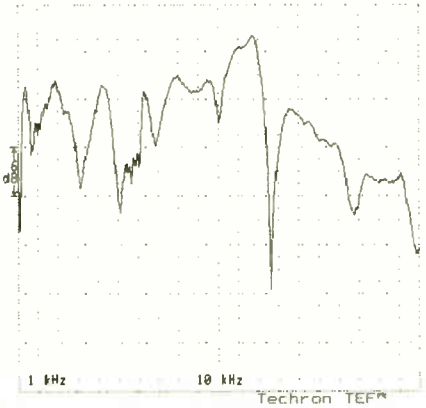


Figure 3. On axis frequency response, 0-20 kHz, 150 Hz resolution.

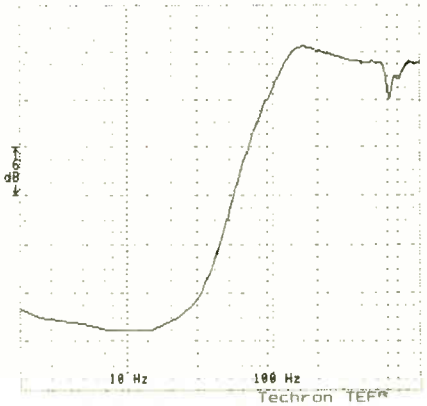


Figure 4. On axis frequency response, nearfield, 0-1 kHz, 45 Hz resolution.

The phase response of the PRO-8A is shown in figure 5. The discontinuity at 5.6 kHz is a result of the display "wrapping" from the bottom up to the top. The curve is in reality continuous. This measurement was made with the analyzer "tuned" for the higher frequencies. The general downward slope of the curve below approximately 10 kHz is due to the sound from the woofer arriving later than that from the tweeter. I have no information from the frequency response of figure 3, I would estimate the crossover frequency to be at or near 10 kHz.

All of the measurements discussed so far have been made without a grill in front of the loudspeaker. In actual use of course, a grill will be present. Figure 6 shows the effect that a commonly used grill has on the frequency response of the PRO-8A. Here the straight line across the center of the display is the normalized response of the loudspeaker without a grill. The curve shows how the response changes up or down with a grill present.

The directional characteristics of the PRO-8A are shown in figure 7. This is a composite of the polar patterns in the 2 kHz octave band for frequencies in 50 Hz steps with a grill in place. At 2 kHz the coverge angle is 80 degrees. The 2 kHz octave band Q is 3.8. Interestingly, the coverage angle at 2 KHz without a grill is 85 degrees and the 2 kHz octave band Q drops to 1.1. It appears that the scattering caused by the grill is actually helpful. The PRO-8A's directional characteristics vary considerably with frequency, when a grill is present. Above 10 kHz the sound is scattered more than distributed. This is really the grill's response, not the loudspeaker's.

Figure 8 shows the response of the PRO-8A has an extended high frequency range as compared to the usual 8 inch ceiling loudspeaker. The somewhat ragged response in the mid-range is audible as is the time smear (see figures 2 and 3). A ceiling full of PRO-8A's, and a little equalization, should yield a system of higher quality than one usually expects from 8 inch ceiling loudspeakers.

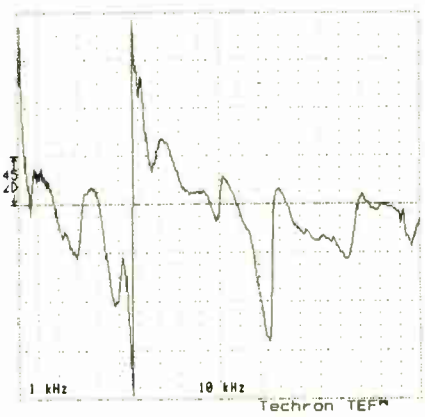


Figure 5. On axis phase response, 0-20 kHz, 150 Hz resolution.

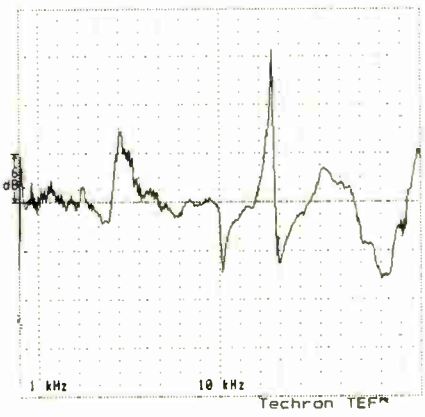


Figure 6. Effect of grill on frequency response, 0-20 kHz, 150 Hz resolution.

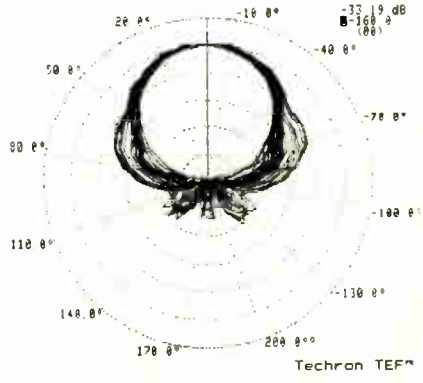


Figure 7. 2 kHz composite polar pattern, 10 degrees/data point, 6 dB/major division.

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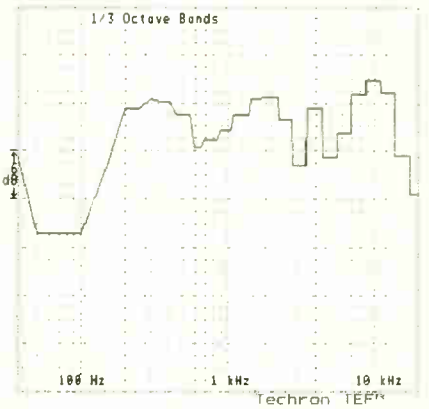


Figure 8. On axis frequency response, 0-20 kHz, ⅓ octave bands.

2 kHz the coverge angle is 80 degrees. The 2 kHz octave band Q is 3.8. Interestingly, the coverage angle at 2 KHz without a grill is 85 degrees and the 2 kHz octave band Q drops to 1.1. It appears that the scattering caused by the grill is actually helpful. The PRO-8A's directional characteristics vary considerably with frequency when a grill is present. Above 10 kHz the sound is scattered more than distributed. This is really the grill's response, not the loudspeaker's.

Figure 8 shows the response of the PRO-8A has an extended high frequency range as compared to the usual 8 inch ceiling loudspeaker. The somewhat ragged response in the mid-range is audible as is the time smear (see figures 2 and 3). A ceiling full of PRO-8A's, and a little equalization, should yield a system of higher quality than one usually expects from 8 inch ceiling loudspeakers.

NSCA PRODUCTS

(continued from page 18)

struction, and is easy to interface with most environment.

Power Solutions

Everybody is building a new power amplifier. But 2,000 watts @ 4 Ω in a two-rack-space, 26 pound package! The PS-2000 Digital Bass Amplifier by Power Solutions directly rectifies the AC line and supplies the output stages with ± 170V rails uses a switch-mode supply to operate at over 90 percent efficiency. Because of the heavy filtering used for this power supply configuration, the PS-2000 is intended for use below 400 Hz only, which is where high-power is needed. The specs look good, but unfortunately, we didn't hear the unit.

Rane

It's about time that someone introduced a low-voltage power supply for audio gear! When esoteric hi-fi companies started using remote supplies for their units (actually a throwback to the early Western Electric days) many of us wondered why this was not being exploited in the pro sector. Over a decade later, Rane introduced the RS-10 at its booth. The unit supplies standardly-used ±24 volts using RJ-type connectors. All new Rane products will include this type of power input (as well as the standard AC), and any other manufacturer's products may be adapted by simply installing the appropriate RJ connector. Other features include supply status indication, protection circuitry, and start-up/shut-down delays.

Richmond Sound

The trend towards more computer-controlled sound systems was evident at Richmond Sound's display of their Commodore Amiga® -based, Command/Cue 4096 theater control systems. The high speed, color graphics, mouse/icon/pull-down-menu, and low cost features of the Amiga® provide an economical, user-attractive, audio-

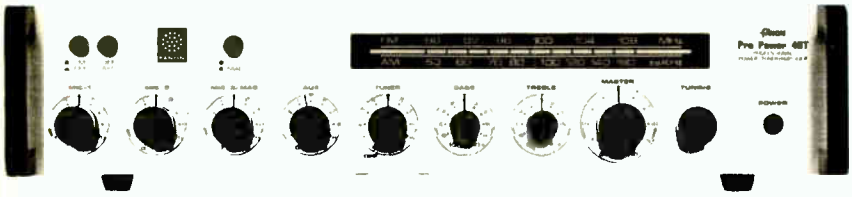
(continued on page 52)

COMMERCIAL SOUND PRODUCTS

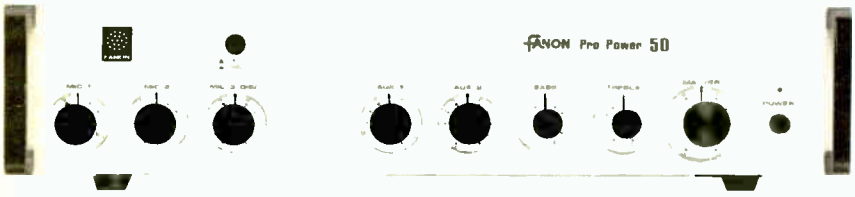
FANON

PRO POWER SERIES.. PROFESSIONAL PA and BACKGROUND MUSIC AMPLIFIERS

PRO-20T



PRO-40T



PRO-50

PRO-120

PRO-T

- Professional, rugged P.A./ Background music systems
- Built-in custom features
- Balanced or unbalanced, high or low impedance microphone inputs. No matching transformers required.
- ALL CANNON lock-in microphone connectors
- *TRUE RMS* Power ratings
- Efficient integrated circuit construction. Lowest noise microphone preamps in any P.A. line
- Rack Mount construction
- Overload Protection built in
- Equalizer Input feature in all models except PRO-20T
- Up to *FOUR* Microphone inputs
- PRIORITY PAGING Feature
- AM-FM Tuner accessory unit (Model PRO-T)
- Background Music AM-FM Tuner built-in (Models PRO-20T, PRO-40T)
- Phone-type jacks for speaker connections
- Traditional Fanon Quality construction and advanced engineering
- Full Fidelity—Factual, guaranteed specifications
- Custom Styling
- "Soft Gold" Anodized front panels
- Four step-up Power Ratings: 20 watts, 40 watts, 50 watts and 120 watts.
- More Watts per dollar

FANON COURIER 14281 Chambers Rd. • Tustin, CA 92680 • (714) 669-9890 • TLX: 85-2263 • FAX: 714-669-1081
A Shelly Company

Circle 231 on Reader Response Card

Blonder-Tongue's Frequency Agile Modulator

Blonder-Tongue Laboratories has announced the availability of its new FAVM-450 frequency agile heterodyne audio/video modulator. The FAVM-450 accepts video and audio baseband inputs from any source, and provides a modulated visual and aural RF carrier output on any channel in the frequency range 50 to 450 MHz.

Any standard output channel can be selected by the setting of an eight position DIP switch located behind an access door on the rear panel of the unit. The FAVM-450 is SAW filtered for spurious reduction. Surface mount devices (SMD) on the wideband VCO provides state of the art performance according to the company.

The overall channelization configuration of the FAVM-450 can be changed from standard to any offset by a field change (or factory preset) on a module within the unit. HRC IRC, inverted (or any other offset, in .25MHz increments) assignments can be readily implemented.

A simple field change, such as removing preemphasis, makes the modulator compatible with a BTSC encoded MTS stereo audio input. A frequency trim adjustment, accessible from the rear panel, enables compliance with FCC pocket 21006 Aeronautical frequency offset requirements.

Circle 1 on Reader Response Card

Leader Introduces Digital Video Sync/Test Signal Generator

Leader Instruments has announced the availability of a new Digital Video Test Signal Generator, Model LCG-410. The LCG-410 features NTSC, EIA, SMPTE and full field color bars, stairstep, modulated stairstep, multiburst (50 and 100 percent) 2T $\sin^2$/12.5 modulated $\sin^2$ and bar signal window, dot/crosshatch, and full red and white rasters.

All signals are synthesized from a 10 bit digital to analog converter for precision and long term stability.

Circle 2 on Reader Response Card

Paso Sound Introduces CMDS

Paso Sound Products has announced the introduction of Compact Music Distribution Systems, also known as CMDS. The CMDS line is comprised of compact multi source page amplifiers, available in several configurations. They offer FM broadcast and/or auto reverse cassette playback as well as paging from a microphone or telephone system. The 30 watt low distortion amplifier can drive 20-30 speakers that can be split into four separate zones each with individual attenuator and front panel selector. "Stackable" auto reverse cassette decks automatically provide continuous music playback. Electronic units include the PA-30/FM watt receiver, CP30/4 dual auto reverse cassette deck with 30 watt integrated amp and the CP-2 dual transport auto reverse cassette playback unit. All units can be rack mounted with use of the 27/2467B rack kit. All amplifier units provide four, eight, 16 and/or 25 or 70 volt low output, separate bass and treble controls, separate mic volume and program volume controls. In the CMDS product group, Paso also introduces the B50 desk paging microphone with its unique pivoted arm and the C90 tri-dimension 20 watt full range surface mount two way speaker system.

Circle 3 on Reader Response Card

a closer look

by gary d. davis

HME'S DJ Mixers And Other Equipment

HM ELECTRONICS, INC. (HME) has introduced a complete line of DJ Mixers, a Power Amplifier, two new Cabled Microphones, and accessories.

The HME Mixers, ranging from the low-cost, four channel stereo mixer, to the top-of-the-line six channel, equalized professional recording model, offer the user the flexibility and performance he needs at prices he can afford.

Comments: HME is best known for its diverse line of wireless microphones. The latest product news from the company signals a diversification of their product line. (I bet you thought we were going to make some clever pun with the word "diversity," didn't you?) There are too many products for us to review here, so we'll focus on one of them, the MX99 Mixer.

HME calls the MX99 a "Four Channel Equalized Stereo Mixer." This 8¾-inch high x 19-inch wide rack mount unit is just under four inches in depth, which means it will be very easy to build into the wall of a night club, bar, etc. The unit has three stereo input channels, all equipped with RCA type phono jacks. The first two of them each can be switched to accept a stereo phono source (47 kohm, 3 mV nominal input preamps with 1 dB tolerance to RIAA curve are built in) or a line level source. The third stereo input is dedicated to line level sources (10 kohm, 350 mV nominal). A fourth input intended for a DJ or announcer microphone (mono) is equipped with a balanced T/R/S jack (3.5 kohm, 1 mV nominal). We queried Steve Winawer at HME for additional details.

The mic input includes a three-position switch: Standby turns the mic off, On applies the mic signal to the stereo mix (center mono), and Talkover applies the mic to the stereo output while muting the rest of the stereo mix by some 15 dB (a typical disco "DJ" or announcer feature). While preliminary specs indicated otherwise, this input does have a full 20 kHz bandwidth.

Incidentally, all five vertical faders (three stereo input channels, mic input channel, and master output level) are equipped with an adjacent "guide" pointer. That pointer can be set to a previously established level, enabling the operator to pull faders all the way down and quickly re-set the original levels without grease pencils or bits of masking tape. This is a very simple, yet useful feature. There is also a horizontal cross-fader which affects the two line/phono input channels, permitting smooth transition between different stereo sources. A cue/headphone monitor system further enhances this capability.

The return from a signal processor insert point, just ahead of the stereo Master Fader, is controlled by a front-panel Processor In/Out switch; the switch applies or defeats whatever effect or processing happens to be hooked up. The insert output jack (10 kohm, 150 mV) is always hot, however, so it can be used as a recording output. (Incidentally, HME ships the MX99 with jumper bars across this patch point so that if someone should select "In" mode when nothing is patched into the loop, the sound does not disappear, a thoughtful move, in my opinion.) A dual bar-graph style output meter utilizes green, amber and red LEDs to display VU (more or less) levels across the stereo output. In the event an output is short circuited, a protection relay disconnects it, and the meter, so you can see something is amiss.

A five-band stereo graphic equalizer is built in, and comes just before the insert point so that the stereo mix can be EQ'd prior to feeding any external signal processor (or tape machine). Sliders provide ±/−12 dB range at 55 Hz, 250 Hz, 1 kHz, 5 kHz and 15 kHz. With no closer than two-octave spacing, this is clearly intended to be used as a more capable "tone control" and is not for fine tuning of the speaker system.

The actual output connectors are RCA phono jacks Q two pair, so multiple amps, amps and tape machines, etc. can be driven without Y-adaptors. Though unbalanced, the actual source impedance of these outputs is 200 ohms, and the circuits are designed to drive 600 ohm or higher impedance loads. A rear-panel rotary switch permits the nominal output level to be calibrated to 0.2V, 1.25V, 1.5V, or 2.0V RMS (corresponding roughly to −12, ±4, ±6 or ±8 dBu). Maximum output level is about 8.5 V RMS, or just over ±20 dBm. That suggests this unit yields better then 2 dB more headroom than many comparable mixers (typically at ±18 dBm), though not as much as the ±24 dBm units. Given the DJ style features and relatively few input channels, this

(continued on page 54)

Berk-Tek Offers Woven Ribbon Cable Catalog

Berk-Tek has released a brochure on woven ribbon cable for advanced electronic applications which includes descriptions and photographs of the company's complete woven ribbon cable product line and capabilities.

Circle 20 on Reader Response Card

University Sound's Installation Guide

To help sound installers design systems that will provide better quality sound, University Sound has published a free guide called the *Commercial Sound and Public Address Installation Guide*. "The definitions, guidelines and system examples contained in the guide will guide installers in selecting the proper equipment and determining optimum setup for a wide variety of sound systems," according to Doug Wilkens, marketing manager.

"We've tried to make the information presented in the guide easily understandable," Wilkens stated. "It begins with a practical explanation of speaker specifications aimed at answering basic questions. Next, the guide discusses system design to achieve adequate SPL and intelligibility in different room environments. Following basic principles, the text explains how to choose speakers with appropriate coverage patterns, and how to aim and power those speakers to achieve a uniform direct field in a variety of venues. Illustration of typical sound system installations are used to suggest proper setup," Wilkens said.

The University Guide provides a new, more detailed approach to system design. Derived from Electro-Voice's compute-based VAMP™ (Very Accurate Mapping Program), the new Easy-VAMP™ system provides a similar design aid without the cost and complexity of VAMP. Essentially, the guide gives users Easy-VAMP isobars for four common speaker orientations; each isobar shows sound projection onto a floor relative to the height at which the speaker is mounted. "By laying a scale drawing of the room over various isobars and calculating levels, an ideal coverage pattern can be determined," said Wilkens.

Circle 21 on Reader Response Card

Winsted Expands Security Catalog

A free catalog from the Winsted Corporation features the company's expanded line of Security and Surveillance Support Systems.

The 16-page, full color catalog reflects an increase of 50 percent in the number of models in the Winsted line. Included in the catalog is a selection of equipment racks, desks, consoles, and security command centers. The modular units are designed for compatibility with major brands of electronics equipment, and can be configured to meet a variety of requirements.

The catalog includes product illustrations, specifications and pricing for the complete line of Security and Surveillance Support Systems.

Circle 22 on Reader Response Card

Audio-Technica Offers Brochure on Field Mixer

A brochure describing the functions and features of the AT4462 stereo field production mixer is now available from Audio-Technica.

The AT4462 is the first ENG mixer designed for stereo location recording, and has two pannable mono inputs and two true stereo inputs. The brochure explains in detail the many functions of the AT4462, such as Lev-Alert, an audible clipping indicator, and Modu-Comm, a two-way intercom system that uses the existing microphone line. Complete specifications are included.

Circle 23 on Reader Response Card

Leasametric Offers New Instrument Rental Product Guide

Leasametric has released its free, 1987 rental product guide. This document lists more than one thousand models of electronic test, industrial and telecommunications equipment.

The 198-page illustrated catalog is designed for each reference incorporating an overview, product descriptions, specifications and selection guides. Special features are also included such as manufacturers' and product indexes and easy to use cross reference charts so customers can compare products that best suit their applications.

Leasametric offers various programs that include short-term rentals, longer-term leases, various options to buy-off-rent and the purchase of used equipment.

The company stocks a range of products from major manufacturers such as Hewlett-Packard, Tektronix, Intel, Honeywell, Anritsu and Fluke. These products include: oscilloscopes, analyzers, temperature equipment, protocol analyzers, microwave analyzers, fiber optics, and more.

General information, specifics on equipment, application assistance and responsive technical support are always available, according to the company.

Circle 24 on Reader Response Card

Print Products International Offers Free Catalog

Print Products International has announced its Spring '87 Sale Catalog containing tools and supplies for electronic maintenance and service. New items featured in this edition are Kenwood test equipment, Huntron Boardwalker 101 and 4500, Solormat instruments, Bogen sound systems, Clauss tools, Sterling drills, Platt tool cases, as well as many brand name tools and instruments for repairs in the field or depot.

Circle 26 on Reader Response Card

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.

ALABAMA
Birmingham: University of Alabama, Convention and Activity Center, 1, C. Contact: M. David Egan, PE, Boston, Ma; (617) 262-2428.

ALASKA
Fairbanks: Fairbanks Activity Center, NA, C. Contact: Craig Park, Paoletti/ Lewitz/Associates, San Francisco, CA; (415) 391-7610.

CALIFORNIA
Cerritos: Performing Arts Center, 4,A. Contact: Robert Long, Theatre Projects, New York, NY; (212) 873-7211.
Cupertino: Hewlett Packard, NA, D. Contact: Edward McCue, Paoletti/Lewitz/Associates. San Francisco, CA; (415) 391-7610.
Irvine: Donald Bren Events Center, NA, B. Contact: Edward McCue, Paoletti/ Lewitz/Associates, San Francisco, CA; (415) 391-7610.
Los Angeles: New Otani Hotel, 2, D. Contact: Neil A. Shaw, Paul S. Veneklasen & Associates, Inc., Santa Monica, CA; (213) 450-1733.
Los Angeles: Simon Wisenthal Center, 3, A. Contact: Neil A. Shaw, Paul S. Veneklasen & Associates, Inc., Santa Monica, CA; (213) 450-1733.
Oceanside: Oceanside City Council Chamber, 2,A Contact: Neil A. Shaw, Paul S. Venklasen & Associates, Inc., Santa Monica, CA (213) 450-1733.
Ojai: Ojai Valley Inn, 5,D. Contact: Neil A. Shaw, Paul S. Veneklasen & Associates Inc., Santa Monica, CA; (213) 450-1733.
Pasadena: Lake Avenue Congregational Church, 4,A. Contact: Neil A. Shaw, Paul S. Veneklasen & Associates, Inc., Santa Monica, CA; (213) 450-1733.
Sacramento: Mercy Hospital, 2,D. Contact: Neil A. Shaw, Paul S. Veneklasen & Associates, Inc. Santa Monica, CA; (213) 450-1733.
San Francisco: St. Mary's Cathedral, NA, D. Contact: Marc Beningson, Jaffe Acoustics, Norwalk, CT. (203) 838-4167.
San Jose: San Jose State University Recreation and Events Center, NA, D. Contact: Edward McCue, Paoletti/Lewitz/Associates, San Francisco, CA; (415) 391-7610.
Santa Monica: Santa Monica Bay Hotel, 5,A. Contact Neil A. Shaw, Paul S. Veneklasen & Associates, Inc., Santa Monica, CA (213) 450-1733.

CONNECTICUT
Hartford: Connecticut State Capitol Hall of the House of Representatives, NA, D. Contact: Marc Beningson, Jaffe Acoustics Inc., Norwalk, CT; (203) 838-4167.

FLORIDA
Miami: Bayfront Park, 2,C. Contact: Chuck McGregor, Jaffe Acoustics, Inc., Norwalk, CT; (203) 838-4167.
Naples: Naples Performing Arts Center, 4,B. Contact: Robert A. Lorelli, Brannigan-Lorelli Associates, Inc., New York, NY; (212) 420-8787.
St Petersburg: Bayfront Center Auditorium Renovations, 3,C. Contact: Robert Long, Theatre Projects, New York, NY; (212) 873-7211.

ILLINOIS
Highland Park: Ravinia Young Artists Insititute, 2,C. Contact: Chuck McGregor, Jaffe Acoustics, Inc., Norwalk, CT; (203) 838-4167.

KENTUCKY
Alexandria: Campbell County H.S. Gymnasium, 1,B. Contact: Richard J. Lemker & Associates, Covington, KY; (606) 261-9529.
Covington: Holmes High School Auditorium, 1,D. Contact: Richard J. Lemker, Lemker & Associates, Covington, KY; (606) 261-9529.

MASSACHUSETTS
Medford: Cohen Auditorium Tufts University, 1,C. Contact: M. David Egan, PE, Boston, MA; (617) 262-2428.

MISSOURI
Mokane, Callaway County: South Callaway R-2 School District, NA, C. Contact: J. T. Weissenburgger, Engineering Dynamics International, St. Louis, MO; (314) 991-1800.

NEW YORK
Astoria: American Museum of Moving Images, NA,B. Contact: Marc Beningson, Jaffe Acoustics, Norwalk, CT; (203) 838-4167.
Jamestown: Palace Theater, 2,B. Contact: Robert A. Lorelli, Brannigan-Lorelli Associates, Inc., New York, NY; (212) 421-8787.
New York: John Jay College for Criminal Justice, 5,C. Contact:Robert Benson, Knudson-Benson Associates Inc., Mercer Island, WA; (206) 232-2273.
New York: JP Morgan Bank Trust Committee Room, NA,D. Contact Marc Beningson, Jaffe Acoustics, Inc. Norwalk, CT (203) 838-4167.
New York: Metropolitan Opera, NY Philharmonic Summer Parks Concerts, 3,A. Contact: Chuck McGregor, Jaffe Acoustics, Inc., Norwalk, CT; (203) 838-4167.

OHIO
Cleveland: Cleveland State Music Building, 5,A. Contact: Chuck McGregor, Jaffe Acoustics, Norwalk, CT; (203) 838-4167.
Cleveland: Palace Theatre-Playhouse Square, 2,D. Contact: Marc Beningson, Jaffe Acoustics, Inc., Norwalk, CT; (203) 838-4167.
Columbus: Ohio State Office Tower (Office) NA, C. Contact: Marc Beningson, Jaffe Acoustics, Inc., Norwalk, CT; (203) 838-4167.
Columbus: Ohio State Office Tower (Theaters), 5,C. Contact: Chuck McGregor, Jaffe Acoustics Inc., Norwalk CT; (203) 838-4167.
Columbus: Ohio State University Wexner Center for the Visual Arts, 5,D. Contact: Chuck McGregor, Jaffe Acoustics, Inc., Norwalk, CT; (203) 838-4167.
Dayton: US Air Force Logistics Command Post, 2, A. Contact: Marc Beningson, Jaffe Acoustics, Norwalk CT; (203) 838-4167.
Sharonville: Sharonville Municipal Building, 2,D. Contact: Richard Lemker, Lemker & Associates, Covington, KY. (606) 261-9529.

OKLAHOMA
Oklahoma City: Remington Park, 5,B. Contact: Neil Johnson, Ewing Cole Cherry Parsky, Philadelphia, PA; (215) 923-2636.

SOUTH CAROLINA
Columbia: University of South Carolina, Kogor Center for the Arts, 3,D. Contact:

Chuck McGregor, Jaffe Acoustics, Inc. Norwalk, CT; (203) 838-4167.

TEXAS
Houston: Enron Corporation Headquarters, NA, D. Contact: Edward McCue, Paoletti/Lewitz/Associates, San Francisco, CA; (415) 391-7610.

WASHINGTON, D.C.
Washington, DC: National Council of Catholic Bishops Conference Center, 2,D. Contact: Marc Beningson, Jaffe Acoustics, Inc. Norwalk, CT; (203) 838-4167.
Washington, DC: US Holocaust Museum, NA, A. Contact: Marc Beningson, Jaffe Acoustics, Norwalk, CT; (203) 838-4167.

CANADA
NEW BRUNSWICK
St. John: Bicapital Theater Project, 2,A. Contact: Robert A. Lorelli, Brannigan-Lorelli Associates Inc., New York, NY; (212) 420-8787.

NOVA SCOTIA
Halifax: Art Gallery of Nova Scotia, NA,B. Contact: Peter Terroux, Halifax, N.S.; (902) 429-4616.
Halifax: A/V system for City Council Chamber of Halifax, NA,C. Contact: Peter Terroux, Halifax, N.S.; (902) 429-4616.
Halifax: St. Theresa's Church, NA,B. Contact: Peter Terroux, Halifax, N.S.; (902) 429-4616

ONTARIO
Toronto: Greenwood Race Track, 2,A. Contact: Neil A. Shaw, Paul S. Veneklasen & Associates, Inc., Santa Monica, CA; (213) 450-1733.
Toronto: Metro Toronto Convention Center Ballroom, 1,D. Contact: Neil A. Shaw, Paul S. Veneklasen and Associates, Inc., Santa Monica, CA; (213) 450-1733.

To have your jobs listed in S&C's Job Report, send your information to:
S&C's Job Report
25 Willowdale Avenue
Port Washington, NY 11050

ALS

(continued from page 33)

multiple emitter panels are needed. A typical FM installation will cost the end user $800 to $1,500. A typical infrared installation will run from $2,500 to $4,000. Receiver cost is significant since it is the multiplier factor in system cost. FM receivers are available for under $100, less than the price of infrared receivers.

For applications where transmission security is not vital, and radio interference can be overcome by frequency selection, FM systems are hard to beat. If transmission security is vital, or if a great number of independent systems are needed in adjacent rooms, or if radio interference precludes the use of FM systems, infrared systems are a logical choice.

Making the Most of the System

First, make sure that the end user knows how to operate the system and what to expect from it. Second, be aware of the optional earphones and hearing aid interface devices like neck-loops and direct audio input cords that are available. Each hearing impaired listener is unique. Most manufacturers offer a choice of accessories to accommodate these differences. Lastly, for successful installations, follow the instructions provided by the manufacturer. Don't assume you know the best way to do it. You'll save time and aggravation.

Conclusion

It is important for sound system designers to recognize the needs of hearing impaired listeners and to fully understand that these needs cannot be met solely by sound reinforcement systems, or by a personal hearing aid. Given the ready availability of equipment to do the job at a reasonable cost, it is time that no sound system design is considered complete without including hearing assistance equipment.

TECHNICALLY SPEAKING

(continued from page 10)

dors currently offer products that use computers to control a sequence of audio events over specific intervals. The proliferation of computer technology into the music business is exemplified by inexpensive software that allows the musician to 'dissect' sounds and manipulate them with more precision than the acoustic instrumentation available to many of us at a higher price.

Advanced software techniques were also demonstrated at the conference drawing from the Artifical Intelligence, LAN (Local Area Network in computer communications), and 32--bit microcomputer sectors. Telling a computer to, "give me a bit more reverb on the vocal," or "put the bass onto channel 23," are happening now on mini-computers. Soon, we will have these capabilities in our small micro-computers. PC's, whether they are of the IBM®, Apple®, or Atari® brand, are soon to become the 'brains' of many audio systems.

FACES AND PLACES

USD Names Eastern Regional Sales Manager

Underwriters Safety Device (USD) has announced the appointment of Larry Geighes as eastern regional sales manager. Geighes will supervise all east coast electrical and electronic product sales, with eight independent representative firms reporting directly to him.

Geighes has a background in electrical/electronic component sales, having recently ended a 17 year selling career with TRW. In his last position with TRW, he served as national account manager for its electronic assemblies division.

Russ Farrell Joins Renkus-Heinz

Russ Farrell joins Renkus-Heinz as the new director of marketing and sales.

Farrell spent over eight years with Altec-Lansing as a district sales manager in the northeast, and then as OEM sales manager at Altec's corporate office. Farrell has also been a regional sales manager for Bogen, and national sales manager for Trigon. Prior to joining Altec-Lansing, he had over five year's experience in system design and sales for a Massachusetts sound contractor.

PAUL RUGGIERI

Ruggieri Appointed Ring Group's CEO

Ring Group of North America has announced the appointment of Paul Ruggieri to chief operating officer.

Ruggieri joined Ring in May, 1983 as vice president. Under his stewardship, Ring's Automatic Call Distributor (ACD) business unit increased its sales of business.

In addition to his continuing ACD commitments, Ruggieri will oversee sales of the company's intercommunications equipment as well as assume overall operating management responsibility.

Before joining Ring, Ruggieri was field sales manager for the Data Equipment Systems Division of International Telephone and Telegraph corporation (ITT).

KAZUNORI KURATA

Kurata Named President Sony Pro Products

Kazunori Kurata has been named president, Sony Professional Products Company (SPPC), it was announced by Neil Vander Dussen, president, Sony Corporation of America.

In his new position, Kurata will be responsible for the manufacturing and engineering operations of SPPC.

Prior to this appointment, Kurata was vice president, customer service, Sony Communications Products Company. He joined Sony Corporation in 1970 when the U-Matic® VCR was first introduced in the U.S. He returned to the U.S. in 1980. He has since held various Sony positions in the U.S. including director of technical services division.

Wilkens Named Marketing Manager

W. Douglas Wilkens has been named marketing manager, commercial products for Electro-Voice, Inc. In this position, he will be responsible for the launch of the *new* University Sound. Wilkens will report to Electro-Voice's vice president of marketing, Paul McGuire.

Most recently, Wilkens was chief engineer for Peirce-Phelps, Audio Systems Division (Philadelphia) where he was responsible for the design of numerous major systems including the Valley Forge Convention Center, the upgrade to the sound system for the Spectrum in Philadelphia and the Scanticon-Princeton Executive Conference Center Expanison Project in Princeton, NJ. Wilkens also had marketing responsiblities for Peirce-Phelps Audio Division.

Wilkens has also served as a two-term chairman for the Audio Engineering Society, Philadelphia.

REP NEWS

Paso Sound Products has announced the appointment of three new representative organizations. **Pace Sales** Charlotte, North Carolina; **Yarish and Associates,** Florida; and **J.Y.S. Communications Co.,** Dallas, Texas. All three organizations will be responsible for Paso's packaged sound, commercial sound and Elvox Intercom product lines.

Oldaker Manufacturing Corp. presented its Distributor of the Year Award to **SF Electronics** of Grand Rapids, Michigan, and its Rep of the Year Award to **Repptronics,** whose territory is Ohio.

Allen and Heath Brenell has presented its Award for Rep Firm of the Year to **Audio Associates** of Glenwood, Maryland. Audio Associates represents Allen and Heath Brenell in Maryland, Pennsylvania, Virginia, West Virginia, Delaware, and southern New Jersey. Dealer of the Year went to **Washington Music Center** of Wheaton, Maryland.

At a recent National Sales meeting, **Carter-Craft's** president **Bob Fleming** presented the top award for the top-producing sales representatives. The award was given to **W.S. Sales** and **Walter Sachewicz** for outstanding performance in their field. W.S. Sales represents Carter-Craft in northern Illinois and southern Wisconsin.

Leading **Agfa-Gevaert,** Inc. sales representatives and managers of the Magnetic Tape Division, took top honors for their achievements at this year's National Sales Meeting. Top prize of a one-week trip for two to Germany, including airfare, hotel, and cash award went to **Jeff Hamilton,** technical sales representative and **Peter Jensen,** regional sales manager, of the central region. The sales ability of **Dean Sauer,** also a technical sales representative for the central region, earned him an excursion for one to Germany. Third prize cash awards were presented to **Jim Rouse** and **Mike Caputo,** technical sales representatives for the Pacific and Atlantic region, respectively. In addition, **Jeff Williams** and **Barry Rosen,** technical sales representatives-Atlantic Region, as well as **Jim Rouse** won memberships in the Multi—Million Dollar Club for amassing more than $2 million in sales.

Strap Loc™ Reduces Cable Waste

A new cable tie design has been introduced by Advanced Cable Electronics Corp. The new design reduces the need for stocking many different lengths of cable ties because the product is cut from the spool, assembled with a lock and used like any standard cable tie. No special tools are required. Waste is reduced because any excess can be reused.

Features of the cable tie include ability to space and separate wires and cables in groups or individually, thereby reducing EMI crosstalk between lines.

Strap Loc™ is available in nylon 6/6 for general use and nylon 12 for use in harsh environments.

Circle 27 on Reader Response Card

Superelay Reduces AC Arcing

Henry Engineering has announced the Superelay, which is a multi-purpose relay and AC control unit that has applications in the commerical sound and audio/visual industries. It permits control of several equipment functions with a single controlling input or signal. The unit provides six relay outputs for utility use, plus a switched AC outlet that will power up to 300 watts of AC load, such as "On The Air" or "Recording . . . Do Not Enter" warning lights. The AC is switched using a solid state synchronous relay to eliminate any chance of AC arcing. Superelay can also be connected to any dial-up telephone line for control of outboard equipment when the line rings. Superelay is priced at $195.

Circle 28 on Reader Response Card

Aiphone's AC Transformers For IC Intercoms

Aiphone has introduced a new AC transformer to be used as the power supply for the company's IC Series intercoms.

The 12-volt, UL-listed PT-1210 transformer has AC 120-volt input and 10 VA capacity.

Designed primarily for Aiphone's IC-1AD and IC-2AD intercoms, the transformer can also be used with Aiphone's EL-9S electric door release —an optional feature in all of the company's intercom systems.

Circle 29 on Reader Response Card

Winsted Corp. Introduces New Video Centers

Winsted Corporation has introduced four new models of A/V carts. The new units are made for A/V equipment, VCRs and monitors. The carts are large with an open design that allows access to equipment.

Models are available in 34-inch high, with two or three shelves and in 54-inch high with three or four shelves. Construction is of sturdy formed and welded steel. They are finished in shadow gray baked enamel with chrome legs.

Circle 30 on Reader Response Card

(continued on page 57)

Mann Meets Monster

The Mann Village Theater in West Los Angeles has recently rewired its complete system with Monster Cable Products. To celebrate the occasion a private showing of "Star Trek IV: The Voyage Home" was held. The movie was also recorded with Monster Cable, thus making this the first time a film was recorded and played back entirely with Monster Cable, according to the company.

Ed Bannon of Taj Soundworks, who did the sound for the movie, said, "The use of Monster Cable in the recording process brought an amazing degree of realism and impact to the visual. It gives the audience a sense of immediacy and feeling of being there."

Nearly a mile of "M Series" Sonic Reference Standard Audio Loudspeaker and Interconnect Cables were used to wire together all the components of the sound system. Bruce Coleman, director of engineering for Mann Theaters said, "Mann Village is now able to present the finest sonic experience available anywhere for a motion picture. Monster Cable provided the added clarity, extended bass detail and wider three-dimensional stereo soundstage that thrilled our audience."

Other components of the sound system include: THX Sound System Program (Lucasfilm); 70mm Six-track Dolby Stereo and Dolby SR (Dolby Laboratories); Stage Screen Loudspeakers (JBL); powered Subwoofer System (Kintek); Subwoofers (Cerwin Vega); Surround Loudspeakers (Bose Corp) and Sound System Amplification (BGW Systems).

EXCELANDT TAKES TOA TO DINNER

Excelandt, a sound contracting firm in Mount Prospect, IL, has installed TOA electronics and speakers in the Forum, a 650-seat restaurant in Arlington Heights, IL. The Forum is an A-frame building with two dining areas separated by a two-story cocktail lounge and stage.

The challenge to Excelandt, according to Tom Wendlandt, who heads the company said, "We had to contain the sound in the lounge area to prevent seepage into the dining room."

Part of the solution was the installation of a pair of HS-315 speakers plus 10 F-300's, with a W-912 amplifier in the wall near the stage area. Other equipment includes 900 Series power amplifiers; the PM-600U paging microphone; the BA-400 continuous four-cassette tape player; and several CS-61P weather-resistant horns to carry music to the outside entrance and lobby areas.

THEATRE TECHNOLOGY MAKES CARNEGIE SING

Theatre Technology has designed the new, permanent sound system that is now in use at Carnegie Hall in New York City.

The design was a challenging task, agreed Louis Shapiro and Peter Erskine, partners at Theatre Technology. "Whatever is there has to integrate with the hall and yet not conflict with its reputation for acoustical excellence," Shapiro said.

In view of this, the entire speaker cluster may be removed when not needed. On the night of the opening gala, the system was used only during Frank Sinatra's performance. The design includes Turbosound TMS2A and TMS1 speakers and Yamaha M406 mixers. Amplifiers chosen were QSC 1400s and the TOA 900 series. UREI 539 equalizers and dbx 163x compressors were also used.

The installation included permanent wiring for mic, line, speaker, video and intercom circuits. The lines interconnect throughout Carnegie Hall including the recording room for "AT&T Presents" and outside trucks.

At the same time Theatre Technology created a sound system for the third-floor Weill Recital Hall, a 268-seat performance space.

Voice Systems Gets Northeast Talking

Richard Medieros, president of Voice Systems Inc., has announced that the company has signed a one million dollar purchase order with New York based Walker Telecommunications to provide to the new Marathon™ key telephone system to businesses throughout Massachusetts and New England.

"Electrical brownouts and blackouts are part of life in the Northeast and can really affect newer computerized phone systems. A power failure without battery backup means no phone service at all. And Marathon's ability to operate eight full hours in a blackout is going to be a real help to our area's businessess," said Paul Girard, Voice System's executive vice president of operations.

Marconi's Ace in the Hand

Marconi Communication Systems has been awarded a contract by the Hull Telephone Company to supply and install automatic cross-connection equipment (ACE).

The equipment, which will be supplied by Marconi's Mini Ace, will replace existing hard-wired cross connections. It will provide a digital-eased line service to subscribers in the Hull area and cater to the expected increase in demand in the next few years.

CALENDAR OF EVENTS

DATEBOOK

DATE	EVENT/COMMENT	LOCATION	CONTACT
June 15-18	**National Computer Conference.**	Chicago, IL	NCC 1-800-NCC-1987
June 19-21	**"The Communications Industry and the Economy Today—Next Year —2000"** Management Conference sponsored by ICIA.	Lexington, KY	ICIA (703) 273-7200
June 23-25	**10th Anniversary Visual Communications Congress.**	New York, NY	VCC (212) 645-1000
June 23-25	**Advanced Manufacturing Systems Exposition and Conference.**	Chicago, IL	Cahners Exposition Group (312) 299-9311
June 23-25	**"PACE '87" Payphone Annual Conference and Exposition.**	Atlanta, GA	PACE '87 1-800-227-1234
June 27-30	**NAMM.**	Chicago, IL	NAMM (619) 438-8001
July 13-14	**"Computer-Aided Engineering."** Conference sponsored by Frost & Sullivan.	San Francisco, CA	Frost & Sullivan (212) 233-1080
July 22-24	**"Microtrends '87 Facing the the Issues."** Seminars sponsored by ICIA.	New York, NY	ICIA (703) 273-7200
August 4-6	**Third Annual Physical and Electronic Security Symposium and Technical Display.** Sponsored by The Philadelphia Chapter of the Armed Forces Communications and Electronics Association (AFCEA).	Philadelphia, PA	Rita Garbe Computer Sciences Corp. (609) 234-1672
August 24	**"The Problems Facing American Industry and Some Thoughts on Their Solution."**	Minneapolis, MN	George Washington University (800) 424-9773
August 25-27	**Static Overstress Seminars.**	Bloomington, MN	Judy Ward Hitchcock Publishing 1-800-826-6270
October 5-9	**Sound Intensity Measurement Course.**	Champion, PA	AVNC (412) 265-4444
December 2-4	**Unicom '87** Exhibition sponsored by NATA.	Dallas, TX.	Karen Palermo (202) 296-9800

NSCA PRODUCTS

(continued from page 41)

events/control workstation for many situations. For example, large theaters with complex inputs, speaker locations, and multiple audio scenes, can be programmed by any sound system operator after a few hours of hands-on at the terminal. Since the Amiga® is capable of operating in a multi-tasking mode, we wonder what's next?

dbx

Another example of using computer technology for analog-audio devices was on display at the dbx booth. Dbx's RTA-1 ⅓ octave real-time analyzer is based on its patented RMS converters and uses a micro-computer with its resident resources (graphics, memory, communications, etc.) and an "electronic bank teller machine" type operator interface. Just about everyone is familiar with the operation of these money machines these days, and the current ones use "soft switches," or a bank of switches whose functions vary with program status and are described on the monitor display. The RTA-1 is easy to use, and features dual multiplexed inputs that are under software control so that correlation measurements may be performed with ⅓ octave resolution. For example, the output of a console may be fed to one input, and a microphone (or several using an external multiplexer) may be placed in a selected audience location, and in several minutes the "room/system response" will be displayed. While the computer is comparing the inputs, an algorithm is used to determine the validity of the incoming data. Data is displayed as it is determined valid, other data is also displayed in a lighter hue.

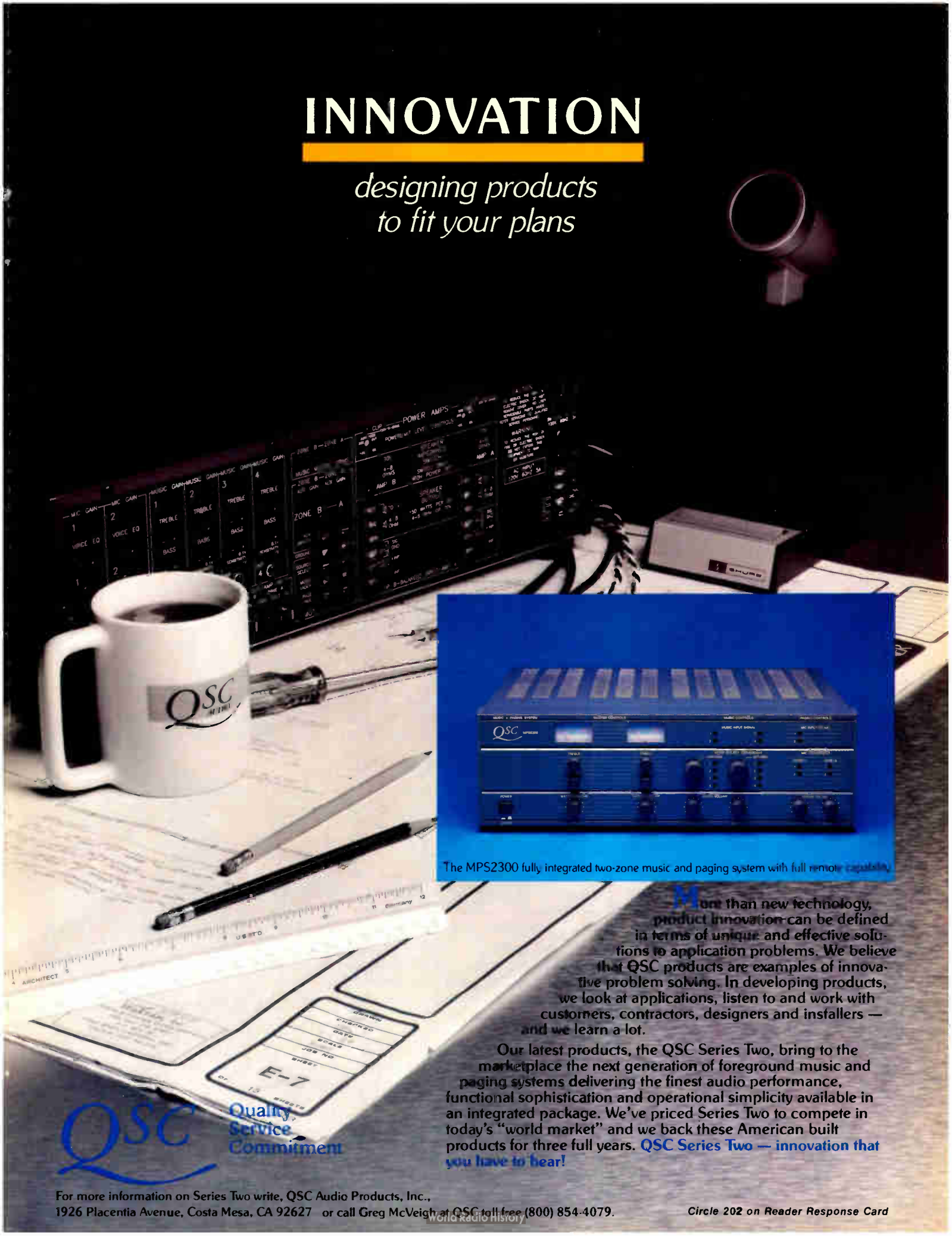
Audio Control:

While several manufacturers had test gear on display with price tickets starting in the $10K range, Audio

(continued on page 54)

INNOVATION

designing products to fit your plans



The MPS2300 fully integrated two-zone music and paging system with full remote capability

More than new technology, product innovation can be defined in terms of unique and effective solutions to application problems. We believe that QSC products are examples of innovative problem solving. In developing products, we look at applications, listen to and work with customers, contractors, designers and installers — and we learn a lot.

Our latest products, the QSC Series Two, bring to the marketplace the next generation of foreground music and paging systems delivering the finest audio performance, functional sophistication and operational simplicity available in an integrated package. We've priced Series Two to compete in today's "world market" and we back these American built products for three full years. **QSC Series Two — innovation that you have to hear!**

QSC Quality Service Commitment

For more information on Series Two write, QSC Audio Products, Inc., 1926 Placentia Avenue, Costa Mesa, CA 92627 or call Greg McVeigh at QSC toll free (800) 854-4079.

Circle 202 on Reader Response Card

SOUND SYSTEMS

(continued from page 26)

tant aspect is that every auditor hears differing sound from differing places on the stage and is not particularly critical of the exact positions of the sounds so long as he receives some spatial impression.

References

1. Harvey Fletcher, *Auditory Perspective—Basic Requirements*, Trans. AIEE (Electrical Engineering), Vol. 53, No. 1, pp 9-11, January 1934.

2. J.C. Steinberg and W.B. Snow, *Auditory Perspective—Physical Factors*, Trans. AIEE (Electrical Engineering), Vol. 53, No. 1, pp 12-17, January 1934.

3. William B. Snow, *"Basic Principles of Stereophonic Sound," Journal of the SMPTE*, Vol. 61, pp 567-589, November 1953.

4. Paul S. Veneklasen, *Five Channel Stereophonic Reinforcement, Sound System Specification, Section 11790, part 1.10*, January 1986.

5. Paul S. Veneklasen, *Objectives of High Quality Sound Reinforcement, Sound System Specifications, Section 11790, part 1.10*, September 1973.

Next month: The Basic Principles of Stereophonic Sound.

CLOSER LOOK

(continued from page 44)

unit is likely to be used in a small system. Therefore, in my opinion, driving long lines or numerous amplifier inputs is not a significant requirement, and the output level/headroom choice is quite reasonable. Additional performance information: frequency response is listed at 15 Hz to 30 kHz (±/−1 dB), THD is spec'd less than 0.03 percent @ 1 kHz, and S/N ratio is claimed to be better than 75 dB. Not bad at all.

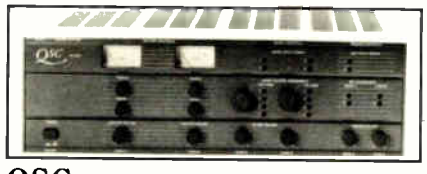
HME's MX99 is a departure from their established product line, and an interesting first step. While I was at first, wary of its unbalanced connections (save the mic input), a closer examination uncovered a number of interesting features. Though there are still some oddities (−12 and ±6 dBu output level selections, and the output EQ frequencies), the overall design seems straightforward and appropriate for its intended market. After all, you can get ±4 nominal, and an octave or third octave EQ can be patched in if need be. Six other rack-mount mixers introduced at the same time include models with from four to six input channels with some designs optimized for recording, and others for general reinforcement; the MX99 even includes a built-in 60 watt/channel (at 8 ohm) power amp. I think HME has taken a bold step in a new direction, one that deserves *your Closer Look*.

Circle 4 on Reader Response Card

NSCA PRODUCTS

(continued from page 52)

Control showed its SA-3050 ⅓ octave real-time analyzer that retails for well below $1K. Their unit is 4½ × 10 × 12.75, and weighs only 10 pounds. The unit features an LED-type display, memory functions, optional battery operation, standard parallel printer interface option, and carry case.



QSC

QSC, an established manufacturer of traditional-type power amplification, debuted the MPS 2300, an integrated mixer/amplifier for the paging/background music buisness. The MPS-2300 features two 150 watt amplifiers that drive a 70-volt line directly, resulting in high-quality audio demanded by the widespread use of 'over $25-type' speakers. The amplifiers are capable of driving low impedance loads, may be bridged, and include 'soft-knee' limiting, bass and treble controls, turn-on/turn-off muting, and sub-sonic and RF filtering. The mixer section features two mic inputs for paging, four music inputs, two auxiliary inputs, and full remote control capabilities for paging volume, music volume and music source. The mic inputs incorporate AGC (Automatic Gain Control) circuit which emphasizes treble as limiting increases for optimal speech intelligiblity. Other unique features include single-knob EQ, and up to 30 dB of 'smooth' music muting when the paging mic is keyed. The unit is jam-packed with all sorts of other goodies to make the contractor's job easier, e.g., signal processing insert points, DC power supply output, and zoning.

360 Systems

These guys have been in the synthesizer business for a while, and are known for their high-quality digital samplers. Applying this technology to the sound contracting market, 360 Systems introduced a digital (tapeless) message record/playback unit called Permanent Playback™. The system is based on channel-cards using digitally-encoded messages (music, effects, and/or voice) stored on EPROMs. The unit provides on each channel the following: audio outputs, front-panel or remote start using either momentary or continuous ground closure, variable pitch, adjustable level from −10 dBu to +10 dBu, ¼" audio monitor jack, and status LED. The system may also be used with a larger memory card that features sequenced message chaining, looping, logic output of individual channel status, FTFO (First Triggered First Out), and an optional STOP button. The system may be used with 10 kHz or 15kHz cards, and cards may be populated with EPROMs offering up to four or six minutes or playback time respectively. The unit on display houses up to 16 cards, while another 'half-rack' unit houses four cards. We heard music and voice playback that was of very good quality.

Looking back at SOUND & COMMUNICATIONS

30 Years Ago. . .

In the June, 1957 issue of *Sound & Communications*

The Institute of High Fidelity Manufacturers reported retail sales of hi-fi components and tape recorders for home music system for 1956 at $166,220,000—a 33 percent increase over 1955. The group anticipated sales of $221,000,000 for 1957.

The Sound Bug, which were University loudspeakers, University's Cobreflex-2 speakers and model LH reflex trumpets put on a pole and stuck in the rear of a jeep, was used by Indian Prime Minister Nehru during his reelection campaign. There is no truth to the rumor that it ran on Raid™.

20 Years Ago. . .

In the June 1967 issue of *Sound & Communications*

Edwards Company advertised a control console that could program classes, signal fires, correct clocks and play Beethoven—but did it do windows?

In a "Seminar in Print" one of the questions was "Will transistors completely block out all tubed equipment, or will transistors and tubes live side by side?" Richard Goldstein, president of Perma-Power Company said, "In sound equipment the future will be a tubeless one. The key advantage of solid state over tubes lies...in reliability."

15 Years Ago. . .

In the June, 1972 issue of *Sound & Communications*

The Pittsburgh Three-River Stadium was profiled in "Sound Steers Stadium Traffic." Atlas Sound speakers were installed at each section ramp that leads to the seats, and one at each of the major entrances as well as around the outside of the lowest level to assist in moving people in and out of the facility, to assist official and press parking areas, and to direct people to special chartered and public buses.

Under the headline "Electret Headsets," S&C proclaimed "The first of a new generation of telephone headsets based on the revolutionary electret principal has been designed by Bell-Northern Research of Ottawa. The headset employs a noise-cancelling electret microphone to guard against background noise and reduce operator fatigue in noisy environments. The headset consists simply of a receiver and an electronic microphone amplifier in a behind-the-ear housing, eartip and attached thin boom which holds the microphone close to the mouth. A neck lanyard supports the telephone cord for the less than one ounce headset."

COMPUTERS

(continued from page 14)

gram to solve our problem is to make a flowchart that shows the procedure to be followed. In this case we will set up the program to accomplish the following:

Find: the number N (a decimal value)
Use equation: x + y = N
Let: x = $0A_{16}$ (operand)
y = 07_{16} (operand)

Fig. 7-10 shows a simple program flowchart to be followed to solve the problem. The first step, numbered 0, is a simple statement of the problem. Steps one and two are then used as the operands of the problem and indicate the values of x and y. After these values have been obtained, each is placed into a specific accumulator. Step three is then responsible for the addition operation. Since this system deals with binary numbers, conversion to decimal values is also necessary. Step four is a conversion operation that changes binary numbers to BCD values. This value can then be used to energize an output to produce a decimal readout. The fifth and final step of the program is an implied halt opcode that stops the program.

A programming sheet for our problem example is shown in Fig. 7-11. Notice that this sheet indicates the step number, a representative memory address in hexadecimal values, intruction bytes in hexadecimal values, opcode mnemonics, binary equivalents, addressing mode, and a description of each function. The memory address locations employed in the program begin with 66_{16}. In practice, it is a common procedure to reserve the first 100 memory locations, or 00 to 63_{16}, for branch instructions. We have arbitrarily selected location 66_{16} or 102_{10} in order to avoid those addresses being reserved for branching operations.

The program example used here is only one of literally thousands of programs that can be employed by a computer-based system to perform industrial operations. We have tried to show only one simple problem that could be achieved by a computer. The potential capabilities of this type of system are virtually unlimited. The type of microprocessor employed by a system and its unique instructional set are the primary factors that govern its operation in program planning.

A microprocessor is the primary control section of a computer scaled down to fit on a single IC chip. The arithmetic logic unit (ALU) achieves the arithmetic function. Accumulators function as holding registers of operands that are used to temporarily store the address of a memory location that can be accessed for data. A program counter is used to hold the address of the next instruction to be executed in a program. Instruction decoders are used to decipher an instruction after it has been pulled from memory. Sequence controllers maintain the logical order in which events are performed by the microprocessor. Buses are conductor paths that supply data words to registers.

Most computer-based systems employ auxiliary memory units to extend their operating capabilities. Memory permits data to be accessed or retrieved. Read/write memory permits data to be placed or stored in specific memory cells and retrieved at a later time when it is needed. Read-only memory contains permanently stored or rarely altered data. Permanent program data is a prime example of a ROM application. A PROM is a programmable read-only memory. Electrical energy is used to store data in a PROM, and ultraviolet energy is used to erase it.

"Programming" refers to a series of acceptable instructions developed for a computer to permit it to perform a prescribed operation or function. A hardwired program is achieved by electrical circuit construction. Firmware systems have programmed material placed on read-only memory chips. Software programming is created on paper and transferred to the system through a keyboard, punched cards, or magnetic tape. Most computer-based systems combine firmware and software instructions in their programming material.

When programming a computer-based system, the programmer must be aware of specific unit instructions, decide on what instructions are needed to solve a problem, plan a flowchart, develop a programming sheet, initiate the program, correct it if needed, then execute its operation.

SUMMARY

Industry now has instruments and machinery that are classified as intelligent or smart equipment. This type of equipment is also desoribed as a computer-based system.

Dale R. Patrick is a professor of Industrial Education and Technology at Eastern Kentucky University.

Programming Sheet

Title. X + Y = N Date

Purpose. Find N Time

Steps	Memory Address (Hexadecimal)	Instruction Byte 1	Byte 2	Byte 3	Opcode	Addressing Mode	Operand (Binary)	Description
1	66	86			LDA A	Immediate		Load accumulator A
	67		0A				0000 1010	Use data $0A_{16}$
2	68	C6			LDA B	Immediate		Load accumulator B
	69		07				0000 0111	Use data 07_{16}
3	6A	1B			ABA	Inherent		Add the contents of accumulators A and B
4	6B	19			DAA	Inherent		Correct for bad output
5	6C	3E			HLT	Inherent		Stop all operations

Programming sheet.
FIGURE 7-11

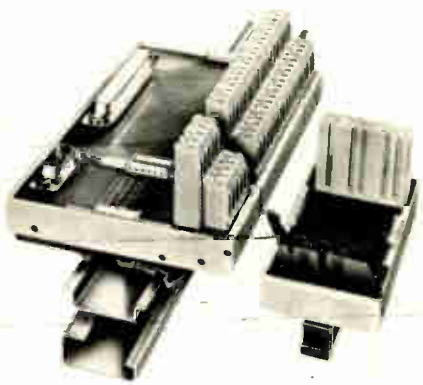
(continued from page 49)

Electronic Specialists' Power Loss Shutdown

Electronic Specialists has announced the introduction of the Power Loss Shutdown to protect micro-computers operating on UPS or SPS power.

The Power Loss Shutdown is designed to power down an entire computer system if commercial AC power has not yet been restored when UPS or SPS batteries have discharged. This prevents undesired computer and power system start up after a power outage. Models with adjustable AC line drop-out voltage level are available to accommodate the inherent brown-out protection capabilities of most UPS systems. Priced from $150, the PLS models are available from stock.

Circle 48 on Reader Response Card



Electrovert's Module Assemblies Offer Circuit Transition

Electrovert's electrical division has announced a line of rail mounted interconnection modules for interfacing discrete wiring with either flat ribbon, D-subminiature or DIN 41621 electronic cable connectors.

Designed to provide compact and cost-effective transition, the interface module consists of a screw clamp-type terminal block and electronic connector mounted and interconnected on a printed circuit board housed in a DIN rail mountable platform.

In addition to integrating different wiring and/or voltage Systems, Electrovert's interface modules can incorporate a wide variety of circuit components such as relays and resistors as well as different functions such as overload protection and a fault indicator.

Terminal strips for the discrete wiring are the interlocking 8190 series, rated 300V for up to 12 awg, and are supplied in single or double tier versions for high density applications.

The D-subminiature connector is available in 9, 15, 25, 37, and 50 pin position. It is rated 1.5 amps, 125V. Designed to MIL-C-24308, it is compatible with all D-subminiatures on the market.

The flat ribbon cable connector is available from six to 64 standard positions designed to MIL-C-83503 (DIN 41651) and is rated 1 amp, 65V.

The D-subminiature and flat ribbon connectors are polarized and also incorporate an interlocking device to assure positive contact even under conditions of shock and vibrations, according to the company. Contact areas are gold plated. Interface module assemblies can be marked at the side of the unit. It mounts directly into either an asymmetrical or symmetrical DIN rail.

Delivery is four to eight weeks depending on configuration, circuitry and quantity. Pricing is also dependent upon the above mentioned.

Circle 49 on Reader Response Card

Phoenix Contact's Surge Voltage Arrestors

The risk of damage to unprotected electronic equipment due to lightning strikes and other surge voltage effects can now be reduced with TRABTECH (Transient Absorption Technology) surge voltage protection devices offered by Phoenix Contact. The Trabtech series features 10 designs to cover a variety of cost, application and function variations.

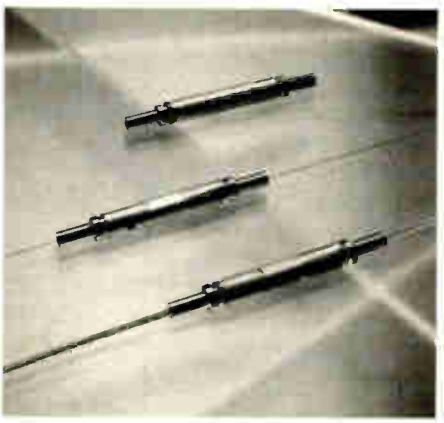
Specific models included in the TRABTECH lines, and their application are:

Powertrab—a high energy surge arrestor designed to be directly connected to a building's power supply. The unit can withstand multiple strikes and features a fault signal lamp to indicate when the unit should be replaced and a test button for functional verification. It mounts on a DIN rail.

Plugtrab—a pluggable surge voltage protection device. Testing and replacement of the protection elements can be accomplished without affecting circuit operation. An optional, portable plug tester is also available. It also mounts on a DIN rail.

Variations of each model are available to cover specific voltages (AC/DC and rating) and protection ranges.

Circle 50 on Reader Response Card



AMP's Optimate Splices Without Glue

AMP's Optimate has introduced a mechanical splice for multi-mode and single-mode optical fibers.

The design and crimping method of the Optimate compensates for fiber diameter variations, insuring center axis alignment without tuning procedures. The uniform crimp avoids mircobends and other loss producing fiber deformations, according to the company. Splice performance is rated at less than .25dB loss average.

A compact workstation is the only tool required. It's self-contained, it needs no power, and minimizes operator training. With its closely toleranced fiber holding capability, the "third hand" requirement of other splicing methods is eliminated, according to the company.

Circle 51 on Reader Response Card

CLASSIFIEDS

HELP WANTED

TECHNICAL MANAGER
National Sound and A/V Contractor specializing in hotel and entertainment systems requires qualified engineer to handle system design and specifications, estimating, technical drawings, and project supervision.

Ability to manage sub-contractors and use personal initiative in this highly paid position. Florida based with travel required to project locations. Send resume, photograph and salary requirements to: Design Associates, 2101 S.W. 27th Avenue, Miami, FL 33145 # (305) 858-7000.

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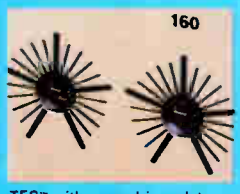
TEQ™ EQUALIZER TECHNOLOGY

. . .now available in 29 Band– 1/3 octave units

The benefits of transversal technology . . . Your choice of controls.

With a list of international installations to its credit, and praise from leading acoustical consultants, the TEQ™, Transversal Equalizer, is rapidly becoming the EQ of choice. TEQ™ eliminates unnecessary ringing and transient coloration of signals. While tuned filter equalizers respond correctly at their control frequencies they often create response ripples between control frequencies, causing audible coloration. But the unique TEQ™ design produces frequency responses with a single filter. Its transient response is the weighted response of a single tapped delay chain, and is ripple free over the entire 20dB adjustment range.


TEQ™ with sliders



TEQ™ with screwdriver slots

TEQ™ with rotary knobs

The TEQ™ is now available with the standard ISO 29-band, ⅓ octave frequencies. Also, choose the controls that best fit your particular applications—rotary knobs, sliders or screwdriver slots. Get the benefits of what Don Davis referred to as, ". . . the first genuine step forward in equalizers since the original ⅓ octave units . . ."


Expo '86, Vancouver

Discover for yourself how affordable state-of-the-art equalizer technology brings a transparent sound to your next installation. For more information, including technical data sheet, call or write:

INDUSTRIAL RESEARCH PRODUCTS, INC.
A Knowles® COMPANY
321 Bond Street • Elk Grove Village, IL 60007
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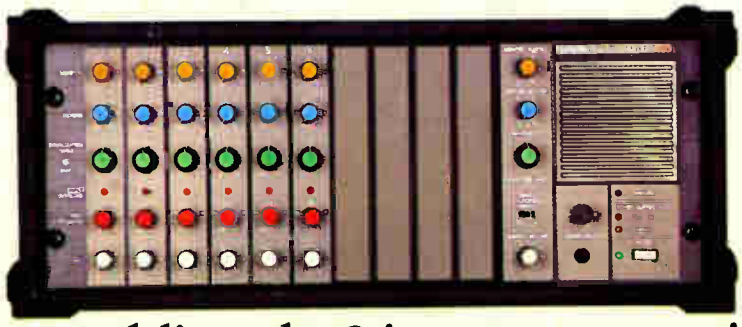
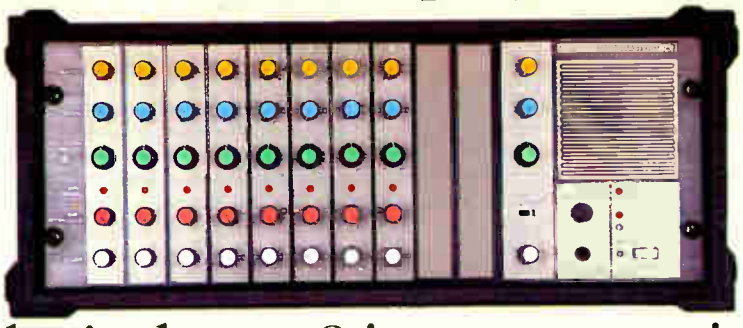
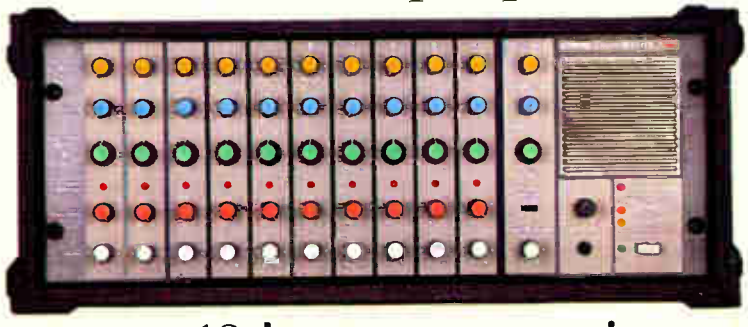
The new Audiomaster® 1200.



The world's only 6-input powermixer



...that's also an 8-input powermixer



...or a 10-input powermixer.

It starts with a 200-watt, 6-input powermixer. But in just minutes, you can add one or two A1200MX Expansion Modules to provide a total of eight or ten transformer-balanced inputs. So you can stock fewer models and capture follow-up sales when customers add on to their systems.

What's more, Audiomaster is the only expandable powermixer you can rack-mount.

Easier for customers to operate.

Instead of hard-to-read meters, the 1200 has LED indicators, color-coded controls and clear function descriptions. A new switchable limiter circuit prevents amplifier overload, and individual attenuators eliminate input overload.

Superior audio quality.

The Audiomaster 3200 Speaker System features a constant directivity horn to assure smooth high frequency response off-axis as well as on-axis. The Time Sync™ crossover network is time corrected for coherent sound, free from phasing problems in the crossover region.

Legendary Shure ruggedness and reliability.

Five-way circuit overload protection...metal powermixer enclosure...RF protection... solid plywood speaker cabinet with metal grille and hard rubber corner protectors. The new Audiomaster is built to last.

Shure Brothers Inc., 222 Hartrey Avenue, Evanston, IL 60202-3696. (312) 866-2553. Call for G.S.A pricing.

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