

SOUND & COMMUNICATIONS

FOR CONTRACTORS, SYSTEM MANAGERS AND SPECIFIERS

MARCH 1988



The World Harvest Church Sound & Video System

Basic Principles
for Suspended
Loudspeaker Systems

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SPECIAL PULL-OUT SECTION
The Contractor's Guide
to Power Amps

Refined.

MA/MR Series mixer/amps put style in sound reinforcement. The MA/MR Series mixer/amps look right in any setting. Clean lines and a modern black finish add to their attractive, professional appearance.

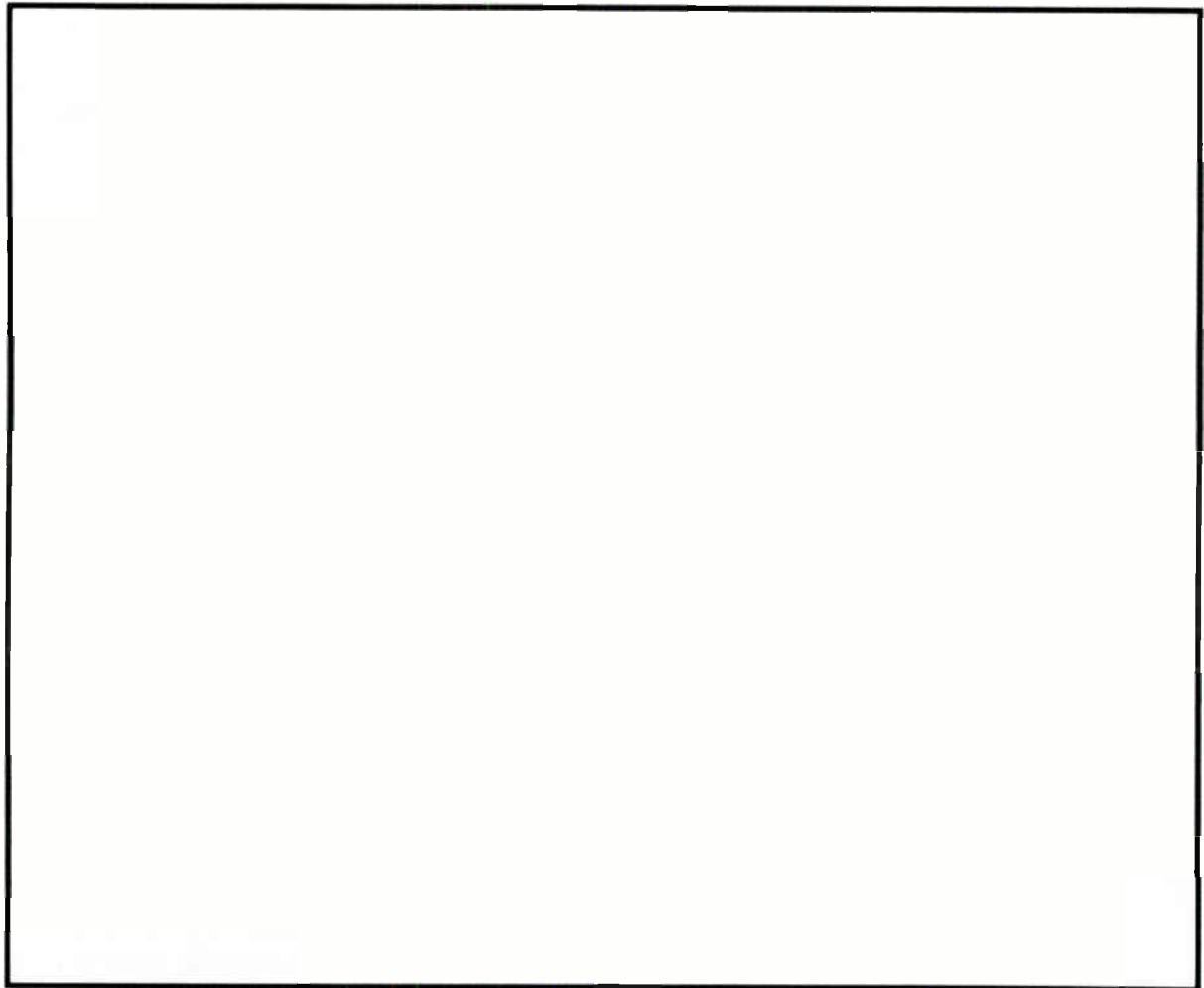
And behind the styling is pure practicality. The first of the new University Sound electronic products line, the MA/MR Series offers conservatively-rated outputs of 35, 60 and 100 watts, with the features you asked for. Two balanced mic inputs, two auxiliary source inputs and a switch-selectable mic or magnetic phono input are standard, as well as a rear panel "paging" input with automatic muting. The MR-355 model (35 watts) includes an AM-FM tuner for background music applications.

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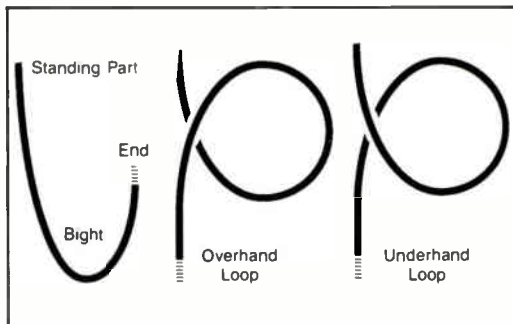
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ON THE COVER

A "World Class Tele-Production facility" was recently installed in the World Harvest Church in Canal Winchester, Ohio. The 5,200 seat church includes an Amek "Scorpion" mixing console, Sony monitors, and a 1,800 lb. main cluster which includes six P-100 Tannoy speakers.

Photo by Ernest Smith

FEATURES

17 BASIC PRINCIPLES FOR SUSPENDING LOUDSPEAKER SYSTEMS, PART I a reprint of JBL Technical Notes Vol. 1 No. 14

Great, we have this pile of horns, drivers and boxes. Now how do we get them to stay up in the air, and adjust them $\pm 15^\circ$ in pitch, yaw and roll? Perhaps it's all Newton's fault for being struck in the head by an apple and leaving us with the defiant laws of gravity. Since Newton never included the "Murphy Laws of Cluster Hanging," in his texts, we have taken the liberty to present the ins and outs of loudspeaker rigging.

24 STATE OF THE MARKET IN WIRE & CABLE by Greg Prince

Thirteen manufacturers talk about how these once forgotten components are now part of a booming business.

28 CONSULTANTS AND CONTRACTORS CRITERIA FOR CHOOSING POWER AMPS by John Parris Frantz

Sound & Communications surveyed consultants and contractors in the industry as to what is important and what's not in selecting power amps.

32 SPECIAL PULL-OUT SECTION ON POWER AMPLIFIERS

This comprehensive guide provides sound contractors with a diverse selection of power amps to choose from.

42 INSTALLATION PROFILE: THE WORLD HARVEST CHURCH SOUND & VIDEO SYSTEM

by Sandy Dillon

The consultant for this job worked round-the-clock for three months to install one of the most elaborate audio and video church systems in the country.

COLUMNS

56 Products in Review: A Closer Look

Gary D. Davis takes a closer look at the Frazier CAT 40 loudspeaker system.

WHAT TO LOOK FOR WHEN YOU LISTEN TO A POWER AMPLIFIER.

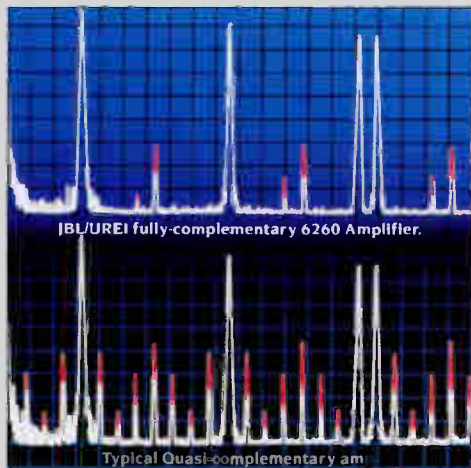
When it comes to evaluating amplified sound, seeing is believing.

In fact, when engineers judge the sound quality of an amplifier, they often rely on *two* precision instruments: the human ear, and the industry-standard Transient Intermodulation Distortion Test, because when measuring sound with T.I.M. what you see is what you get.

And what you see can be eye-opening. Amplifiers that seem to square off evenly spec. for spec., often perform very differently under the scrutiny of T.I.M. Pushed to their limits, many produce brittle, edgy or distorted sound especially during high frequency passages and sharp transients.

Many manufacturers deal with distortion by using massive amounts of feedback through a single overall feedback loop, placing greater demands on the amplifier and producing an inferior sound.

When we built our new JBL/UREI Amplifiers, we committed ourselves to designing the industry's purest-



Red spikes in the TIM Spectrum reveal the dramatic differences in distortion output.

sounding amps that would not only score highest marks on the T.I.M. Test, but deliver the truest amplified sound ever heard.

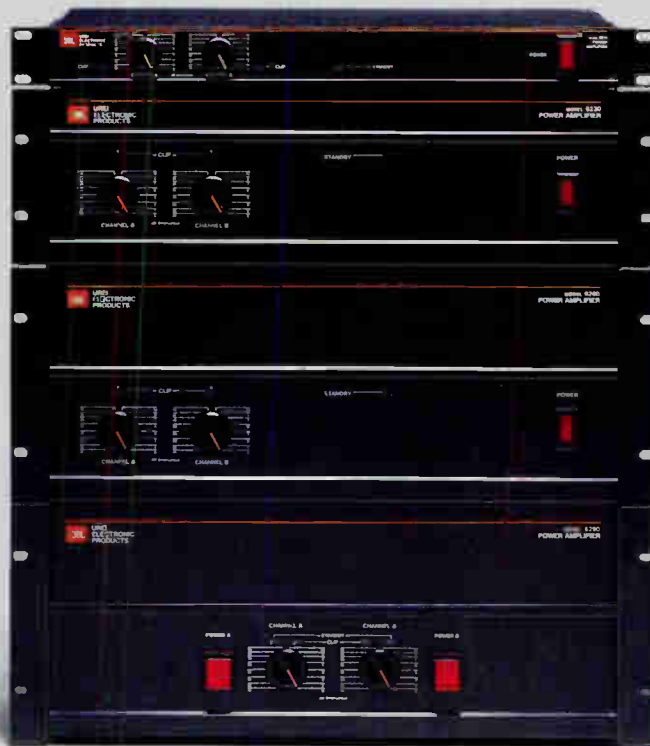
Instead of sloppily force-feeding massive amounts of

output signal back into input stages, and congesting it all into one circuit loop, we've established operating points at *each* gain stage. This allows signal purity to be maintained along the entire circuit. And permits optimized use of the type and amount of feedback for each individual gain stage.

In a simple analogy, the new JBL/UREI Amplifiers do each signal track right the first time, so that you don't have to fix it in the mix. The result is sound far cleaner than typical quasi-complementary and fully-complementary output stages only. And far more pleasing to the ear.

Put JBL/UREI's remarkable new Amplifiers to the test at your local JBL/UREI dealer today. We're confident you'll think it's the finest amplified sound you've ever heard. Or seen.

For an informative Technical Paper on the unique design philosophy behind the new JBL/UREI Amplifiers, please write to:



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Guest Editorial

Intercom—Past, Present and Future

The debate goes on. "What is intercom?" "Why bother with a stand-alone intercom?" "Is there any future in intercom?" With today's hybrid key telephone systems, many people think the sale of stand-alone intercoms will all but disappear. Yet, continuously increasing intercom sales seem to indicate otherwise.

Pages from our industry's history books are worth rereading. How many people realize that Alexander Graham Bell's first "call" was actually an intercom call? His famous call to Mr. Watson found him in the next room; not in a distant town.

In a 1941 copy of a promotional brochure, an intercom company advertises "Break your switchboard bottleneck, avoid costly telephone costs and locate roving personnel instantly." These solutions, important in inter-company communications 47 years ago, are equally vital today—especially in light of today's communications and data conscious world.

Although technology has progressed from hard wired systems, to cross-bar and the latest microprocessor systems; the need to provide solutions to the same customer problems has been the driving force in intercom development.

The future of intercom system sales is bright. Installations are relatively easy and offer good profit margins. Today's telephone systems efficiently handle outside calls coming into a business. Stand-alone intercoms are the perfect companion system, helping to accurately speed the flow of information, hands-free, from person-to-person, without having to lift another handset or cross a room. In addition, a properly designed, stand-alone intercom system will actually save time and money on callbacks, transfers and even in a reduction of the number of telephones needed.

For years, duplex intercoms were looked upon as useful only in health care applications. Now, with new technology and professionally trained sales persons and selling techniques, larger duplex systems are showing up in environments ranging from prisons, factories, the transportation industry and the financial community. All of these areas require the speed and clarity of hands-free communications to speed up the process of obtaining vital information.

As an example, bank and brokerage houses have become totally dependent upon this second track of hands-free communications. Traders and brokers work in a fast moving, stress-filled environment where each day, millions of dollars pass through their hands. Surrounded by a communications turret reminiscent of a *Star Wars* battle-cruiser, they are constantly juggling information sources in an effort to rapidly and accurately manage client portfolios.

Their intercoms are capable of information passing from a trader to another party within eyesight, elsewhere on their floor, in their building, or through special telephone interfaces, anywhere around the world. Most importantly, these communications flow without having to put their most important client "on hold."

In our time sensitive world, intercom sales will continue to grow and play an ever-increasing role in communications. How well we as an industry listen to the needs of our customers, and adapt our product offerings to solve problems, should put an end to the continuing intercom debate.

Peter McLean
Vice President
Ring Group of North America

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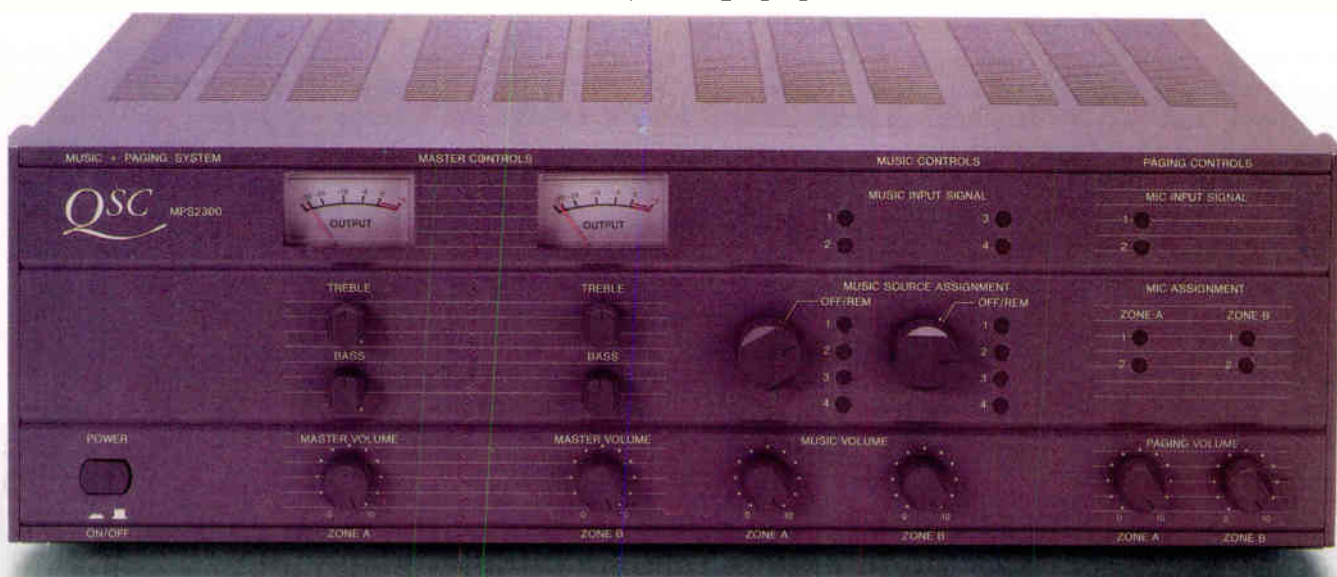
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When adequate is no longer good enough.

MPS 2300



In today's highly competitive business environment you need every advantage you can get. Adequate is no longer good enough. Leading businesses are gaining an advantage by installing high performance foreground systems to provide their customers an enhanced listening environment. At QSC, we have brought our reputation as a leading manufacturer of amplifiers to the foreground. The MPS 2300 is the first professional music and paging system combining advanced mixer/preamp, signal processing, and power amplifier technology in a simple to use package. The MPS 2300 enables businesses to use high performance integrated music and paging systems to their full advantage.

So, when adequate is no longer good enough...

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NSCA GEARS UP FOR EXPO '88, REGIONAL SHOWS DROPPED THIS YEAR

NSCA promises that this year's NSCA convention at the Bally's Hotel in Reno, Nevada, from May 18-20, will be as successful as last year's. Over 4,000 industry people, including exhibitors, reps, consultants and contractors, are expected to attend the show again this year. This year's exhibit hours have been extended by one hour: On Wednesday, May 18, and Thursday, May 19, the floor will be open from noon to 5 PM. On Friday, exhibitors will display their products from 9 AM to noon.

This year seminar tracks have been increased from three to four. They are: Audio, CAD/Instrumentation, CCTV/Teleconferencing, and Marketing. Wednesday's seminars will kick off at 8 a.m. with a keynote address by nationally known motivational speaker Danny Cox; sessions will be held up to show time. Thursday's hours will also be from 8 a.m. until noon, and on Friday from 1 to 3 p.m. contractor Don Fouchet will conduct a tour of the Bally's Grand Ziegfield Room, where the largest stage in the world is located. In addition, prior to the show on Monday and Tuesday, May 16 and 17, a basic salesperson course and an intermediate salesperson course will be held. Although the seminar rooms will be bigger this year, space will be limited to seating only to avoid overcrowding. "We expect this year's show to be bigger and better than ever with more hours of learning to improve the professionalism, skills and profitability of contractors," said Bud Rebedeau, NSCA executive director.

In a related issue, the ESSC (Electronic Sound & Systems Conference), which set up a joint venture of ERA and NSCA four years ago to coordinate regional shows, recently formed an ERA/NSCA Manufacturers' Advisory Committee. The Committee voted to schedule no ERA/NSCA regional conferences for 1988 due to a reorganization of the shows. According to Harold George, ESSC chairman, "We want to step back and reevaluate the value of the shows to manufacturers, reps and contractors and put together a package that will benefit them all. In order to do this and do it well, we need time, we need this year." Mary Beth Rebedeau, NSCA manager said, "We want to make sure we do it right and plan far enough in advance for budgetary and promotional purposes. We have decided to only go to markets that have at least 300 contracting companies within a 200 mile radius. The reps seem very happy with the changes." Other committee changes include a limit of three shows per year, possibly moving the shows to different sites such as American Legions or high school gyms, serving less elaborate food and beverage to cut down on costs, beefing up the educational program and not running it during show hours. (See Sound & Communications Editorial, January 1988.)

STUDER REVOX AMERICA REORGANIZES MANAGEMENT

In order to meet the demands of new product introductions and an expanding market in 1988, Studer Revox America has made some changes in its staff and organizational structure. SRA has reorganized its sales and administrative support staff in both the Studer and Revox branded lines. An important part of this reorganization move involves the appointment of Chris Ware as manager of Studer direct sales. Formerly regional sales manager for the southwestern U.S., Ware has been with the company for six years and will be relocating to Nashville, SRA headquarters. In his new position, for which he will assume full duties in early April, Ware will be responsible for managing sales of all non-dealer Studer branded products sold directly by the company. Overall sales and administrative efforts will be headed by executive vp Bill Muggler. Thomas E. Mintner, former vice president and general manager and formerly in charge of Studer direct sales, has resigned to pursue other activities. Other organizational changes to take place within the coming months include expanding operations and sales/service personnel on the West Coast.

SYN-AUD-CON TO HOLD LOUDSPEAKER DESIGN WORKSHOP

Synergetic Audio Concepts (Syn-Aud-Con) will hold a loudspeaker Designers Workshop in Atlanta, GA, on April 15-17. The staff for the Loudspeaker Designers Workshop offers the participants an opportunity to work with three loudspeaker designers. They are: Edward M. Long, the father of Time Align, PZM and ELF; Don Keele, the developer of the constant directivity horn, loudspeaker reviewer for Audio magazine and a key program developer for the TEF analyzer at Techron; and Dr. Eugene Patronis, the workshop chairman, is in the physics department at Georgia Tech and the designer of many loudspeaker systems. For more information contact Syn-Aud-Con at P.O. Box 1239, Bedford, IN, 47421; phone, (812) 275-3853.

ELECTRO-VOICE TO CO-SPONSOR WORLD EXPO '88

Electro-Voice, Inc. has announced its participation as a corporate sponsor of the United States Pavilion at World Expo '88 in Brisbane, Australia, joining many other U.S. Corporations that have responded to the call from President Reagan for private sector support of this project. The United States Information Agency is responsible for producing and managing the U.S. Pavilion. The sound in the Pavilion will be heard via Electro-Voice sound reinforcement equipment, including 20 S-200 speakers, 21 FM-1502 floor monitor speakers, 10 SH-1810 speakers and various N/DYM microphones.

Expo '88 is the first world's fair in the Southern Hemisphere in a century and part of Australia's 200th birthday celebrations and will be open from April 30 to October 30, 1988. In addition to the U.S., 38 other countries are expected to participate. In addition to Electro-Voice, Bell Helicopter, Textron, Boeing Company, Continental Airlines, Eastman Kodak, Hewlett-Packard, Life Fitness, 3M, Rathe Productions, Inc., Reebok, Sheraton, Spalding and USA Today are contributors.

EDS LOOKS TO BE A SOLD OUT SHOW

The 1988 Electronic Distribution Show and Conference (EDS) to be held from April 26-28 at the Las Vegas Hilton is nearly sold out, according to David L. Fischer, executive vice president of the Electronic Industry Show Corporation. As of March 1, 290 exhibitor companies had registered to participate at EDS, 15 more than at the same time last year. Some exhibit hall space is still available, but Conference Rooms and Executive Suites are virtually all committed. Eurostyle Salon Units, a private meeting room format on the show floor, are still available to meet the conference needs of late-enrolling manufacturers. Some 16 exhibitors are participating in EDS for the first time. Newcomers include Automated Production Equipment Corp., Baldwin Components, Exttech Instruments, TDI Batteries and Wire-Pro.

DIGITAL SOUND FOR MOTION PICTURE THEATRES

An industry source recently announced that a practical digital sound reproduction technology for motion picture theatres could be available by the first quarter of 1989. The system will require that film producers record various sound elements digitally in order to produce a composite digital master. The new electronic technology will marry the digital playback to the image at the time of projection. It is presumed that some changes will be needed in the theatre electronics and loudspeakers for proper reproduction of the dynamic range of digital audio. At this time the costs of the new digital system are expected to be slightly more than existing analog stereo or multi-track methods.

A REP SPEAKS OUT

Dear Editor:

This is regarding the ERA/NSCA editorial in the January issue of *Sound & Communications*. When you point out that "manufacturers didn't know that the bulk of contractors in Missouri are in Kansas City and not St. Louis," you make one helluva case for companies having reps who know the territory.

Too many firms want to sell direct or use "big apple type salesmen" to beat the bushes (or beat the reps when they do have them.) As a sage once said, "All business is local."

In my opinion, it is a cop-out to cut the show from two days to one. The two days are good *if* there is traffic. The contractor gets an option of which day to come. He might go the first day and send one of his people on the second day to see something that caught his attention the first day, ad infinitum.

It is up to the manufacturers to support Rebedeau who must exert every

energy to produce a lively regional show with stimulating programs and booth prices that will attract more reps.

The attendance in Chicagoland seemed poor this year. Apparently it was the same in other cities. Let us hope that it won't cause interest to wane and support to drop for an association whose time really has come. Thanks for saying it like it is.

Frank Luppino, Jr.
Mid-west rep.
Marketing Insights

"NO NEED FOR REGIONALS"

Dear Editor:

I read your editorial in the January issue of *Sound & Communications* with interest. Frankly, I think you missed the point.

Any manufacturer who doesn't know where the bulk of his contractors are or the economic status of the various regions doesn't deserve to be in this business. I can't imagine any

manufacturer who doesn't have sufficient data processing reports at his fingertips which would highlight such information.

The regional shows are a waste of time, plain and simply because ours is a small industry and there just are not that many contractors in a given region. In addition, these contractors for the most part are small businessmen and cannot afford to take the time away from a busy day to attend a somewhat questionable series of seminars and displays.

From a manufacturer's viewpoint there are just too many shows. The NSCA, in and of itself, is adequate for the needs of the installed contractor marketplace. There is no need for regional shows.

Donald E. Merreen
Director of Marketing
Communication Products
Telex Communications, Inc.

Editor note: See Newsletter this issue, page 8.

"The Crown PS SERIES amplifier provides more service for the dollar."

"We have enjoyed an extremely good relationship with the people of Crown for many years. We especially value Crown's desire to work with us in developing specific products for specific needs."

Per Haugen has been a leader in the sound contracting business for over 30 years. Heading a company that has installed literally thousands of church and other sound systems Per knows the importance of having quality products such as the **PS-200/400 Amplifiers**.

"Crown's traditional qualities of performance and reliability are very well suited for my business."

"The PS Series Amplifier provides quality sound for years and years and requires very little maintenance, that translates directly to the sound

contractor being able to provide more service for the dollar."

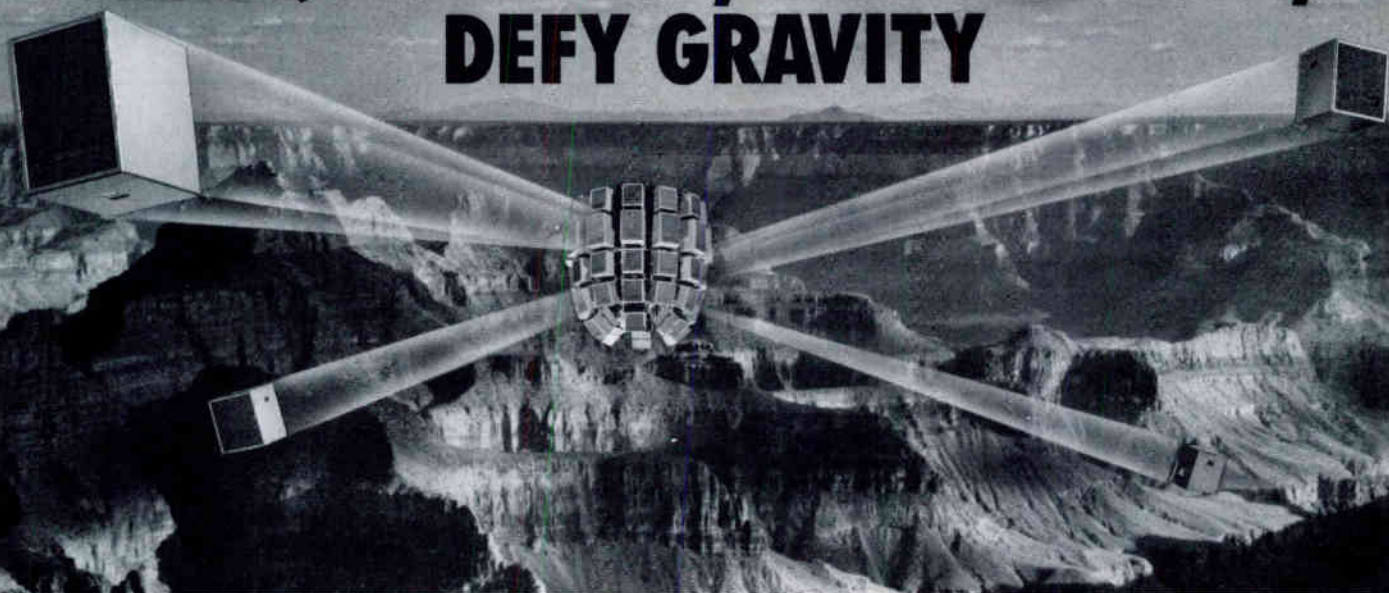
At Crown the feeling is, personal contact guarantees the success of the product line. Untold hours are spent consulting professionals like Per to insure each product satisfies the exacting requirements of those who utilize them. Crown will always value open communications with pros in the field and will always be committed in bringing products to the market that make sense.

Per Haugen, General Communications
Salt Lake City, Utah



 **CROWN** INTERNATIONAL, INC.
1718 W. MISHAWAKA ROAD, ELKHART, IN 46517

CONQUER SPACE, MASTER TIME, DEFY GRAVITY



Some speaker systems attempt to conquer acoustic space with brute force—deploying massive cabinets, firing horns at everything that moves. Others resort to electronic trickery, which requires delicate racks of complex gadgetry.

Innovative designs for effective performance

Turbosound Separated Enclosure installation systems achieve their superior performance without useless bulk or “clever” disguises. Instead, they employ unique, patented design principles proven on tours and installations worldwide.

A true system is more than the sum of its parts

The TSE System focuses Turbosound thinking, outwardly radical yet intrinsically sensible, on the problems of fixed installations. TSE is more than a collection of cabinets: it's a true system, with all elements working together. A variety of straightforward designs, all producing distinguished sound with security and reliability.

What goes up must not come down

In large venues, a point source cluster is often best. TSE flying hardware simplifies cluster design and installation: complete systems have been installed and tested in one day. Each component is load-certified by a UK government-approved testing organization. An expensive proposition, but you should know how your system will perform. Equally severe testing confirms the audio performance of TSE enclosures.

Make full use of your skills

TSE components are made for each other. That makes it easy for you to optimize a TSE system for any installation, large or small. There's no easier way for you to bring your own ideas about sound reinforcement to reality: Dozens of different TSE systems in major venues worldwide prove the point.

TSE systems can't grant you supernatural powers, but they will give you superbly natural sound.

TSE Flying Frames remove load stress from the cabinet. Connected with Quicklinks, frames and cabinets pivot to form a smooth coverage arc. Vertical dispersion is easily adjusted with the TS-6 or TS-10 strap connected to the bottom flying frame and the suspension quadrant.

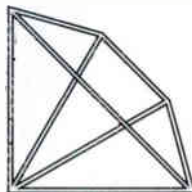


TSE-111—10" TurboMid + HF horn/driver.

Fits the FF-111 Flying Frame, with a square frontal cross section to let you change dispersion patterns by rotating the frame.



Horizontal dispersion is provided by 90° Suspension Quadrants: each quadrant will hold any combination of TSE enclosures. Combining quadrants yields horizontal dispersion of 70°—360° and vertical dispersion of 50°—270°.



TSE-211—2 x 10" TurboMid + V-2 HF unit. Superior Mid and HF projection. Switchable active bi-amped or passive two-way operation. Dual vertically-coupled TurboMid devices double power handling. The V-2 extends frequency response, enhances intelligibility.



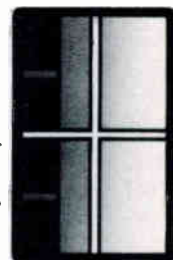
TSE-260—V-2 HF unit.

Two HF drivers coupled with Turbo loading techniques, minimizing phase cancellation and distortion.

TSE-215—2 x 15" TurboBass.

Balancing TSE frequency response is easy—LF units are separate from mid/high cabinets. With six units to choose from, generating the proper frequency response and coverage pattern for any venue can be as simple as laying dispersion angles over the blueprints.

Other bass enclosures available: TSE-115, and TSE-118.



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World Radio History

HIS HEART'S STILL IN THE SOUND BUSINESS

Dear Editor,

As of December 31, 1987, I am no longer in the "sound business" which I had been for the past 62 years. After selling my appliance, TV, two-way radio and electrical parts store in 1980, I have stayed with the "sound business." I am still interested in sound and thus I am renewing my subscription to *Sound & Communications* for another three years.

During those 62 years, I have supplied one of my customers, the Cobleskill Agricultural Fair Assoc., with rental sound for 61 years and this fall sold all the equipment to them. Needless to say, the equipment over those 61 years changed immensely from an amplifier with a pair of UX-250 class "A" amplifier tubes, giving me about 12 watts, and two microphones purchased from the Universal Micro-

phone Co. of Inglewood, California, for a hundred bucks each. These were double button carbon mics. I still have them as well as a couple of the four RCA cone type speakers with electromagnetic fields and a selenium stack on each for rectification of the AC supply. Most of the control equipment used in the system are custom-made to fit the operation of the system. Included with the sale were a dozen intercom units, eight handy talkies and two base stations (Motorola).

My work has been with at least a dozen schools, many churches—both for the sanctuary and belfry—as well as restaurants, mortuaries and race tracks. The equipment was also rented out for community events, horse shows, snowmobile races, celebrations, home shows, motorcycle conclaves, etc. It has been a very eventful business and one I enjoyed very much. I was an independent installing and

servicing agent for Motorola for 25 years and was a sound distributor for DuKane for several years.

When I sold the equipment, there was a total power output of over 1700 watts—64 speakers of various types, 15 microphones, and enough cable that when laid end to end, would reach 46 miles.

I didn't intend to go into this much detail, but one thing led to another. I'll be looking forward to the future issues of *Sound & Communications*.

Edward Schribner

ADVICE ON TURNKEY

Dear Editor:

In Marc Beningson's comments in the November, 1987 issue of *Sound & Communications*, he invites readers' comments on "turn key" or sometimes called "design build" sound system installations. About the same time that the November *Sound & Communications* arrived we received a monthly newsletter from a good client of ours in the energy conservation field. He offered some guidance on design build for HVAC system installations and, I believe, he addresses all of the same issues that would apply to sound amplification systems. So with full credit to our colleague David Elovitz of David M. Elovitz/Kenneth M. Elovitz, Registered Professional Engineers of Natick, MA, we offer the following paraphrased article for *Sound & Communication* readers' consideration:

Many owners see significant advantages in the design-build approach to sound systems, where the contractor is responsible for design, fabrication, installation, and (hopefully) a satisfactory end result. Some also see risks as well as advantages and retain an acoustical consultant to help reduce them. However, the consultant's role is not always well understood by all parties.

Scope of Work

The consultant prepares a document which defines the performance, the design build contractor (DBC) undertakes to deliver in terms of the specific items that can be measured and the

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design conditions the system must meet. These include system functional requirements, uniformity of coverage required and other elements normally found in good technical specifications. The Scope should also establish the overall level of the system quality and identify any constraints or special architectural requirements such as space limitations or aesthetic requirements the DBC must take into account. The owner approved Scope document becomes part of the design

build contract.

Design Review

The consultant reviews the DBC's design documents and advises the owner if he believes the system shown by those documents will meet the criteria presented in the Scope and is generally consistent with the requirements of the Scope. The review may raise questions or flag misunderstandings before they become difficult, if not impossible, to correct. Since the

DBC is solely responsible for meeting the performance requirements, the DBC's engineer is the engineer of record. The DBC engineer stamps the drawings and makes the final decisions with respect to system details since the DBC remains contractually committed to the end product. The acoustical consultant advises, and if necessary screams, but remains the consultant, not the decision maker, in the design review process. It should be clear from the above that the DBC *must* have an experienced, qualified professional engineer on staff if the design build process has any chance of working.

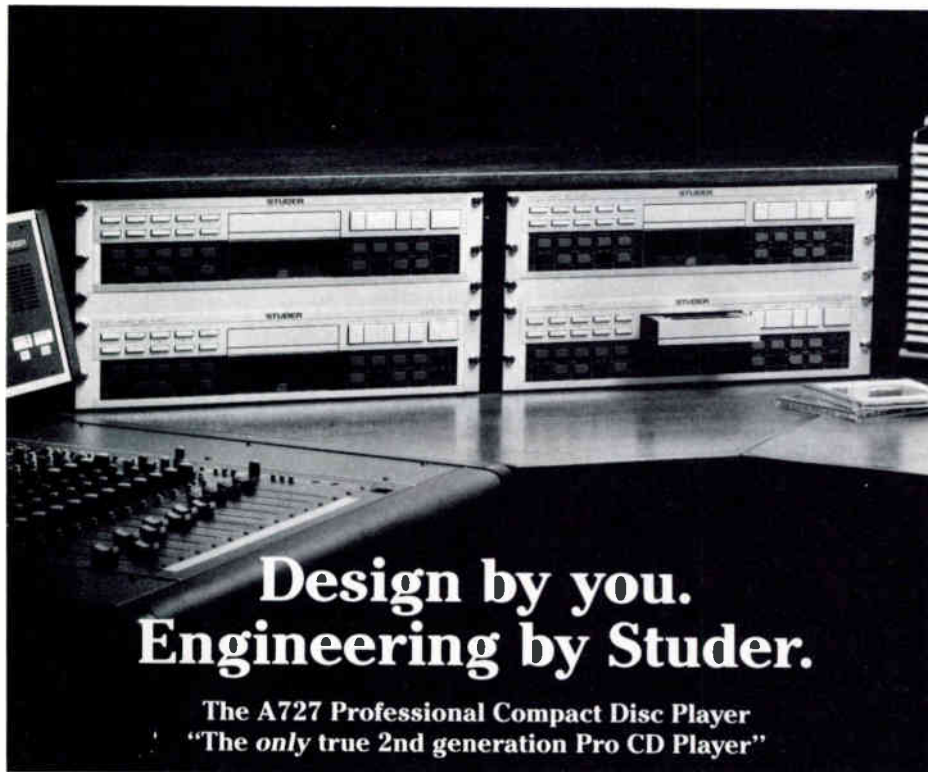
Submittals

The consultant checks submittals for the major equipment and system details to advise the owner if they are consistent with the Scope and the DBC's design. Again, the consultant *does not* approve the submittals and *does not* have the right to reject them—only the engineer of record can do that. However, the consultant's review informs the owner about the major equipment and raises a flag if there are deviations.

Acceptance

Once the DBC says the system is complete, meets all requirements of the Scope, and is operating properly, the consultant can evaluate the system operation and performance under simulated operating modes and advise the owner if the observed performance is generally consistent with the contract Scope. The consultant might be assisted by the DBC or by independent technicians as needed for the performance check-out.

Most DBCs welcome the owner's consultant where his role is defined as above because the consultant helps both the owner and the DBC. All parties concerned want to catch errors or deficiencies before they become costly or difficult to correct. However, if the consultant is set up as an adversary at the outset or at any point in the process, the spirit of team effort towards a common goal will be severely damaged, defeating one of the major advantages of design build. ■
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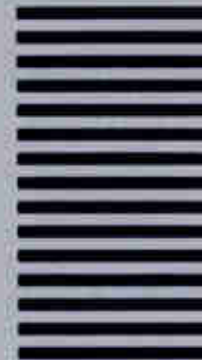
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BASIC PRINCIPLES

for Suspending Loudspeaker Systems

Contractors and sound installers hang loudspeaker equipment in public meeting places and performing art facilities as a matter of routine. This Technical Note details rigging practices appropriate for the sound industry, and is intended to familiarize readers with the proper hardware and techniques for hanging installations. To insure a safe installation and to protect workers on the job site, this work should be undertaken only by persons with knowledge of the proper hardware and safe rigging practices.

This Technical Note contains data for rated capacity for various pieces of hardware, based upon manufacturers specifications for products in new condition and free from defects, either apparent or hidden. All rated load values, unless otherwise noted, are for in-line pull—along the center-line of the item. It is the responsibility of the installer to inspect and determine the actual condition of the equipment used, and to incorporate design factors appropriate to the local job conditions. Where doubt exists as to the actual condition or ratings of hardware, it should not be used.

This article is Part One of three parts, and is a reprint of "Basic Principles for Suspending Loudspeaker Systems," JBL Technical Notes Volume 1, Number 14—courtesy of JBL, Inc., Professional Division.

Load ratings shown herein are based upon usual environmental conditions. Further considerations must be given to item selection when unusual conditions are encountered. All products used for hanging purposes are subject to wear, misuse, overloading, corrosion, deformation, alteration and other usage factors which may necessitate a reduction in the products capacity rating or a reduction in its design factor. It is recommended that all products used for rigging and hanging purposes be inspected prior to each use as a basis for determining if the product may continue to be used at its rated capacity, or removed from service.

Welding of or to load supporting parts and structure can weaken the part or structure, and should be performed only by persons with knowledge of metallurgy and the intended use of the materials being welded.

All information herein is based upon materials and practices common to North America and may not directly apply to other countries because of differing material dimensions, specifications and/or local regulations. Users in other countries should consult with appropriate engineering and regulatory authorities for specific guidelines.

Design Factor

Design factor is a term used by the rigging industry to denote theoretical reserve capability. The rated capacity of all lifting and hanging equipment is based upon the nominal

Part One

strength of the equipment reduced by the design factor.

Design factor is a number representing the fraction of equipment nominal strength chosen to be appropriate for the particular application.

$$\text{RATED CAPACITY} = \frac{\text{NOMINAL STRENGTH}}{\text{DESIGN FACTOR}}$$

Example:

Design factor = 5

Rated capacity of equipment is only 1/5 of its nominal strength.

Minimum design factors vary according to the application, and may be regulated from location-to-location. No design factor discussed herein should be assumed to represent a recommendation on the part of JBL or *Sound & Communications Magazine*. Users must assume all responsibility for the determination of design factors suitable for local conditions.

Shock Loading

When a load is suddenly moved or stopped, its weight may be magnified many times the original value. This is known as shock loading. Shock loading of lifting equipment should be avoided at all times.

Shock loads will usually be instantaneous and may go undetected unless equipment is visibly damaged. No equipment is designed to compensate for poor rigging practices or foolish planning, however. Every tool and piece of equipment has limitations. Safe working practices demand that these limitations be known and fully understood, and that they never be intentionally exceeded.

A 900 pound loudspeaker cluster dropped four inches could cause a shock load of 4500 pounds if the rigging were attached to rigid structures and of a material that would not stretch. However, because all rigging will stretch under shock loading, the exact shock load on a piece of equipment isn't easily predicted. To protect people and property, all tools and equipment should be limited to stresses that are several times smaller than their minimum breaking strengths.

Although shock loading of equipment and structure is usually confined to lifting and installation, it should also be recognized that other forces (such as earthquakes) can impose shock loads upon structures many times that of the static load. It is therefore imperative that hardware can impose shock loads upon structures many times that of the static load. It is therefore imperative that hardware and structures be capable of supporting several times the weight of the equipment being hung.

Center of Gravity

The center of gravity of an object is the point at which the weight of the object acts as though it were concentrated. It is the point at which the object may be completely supported or balanced by a single force.

The center of gravity of a regularly shaped object may be estimated fairly accurately by determining its approximate center. Finding the center of gravity of irregularly-shaped objects can be more difficult, but it is necessary, nevertheless. A load will always hang from its attachment point through the center of gravity. It is important to visualize this before making a lift.

All loads to be lifted should be rigged above the center of gravity in order to prevent tipping and possible hazards to equipment and workers. The lifting force should always be located above the center of gravity and exert a straight vertical pull to prevent swinging of the load.

Ropes

Before discussing actual rigging hardware and systems, it is appropriate to examine ropes and their proper use. Ropes are used for many rigging functions. Although synthetic ropes of great strength are available, most codes prohibit their permanent use in rigging for a variety of good reasons. Nevertheless, ropes are necessary to lift approved cables, fixtures, tools and equipment into position.

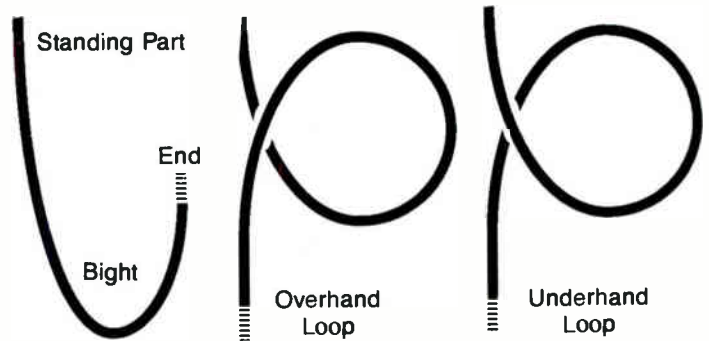


Figure 1. Rope Terminology

In the interest of safety it is important that ground workers be familiar with the proper use of rope and a few basic knots used in rigging.

Rope Terminology

Figure 1. illustrates the six terms associated with rope, they are:

1. The Standing Part is the end of the rope which is inactive.
2. The End is the part of the rope that is free—typically the part in which knots are tied.
3. A Bight is the central part of the rope between the standing part and the working end.
4. An Overhand Loop is formed by crossing the end over the standing part.
5. An Underhand Loop is made by crossing the end under the standing part.
6. Tightening. Once formed, a knot must be tightened slowly and with care. Failure to do so could result in a tangle, or an untrustworthy knot.

Knot Efficiency

Knot efficiency is the approximate strength of a rope with a knot as compared to the full strength of the rope. It is expressed as a percentage of the ropes rated capacity, and refers to the stresses that the knot imposes upon the rope. When a knot is tied in a good rope, failure under stress is certain to occur at the knot. This is because bends result in uneven stresses upon the fibers, with the outsides of the bends taking a greater share of the load. It follows that the tighter the knot, the greater the percentage of the total load that is carried on fewer fibers.

Bends

Bends are used to join two pieces of rope, usually temporarily. Typical knot efficiency is 50%. Bends offer some advantage over binding knots, as they resist untying when slackened or jerked. The Sheet Bend is a simple knot to tie, consisting of an overhand loop on one piece, with the second rope end fed up through the loop from behind, around the

standing part of the first rope and back down through the loop from the front.

Binding Knots

Binding knots are also used to join two pieces of rope. In general, binding knots have a knot efficiency of 50%, but can untie easily when a free end is jerked.

In the square knot, the end and the standing part of each line lie together through the bight of the other. In the untrustworthy granny knot, the end and the standing part are separated by the bight. The granny knot is particularly treacherous in that it will appear to be secure—only to slip under load. The thief knot is deceptively similar to the square knot, but has the two loose ends coming out of the opposite sides, instead of from the same side as in the square knot. This knot is almost certain to fail under load.

Loop Knots

Loop knots are used to hold objects where security is of paramount importance. The bowline, widely used in rigging, won't slip, yet is easily tied and untied. It may be tied in the hand or used as a hitch and tied around an object, usually for lifting purposes (Figure 2).

To tie: Make an overhand loop with the end toward you (Step 1). Pass the end up through the loop from behind (Step

2), then up behind and around the standing part—then down through the loop again (Step 3). Draw up tight. The bowline has a knot efficiency of approximately 60%.

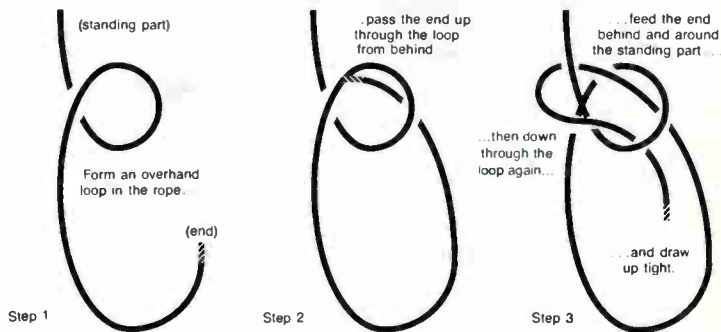


Figure 2. Tying Bowline

Hitches

Hitches are used for temporary fastenings that untie readily. They are generally tied directly around the object—instead of first being tied in the hand and then placed over the object. Hitches must be drawn up tight, as they have a tendency to slip if loose.

The clove hitch (Figure 3) consists of two underhand loops,

Rigging Safety Considerations

by Will Parry, MSI, S & C Technical Council

The headline might read “sound cluster plummets to arena floor killing three, injures 10.” If you're like me that makes your heart skip a beat. What arena? Whose clusters? Who's responsible? That is a fictitious headline. To the best of my knowledge this specific incident did not happen in the audio business. What brought this to mind was a lighting accident at Pulsations Night Club in Media, PA - a light fixture fell on opening night injured three, and killed one person.

A great wealth of rigging knowledge from over 17 years of experience, with both permanent and portable systems, has resulted in practical guidelines for rigging at MSI (Maryland Sound Industries). MSI flies hundreds of *safe* shows each year, with some pretty exotic rigging dates including flying a major cluster over President Reagan's head for the 1980 Inaugural Ball. Below is an overview/outline of the safety guidelines we use in the touring and installation businesses.

We have divided rigging safety into six general categories.

The first—always use overhead rated hardware. Going to the local True Value Hardware Store for chain and large bolts doesn't cut it. Use materials that are specifically rated for the job. Most of the time this means OSHA approved supplies. These supplies are readily available in most cities from commercial/industrial supply houses. One well known brand name is Aeroquip.

The second—always use experienced people to do your rigging. The \$3.38/hour apprentice, or a great wiring technician are not qualified. Use seasoned professionals. If you don't have access to them, subcontract that part of the job out. There are many firms that specialize in this work. If you think this will make you non-competitive in your bid—put it in writing to the electrical contractor, general contractor or owner. They will value and appreciate your covering their collective behinds.

The third—have your work certified by a local professional engineering firm. Note the word *local* to emphasize the need to understand local codes. A contractor from the mid-west may miss an important consideration in an earthquake-prone area like California. The job is not complete until a professional architect or engineer says in writing it is safe, and meets the design parameters. Put that paper in the front of your documentation package.

The fourth—Use a safety factor that lets you sleep at night. MSI uses 5:1 or better rated values. The values are published in the catalogs listing overhead rated hardware and will be checked by your P.E. (state certified Professional Engineer) when he reviews the project.

The fifth—The system is only as good as the weakest link. If you install all rated overhead hardware and the speaker enclosure is particle board with lag bolts—it is unsafe. Conversely, if you use a rated cabinet with only garden store variety chain—it is unsafe. A few manufacturers currently rate their products. Generally, this applies only to “box” systems. If you intend to fly a box system or components and it's not rated, you need to take action. The same P.E. who looks at the rigging hardware should look at what you are hanging and how it will hang. I know this is a problem to do and might cost money, but the cost of this type of back up should have been in your price to begin with; and let's get the manufacturers to provide rated equipment.

The sixth—Put a safety on everything. Most local code calls for a safety, but if not put it on anyway. There are numerous manufacturers who make safeties in various lengths for very reasonable prices. A three foot 1500 pound safety can cost under \$3.00 each. That is a very reasonable insurance rate. With a safety installed, you're that much closer to a totally safe installation.

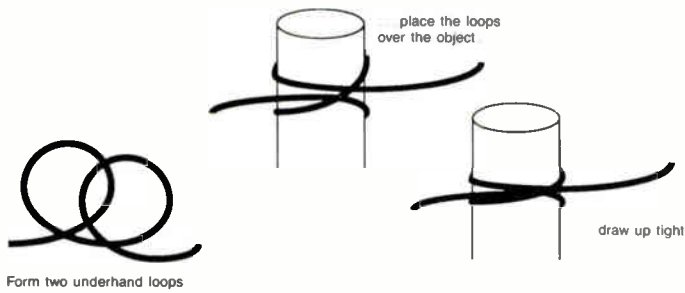


Figure 3. Tying Clove Hitch

which may be tied in the hand and slipped over an object at any point along the length of a rope. Knot efficiency is 60%.

Wire Rope

Most wire ropes are constructed from plow steel, improved plow steel, or extra improved plow steel wire. The wires are woven into strands, which are woven to form the wire rope. Typical wire rope may consist of six strands wound around a central core. The central core supports the outer strands and helps to prevent the rope from crushing under stress. Wire rope core materials may be fiber (abbreviated FC), independent wire rope (abbreviated IWRC), or wire strand (abbreviated WSC).

Wire rope is classified by diameter, number of strands, number of wires making up each strand and core material construction. Rope diameter is measured at its widest dimension. Wire rope is also classified according to the direction the strands and wires are twisted. The distance along the rope required for a strand to make one full revolution is one *lay*.

In *Right Regular Lay* construction, Strands twist to the right, wires twist to the left.

Right Lang Lay construction finds both strands and wires twisting to the right.

Left Regular Lay ropes are constructed with strands twisted left and wires twisted right.

The *Left Lang Lay* configuration twists both strands and wires left.

Regular lay ropes are less susceptible to crushing and deformation because the wires lie nearly parallel to the rope.

Lang lay ropes twist the wires across the direction of the rope, and are therefore more flexible and resistant to abrasion damage. If both ends of a lang lay rope are not fixed, however, it will rotate severely when under load.

Most sound and stage rigging requirements are easily handled by two wire ropes: 3/8' and 1/2' 6 X 19 IWRC classification. These ropes in improved plow steel have a nominal

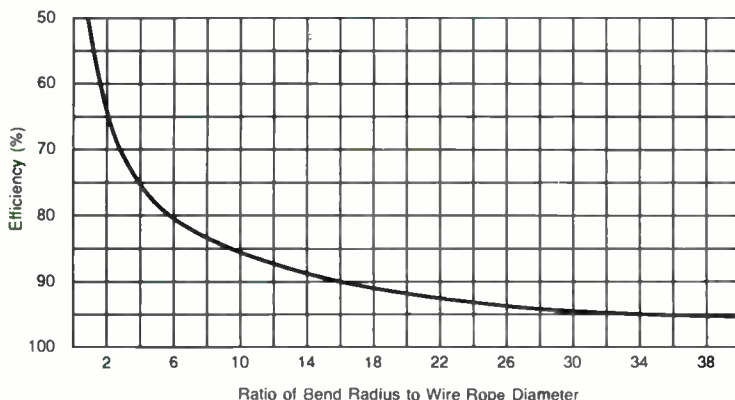


Figure 4. Wire Rope Bend Efficiency

strength of 13120 pounds and 23000 pounds, respectively. If we assume a design factor of 5, rated capacities become 2600 and 4600 pounds.

Just as knotting a fiber rope reduces the nominal strength of the rope, bending of a wire rope also results in a reduction in its nominal strength. The tighter the radius of the bend in the rope, the greater percentage of the load is concentrated on fewer wires and strands. This results in a reduction in the rope's nominal strength and rated capacity.

Figure 4 shows the relationship between wire rope efficiency and the ratio of bend radius to rope diameter. The chart is for 6 X 19 class wire ropes. Note that the chart is nearly asymptotic as the bend radius approaches the rope diameter—such as might occur in wrapping a beam with a basket sling. Overloading of a cable under these conditions could result in irreparable damage to the wire rope, or a possible failure.

Experienced riggers always pad beam edges with softeners before wrapping the beam with a sling, and avoid sharp or jagged edges that could possibly injure the wire rope or sling. Heavy burlap or thick polyester is usually used for this purpose.

Wire Rope Diameter (in)	Quality of Clips	Spacing (in)	Torque (Ft-lbs)
1/4	3	1-1/2	15
3/8	3	2-1/4	45
1/2	3	3	65
5/8	3	3-3/4	95
3/4	4	4-1/2	130

Table 1. Wire Rope Clip Data

Wire Rope Connections

In the touring business, wire rope is employed for slings, usually in lengths of 5, 10, 20, 30 and 50 feet. Each end of the sling is terminated in a swaged or zinc-cast eye, which yields a connection that is at least as strong as the wire rope itself. This type of connection is rated as 100% efficient—the strength of the entire cable assembly is that of the wire rope. These slings are also clean in appearance, won't tear flesh or clothing in the process of handling, and do not require periodic re-torquing. Custom length slings are easily obtained for permanent installations.

Clips are used when eyes must be fabricated to wire rope in the field. Two types of clip are available for this purpose: U-bolt or Crosby clips and J-bolt or fist-grip clips. Only forged clips should be used. Correctly used, clips result in a connection efficiency of 80% (e.g., if the wire rope has a rated capacity of 4600 lbs. and clips are used to fabricate an eye, the rated capacity of the assembly would be 3680 lbs.).

It is important that clips be properly installed. Failure to do so could result in a reduction of rated capacity. U-bolt clips can be installed wrong. The clip saddle must be installed over the live end of the rope to prevent damage to the load-bearing component. J-bolt clips cannot be installed backwards. Always use the proper size clip and thimbles for the wire rope (Figure 5).

The procedure for installing wire rope clips is:

1. Refer to Table 1 for the number of clips, clip spacing and tightening torque.
2. Determine the length of rope required to turn back for

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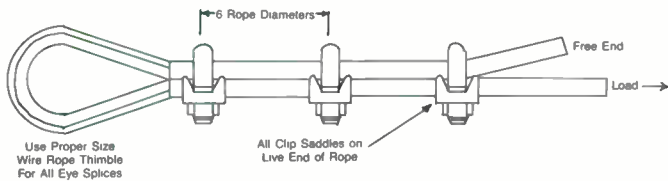


Figure 5. Wire Rope Clip Installation

- proper clip spacing and thimble size. Always use thimbles.
3. Attach the clip furthest from the loop, a distance from the end of the rope equal to the widest part of the clip. Tighten securely.
 4. Apply the second clip as close to the thimble as possible. Turn nuts on firmly, but do not tighten.
 5. Add the remaining clips between the first two at the spacing increments from Table 1. Turn nuts on firmly, but do not tighten.
 6. Apply a light stress on the rope to equalize the tension on all clips, re-position clips if required, then tighten all nuts to the specified torque.
 7. Load the cable and re-tighten all nuts to the specified torque setting. Do not over-tighten. This step is essential, as the wire rope will stretch slightly, reducing its diameter when loaded.
 8. Inspect periodically and re-tighten as necessary.

Note the final step—Inspect periodically and re-tighten as necessary. Failure to make terminations in accordance with the above instructions, or failure to periodically check and re-torque as recommended will result in a reduction in efficiency rating. This requirement makes swaged or zinc-cast eyes an attractive alternative for permanent installations.

Conclusion:

Safe sound system rigging is the application of known and simple engineering principles along with a healthy dose of common-sense and know-how to a relatively uncomplicated set of problems. There are no viable shortcuts in rigging equipment, tools and techniques—the potential losses resulting from property damage and personal injury following the failure of second-rate hardware or faulty rigging practices can be staggering. Safe sound system rigging is no accident.

The material presented in this Technical Note has been assembled from recognized engineering data and is intended for informational purposes only. None of the enclosed information should be used without first obtaining competent advice with respect to its applicability to a given circumstance. None of the information contained herein is intended as a representation or warranty on the part of JBL or *Sound & Communications Magazine*. Anyone making use of this information assumes all liability arising from such use.

Part two of this article will discuss slings, load angle efficiency, hardware, shackles and bolts.

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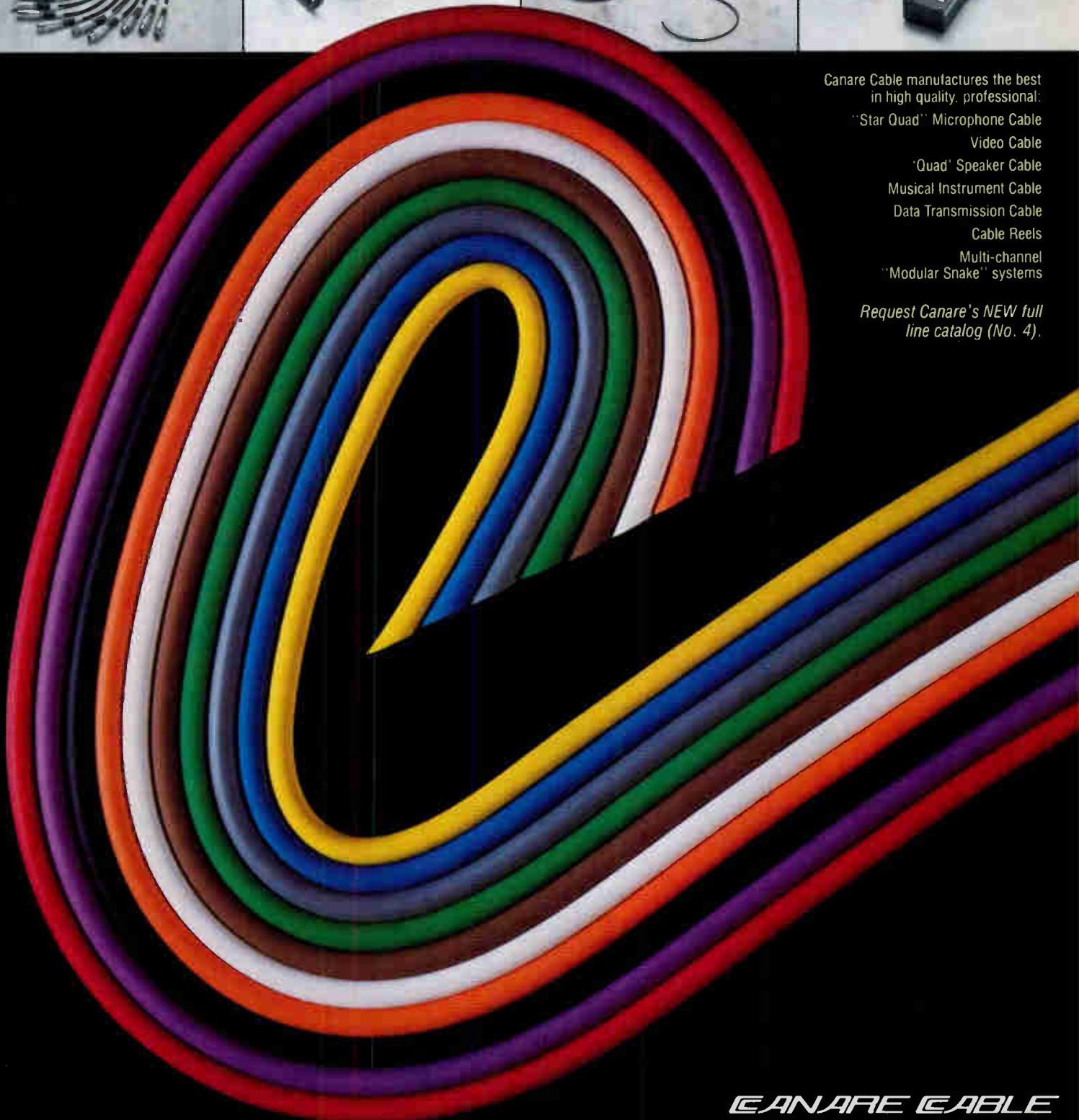
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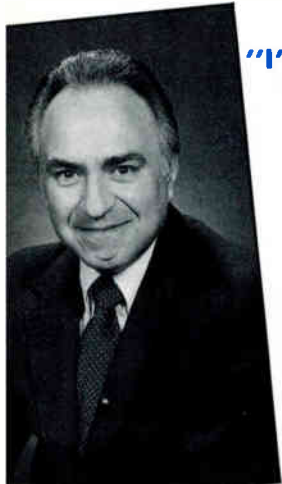
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WIRE &

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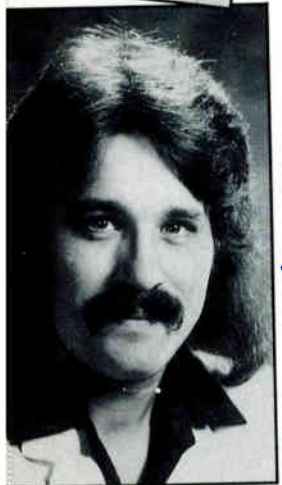
"I've called it the forgotten component, but it can't be forgotten anymore."

Louis Valente
West Penn Wire



"We're seeing requests for cable that is as flexible and pliable as possible, with durable and finer strands."

Bob Swanson
Great Northern
Wire & Cable



Permanent installations in theatres are becoming more elaborate with multicables of 1,000 watts or more. Contractors used to use whatever was lying around."

Larry Spalla
Conquest Sound

It used to be the only time you noticed wire was when you tripped over it. The attitude toward the cable market could have been described with any of three "I's": ignored, invisible or insignificant. Well the "I's" don't have it anymore.

Juice is flowing through wire and cable. As more applications for sound products become viable, there is more demand from contractors for better and different connecting equipment than ever before. The quality has gone up but so have prices, thanks to a rise in the cost of copper and other necessary elements. With the dollar signs stabilizing a bit, manufacturers hope growth can continue. As indicator of the industry's health, according to Mary Beth Rebedeau, member services manager of NSCA, is the increased number of exhibitors at the association's annual trade show. In '87, Rebedeau said, only six cable companies were on hand but 12 have already registered for this year's convention in Reno. Some manufacturers think a shake-out may be inevitable though, just as a few predict fallout from a possible economic downturn. But overall, Rebedeau said "cable people are starting to realize sound installation is a viable field to go after. It's a profitable, viable marketplace and never has so much attention been paid to it before."

"I've called it the forgotten component," said Louis Valente, sales manager for West Penn Wire, "but it can't be forgotten anymore. Today everybody is more conscious of wire, every building owner, designer, anybody who has an occupation in this field. We are, after all, living in the information age. There are completely new structures and retrofittings, data, communications, phone systems, sound and signals for fire alarms and security. A lot of packaging of wire is involved for all of that." Condominiums, co-ops and other housing for older people are providing a great deal of business in particular, Valente said, given

the graying of America.

While acknowledging a 123 percent rise in the price of copper during the past year, Valente sees a reverse trend coming although he's not sure when. "The economy as a whole seems very strong," he continued. "In talking to industry people, sound contractors, and electronic systems contractors, I find they are taking a lot of orders. There is particularly a lot of data communication wiring. Fiber optics is definitely something to reckon with for contractors; the main application is for closed circuit. You get the same advantages and benefits as you might from coaxial."

Unforgettable Cable

Valente listed two reasons for why cable is now unforgettable. "First, systems call for more careful selection of wire," the West Penner said. "The cable has to have the right capacities. You don't have the skimping you might have had a few years ago where somebody would slap an 18-gauge wire in when a 16-gauge one was really needed. The trend, overall, is to use 10- to 12-gauge wire. The other factor is code regulation and increase of enforcement, especially with fire alarms."

Bob Swanson, director of marketing for

"The awareness is really picking up that cable can make a difference in sound. The wire is there forever."

Noel M. Lee
Monster Cable



CABLE

Prince

Great Northern Wire & Cable, agreed with much of Valente's assessment. "Because UL specifications are more rigid, 30-volt applications have been upgraded to 300," Swanson said, "plenum cable, which is more expensive, is in greater use. Despite the copper situation, we're seeing a very good upsurge in demand."

More and more, the demand is for product that really stretches. "We're seeing requests for cable that is as flexible and pliable as possible, with durable and finer strands," Swanson explained. "There is also more call for miniature cables in high-rise applications because space saved is becoming important. I also think stocking fiber optic cable is becoming more of a must."

If 1987 was a harbinger, the remainder of this year holds big doings in store for Conquest Sound, according to vice president and co-owner Larry Spalla. "An internal audit shows we doubled the amount of our business in 1987 and we see it continuing to grow at least another 40 to 45 percent in '88," Spalla said. "That's only because we were out there hustling new accounts and it's a madhouse here. We outgrew our new plant and have to move into another one." Because of the burst of activity, Spalla



"I reluctantly use the phrase, but 'designer' cable has added a new dimension to the industry, bringing cable up from an unknown commodity."
Barry Brenner
Canare Cable

said Conquest can weather a stormy economy. "By not being stagnant, we're OK if some percentage of our business should slow down because we've got the other percentage that is going well."

Michael Laiacona, president of Whirlwind, attributes much of the growth in the wire and cable industry to consumer awareness. "This is the '80s—the audio and video era," said Laiacona. "People want good audio and video in their buildings, whether that be a restaurant, supermarket, convention center, etc., and the only way to get it is by wiring it in."

"People aren't concerned with what type of wire and cable is being installed," Laiacona continued. "The end result of what wire and cable does is what they're concerned with. And they want to be assured that they are quality products that will last 20 years from now."

Theatre Applications

One of the biggest applications for Conquest right now comes from theatres. "Permanent installations in theatres are becoming more elaborate with multi-cables of 1,000 watts or more," Spalla said. "Contractors used to use whatever was lying around." The co-owner/VP also sees big things from MIDI. "Two years ago, nobody ever heard of it," Spalla said. "Now there's a million feet of it a year just for MIDI." Applications in this area are still largely confined to MI, but Spalla believes it may not take too long for MIDI to make an impact in sound reinforcement. "It's just developing so fast," he said.

Noel Lee, president of Monster Cable, said business has steadily increased at his company thanks to a certain cognizant that has reached the market in recent years. "The awareness is really picking up," Lee said, "that cable can make a difference in sound. The wire is there forever."

One experience, however, proves forever doesn't necessarily mean a life time.

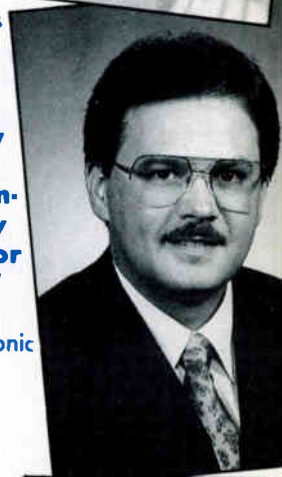
"We sell a lot of connectors, particularly in security. They go anywhere; it's a really a bottomless pit."

Leonard Marshall
Marshall Electronics



"You've always got to keep an eye out for developing fields. You look at new construction, retrofitting, commercial industry and you hope for strong growth."

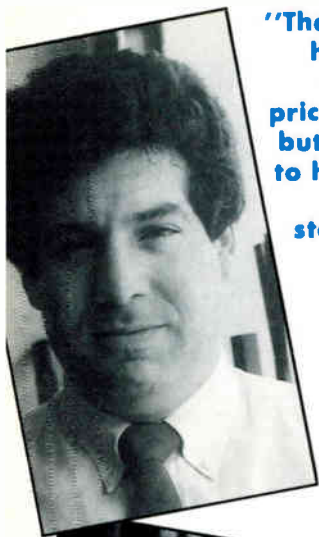
Karl Rankin
Consolidated Electronic
Wire & Cable



"There's a lot going on with computers in the area of data transmission. As electronics becomes more digital, the wire should have a more simple design."

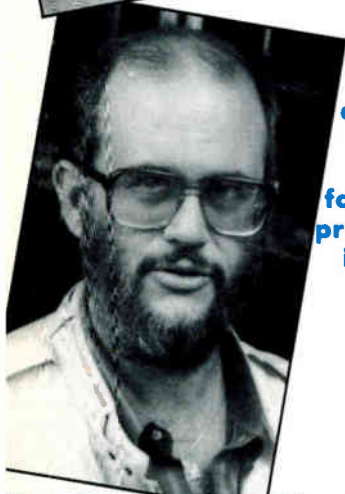
Ron Stier
Belden Wire & Cable





"The copper surge has completely destroyed our price structure . . . but copper seems to have stabilized and I hope it stays that way."

Benjamin Nemser
Nema Electronics



"There's no more cost effective way to improve system performance than proper grounding and high-performance cabling."

Charlie Wicks
Pro Co Sound



"We've seen our gross sales go up 10 percent but our profits go down. There's stiffer competition all around us."

Sidney Grant
Tappen Wire & Cable

Lee reported that Walt Disney Studios pulled out old cable and installed Monstors in its place. "They were revamping and felt an urgency to start over with ours." The future, said the president, is in high clarity and performance product. "For 50 years, it was a matter of using ordinary wire and paying more attention to durability, fire ratings and flexibility," he explained. "Only in the last year and a half has all of that really been joined by the concern for cable that will give you higher clarity at low level audio signals."

Canare Cable has added color to the market—literally. General manager Barry Brenner noted that his company has introduced 10 shades of wire. "I reluctantly use the phrase, but 'designer' cable has added a new dimension to the industry, bringing cable up from an unknown commodity," Brenner said. "Aside from aesthetics, it's more easily identifiable and noise-cancelling. They are used extensively for microphones and multi-channel systems."

Sales were up 21 percent in 1987 for Canare and figures for the first half of fiscal '88 show an increase of over 45 percent. Brenner thinks specialization is the key to success in wire. "Everybody can't cater to the same markets," he said. "For example, we're not heavily into construction. We're a vertical cable company involved in entertainment and communications. Competition is good. Choice belongs in the marketplace."

By putting an ear to the ground, Marshall Electronics has heard what's important in today's consumer society: sound. "Audio is the healthiest part of our business," said vice president and general manager Leonard Marshall. "We can't keep up with it. Even if video is down, you're going to have plenty of construction on new projects, new auditoriums and concert halls or at least revisions. The consumer attending shows has a more critical ear than ever. That person is accustomed to listening to CDs and better recordings. The ear is trained so that if the sound isn't good, that person doesn't want to go back to that place. It takes a lot of good wires for the sound to flow that well. Good designers know state-of-the-art sound is serious."

MIDI's Impact

MIDI has been "just crazy," according to Marshall. Like Spalla of Conquest, he believes its impact in sound installation is only beginning to be felt. The vice president/general manager also pointed to the stability of a commodity known as connectors. "We sell a lot of them, particularly in security," Marshall said. "They go anywhere; it's really a bottomless pit." Overall, higher quality seems to be the wire watchword for Marshall. "There's no question about it," he said. "You don't take \$3,000 and \$4,000 amps and hook them up with thin gauge wire. That ruins the initial plans."

Consolidated Electronic Wire & Cable has fended off the rising price tide well, said Karl Rankin, vice president of sales. "We find demand very strong," Rankin said. "Copper prices have been volatile and they have gone up and drastically so,

but they do seem to have leveled off. We've also had to cope with increases in other products necessary to make our products. Of course sales are up 20 percent over the same period last year so people are willing to pay."

A hot spot for action is in controlled communications broadcasting such as closed circuit TV, Rankin said, and this has helped propel the use of plenum cable. "You didn't see much of it five or 10 years ago, but now you have a lot more options," the VP of sales noted. "In a questionable economic period," Rankin continued, "You've always got to keep an eye out for developing fields. We have to watch out for that," he advised. "You look at new construction, retrofitting, commercial industry and you hope for strong growth."

Belden Wire & Cable is finding a growing market among the bits and the bytes. "There's a lot going on with computers in the area of data transmission," said Ron Stier, marketing director. "As electronics becomes more digital, the wire should have a more simple design." Appearance is another concern. "The biggest change we see is on stage," Stier said. "People want microphones with cable that look really good. The trend is from the glossy type cable you see used in industrial situations to something smooth with a nice dull appearance that you can print the company name on. Smooth and extremely well done."

Diversification

Diversification of applications has helped Nema Electronics. President Benjamin Nemser says his company is involved with hookups for relays, speakers, microphones, alarms, telephones and computers. "We've been pursuing the business a little more," he said. "We use direct mail for video and audio. If there's a slow-down, it means we just have to work harder. We don't depend on just a few major contractors. If one's business is slow, somebody else's isn't."

The copper surge has had its effect on Nema. "It has completely destroyed our price structure," Nema said. "We have to quote on a daily basis which makes buying a lot harder. Certainly it's meant a major upheaval. But copper seems to have stabilized and I hope it stays that way."

Gerald Krulewicz, one of the principals at Wireworks, said his company is benefitting from the number of permanent installations that are in demand. "You've got facilities going up now that look for capabilities like having a video truck pull in and being able to broadcast

right there," Krulewicz explained. "The major thrust is flexibility. It's not simply a matter of having a self-contained structure. You want that additional capability, whether its for a theatre or a broadcasting studio. You'll have call then for more mike lines and speaker lines. Multi-use means you need flexibility in the cable area."

The needs of the industry have led to better product, according to Krulewicz. "Designers and sound consultants are specifying systems very carefully," he said. "They're very conscious, particularly in broadcast applications of certain considerations, such as how the cable is run and routed through the building. All these things come into play. You want to be able to send very high quality signals."

Signal Cable's John Pappas, director of marketing resources, said his company's wire has few limitations and fits virtually all applications. "There's an increasing mix of standard electronics and plenum cable," Pappas said. He added Signal has developed "state-of-the-art" plenum product that has enjoyed great use in the security field. "That's something the market has dictated," Pappas noted.

Common Sense Approach

It's a matter of basics to Pro Co Sound. President Charlie Wicks takes a common sense approach to the wire market. "Our most in-demand product is our technology," Wicks said. "The emphasis on quality to value of product has never been higher and it will continue to rise

"Designers and sound consultants are specifying systems very carefully. . . such as how the cable is run and routed through a building."

Gerald Krulewicz
Wireworks

as Americans tire of shoddy workmanship and poor quality. There's no more cost effective way to improve system performance than proper grounding and high-performance cabling."

Wicks is not terribly concerned about the threat of a recession on Pro Co's business. "Since Pro Co only provides

up-scale products, our markets have remained strong and growing year after year." Jeff Garstick, vice president of sales of the commercial division added that even if construction levels off, that situation is offset by the need for system updates and rehabs.

One industry figure not that optimistic about the next year or so is Tappan Wire & Cable president Sidney Grant. He reported a decline in business for the last two quarters and the only upturn he anticipates will result from the NSCA show because of the "hard sell" that traditionally takes place there. "We've seen our gross sales go up 10 percent but our profits go down," Grant said. "There's stiffer competition all around us." He attributes some of the problems to copper prices and the proliferation of offshore product. "Some companies have faded and others are shaky," Grant said. "If you're asking me if I have any reason for good, solid optimism, I would have to say 'no'."

One would have to say yes, though, to the notion that the wire and cable market has crept from anonymity to vitality. As any contractor or designer would be likely to tell you, you can step over it, but you certainly can't miss it. ■

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FAITH COMES BY
HEARING

Circle 233 on Reader Response Card

Consultants and Contractors Criteria for Choosing Power Amps

by John Parris Frantz

John Parris Frantz is a public relations and trade magazine/writer specializing in audio and video in Chicago. He has written for *Testa Communications* for 10 years and is the president and owner of *JPF Associates* for 11 years.

Sound & Communications Magazine surveyed consultants and contractors on the present state of the power amp market and found a good bill of health. Many had recommendations, but few logged complaints concerning the quality and availability of key power amplifier features. While there's literally over a hundred power amplifier manufacturers on the market, today's sound

consultants and contractors specify and use only a handful of designs. The survey revealed that most contractors or consultants use three to eight brands on sound installations.

With such a large array of amplifiers, the selection process can be tedious especially with the degree of difficulty in interpreting and comparing the diversity of manufacturer claims. Claims include "better power dissipation," "better cooling and temperature gradient management," "greater operating efficiency," and other such bells and whistles that manufacturers use to make their product stand out more.

"There's a lot of 100-watt amplifiers that do what they're supposed to, and you can't tell the difference between 10 or 20 of them," said one consultant. Other people disagree and claim there is a difference especially in sonic quality. Bench tests and subjective sonic quality analysis have limited the selection of power amps to three brands at Foster Sound Inc., Wheeling, Illinois.

"There's too many (power amplifiers) out there trying to chase too few bucks," said one contractor/consultant. "I don't have to tell these people they're going to go belly up, because a lot of them know it. They think quality will rule out and that quality has no fear of time."

Neil A. Shaw, senior associate at Paul S. Veneklasen & Associates, Santa Monica, California, said only two power amps on the market today fit his strict specifications ". . . and I try to avoid the second one," he added.

One reason few power amplifiers fit the bill for Veneklasen work is a stringent list of specifications required by Shaw that manufacturers must meet or be overlooked.

"We like a general input impedance of around 100 k ohms, an output source impedance of a 1/2-ohm maximum, and a gain constancy of .05 dB over the entire range of operating level and over the AC supply variation of 100 to 130V (in other words I don't want the gain to change as a function of the line)," Shaw said. "Frequency response should roll off below and above the pass band. This way when gremlins should get in there, we're not wasting the amplifier on power outside the bandwidth of interest. For example, if we had an 80 kHz oscillation, I want the amplifier to basically not amplify 80 kHz and hog the power. I want it to be impossible for the output to latch at B+ B- for longer than 1/10-th of a second or for B+ or B- to fail independently. The amplifier should be protected against any passive loading into output including short circuits with any input signal up to 60V DC or AC applied."

Others are very permissive on power amp specifications. "We may mention a particular product, but usually say, 'or equal to,' and then list some of the eight brands we deal with," said David L. Klepper, president of Klepper, Marshall, King in White Plains, New York.

Jim Brown, Audio Systems Group Inc., Chicago, Illinois, is somewhat more critical. He delivers one recommendation on bids, but does offer his approval on equipment requested by owners or contractors. Among the pitfalls Brown avoids when writing a specification are restrictions that limit the selection of good sound contractors for the client. "If it's a closed market where the client has to use a contractor that happens to be franchised for a specific line and no other choice is offered, he may not end up with a good contractor," Brown said.

But generally, power amps are the least of contractors and consultants problems today. Many contractors agree that reliability has improved due to output transistor and circuitry design improvements in the last 10 years. Loudspeakers, microphones, and signal processing equipment concern consul-

ants and contractors more than power amplifiers today. Power amplifiers are relatively never the cause of system breakdowns. "We feel power amplifiers are the least troublesome aspect of the audio chain," said Klepper. Although he does specify particular items such as dummy-resistance to protect the power amp from short circuited outputs.

An equally critical factor, in Brown's estimation, is power requirements and the relationship to turn-on characteristics. "What happens if power to the sound system is lost and tens of power amplifiers are started simultaneously?" Brown questioned. "A good alternative is to randomize the turn on times or delays."

Compactness—an '80s Concern

As real estate prices escalate, building owners are increasingly requesting compactness in sound system design. While most consultants are satisfied with power amps today, compactness without the necessity of fans is becoming a popular request. In long-term reliability factors, clogged up fan filters have been the cause of many thermal shut-downs of otherwise perfectly operating power amplifiers. Convection cooling eliminates such possible problems while reducing ambient noise levels.

Rollins Brook, president of RB Systems, Tarzana, California, uses criteria for power amp selection that often includes a built-in crossover or facility for plugging in a crossover module so time delays can be used if necessary. Also, for many applications Brook prefers detented gain controls mounted on the amplifier's back panel for accuracy in resetting levels. At Jaffe Acoustics, Norwalk, Connecticut, standard input sensitivities in the 1.1 V range are looked for in amp design. Different input sensitivities pose a problem when the gain structure is set on a system, according to Chuck McGregor, senior consultant. This integration of more than just power amplification in one package also helps in the reduction of the size of an audio amplifier.

Audio Performance

While most people agree distortion characteristics have improved greatly with amp design, low harmonic and intermodulation distortion under 0.2 percent was a common request. Brown also looks for power output capabilities, input overload, signal-to-noise and distortion when specifying power amps. Because the application is the determining factor, Brown has no regimented statistics for specifications.

"There are jobs where a package amplifier with a signal-to-noise ratio of 80 or 90dB is fine, because it's a paging system," Brown explained. "But there are other situations where I wouldn't use a signal-to-noise of less than 120 dB because it's a concert hall. It has to be able to sustain rock music levels and be quiet when they're playing Rachmaninoff." Echoing Brown's demands is Brook, who is equally concerned with fan noise and prefers convection cooling versus fan-cooled amps.

Data sheets and accurate measurements are important to all sound specialists, but many times what's not on the specification sheet is more important than what is listed. For example, few manufacturers list heat load and efficiency on specification sheets. A single power amp poses no problem, but when as many as 100 units are operating in one room, heat and ventilation become important statistics.

Jaffe Acoustics prefers amps that have some kind of indication of signal presence. This feature is especially important when a number of amps are combined. With signal

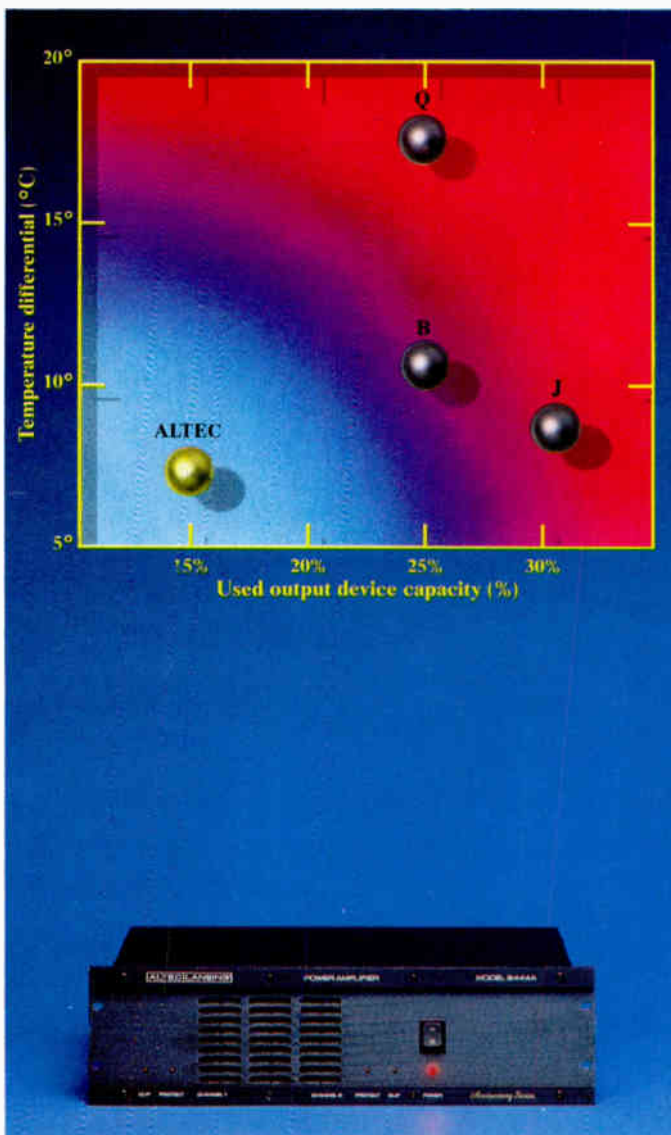
(continued on page 66)

In power amplifiers, less heat equals longer life. It is also correct to conclude that the reliability of a power amplifier often comes down to the reliability of its output devices. At Altec Lansing we compiled a detailed study of these devices in terms of their sturdiness and thermal behavior. We found that two criteria appear to have been ignored in the past.

First, we know that output semiconductors must work together in order to produce accurate, distortion-free power. Therefore, any environmental variation among them varies the stress placed on each device. This poses the possibility that some devices will perform differently, and that those under greater operating stress are more likely to fail.

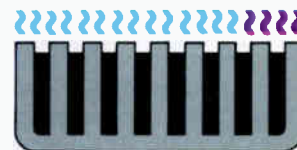
Altec Lansing engineers sought to reduce the variation in operating temperature from one output semiconductor to the next. We designed an asymmetrical heatsink that helps compensate for temperature differences between the transistor closest to the cooling fan and the one farthest away. This reduction in the temperature gradient evenly distributes the thermal stress placed on the devices. Our advanced heatsink has been incorporated into the design of the new Altec Lansing model 9444A power amplifier.

By means of this heatsink, a temperature differential of only 7.4° C is achieved, which is lower than that of any of the other popular, quality, fan-cooled power amplifiers tested. The vertical axis of the graph shows the results. The greater this temperature mismatch, the greater the amplifier



designer's failure to reduce the thermal stress differential among output devices.

The second often overlooked consideration we studied at Altec Lansing is what our engineers call dissipation headroom. This is the percentage of the rated power dissipation of the output semiconductors which is actually used at the rated amplifier output.



Reducing the temperature gradient distributes thermal stress more evenly.

The Altec Lansing 9444A uses sixteen output devices, each rated at 250 W. This means the total rated power dissipation at the output stage is 4 kW, of which 600 W is used as audio output. Thus, only 15% of the rated power dissipation is used, leaving 8.2 dB of dissipation headroom. This is significantly more than was found in other amplifiers, as shown.

What is the benefit of thermal uniformity and dissipation headroom? Our semiconductor manufacturer applied their mean time between failure (MTBF) criteria to these factors. All other factors assumed equal, they computed the output devices in the Altec Lansing 9444A to have a normalized lifetime 18.15 times longer than amplifiers without these provisions. Attention to these details means longer life in service, a vital criterion for sound systems designed by audio contractors and consultants.

Fact.

In Power Amplifiers, Less Heat = Longer Life



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Circle 223 on Reader Response Card

POWER AMPLIFIERS

With such a large array of power amplifiers on the market, it becomes difficult to select the right one for the job at hand. *Sound & Communications* reviewed the many available types and has published its findings in this special, comprehensive pull-out section.

This guide is not intended to be an all inclusive or decisive source. It is, however, intended to be used as a guide in selecting an appropriate group from which a final decision can be made. Also, for your convenience, an alphabetical listing of companies, addresses and phone numbers are located on page 40 of the pull-out section. After using this guide, the manufacturers' specification sheets should be reviewed, and if appropriate should be tested and/or auditioned.

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

POWER AMPLIFIERS

POWER AMPLIFIERS

Model No.	Output @ 4 & 8 ohms	Stereo, Mono, Biamp or Triamp	Input Connector	Output Connector	Weight	Size	List Price
AB INTERNATIONAL, ELECTRONICS							
713	750W/500W	Tri-amp	XLR/1/4" Phone	Dual 5 Way	48	5.25" x 19" x 14"	\$1,749.00
712	750W/500W	Bi-amp	XLR/1/4" Phone	Dual 5 Way	46	5.25" x 19" x 14"	1,449.00
524	325W/200W	Dual Bi	1/4" Phone	Dual 5 Way	40	5.25" x 19" x 14"	1,449.00
644	325W/200W	4 ch.	1/4" Phone	Dual 5 Way	40	5.25" x 19" x 14"	1,329.00
821	1500W/1000W	M	XLR/1/4" Phone	Dual 5 Way	45	5.25" x 19" x 14"	1,329.00
1100A	775W/525W	S	XLR/1/4" Phone	Dual 5 Way	40	5.25" x 19" x 14"	1,099.00
421	750W/500W	M	XLR/1/4" Phone	Dual 5 Way	33	5.25" x 19" x 14"	969.00
900A	525W/325W	S	XLR/1/4" Phone	Dual 5 Way	35	5.25" x 19" x 14"	919.00
600A	325W/200W	S	1/4" Phone	Dual 5 Way	33	5.25" x 19" x 14"	689.00
221	150W	M	XLR/1/4" Phone	Dual 5 Way	20	1.75" x 19" x 14"	619.00
222	75W/50W	S	XLR/1/4" Phone	Dual 5 Way	20	1.75" x 19" x 14"	619.00
400	175W/125W	S	1/4" Phone	Dual 5 Way	29	5.25" x 19" x 14"	499.00
AMR (AUDIO MEDIA RESEARCH)							
PMA 200	100W/100W	Stereo	1/4"	Binding Posts	29	5.25" x 19" x 12"	\$399.50
PMA70+	35W/35W	Stereo	1/4"	Push Terminals	10	5.25" x 7" x 9"	179.50
ATI							
MA1000	10W @8	SM	Barrier Strip	Barrier Strip	4	8.5" x 1.75" x 7"	\$385.00
ALTEC LANSING							
1590E	200W @4	1-Channel	NA	NA	41	10.5" x 19" x 8.75"	\$1,612.00
1594C	100W @8	1-Channel	NA	NA	35	7" x 19" x 8.5"	1,236.00
1593C	50W @8	1-Channel	NA	NA	23	5.25" x 19" x 7.38"	1,056.00
1270C	400W/220W	2-Channel	XLR/PIN/Barrier Strip	5-way Binding Post	52	3.25" x 19" x 15.75"	1,164.00
1269	200W/120W	2-Channel	Female/Cannon	5-way Binding Post/Phone	31	3.25" x 19" x 14.75"	1,100.00
1268	100W/60W	2-Channel	Female/Cannon	5-way Binding Post/Phone	27	3.25" x 19" x 10"	900.00
9444A	300W/200W	2-Channel	Barrier Strip/XLR/VDC	Barrier Strip	39	5.25" x 19" x 12.75"	900.00
ASHLY AUDIO							
FET 500	500W/300W	Stereo	XLR/Phone	5-way	60	5.25" x 19" x 16"	\$995.00
FET 200	120W/200W	Stereo	XLR/Phone	5-way	37	3.5" x 19" x 16"	599.00
AUDIO CENTRON/ST. LOUIS MUSIC							
RMA2000	1.3kW/800W	Stereo	XLR + Phono	Phono	75	5.25" x 19" x 15"	\$1,275.00
RMA1000	440W/300W	Stereo	XLR + Phono	Phono	42	2.5" x 19" x 15"	600.00
RMA300G	300W	Mono	Phono	Phono	40	2.5" x 19" x 15"	475.00
RMA300	200W/125W	M	.25"/XLR	Binding Post/.25"	NA	3.5" x 19" x 13"	400.00
RMA250	125W/250W	Stereo	Phono	Phono	40	2.5" x 19" x 15"	400.00
BGW SYSTEMS							
BGWSPA-3	400W/250W	Tri-amp	XLR/1/4"	5-way	43	5.25" x 19" x 13.1"	\$2,499.00
BGWSPA-1	1200W/800W	Sub Bass	XLR/1/4"	5-way	41	5.25" x 19" x 13.7"	1,949.00
BGWGTA	600W/350W	Stereo	XLR/1/4"	5-way	72	5.25" x 19"	1,799.00
BGWGTB	400W/275W	S	XLR/1/4"	5-way	50	5.25" x 19" x 13"	1,399.00
BGW750E	400W/250W	Stereo	XLR/1/4"	5-way	50	7" x 19" x 13"	1,699.00
BGW750D	400W/250W	Stereo	XLR/1/4"	5-way	50	7" x 19" x 13"	1,499.00
BGW620B	200W	Stereo	1/4"/Barrier	Barrier	58	8.75" x 19" x 11.75"	1,329.00
BGW250E	150W/100W	Stereo	XLR/1/4"	5-way	33	5.5" x 19" x 11.75"	1,099.00
BGW7500	250W/200W	Stereo	1/4"	5-way	36	5.25" x 19" x 13"	999.00
BGW250D	150W/100W	Stereo	XLR/1/4"	5-way	33	5.5" x 19" x 11.75"	999.00
BGW320B	100W	Stereo	1/4"/Barrier	Barrier	39	5.25" x 19" x 11.75"	979.00
BGW2242	Dist. Amp.	Stereo	Barrier	Barrier	11.5	1.75" x 19" x 11"	799.00
BGW150	75W/50W	Stereo	XLR/1/4"	5-way	18	1.75" x 19" x 11.75"	799.00

Model No.	Output @ 4 & 8 ohms	Stereo, Mono, Biamp or Triamp	Input Connector	Output Connector	Weight	Size	List Price
BGW7500T	250W/200W	Stereo	Barrier	Barrier	36	5.25" x 19" x 13"	699.00
BGW6500	130W/100W	Stereo	1/4"	5-way	25	3.5" x 19" x 12"	649.00
BGW85	45W/35W	Stereo	1/4"	Barrier	14	1.75" x 19" x 11.5"	519.00
BGW2125	100W	Mono	1/4"/Barrier	Barrier	31	3.5" x 19" x 12"	489.00
BIAMP SYSTEMS							
XA1000	500W/300W	SM	25"/XLR	5-way Binding Post	35	5.25" x 19" x 12"	\$1,199.00
XA600	300W/200W	SM	25"/XLR	5-way Binding Post	24	3.5" x 19" x 5.5"	849.00
XA300	150W/100W	SM	25"/XLR	5-way Binding Post	21	3.5" x 19" x 15.5"	649.00
XA100	50W/35W	SM	XLR/.25"/Barrier Strip	5-way Binding Post	13.5	1.75" x 19" x 11.75"	499.00
T1000	480W/310W	SM	XLR/.25"/Barrier Strip	Binding Post	48	7" x 19" x 14"	1,599.00
T500	240W/150W	SM	XLR/.25"/Barrier Strip	Binding Post	35	5.25" x 19" x 10"	1,199.00
BOGEN							
HTA250A	25V/70V	M	Phono/Hii Z /Terminal	Screw Terminal	56	19" x 11" x 5.25"	\$1,480.75
BPA60	8/16/25V/70V	M	Phono/Hii Z /Terminal	Screw Terminal	19	15.25" x 8" x 3.5"	683.15
HTA125A	25V/70V	M	Phono/Lo Z Bal/Terminal	Screw Terminal	41	19" x 11" x 5.25"	905.75
BOULDER AMPLIFIERS							
500	150/250	Stereo	XLR	5-Way	51	17.25" x 7" x 15.5"	\$2,875.00
BRYSTON VERMONT							
6B	800W/500W	M	XLR	5-way Binding Post	55	19" x 5.75" x 11"	\$1,700.00
4B	400W/250W	S	XLR	5-way Binding Post	55	19" x 5.75" x 11"	1,600.00
3B	200W/100W	S	XLR/.25"	5-way Binding Post	38	19" x 5.75" x 9"	1,075.00
2BLP	100W/50W	S	XLR/.25"	5-way Binding Post	20	19" x 1.75" x 10"	650.00
CARVER							
PM 2.0t	600W/465W	SM	XLR/TRS	XLR/TRS	10.7	3.5" x 19" x 12.25"	1,660.00
PM 1.5	600W/450W	SM	XLR/TRS	XLR/TRS	21	3.5" x 19" x 10.813"	1,160.00
PM 350	350W/450W	SM	XLR/TRS	XLR/TRS	21	3.5" x 19" x 11.5"	940.00
PM 175	175W/250W	SM	XLR/TRS	XLR/TRS	19	3.5" x 19" x 11.5"	720.00
All amps have 70V Direct Drive capability							
CARVIN							
FET2000	800W/1.6kW	Stereo	1/4"/XLR	1/4"/5-way	55	5.25" x 19" x 13"	\$995.00
FET900	400W/600W	Stereo	1/4"/XLR	1/4"/5-way	35	5.25" x 19" x 10"	599.00
FET400	200W/400W	Stereo	1/4"/XLR	1/4"/5-way	28	5.25" x 19" x 10"	449.00
DCM301	160W/100W	Mono	XLR/Phono	Phone/Posts	35	5.25" x 19" x 12"	359.00
CETEC IVIE							
5825	75W/50W	S	Terminal Strip	Terminal Strip	9.8	8.5" x 4.2" x 1.7"	\$695.00
5807B	140W/100W	M	Terminal Strip	Terminal Strip	9.8	8.5" x 4.2" x 1.7"	620.00
5807A	140W/100W	M	Terminal Strip	Terminal Strip	9.8	8.5" x 4.2" x 1.7"	613.00
5805A	140W/100W	M	Terminal Strip	Terminal Strip	9.8	8.5" x 4.2" x 1.7"	550.00
5808	140W/100W	M	Terminal Strip	Terminal Strip	9.8	8.5" x 4.2" x 1.7"	410.00
5806	140W/100W	M	Terminal Strip	Terminal Strip	9.8	8.5" x 4.2" x 1.7"	385.00
CETEC RAYMER							
1811	100W	M	Screw Terminal/RCA	Screw Terminal	27	16.625" x 12.625" x 4"	290.00

Model No. Output @ 4 & 8 ohms Stereo, Mono, Biamp or Triamp Input Connector Output Connector Weight Size List Price

CREST AUDIO

1001A	55W/85W	SM	XLR, 1/4", Barrier	Binding Post	17	1.75" x 19" x 10.5"	\$679.00
1501A	90W/150W	SM	XLR, 1/4", Barrier	Binding Post	17	1.75" x 19" x 10.5"	839.00
2001A	155W/250W	SM	XLR, 1/4"	Binding Post	32	3.5" x 19" x 13"	1,059.00
2501A	225W/360W	SM	XLR, 1/4"	Binding Post	38	3.5" x 19" x 13"	1,279.00
3000	260W/475W	SM	XLR, 1/4", Barrier	Binding Post, Barrier	46	5.25" x 19" x 11.5"	1,789.00
3001	260W/475W	SM	XLR, 1/4", Barrier	Binding Post, Barrier	46	5.25" x 19" x 11.5"	1,589.00
4000	340W/600W	SM	XLR, 1/4", Barrier	Binding Post, Barrier	58	5.25" x 19" x 13"	2,279.00
4001	340W/600W	SM	XLR, 1/4", Barrier	Binding Post, Barrier	58	5.25" x 19" x 13"	2,079.00
8001	750W/1200W	SM	XLR	Binding Post, Barrier	80	5.25" x 19" x 13"	2,799.00
Powerline 600	325W/235W	Stereo	XLR/1/4" Phone	5-way Binding	43	3.5" x 19" x 16"	1,199.00
Micro Tech 1200	465W/320W	Stereo	1/4" Phone	5-way Binding	45	3.5" x 19" x 16"	1,199.00
Power Base 2	320W/320W	Stereo	1/4" Phone	5-way Binding	36	3.5" x 19" x 16"	1,049.00
DC-300A II	295W/175W	Stereo	1/4" Phone	5-way Binding	45	7" x 19" x 9.7"	1,049.00
Micro Tech 600	325W/235W	Stereo	1/4" Phone	5-way Binding	41	3.5" x 19" x 16"	949.00
Power Base 1200W	1200W/200W	Stereo	1/4" Phone	5-way Binding	34	3.5" x 19" x 16"	769.00
D-150A SII	150W/95W	Stereo	1/4" Phone	5-way Binding	27	5.2" x 19" x 8.7"	749.00
D-75	45W/35W	Stereo	XLR/1/4" Phone	5-way Binding	13	1.7" x 19" x 9"	524.00

DAX

A-100	120W/80W	S	XLR, .25"/RCA	.25" Phono/5-way	19	19" x 3.5" x 11"	\$599.00
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DUKANE

1A3250	250W @8	N/A	Terminal	Screw Terminal	44	5.25" x 19" x 15"	\$1,300.00
1A3125	125W @8	N/A	Terminal	Screw Terminal	22	5.25" x 19" x 6.625"	665.00
Battery backup on B-version							
1A3060	60W @8	N/A	Terminal	Screw Terminal	16	5.25" x 19" x 6.25"	538.00

ELECTRO-VOICE

E-V 7300	300W/200W	Stereo	XLR/Phono	Binding Post	39	5.25" x 19" x 12.75"	\$958.00
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FM ACOUSTICS

FM801	750W/420W	S	XLR	4-way Binding Post Banana plug socket	63.8	482 x 177 x 360mm	\$8,620.00
FM1000	750W/450W	M	XLR	4-way Binding Post Banana plug socket	63.8	482 x 177 x 360mm	6,880.00
FM300A	150W/100W	S	XLR/RCA	4-way Binding Post	26.4	482 x 82 x 300mm	2,740.00

FENDER

2235	2 x 350W	Stereo	Phono	5-way Binding Post	47	5.25" x 19" x 13"	\$749.99
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HACOUSTIC USA

AP1120	120W @8	M	XLR/DIN	BS/SPG	26.9	5.2" x 17.3" x 12.8"	\$944.55
AP1075	75W @8	M	XLR/DIN	BS/SPG	20.5	5.2" x 17.3" x 12.8"	793.90

POWER AMPLIFIERS

Model No.	Output @ 4 & 8 ohms	Stereo, Mono, Biamp or Triamp	Input Connector	Output Connector	Weight	Size	List Price
HILL AUDIO							
DX3000	900W/550W	SM	XLR/1/4"	Binding Post & Banana	90	5.25" x 19" x 18"	\$2,999.00
DX2000	650W/400W	SM	XLR/1/4"	Binding Post & Banana	75	5.25" x 19" x 18"	2,750.00
DX1000A	800W/500W	SM	XLR/1/4"	Binding Post & Banana	65	5.25" x 19" x 12"	2,450.00
DX1500	500W/300W	SM	XLR/1/4"	Binding Post & Banana	35	3.5" x 19" x 13"	1,449.00
DX800	400W/250W	SM	XLR/1/4"	Binding Post & Banana	30	3.5" x 19" x 13"	1,199.00
DX300	-/200W	S	XLR/1/4"	Strip/Banana	16	3.5" x 19" x 9"	899.00
HME							
PA120	100W/60W	SPM	1/4" phone	Push type	13	3.5" x 19" x 8.75"	\$476.00
DAVID HAFLER							
P500	400W/255W	M	.25"/Screw Terminal/XLR	5-way Binding Post	53	7" x 19" x 13"	\$1,095.0
P505	400W/255W	SM	.25"	5-way Binding Post	48	19" x 7.25" x 13.5"	995.00
P230	175W/115W	SM	.25"	5-way Binding Post	28	5.25" x 19" x 10.5"	560.00
P125	75W/62W	SM	.25"	5-way Binding Post	22	3.5" x 19" x 9"	450.00
ED							
6208	200W	Mono	terminals	5-Way	2.38	(card in mainframe)	\$783.00
INDUSTRIAL RESEARCH PRODUCTS							
DH4020	100W	S	Barrier Strip or XLR	Barrier Strip or XLR	13.5	1.75" x 19" x 14"	\$1,012.00
JBL/UREI							
6290	2KW/1.4KW	Stereo/Mono	XLR/1/4" Barrier	Dual 5 Way	63	7" x 19" x 14"	\$1,299.00
6260	180W/600W	Stereo/Mono	XLR/1/4" Barrier	Binding Post	44.5	7" x 19" x 11"	870.00
6230	720W/420W	Stereo/Mono	XLR/1/4" Barrier	Binding Post	26.25	5.25" x 19" x 11"	618.00
6215	225W/180W	Stereo/Mono	XLR/1/4" Barrier	Binding Post	10.5	1.75" x 19" x 9"	576.00
6211	40W @ 8	M	XLR/1/4"	Timed Wire Leads	6.5	8" x 8 1/2" x 2.75"	312.00
6210	40W @ 8	M	XLR/1/4"	Timed Wire Leads	6.5	8" x 8 1/2" x 2.75"	279.00
JENSEN TRANSFORMERS							
500	150W/250W	Stereo	XLR	5-way	51	17.25" x 7" x 15.5"	N/A
MCGOHAN ELECTRONICS							
MS1001	100W @ 8	M	Phono	Screw Terminal	31	17" x 11.5" x 6"	\$602.50
MS501	50W @ 8	M	Phono	Screw Terminal	30	17" x 11.5" x 6"	551.50
MS351	35W @ 8	M	Phono	Screw Terminal	11	8.5" x 9" x 3.625"	361.50
MS201	20W @ 8	M	Phono	Screw Terminal	9	8.5" x 9" x 3.625"	240.50
MS101	10W @ 8	M	Phono	Screw Terminal	9	8.5" x 9" x 3.625"	218.50
DEAN MARKLEY ELECTRONICS							
RM-100MT	100W @8	M	XLR	XLR	30	-	\$599.00
All Tube power amp							
MEYER SOUND LABORATORIES							
MS 1000	1200W @4	Stereo	XLR	5-way	69	19" x 5.25" x 16"	\$2,175.00
NUMARK ELECTRONICS							
SA2200	375W/225W	S	Parallel .25"/RCA	Universal Binding Post	32	19" x 5.25" x 12"	\$899.95
PASO/NIKKO							
Alpha 650	350W @8	Stereo	XLR/Phono/Banana	Phono	60.5	7.25" x 19" x 18.33"	\$1,499.00
Alpha 450	220W @8	Stereo	Phono	Phono	47.5	7.25" x 19" x 18.33"	899.00
Alpha 230	120W @8	Stereo	Phono	Phono	29.5	5.33" x 19" x 13.5"	499.00
Alpha 130	100W @8	Stereo	Phono	Phono	26.5	5.33" x 19" x 13.5"	379.00

Model No. Output @ 4 & 8 ohms Stereo, Mono, Blamp or Triamp Input Connector Output Connector Weight Size List Price

PEAVEY

DECA/1200	600W/350W	Stereo	XLR/1/4"	Binding Post/1/4"	26	3.5" x 19" x 15"	\$1,399.50
CS-1200	600W/350W	Stereo	XLR/1/4"	Binding Posts	70	7" x 18.875" x 15.5"	1,299.50
DECA/724	350W/200W	Stereo	XLR/1/4"	Binding Post/1/4"	35	3.5" x 19" x 16"	999.50
CS-900	450W	Stereo	XLR/1/4"	Binding Post/1/4"	N/A	N/A	949.50
CS-800	460W/280W	Stereo	XLR/1/4"	Binding Posts	59	7" x 19" x 13.5"	799.50
M7000	350W	Stereo	1/4"	1/4"	N/A	N/A	749.50
DECA/424	200W	Stereo	1/4"	1/4" Balanced	33	3.5" x 19" x 15.5"	699.50
M4000	250W	Stereo	1/4"	1/4"	N/A	N/A	579.50
M3000	225W/130W	Mono	XLR/1/4"	Binding Posts	29	5.25" x 19" x 12.5"	449.50
M2600	130W/75W	Stereo	1/4"	1/4"/Phone	29	5.25" x 19" x 12.125"	399.50
300 Monitor	150W	Mono	1/4"	1/4"	N/A	N/A	299.50

POWER SOLUTIONS

PS-2000	2000W/1500W	M	XLR and Phono	Wall Receptacle	27	3.5" x 19" x 17"	\$1,895.00
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QSC AUDIO PRODUCTS

3800	600W/375W	Stereo	XLR/RTS/Barrier Strip	5-way Binding Post	75	5.25" x 15.9" x 19"	\$1,958.00
3500	450W/300W	Stereo	XLR/RTS/Barrier Strip	5-way Binding Post	50	3.5" x 15.9" x 19"	1,488.00
MX2000	625W/375W	Stereo	XLR/RTS/Barrier Strip	5-way Binding Post	75	5.25" x 15.9" x 19"	1,395.00
3350	300W/200W	Stereo	XLR/RTS/Barrier Strip	5-way Binding Post	41	3.5" x 15.9" x 19"	1,248.00
1700	500W/325W	Stereo	XLR/RTS/Barrier Strip	5-way Binding Post	57	7" x 10.8" x 19"	1,098.00
MX1500	500W/330W	Stereo	1/4"/RTS/Barrier Strip	5-way Binding Post	47	3.5" x 17.9" x 19"	998.00
3200	140W/110W	Stereo	XLR/RTS/Barrier Strip	5-way Binding Post	26	1.75" x 14.6" x 19"	958.00
1400	300W/200W	Stereo	XLR/RTS/Barrier Strip	5-way Binding Post	34	5.25" x 9.5" x 19"	768.00
1200	150W/100W	Stereo	XLR/RTS/Barrier Strip	5-way Binding Post	24	5.25" x 9.5" x 19"	548.00
1080	50W/35W	Stereo	XLR/RTS/Barrier Strip	5-way Binding Post	12	1.75" x 8.7" x 19"	488.00
A2150	150W @ 8	Mono	Barrier Strip	Barrier Strip	24	5.25" x 17" x 12"	TBA
A2300	150W @ 8	S	Barrier Strip	Barrier Strip	26	5.25" x 17" x 12"	TBA

RTS SYSTEMS

410	10W @ 8	M	XLR/ .25" Phono	.25"/Binding Post	6.75	1.75" x 8.38" x 12"	\$410.00
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RAMSA/PANASONIC

WA-755A	120W	Mono	XLR/Phono/Screw Terminal	Screw Terminal	27.5	420x147x276mm	\$850.00
WA-745A	60W	Mono	XLR/Phono/Screw Terminal	Screw Terminal	22	420x103x276mm	750.00
WA-735A	30W	Mono	XLR/Phono/Screw Terminal	Screw Terminal	17.6	420x103x276mm	650.00
WA-750A	120W	Mono	XLR/Phono/Screw Terminal	Screw Terminal	26.4	420x147x276mm	625.00
WA-740A	60W	Mono	XLR/Phono/Screw Terminal	Screw Terminal	20.9	420x103x276mm	510.00

The following four models are 2-channel PA rackmount

WP-9440	350W @ 8	Stereo	XLR/Phono	5-way Binding Post	74.8	480x145x486mm	\$2,090.00
WP-9220	300W/200W	Stereo	XLR/Phono	5-way Binding Post	38.5	480x145x383mm	1,090.00
WP-9110	150W/100W	Stereo	XLR/Phono	5-way Binding Post	28.6	480x105.5x383mm	840.00
WP-9055	50W @ 8	Stereo	XLR/Phono	5-way Binding Post	18.7	480x59x333mm	590.00

RANDALL ELECTRONICS

RPMQ-300	600W/500W	Stereo	XLR/1/4"	5-way/1/4"	38	3.5" x 19" x 16"	TBA
RPM2-120	400W/20W	Stereo	XLR/1/4"	5-way/1/4"	23	5.25" x 19" x 12"	\$575.50
RPM2-80	200W/160W	Stereo	1/4"	1/4"	12	1.75" x 19" x 10"	429.50

POWER AMPLIFIERS

Model No.	Output @ 4 & 8 ohms	Stereo, Mono, Biamp or Triamp	Input Connector	Output Connector	Weight	Size	List Price
RANE							
MA6	150W/100W	6 ch	Phono	Terminal	44	5.25" x 19" x 11.5"	\$1,349.00
HC6	350mW	6 ch	Phono	Phono	8	1.75" x 19" x 8.5"	369.00
HM42	350mW	Stereo	Phono	Phono	5	1.75" x 19" x 5.25"	\$29.00
RICKENBACKER INTERNATIONAL							
RA600	440W/280W	Stereo	XLR/Phono	Banana/Terminals	36	19" x 5.75" x 16.125"	\$999.00
RA300	220W/140W	Stereo	XLR/Phono	Banana/Terminals	29	19" x 4" x 15.875"	649.00
ROSS SYSTEMS — IMC							
Mega 2	190W @8	Stereo	1/4"	1/4"/Banana	65	3.5" x 19.5" x 17"	\$449.95
SCS/SOUND CODE SYSTEMS							
2600A	600W/350W	Stereo	XLR/Phono	5-way Binding	52	5.5" x 19" x 12.25"	\$1,099.00
2450A	450W/275W	Stereo	XLR/Phono	5-way Binding	44	5.5" x 19" x 12.25"	899.00
2350A	350W/260W	Stereo	Phono	5-way Binding	38	5.5" x 19" x 12.25"	729.00
2150A	150W/100W	Stereo	Phono	5-way Binding	24	3.5" x 19" x 10"	579.00
SOUNDCRAFTSMEN							
900X2	675W/375W	S/M	XLR/Phone	Binding Post	65	5.25" x 19" x 16.5"	\$1,599.00
PM860X2	315W/210W	4 Channel	Phone	Binding Post	42	5.25" x 19" x 14"	1,247.00
RA7502	420W/275W	S/M	Phone	Binding Post	53	7" x 19" x 15"	1,049.00
RA7501	420W/275W	S/M	Phone	Binding Post	52	7" x 19" x 15"	949.00
RA6501	420W/275W	S	Phone	Binding Post	50	7" x 19" x 15"	849.00
450X2M	315W/210W	S/M	XLR/Phone	Binding Post	30	5.25" x 19" x 12"	899.00
450X2	315W/210W	S/M	XLR/Phone	Binding Post	30	5.25" x 19" x 12"	799.00
200X2M	210W/145W	S	XLR/Phone	Binding Post	32	5.25" x 19" x 15"	799.00
200X2	210W/145W	S	XLR/Phone	Binding Post	30	5.25" x 19" x 15"	699.00
PM860	315W/210W	S	Phone	Binding Post	20	8.25" x 5" x 14"	599.00
SOUNDTECH							
PL450	450W/240W	S/M	XLR/Phono	Phono/Banana	55	3.5" x 19"	\$999.00
PL1000							
4-channel	250W/153W	Quad/Tri/S	XLR/Phono	Phono	46	3.5" x 19"	1,099.00
PL300	300W/140W	S/M	XLR/Phono	Phono/Banana	38	3.5" x 19"	799.00
PL500	250W/153W	S/M	XLR/Phono	Phono	29	3.5" x 19"	699.00
PL150	150W/80W	S/M	XLR/Phono	Phono/Banana	22	3.5" x 19"	599.00
SPECO DIVISION, COMPONENTS							
PAT120	50W	M	.25"/Phono/RCA	Screw Terminal	22	5.5" x 17" x 14"	\$299.95
PAT60	20W	M	.25"/Phono/RCA	Screw Terminal	9	4.5" x 10" x 8.5"	159.95
PAT30	10W	M	RCA	Screw Terminal	9	4.5" x 10" x 7.5"	119.95
SPECTRA SONICS							
712	70W	Stereo	Phono	Binding Post	24	19" x 14.5" x 5.5"	\$760.00
712B	60W	Stereo	Phono	Binding Post	22	3.5" x 19" x 13"	595.00
701	80W/160W	N/A	Hardwire	Binding Post	.88	2.5" x 10" x 1.875"	108.00
STUDER REVOX							
B242	200W/200W	S/M	RCA/XLR	Binding Post	37	7.7" x 6" x 14.2"	\$3,000.00
SYMETRIX							
A-220	20W	S/M	.25"/XLR	Barrier Strip	9	19" x 1.75"	\$315.00

Model No. Output @ 4 & 8 ohms Stereo, Mono, Biamp or Triamp Input Connector Output Connector Weight Size List Price

TANNOY NORTH AMERICA

SR840	500W/250W	S or M	XLR or Phono	Binding Post	53	5.25" x 19" x 19"	\$3,495.00
SR740	750W/425W	S or M	XLR or Phono	Binding Post	61	5.25" x 19" x 16.5"	1,995.00
SR140	225W/150W	S or M	XLR or Phono	Binding Post	26	5.25" x 19" x 12"	995.00

TAPE-A-THON

AM203A	70W @ 8	Mono	RCA/Phono	N/A	6	8" x 8" x 3.5"	\$360.00
AM202A	40W @ 8	Mono	RCA/Phono	N/A	5	8" x 8" x 3.5"	310.00
AM101A	70W @ 8	Mono	RCA/Phono	RCA/Phono	7	8" x 8" x 3.5"	265.00
AM252A	20W @ 8	Mono	RCA/Phono	RCA/Phono	4	8" x 6" x 3.5"	215.00
AM251	10W @ 8	Mono	RCA/Phono	RCA/Phono	4	8" x 6" x 3.5"	190.00

TIMES ONE TECHNOLOGY

PA2700	700W/400W	Dual	RTS/XLR	5-way	53	5.25" x 19" x 12.5"	\$1,200.00
PA2900	900W/500W	Dual	RTS/XLR	5-way	60	5.25" x 19" x 13.25"	1,500.00

TOA ELECTRONICS

P-924	240W @ 8	M	Screw Terminal/Card edge	Screw Terminal	43	5.9" x 16.5" x 13.1"	\$1,075.00
P-912A	120W @ 8	M	Screw Terminal/Card edge	Screw Terminal	31.2	5.7" x 16.5" x 12.4"	599.00
P-906A	60W @ 8	M	Screw Terminal/Card edge	Screw Terminal	22.9	5.7" x 16.5" x 12.4"	491.00
P-300D	480W/300W	S	XLR	Binding Post	77	19" x 8.75" x 18.75"	1,798.00
P-150D	220W/150W	S	XLR	Screw Terminal	44	19" x 5.25" x 18.75"	1,111.00
P-75D	100W/75W	S	XLR	Screw Terminal	29	19" x 3.5" x 18.75"	825.00
P-300M	480W/300W	M	XLR	Screw Terminal	62	19" x 8.75" x 18.75"	1,174.00
P-150M	220W/150W	M	XLR	Screw Terminal	40	19" x 5.25" x 18.75"	898.00

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PC2002M	240W @ 8	Stereo	XLR/1/4"	Binding Post	45	7" x 19" x 16"	\$1,650.00
PD2500	360W/250W	Stereo	XLR	Binding Post	26.5	3.5" x 19" x 19"	1,545.00
PC2002	240W @ 8	Stereo	XLR/1/4"	Binding Post	44	7" x 19" x 16"	1,485.00
PC1002	150W/100W	Stereo	XLR/1/4"	Binding Post	34	5.25" x 19" x 16.75"	985.00
P2250C	265W/185W	Stereo	XLR/3-way Barrier	Barrier Strip	42	5.25" x 19" x 16.75"	895.00
P2250	265W/185W	Stereo	XLR/1/4"	Binding Post/1/4"	42	5.25" x 19" x 16.75"	895.00
P2150C	165W/105W	Stereo	XLR/3-way Barrier	Barrier Strip	37.4	5.25" x 19" x 16.75"	695.00
P2150	165W/105W	Stereo	XLR/1/4"	Binding Post/1/4"	37.4	5.25" x 19" x 16.75"	625.00
P1250C	265W/185W	Mono	XLR/3-way Barrier	Barrier Strip	33	5.25" x 19" x 16.75"	595.00
P1250	265W/185W	Mono	XLR/1/4"	Binding Post/1/4"	33	5.25" x 19" x 16.75"	595.00
P2075C	75W/50W	Stereo	XLR/3-way Barrier	Barrier Strip	21	3.75" x 19" x 14.375"	495.00
P2075	75W/50W	Stereo	XLR/1/4"	Binding Post/1/4"	21	3.75" x 19" x 14.375"	495.00
P1150C	165W/105W	Mono	XLR/3-way Barrier	Barrier Strip	28.6	5.25" x 19" x 16.75"	495.00
P1150	165W/105W	Mono	XLR/1/4"	Binding Post/1/4"	28.9	5.25" x 19" x 16.75"	495.00

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BETA-800	400W @ 4 x 2	Stereo	1/4"	1/4"	60	21" x 15.5" x 7.5"	\$995.00
AP-500	250W @ 4 x 2	Stereo	1/4"/XLR	1/4"/Binding Post	40	22" x 9" x 7"	775.00
BETA-500	310W @ 4	Mono	1/4"	1/4"	45	21" x 15.5" x 7"	585.00
BETA-150eq	150W @ 4	Mono	1/4"	1/4"	22	22" x 9" x 7"	375.00
BETA-150	150W @ 4	Mono	1/4"	1/4"	22	22" x 9" x 7"	315.00

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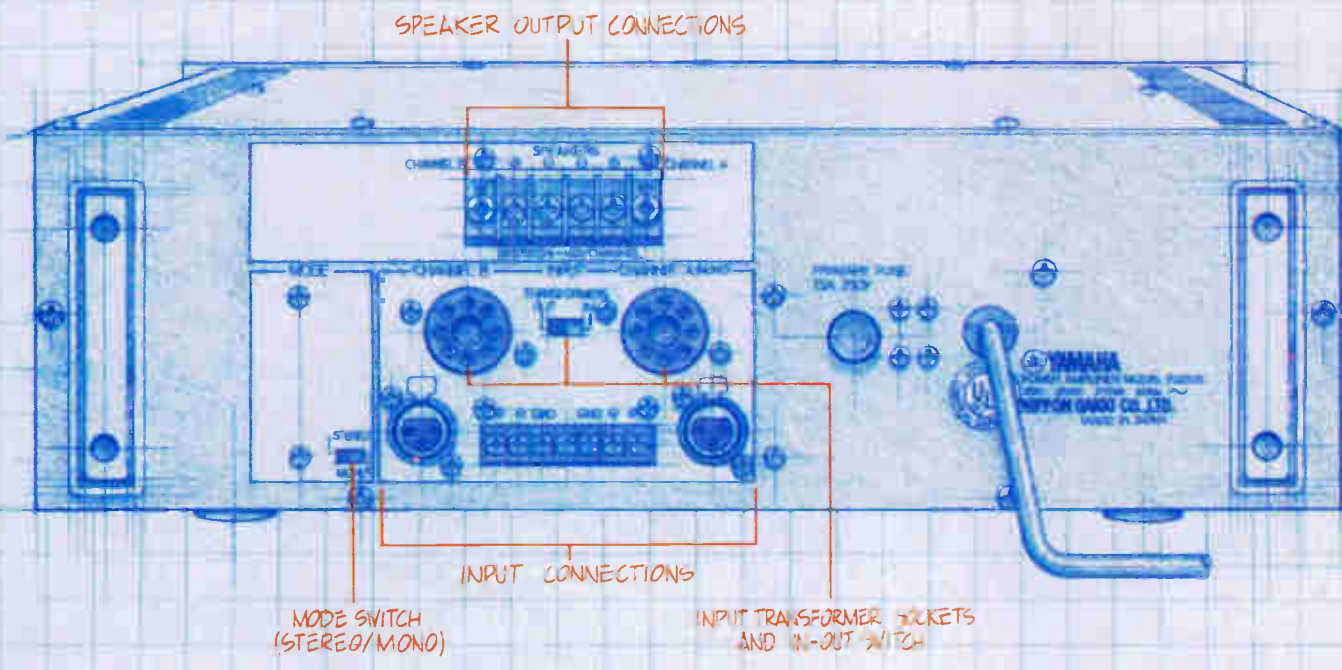
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Installation Profile

The World Harvest Church

Sound & Video System

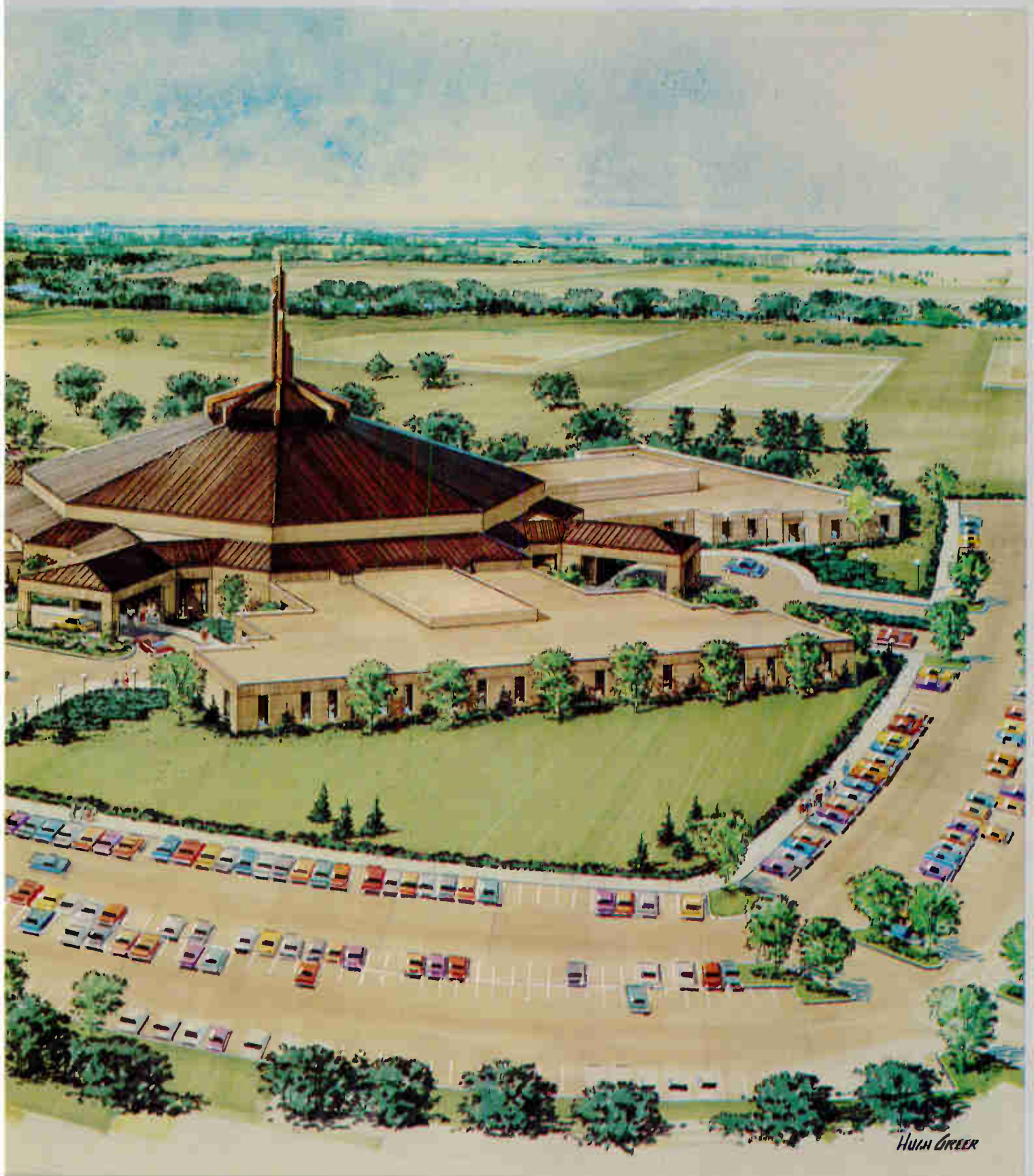
One of the worst possible things that can happen to a consultant is being asked to design a sound system for a building that is almost finished. In cases where proper forethought has not prevailed, you don't have a snowball's chance to design as good a system had you been brought in on the pre-planning stages. The World Harvest Church (formerly Word of Life) in Canal Winchester, just outside Columbus, Ohio, was just three months from its first service when the author was hired as a consultant. It was not until the actual job site visit that it became apparent—this was no ordinary church. These folks were serious about not only having church, but having a “World Class Tele-Production facility.”

THE CALLING

The main sanctuary is 217 feet in width, 214 feet long with the ceiling height at 28 feet at the closest point and 33 feet at the highest, and will seat 5,200. The lower section holds 3,800, and the rear section 1,400. The rear section has a curtain that will close the back section for smaller services and meetings. The *stage* is 85 feet across and 22 feet in depth, with an area



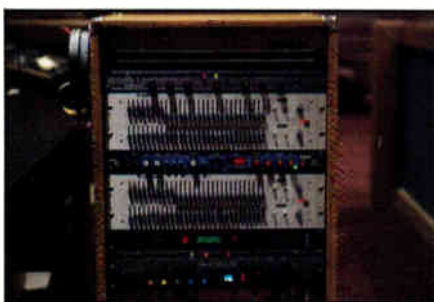
by Sandy Dillon



The 5,200 seat World Harvest Church has an elaborate audio/video system.

ten feet by six feet for the pastor that can be removed in sections and stored to give a stage look. The main sanctuary is just under 1.4 million cubic feet. The back section of seating is on a *bleacher* type rise. The floor also slopes from the back down to the front at about a nine foot slope.

The building is also home to a Christian school, television and recording studio, plus the church offices. These are in three different wings of the building, surrounding the sanctuary, with a common hall around the circular structure. The television area will provide facilities for video taping their services on broadcast-quality one-inch format Sony equipment; and editing the service for broadcast in the computer editing suite. Audio sweetening and re-mixing will be



The house effects system includes an Aphex compellor, two Klark Teknik DN-360 1/3 octave equalizers, a Lexicon PCM 42 digital delay, a Yamaha SPX 90 mkII for reverb and a Roland SDE 1000 for digital effects.

done in the recording studio control room, that also acts as a TV audio control room.

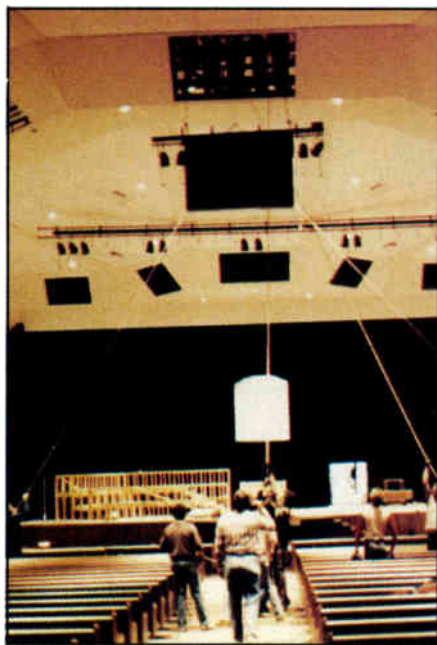
Just off the main sanctuary is a studio that provides the ability to produce their own programming in a studio larger than most commercial television stations. Executives from Sony have said, "This Church will be the most technically superior of any in the United States." Marcus Vegh had worked on the design of the technical facilities and supervised the lighting, staging, electrical, sound, and video for the entire project. Working 15 hour days was the norm for Vegh and his crew from the church.

SURVEY CONCEPT

Even with the shaking that is prevalent in the church today, there is a move that is producing a number of 5,000 plus seat churches. This church, like many others, worships in the flow of the Holy Spirit or *charismatic* type services. These larger churches bring different types of problems than with churches in years past. If the spoken word was understandable you did a good job. Over the last 10 years, music has increasingly played a much greater part in the overall worship service.

The church's pastor, Rev. Rod Parsley, participated in evolving the sound system concept. Rev. Parsley spoke of the number of churches visited during the planning stages and almost without exception said that they had inadequate sound, either in coverage or in sound quality. The most prevalent problem he encountered is when someone designs a system for a mode of worship which he does not understand.

Most charismatic churches need a full blown "rock'n roll" system, but without lots of "ugly black boxes" hanging in the middle of the sanctuary. The sound system needs to be able to deliver upwards of 105 to 115 decibels but without the folks in the front pews looking like a Maxell tape commercial. The pastor was emphatic about needing full Hi-Fi sound

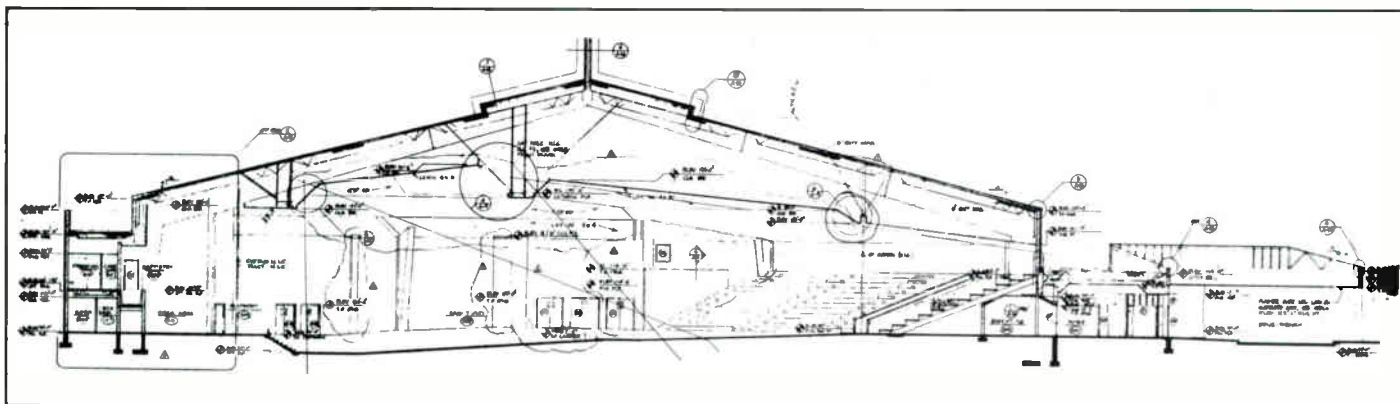


Lots of man power was used to rig the largest of 10 groups of speakers weighing in at 1,800 lbs. This main cluster includes six P-100 Tannoy speakers and two Tannoy "Leopard" bass cabinets.



Photos by Sandy Dillon

Sound is provided for the main auditorium via [left rack] five SCS 2600 stage monitors and [right] four Perreaux 8000B amps and three smaller Perreaux 600B amps.



The main sanctuary is approximately 1,300 cubic feet.

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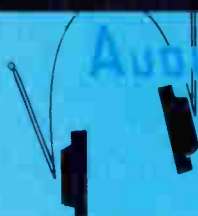
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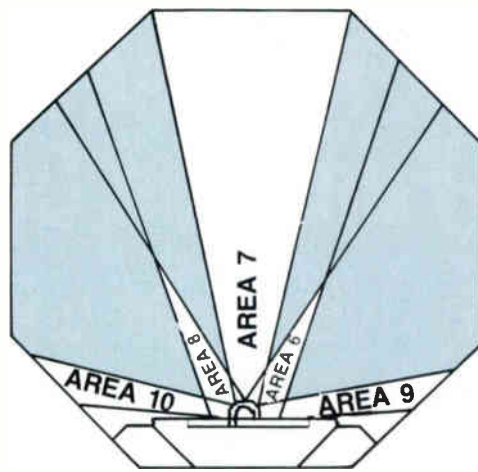
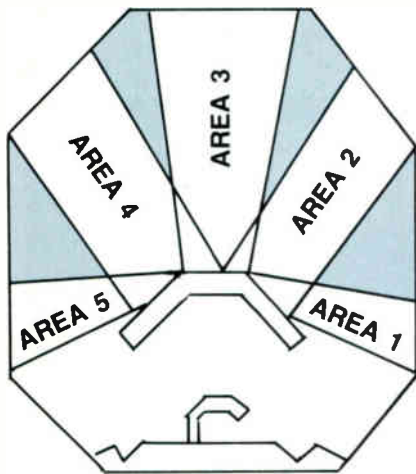
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Areas 1 through 10 as specified.

without sacrificing the spoken word.

SYSTEM DESIGN

The actual design of the system was a group effort using the new HIS Systems (High Intelligibility Systems). This network of dealers and consultants are most familiar with how best to use these speakers and enable them to compute the exact needs of the individual church. Those in membership work closely with each other sharing information and design techniques.

After being introduced to Tannoy's Wildcat series, the author's first reaction was which pastors would want a Cougar, Panther, Puma or whatever in their churches. Nonetheless, the Tannoy concept of a single source loudspeaker the "dual concentric" is the closest thing to meeting both the "Hi-Fi" aspect of the music and the high intelligibility needed in a large church.

The World Harvest system is composed of two separate systems, one on a delay for the main sanctuary and back riser section, and one that is essentially front and side fills. A total of 21 Tannoy Pumas—a 300W, 15 inch, full range (50 Hz to 20 kHz) dual-concentric speaker—were used. The low frequency speakers are 12 Leopard dual-concentric speakers, that have a 15 inch driver also and will produce lows from 15 Hz to 500 Hz. The Tannoy Puma or P-100 (the contractor version) not only sounds very good but provides good coverage versus directivity.

The Main cluster (Area 3) has three P-100's stacked with two bass cabinets on either side. In Area 2 and 4, there are three P-100's and two bass bins to the outside. The three groups of three P-100's are each driven by one amp channel; so the top P-100's are on one amp side, the center three on one side, and the bottom three on one side. This pro-

vides the ability to layer the sound or pull the sound from either section depending on the need. The bass cabinets are also set up, three to an amp side. On the main (delayed) system a Lexicon PCM 42, with an 80ms delay, drives 13 P-100 cabinets and 8 bass cabinets. The remainder of the main system is two P-100's in Areas 1 and 5. These are basically side fills where the short throw keeps more sound from the side and back walls.

The main cluster is directly in front of the lighting cat walk and holes were cut in the already existing slope. This ended up being one of the few problems that arose. The angle of the slope needed to be the same degree as the ceiling. We ended up needing the slope to be the same angle as the ceiling and because it wasn't, the lower part of the three clusters sticks out into the room about 14 inches. This will be rectified when the

speaker grill is installed before the main dedication services this April.

The front system is smaller than the other; (in Area 7) the front cluster is comprised of two P-100's with a single bass cabinet on either side. In Areas 6 and 8 (to either side) there is one P-100 and one bass bin. In Areas 9 and 10 there are front fills. The two systems are set up to provide control over the lows and full range yielding total coverage in every area of the room, with full frequency response and excellent intelligibility. With the split system, neither of the clusters have to be pushed very hard for coverage in normal services.

Since there is a dual system and the pastor does not like to be confined to the platform, he was able to walk out into the coverage of the front cluster wearing a wireless lav, and the system did not feedback. Other areas we were careful with were the amplifiers and the speaker cable. We wanted to maintain the highest quality components throughout the signal path, yet maintain the \$150,000 budget.

First, an amplifier was needed that would deliver high power and have the sonic qualities of an "esoteric" Hi-Fi unit. During the search for the perfect amp the name Perreaux came up repeatedly. We purchased four of the Perreaux 8000B (1000W @ 4 ohm with peaks of 2,700W @ 2.7 ohms). The front system uses three of the Perreaux 6000B, a smaller amp with about half the power, 500W @ 4 ohms.

Second, the speaker cable we used was Kimber 4TC, a Teflon coated braided cable. The longest speaker run was close to



Services are taped in this TV audio control room where computer editing takes place on various Sony equipment.

Photo by Sandy Dillon

200 feet—more than just regular 10 or 12 gauge cable was needed. The first use of this cable was like getting an extra four or five dB in gain from the amp without the coloration or loss encountered in some of the cable normally used. The cable used on the bass bins is the 8VS which is a more cost effective cable since our sonic performance criteria is not as critical in the low frequencies as in the mids and highs.

There is very little signal processing equipment in the system. The signal path goes to a stereo Aphex Compellor, with the left channel of the Amek Scorpion house audio console feeding channel one of the Compellor, then to the inputs of a Klark-Teknik DN-360 (stereo 1/3 octave equalizer). The top channel is for the bass and the bottom channel is for the full range P-100. Equalizers, instead of a crossover, were used to take advantage of the full range of the P-100's. The bass cabinets were pulled at 150 Hz (a crossover point), and the P-100's were rolled off below 30 Hz.

The delayed system is fed from the right channel of the board, through the Compellor, the Lexicon PCM 42 (80ms delay) then to the DN-360, where it is separated the same as above.

STAGE AND CONSOLE SET UP

There are three mixing positions, main house, stage monitor, and television/recording. In the house position is a 40 by 8 by 2 Amek Scorpion. The amps are fed via a Logitek stereo distribution amp. The monitor board is the mate to the house with 12 monitor sends for the band, singers, and pastor's foldback. Both mixing positions have two UREI LA-4 compressor/limiters and an Aphex Compellor with Aphex C, a Yamaha SPX 90 mkII for reverb, and a Roland SDE 1000 for digital effects.

As for television/recording, the console has not been chosen as of this writing. But, we expect to install a SONY/MCI with two multi-track machines that are slaved to the Video editing system. This will help to fully support the TV stereo mix for services as well as the concert series of live Christian concerts.

In addition to the 10 monitor speakers (Tannoy Cougars, a 15 inch dual-concentric), the rhythm section is covered with a Rane headphone amp that uses the same mix but gives six separate volume controls. This was also done for the keyboard musicians but with their own mix. A need arose when the pastor asked us to come up with a monitor system that could be used as the pastor came off the platform. These would be under the front pews.

Fabricating the six floor monitors (24 inches in length, 11.5 inches high at the front with a slope to 9 inches at the rear) was handled by Tannoy in Kitchener, Ontario. The speakers have a foam and a metal grill for protection. They are on a delay so there is little competition with the overhead system. SCS (Sound Code Systems) amps are used for all the stage monitoring. The 2600 amp is 350 watts @ 8 ohms and 600 watts @ 4 ohms. These are good sounding MOS-FET amps.

However, the stage presented a new set of problems, the least of which was having 96 mic inputs at three consoles, with phantom power on all Shure, Electro-Voice and Neuman mics at each position. After discussing the situation with a number of designers, all who gave good advice on how they had overcome potential problems, Ken Musselman, of Milam Audio, and the author designed a combination mic-split/patching network. The job of fabricating this went to Pro Co Sound, who precisely executed our design.

The microphone distribution system features all 96 inputs from the stage which are on a panel of male XLRs, and can be patched via mic cable to the 48 inputs to the split. These also come up on

patchbays for each mixer to choose the mics the pastor needs. The 48 inputs have a toggle switch and a red LED that lights when phantom power is activated, with a back-up power supply that takes over if the first were ever to fail.

Thus, each mixer has the ability to have 40 channels for the console, with an additional 8 inputs that can be split to each console. They can be used for extra drum mics in the house not needed by the monitor mixer, audience response mics for video mix, or whatever the need. In addition to the 48 microphone inputs that come up on 96 point patchbays. Each console has a number of lines between each mixing station and the mic split. This is done via a house board to TV, 1-12 pair, 350 feet; a house board to amp rack, 1-12 pair, 300 feet; a house board to monitor, 1-12 pair, 250 feet; a house board to mic-split, 1-32 pair and 1-16 pair, 300 feet; a monitor board to mic-split, 1-32 pair and 1-16 pair, 75 feet; a monitor board to TV, 1-12 pair, 150 feet; a TV board to mic-split, 1-32 pair and 1-16 pair, 150 feet; a TV board to lighting grid, 1-6 pair, 300 feet; a TV board to studio, 4-12 pair, 100 feet x 4.

Each mixing position has two 96 point patchbays that all mate via ELCO multi-
(continued on page 65)

Good Things Come In Small Packages



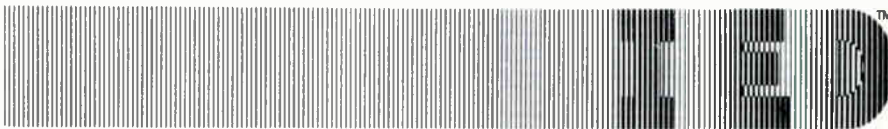
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Circle 244 on Reader Response Card

Looking back at **SOUND & COMMUNICATIONS**

30 Years Ago . . .

In the March, 1958 issue of *Sound & Communications*

Rocketdyne, the company responsible for the liquid rocket engine which sent Jupiter C into space, employed a CCTV system at its Canoga Park, CA, facility to provide observers with visual details of rocket launching performance. A 20 camera network enables Rocketdyne engineers to observe test firings of high thrust, liquid propellant engines.

"Late Lines" reported that CCTV was being hypo'd by over the air educational TV from 28 stations that were on the air at that time which served a total population of 50 million people. The column also reported that between 1954 and 1957 educational TV programming had tripled. There were no reports on how or if advertisers took advantage of this huge potential buying public.

20 Years Ago . . .

In the March, 1968 issue of *Sound & Communications*

The column "db's" reported on a nifty item called the VIP Electronic Desk, which was manufactured by Interstate Industries and sold for \$1,300. Built into the desk was an electronic center which included a UHF/VHF television receiver, with optional facilities for closed-circuit channels, a portable recorder, an AM/FM clock radio with an alarm warning device to remind the VIP of an appointment, a high intensity lamp, a telephone index, a digital calendar, a memo compartment and a pen and pencil set.

In "Mobile Communications" the FCC marked the presentation of the 100,000 license in business radio service by honoring Horace W. Hooie, a Rogersville, AL, plumber and Raymond Tobios from Lyons, KS, was also honored as the first small businessman to be licensed in that service.

15 Years Ago . . .

In the March, 1973 issue of *Sound & Communications*

A little leprechaun magic was performed by the Tape-A-Thon Corp. as it bought the sound of London's Big Ben to the London Bridge that is located in Lake Harasu City, AZ. Tape-A-Thon's Chimes System was installed and engineered by Hollywood Sound Systems of Hollywood, CA, to stimulate the sound of the famous clock. The "clock" struck the half hour each day from eight in the morning to nine at night.

In the "Companies" column, *Sound & Communications* reported that MCI Communications Corp., in Washington, D.C., was "open, in businesses, and ready to serve customers," according to then senior vice president Carl M. Vorder Bruegge. MCI served customers on its microwave communications system between Chicago and St. Louis.

Performance impressive enough
to change a sound pro's old habits.

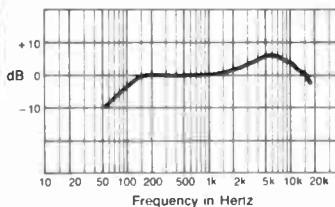
SURPRISING!

Telex TE10 and TD13 sound reinforcement mics are making believers out of sound pros who have been automatically specifying the same microphone for years. These new low mass design condensers (TE10) and high output dynamics (TD13) are meeting the demands of even the toughest pros while at the same time providing unexpected savings. Surprise yourself. For detailed information write Telex Communications, Inc.

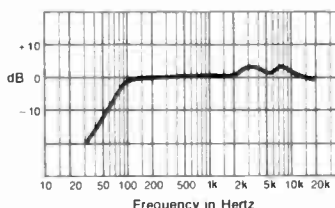
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Controlled frequency response on TD13 dynamic enhances vocals



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Was this the type of delay you originally specified?



Klark-Teknik reliability means fewer unplanned service calls

When you're responsible for maintaining intelligibility, malfunctioning distribution delay lines can garble your schedule, along with the program your venue has scheduled. Klark-Teknik delays are designed to produce outstanding audio quality, and produce it reliably.

Klark-Teknik experience means superior performance

Digital circuit design is a science, but one that involves a considerable amount of art. For over a decade, Klark-Teknik has developed and refined digital audio technology to create delays of superlative performance. Each of the DN 716's three outputs is independently adjustable up to 1.3 seconds of delay in 20 *microsecond* increments, for total alignment precision. And each output has a full 20 Hz—20 kHz bandwidth with 90 dB of dynamic range, achieved with proprietary 16 bit linear A/D and D/A converters.

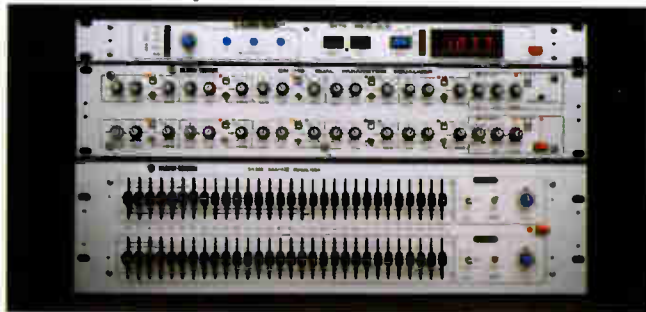
Klark-Teknik quality stems from unrelenting scrutiny

Our standards are demanding: so are Klark-Teknik installations like Yankee Stadium, St. Paul's Cathedral and leading Broadway and West End theaters. We use only the highest grade components: lithium battery backup for the non-volatile memory, sturdy rack mount chassis, an electronic safe switch that prevents unauthorized access to the delay settings.

Series 700 Digital Delays have proven their reliability over ten years of use: like all Klark-Teknik products, they undergo 100 hours of testing before

being shipped. Our standard procedures include stereo dynascope board inspections, full performance verification and a cycled burn-in followed by a complete re-check. Lower standards of design, construction and testing could make our delays easier to purchase. But it would make them far more difficult to install and operate. There simply are no short cuts to true "set and forget" operation.

If you dislike unnecessary delays as much as we do, investigate Klark-Teknik digital delay lines, graphic and parametric equalizers. For full information on their design, construction and applications, please contact Klark-Teknik or your local distributor.



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Belden Expands Line of Conformable Coax Cables

Belden Wire and Cable has developed new conformable coax cables for "black box" applications where high temperature rating, tight ending radii and shielding are required.

Belden's conformable coax cables were designed for applications involving internal, head-end wiring of electronic equipment, including RF applications. They are used for test, instrumentation, radar, video and computer equipment and avionics.

Circle 2 on Reader Response Card

AMP's High Speed Cable Assembly Connectors

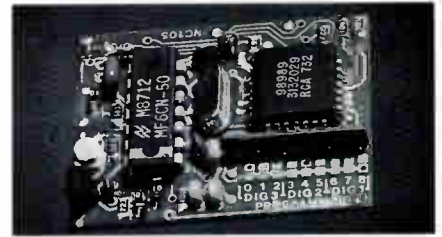
AMP has introduced bus connectors. These straight and right-angle receptacles, available in 8 through 64 position size, feature reliable contacts and optional center or military polarization. They offer a choice of beryllium copper contacts plated with 50 microinches of gold. These receptacles mate with universal eject headers with a .565 inch latch height or with two-row continuous headers on .100 inch by .100 inch grids.

Low profile receptacles accommodate transmission cable with or without shielding on .050 inch signal contact centerline spacing; miniature coax cable up to .050 inch in diameter; shielded parallel or twisted pair cable; and standard and high speed tri-lead cable. They terminate to tin- or silver-plated solid conductors through resistance welding.

The overmold strain relief design provides cable retention of a 25 pound minimum or .5 pound per contact position. Signal-to-ground patterns can be programmed to be specified

patterns and ratios, and other options include pull loops, daisy chaining or full shielding.

Circle 3 on Reader Response Card



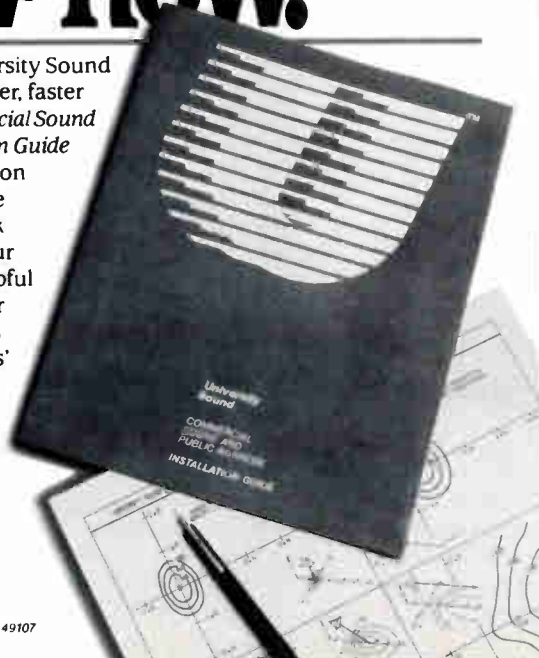
NorComm Introduces Squelch Encoder/Decoder

NorComm Corp. has introduced its Model NC-105 Digital-Coded Squelch Encoder/Decoder, which is a signaling product designed specifically for squelch control applications. It offers compatibility with both Motorola's DPL and General Electric DCG systems, as well as microprocessor circuitry, over 150 field programmable codes and a mini 1.25 inch wide by 1.60 inch long by .25 inch high package achieved through the use of SMT.

Circle 4 on Reader Response Card

Your Advantage: Know-how.

Free information from University Sound can help you do your job better, faster and more easily. The *Commercial Sound and Public Address Installation Guide* contains useful information on system design, plus exclusive Easy-VAMP™ charts for quick speaker location plotting. Our newsletter, *Contact*, offers helpful articles and tips to make your work more profitable. What's more, spec sheets and owners' manuals are clearly written for you and your customers. Get some extra know-how. Contact us to receive copies of the *Guide* and newsletter.



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As You Might Expect, No \$700 Amplifier Has Ever Equalled The Performance, Quality And Reliability Of The \$1000 BGW 7500...



Until Now!

Introducing The BGW 7500T. \$1000 Performance At A \$699 Price.

There are thousands of BGW 7500 amplifiers in the field today. In every case, our \$1000 model 7500 was chosen over a number of lower priced alternatives, for its superior quality, durability and sonic performance.

But BGW knows that you don't always have the luxury of choosing the higher quality, higher priced amplifier. Until now, the price-sensitive buyer has had no choice but to settle for a less expensive, lesser performing unit.

Not anymore. Because BGW's new 7500T amplifier delivers exactly the same performance as our legendary model 7500, at a price that goes head-to-head with any U.S. or foreign competitor—just \$699 professional list.

The model 7500T is a price/performance breakthrough. You get the same conservatively-rated 200/250 Watt-per-channel power (@ 8/4 ohms), the same performance specs—in fact the exact same amplifier design, circuitry and components as our no-compromise model 7500 — at a \$300 savings.

How did we do it? We selectively trimmed a few of the model 7500's nice but non-essential frills. The 7500T has a steel front panel instead of a fancy aluminum one, and uses cost-effective barrier strip terminations. The 7500's LED indicators are omitted on the 7500T. The lower-priced model accommodates one optional BGW internal crossover card for biamp applications, while the 7500 can take two cards. These differences aside, our new economy model is a BGW model 7500 through-and-through.

The 7500 and 7500T are the most rugged and reliable amplifiers you can buy. Inside, you'll find no trouble-prone relays and no sound-degrading IC's.

And here's an important difference between the 7500/7500T and other competitive units: Many use inexpensive MOSFET designs which require high bias, and consequently run very hot. Other brands use inadequate heat sinking. These competitive amplifiers can't live without forced air cooling.

BGW's exclusive copper header output devices don't require bias at all. We mount them directly on highly efficient heat sinks. As a result, the 7500 and 7500T run cool and efficient—so they don't require forced air cooling. And that means you can forget about replacing burned-out fans every few years.

BGW's 7500 has always been the ultimate choice for quality and dependability. Now that our 7500T gives you the same unmatched performance at just \$699, there's really no reason to settle for anything less than BGW. Call us toll-free at 1-800-252-4800 (In CA, 213-973-8090) to arrange for a demo trial.

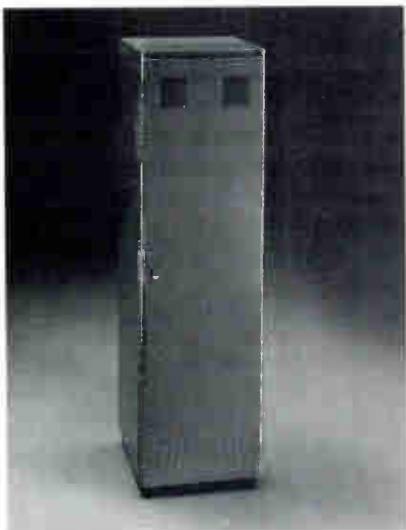


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PRODUCTS IN REVIEW



Atlas/Soundolier Adds Modular Equipment Enclosures

Atlas/Soundolier has introduced heavy duty modular enclosures for the electronics, telecommunications, broadcasting, security, and commercial sound industries.

Designed for optimum strength to weight ration, the 40 plus models of Select Series V enclosures are manufactured to EIA standards from 14 gauge cold rolled steel and feature removable side panels. Enclosures include solid or fully perforated top panels, solid or louvered doors in both surface or flush mount, various enhancement trim strips for individualizing appearance, and a selection of performance oriented accessories are also being introduced.

The new cabinets are available in 19 inch, 24 inch, and 30 inch panel widths, depths of 25½ inches or 30 inches, and from 21 inches to 70 inches high.

Circle 5 on Reader Response Card

Stewart Electronics' 6-Channel Phantom Supply

Stewart Electronics has introduced a six channel 48V phantom power supply as an inexpensive alternative to

more costly auxiliary supplies.

The PM-6 is capable of delivering up to 10ma of 48V DC to microphones, direct boxes and any other equipment requiring phantom power. Like all Stewart phantom power supplies, the PM-6 features short circuit protection for each channel, isolated outputs, individual regulation of each channel, very low noise and crosstalk.

The PM-6 is powered by Stewart's PS-1 24V AC supply (included). Because of its design, the PM-6 can be used with other Stewart phantom supplies for up to 12 channels, all powered by a single PS-1.

Circle 6 on Reader Response Card



Sentex Systems' Infinity System

This month, Sentex plans to introduce the Infinity System. The Infinity is a powerful and flexible access control system combining telephone entry and card and keypad entry. For telephone entry, the system has an electronic directory to display tenant names and codes. Capacity is virtually unlimited since names can be easily paged by the user. Programming is simple and is aided by prompts on the display. Three different size displays are available to meet every application.

The entire system, including the directory, can be completely programmed from a remote location using an on-board model option. Or the user can program the complete system

Your Advantage: Integrity.



The 660 family of dynamic cardioid mics from University Sound offers a unique combination of advantages—smooth response and superior durability. The patented Variable-D' feature assures uniform sound quality, either close up or at a distance. In a mic design so tough it was demonstrated driving nails without functional damage and earned the name "Buchanan hammer." An outstanding warranty and service back you up, as well. In short, the 660 mics give you added integrity. For more information, call or write.

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New Carver Amps for permanent installation, studio, and concert use. PM-175 and PM-350.

NOW THAT THE CARVER PM-1.5 IS PROFESSIONALLY SUCCESSFUL, IT'S STARTED A FAMILY. INTRODUCING THE NEW CARVER PM-175 AND PM-350.

Month after month on demanding tours like Bruce Springsteen's and Michael Jackson's, night after night in sweltering bars and clubs, the Carver PM-1.5 has proven itself. Now there are two more Carver Professional Amplifiers which deliver equally high performance and sound quality — plus some remarkable new features that can make your life even easier.

SERIOUS OUTPUT. The new PM-175 delivers 250 watts RMS per channel into 4 ohms. As much as 500 watts RMS into 8 ohms bridged mode. The larger PM-350 is rated at 450 watts per channel into 4 ohms. Up to a whopping 900 watts in 8 ohm bridged mode. Both with less than 0.5% THD full bandwidth at any level right up to clipping. Plus 2 ohm capability as well.

SERIOUS PROTECTION. Like the PM-1.5, both new amplifiers have no less than five special protection circuits including sophisticated fault interruption against dead shorts, non-musical high frequency, and DC offset protection, as well as low level internal power supply fault and thermal overload safeguards. The result is an amplifier which is kind to your expensive drivers — as well as to itself.

OUTBOARD GOES INBOARD. Each PM-175 and PM-350 has an internal circuit card bay which accepts Carver's new plug-in signal process-

ing modules. Soon to be available is an electronic, programmable 2-way stereo crossover, with 24 dB per octave Linkwitz-Reilly phase-aligned circuitry, a built-in adjustable high-end limiter and balanced outputs. And more modules will be available in the near future to further help you streamline your system.

PRO FROM CONCEPTION. The PM-175 and PM-350 inherited their father's best features. Including slow startup and input muting to eliminate turn-on current surge, 11-detent level controls, phone jacks, power, signal, clipping and protection indicators as well as balanced XLR input connectors. In a bridged mode, both amplifiers will drive 70-volt lines without the need for external transformers.

MEET THE FAMILY AT YOUR CARVER DEALER. All remarkable Carver Professional Amplifiers await your own unique applications. Hear their accuracy and appreciate their performance soon.

SPECIFICATIONS: CARVER PM-175 Power: 8 ohms, 175 w/channel 20-20kHz both channels driven with no more than 0.5% THD. 4 ohms, 250 w/channel 20-20kHz both channels driven with no more than 0.5% THD. 2 ohms 300 w/channel 20-20kHz both channels driven with no more than 0.5% THD. Bridging: 500 watts into 8 ohms; 400 watts into 16 ohms. THD-less than 0.5% at any power level from 20 mW to clipping. IM Distortion less than 0.1% SMPTE. Frequency Bandwidth: 5Hz-80kHz. Gain: 29 dB. Input Sensitivity: 1.5 V rms. Damping: 200 at 1 kHz. Slew rate: 25V/ micro second. Noise: Better than 115 dB below 175 watts. A-weighted. Inputs: Balanced to ground, XLR or TRS phone jacks. Input Impedance: 15k ohm each leg. Compatible with 25V and 70V systems. 19" W x 3.5" H x 11.56" D

SPECIFICATIONS: CARVER PM-350 Power: 8 ohms, 350 w/channel 20-20kHz both channels driven with no more than 0.5% THD. 4 ohms, 450 w/channel 20-20kHz both channels driven with no more than 0.5% THD. 2 ohms 450 w/channel 20-20kHz both channels driven with no more than 0.5% THD. Bridging: 900 watts into 8 ohms; 750 watts into 16 ohms. THD-less than 0.5% at any power level from 20 mW to clipping. IM Distortion less than 0.1% SMPTE. Frequency Bandwidth: 5Hz-80kHz. Gain: 31 dB. Input Sensitivity: 1.5 V rms. Damping: 200 at 1 kHz. Slew rate: 25V/ micro second. Noise: Better than 115 dB below 350 watts. A-weighted. Inputs: Balanced to ground, XLR or TRS phone jacks. Input Impedance: 15k ohm each leg. Compatible with 25V and 70V systems. 19" W x 3.5" H x 11.56" D



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MUSICAL

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from a TouchTone telephone by itself and have synthesized voice prompts and responses walk the user through the programming. An RS-232 port for hook-up to a terminal or printer is also provided as a standard feature.

Circle 7 on Reader Response Card

Chips With Lips Electronic Shelf Talker

Chips with Lips Electronic Shelf Talker has digital sound technology, replaceable message cards (any voice or music message can be quickly recorded on replaceable 4 to 64 second message cards), an auto timer, and speaker options. The Shelf Talker system meets any display design or acoustic requirement with a range of compact and high performance indoor and outdoor speaker options, according to the company. The Shelf Talker plays the recorded message when triggered by movement, light or touch

sensors mounted on point of sales displays.

Circle 8 on Reader Response Card



Audio Technica's Two New Atus Mixers

Audio-Technica U.S., Inc. has stretched out its Atus mixer line with two new models. The new AM500E, at a suggested retail price of \$409.95 and the new AM50 at \$89.95.

The new Atus AM500E adds electronic echo to the company's model AM500 and replaces it in the line. The

AM500E is a six channel wood-paneled, console-style stereo mixer capable of handling two turntables with phono cross-fader, two microphones—with a priority "talkover" feature, and two auxiliary sources. The new model features separate left/right five band equalizers, two VU meters, individual and master gain controls.

Circle 9 on Reader Response Card

Beyer's M58 ENG/EFP Microphone

Beyerdynamic has introduced the M 58 microphone for use in electronic news gathering (ENG) and electronic field (EFP) applications.

The M 58 incorporates an internal shock mount system which reduces undesirable handling noise. The high output microphone's extended response is contoured with a subtle upper frequency rise.

Circle 10 on Reader Response Card

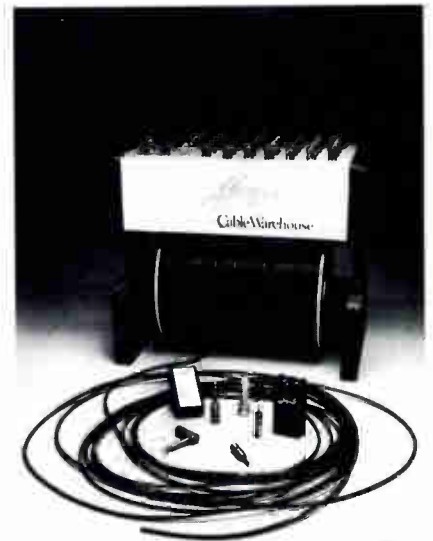
Your Advantage: Clarity.



CDP® horns from University Sound utilize an exclusive driver design. The result: even pattern control with extended high-frequency response. So you can offer customers more natural voice reproduction and far greater music fidelity. What's more, you're providing a long-term solution—CDP horns stand up to rough weather and years of use. They're clearly reliable. Call or write to learn more.


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Circle 240 on Reader Response Card



George L's

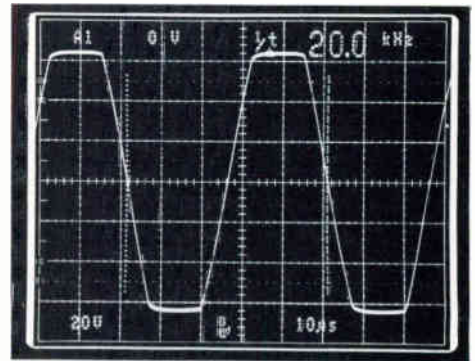
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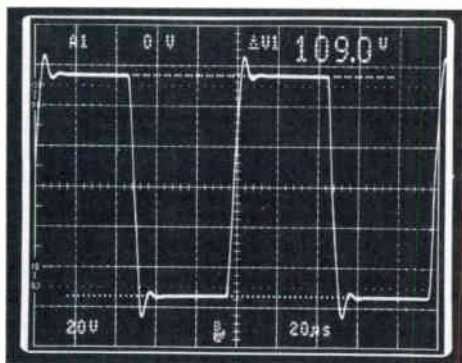
Circle 251 on Reader Response Card

Knowledge is Power.

The more you know about RAMSA power amps, the better they look. Designed for stability and reliability,* they reflect our knowledge of the most demanding applications. And their graceful overload



The WP-9920 exhibits gentle overload characteristics even when overdriven 3dB into 4Ω Load at 20 kHz (643 Watts).



The WP-9220 exhibits minimum ringing even with extremely reactive loads. (8Ω, 1μF: 10 kHz square wave input.)

characteristics dramatically improve apparent headroom. To learn more, see your RAMSA dealer, or write to 6550 Katella Avenue, Cypress, CA 90630.

*Ramsa amplifiers carry a 5-year limited warranty.

RAMSA

Panasonic
Industrial Company



a closer look

by gary d. davis



Frazier CAT 40 Loudspeaker System

The Frazier CAT 40 is a loudspeaker system suited for use in highly reverberant environments where speech intelligibility is typically very



difficult to maintain. It makes use of Coincident-Aligned Transducers in a compact, two-way, full-range system. An eight-inch heavy duty woofer is housed in a bass reflex enclosure that features conical horn loading. The

high frequencies are reproduced by a 1-inch phenolic-diaphragm compression driver and horn which are coaxially mounted in front of the woofer.

The beamwidth of the low and high frequency sections is very closely matched throughout the critical crossover region (approx 90° x 90°), eliminating crossover dropout and lobing off axis. Beamwidth is actually 120° x 120° at frequencies below 500 Hz, and narrows to 90° x 80° at 4 kHz and 90° x 70° at 8 kHz. The horn-loaded low-frequency section increases headroom, reduces distortion over a four-octave region, and improves pattern control. In addition, the directional behavior of the CAT 40 allows optimal interactions of multiple units when properly splayed. This, in conjunction with its light weight and compact dimensions, makes the unit ideal for use in array designs.

The standard finish of the 17-5/8-inch x 17-5/8-inch x 8-1/2-inch enclosure is textured black paint; oak veneer, walnut veneer or carpeted finishes are optional (the carpeted version includes a carrying handle and protective metal grille). Net weight is 33 to 35 pounds, depending on the model.

The CAT 40 is rated at 85 Watts (AES) power handling, 93 dB/w/m sensitivity, and has on-axis response of 65 Hz to 17 kHz (±3 dB). Nominal impedance is 8 ohms, and the unit is available with an optional line matching transformer for constant voltage systems.

Comments

The CAT 40 is compact, indeed, at only 8.5-inches deep and under a foot-and-a-half square. We were curious about some of the details of construction and operation, so we spoke with Jay Mitchell of Frazier. The coaxial design, and Frazier's claims of better point imaging, led us to question whether the two drivers are actually aligned with respect to wavefront emanation. Most coaxial 2-way
(continued on page 64)

Your Advantage: Control.



Smooth coverage of the critical voice range. Improved low-frequency response. Reduced coloration and ringing. Fewer reverberation problems. The Cobreflex IIB folded exponential horn gives you all this in an extremely rugged package. So you can give customers a better system. The Cobreflex IIB lets you control the installation—and its success. Call or write for all the details.

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SOUND & COMMUNICATIONS

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PRODUCT
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3	17	31
4	18	32
5	19	33
6	20	34
7	21	35
8	22	36
9	23	37
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12	26	40
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SOUND & COMMUNICATIONS MARCH 1988 QUICK PRODUCT INFORMATION CARD

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Dear Dr. Wokka

Dear Dr. Wokka,

What is an equalizer? How can I learn to use one in a scientifically correct manner? How do they operate? Where can I get the best one?

Anonymous (to avoid professional embarrassment over such a mundane question.)

Dear Anonymous,

I think, in their heart of hearts, most of the professionals in this business are secretly asking the same questions. Bravo for stepping out boldly and baring your soul.

First, it is not for you to question how equalizers work. A true knowledge of these working principles are known only to a few Men of Science like myself. Don't worry, however. You only have to know how to use them (Can you imagine having to understand how it's coded to be able to play Space Invaders?)

Equalizers are a wonder of modern electroacoustics. Why I've seen them make six inch Allied Radio speakers sound just like the big ones in the 30th

Street Station, Philadelphia. This proves the scientifically correct fact that *a system's sound quality has nothing to do with the loudspeakers themselves, only with the electronics controlling them.* The big ones only put out more power.

The best kind to use is the "third octave" kind. This provides all the control you need. The following is the only way to set them up. Place the first three controls on "full" and also the last three. Then alternate the middle controls full up and full down. This is all you need to do, and an observation of equalizer settings in many fixed installations and concert systems show a trend toward this. The problem is that the people who set these up are afraid of professional ridicule and never quite "go all the way," even though they know they should deep in their hearts. Intellectuals make silly arguments about phase distortion and the like. Rubbish. They know nothing. Trust me; Do it. Pre-packaged pre-set equalizers with these characteristics are sold as "Audio Enhancers" or some such name by various manu-

facturers. These do the same thing—eliminate feedback and make very pleasant sound come out of any speaker or speaker system. However, the client buying the system usually wants to see all the controls so the "equalizer" is the thing to buy. Just remember, full up and down.

All equalizers are the same and produce the same effect. There is absolutely no difference in sound quality, especially using the prescribed settings. Buy the cheapest. Actually, if you buy enough different "guitar-type" equalizers and put them in series, this will work too. The \$89 equalizers you see in discount catalogs are also great. Buy three and cascade them and the effect will be as good.

Lastly, the "slider 1/3 octave" equalizer is basically the "keyboard" for playing the now-obsolete video game "Real Time Analysis," covered in last month's column. I hope this puts the readership's "EQ anxiety" to rest. You must trust me on these points. ■

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Mark 200/D, 200/CPS

Remote intercom units powered by battery or external DC source.

Mark Q/DC

Remote intercom receiver powered by battery or external DC source.

Mark 200 RPL/D



Mark 200/CPS



Mark Q/DC

Mark 200D



HS200D/B



HS 200D/T



Circle 232 on Reader Response Card

Silicon Systems Installs CCTV System

by Laura Vieth
Video-Tec and
Bill Prichard
Odetics/GYYR

Like many businesses across the country, Silicon Systems, Inc. based in Tustin, CA, is countering increased security needs with increased use of closed-circuit television. From an initial installation for perimeter surveillance in 1986, the company gradually brought CCTV "inside" its two buildings throughout last year.

The company originally moved to a CCTV system in order to monitor the parking lots surrounding its Buildings A and B, which lie side by side facing a busy street. "We were having security problems in the parking lots," said

security supervisor Keith Myers. "Our primary concern was to prevent recurrences of such things as equipment being stolen off cars, stolen stereos and miscellaneous mischief such as broken windows and scratches."

In December 1986, Silicon Systems accepted a bid from Video-Tec of Anaheim to install a CCTV system.

The original installation featured three cameras for perimeter surveillance of the facility. The first camera is mounted on top of Building A on the front corner adjacent to Building B. Using a pan and tilt mechanism, this camera surveys the front of both buildings and the parking area between them.

The other two cameras are mounted



Silicon Systems' security supervisor Keith Myers stands by the company's extensive CCTV monitoring equipment.

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on 15 foot high poles located at opposite corners of the back parking lot. Also equipped with pan and tilt mechanism, these two cameras survey the outlying sides of the company's property, in addition to the back of the two buildings.

The three exterior cameras are enclosed in weather-proof metal housings and all of them use zoom lenses.

With the cameras thus deployed, Silicon Systems installed two video monitors in the main security office adjacent to the back door of Building A. All three camera outputs are displayed simultaneously on one of the monitors using a four-quadrant digital multiplexer. The second monitor is used at the discretion of security personnel to view a quadrant of particular interest.

The digital multiplexer also permits simultaneous recording of all three camera outputs by a timelapse video recorder.

(continued on page 67)

FACES



**GARY
CARTER**

Carter Appointed For-A National Sales Manager

For-A Corporation of America has announced the appointment of Gary Carter to national sales manager. Carter had spent the past year as For-A western region sales manager and previously held similar positions at both Hedco and Paltex.

Reporting to Carter will be For-A field service engineer John Margardo, plus region sales managers Gary Chapman (eastern), Don Marr (central) and Randall Smith, who replaces Carter in the western region. Carter will be based at For-A Corp.'s headquarters in Newton, MA.

Bonis Joins ART Team

Applied Research and Technology (ART) has appointed Jim Bonis to the post of marketing manager. Bonis, who specializes in corporate product promotion, was previously vice president of marketing and general manager for Whirlwind Interface International.



**PETER
BAIRD**

Comcast Promotes Baird to General Manager

Peter E. Baird has been named general manager of Comcast Sound Communications, Inc.'s Warren, MI, office. He will be responsible for Comcast Sound's marketing, engineering and administrative functions in the Detroit area.

Baird first joined Comcast in 1985 as a design engineer. He had previously owned and operated Sound Planning Associates in Dearborn, MI, for 15 years.

Can a Monster Cable really make a difference?

Here are a few people who believe it can.

"We now use Monster on every project to the extent that we would not consider making a recording without them. We've flown Monster Cable all over the world to achieve that goal."
— Jack Renner, The Telarc Digital Label, Cleveland

"If I had one wish, I'd wire every tape machine, every monitoring system, every console — in fact, every recording studio I've ever worked in — with Monster."
— John Arrias, Recording Engineer/Producer, Los Angeles

"It's the only way I can maintain a reference to accurately record, playback, and transfer what is on the tape."
— Ian Eales, Recording Engineer, Los Angeles

"I insist on Monster for all my recordings. It lets me capture all the sound that's missing with other cables."
— Jeff Balding, Recording Engineer, Nashville

"In my 20 years of building recording studios, all the amps, consoles, recorders, loudspeakers — everything I've run across, combined — has not made the difference Monster Cable's wire technology has."
— Ed Bannon, TAJ Soundworks, Los Angeles

"Due to Monster's 'phase-alignment' technology, it was like a mask, a veil, had been lifted from the sound."
— Bob Hodas, Recording/Concert Engineer, Sausalito, CA

"I can't believe that all this time I've been EQing for my cables! Now I'm getting so much sound I find myself using much less EQ."
— Randy Kling, Mastering Engineer, Disc Mastering, Nashville

"It was a little frightening, the difference we heard with Monster Cable. Suddenly the stereo image was better, the tightness of the sound was better, the openness was better."
— Bob Ludwig, Mastering Engineer, Masterdisk, New York

Something's happening here. But this time, it's exactly clear.

At least to the growing number of audio professionals in recording studios, mastering rooms, and feature film sound effects facilities.

They've discovered the significant performance differences Monster makes in their work. And they consider Monster Cable to be a milestone achievement in audio engineering.

They're pioneers. But they were once skeptics. Until they opened their minds to the idea of high-performance cable. And their ears to the sound of Monster Cable.

Now some of them won't even work without Monster.

Must be because of Monster's innovative cable technologies and construction.

Like "Bandwidth Balanced®" multiple-gauge wire networks, "MicroFiber™" dielectric, and "Duraflex®" jacketing.

Each an advanced technology other cable manufacturers can only dream about.

And a 1987 TEC Award winner for Outstanding Technical Achievement in Ancillary Equipment Technology.

So what *is* happening here?

Simple. Audio professionals are beginning to realize that audio cables are not only a critical component, but an essential factor in achieving recording excellence.

The implications for the industry are astounding.

As a panel of audio professionals admitted during the recent AES convention, once you open your ears, it's very clear:

Monster Cable *will* make a difference in your work.

Take their word for it.

Monster Cable. Advancing the Art of Recording.

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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.

CALIFORNIA

Concord: Automatic Data Processing, 1,D. Contact: Craig E. Park, Paoletti/Lewitz/Associates, San Francisco, CA; (415) 391-7610.

FLORIDA

Miami Beach: TOPA, 3,A. Contact: Chuck McGregor, Jaffe Acoustics Inc., Norwalk, CT; (203) 838-4167.

Naples: Marco Philharmonic Hall, 3,B. Contact: Rick Dyckman, Boran Craig Barber Construction, Naples, Fl; (813) 643-3343.

KENTUCKY

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

MARYLAND

Ocean City: Isle of Wight, NA, A. Contact: Chuck McGregor, Jaffe Acoustics, Inc., Norwalk, CT; (203) 838-4167.

MASSACHUSETTS

Boston: Hayden Hall, Boston University, 2,C. Contact: Chuck McGregor, Jaffe Acoustics, Norwalk, CT; (203) 838-4167.

MICHIGAN

Clawson: Design Evangelistic Temple, 3,A. Contact: Wade Bray, Jaffe Acoustics, Norwalk, CT; (203) 838-4167.

MINNESOTA

Minneapolis: Minneapolis Armory, NA, A. Contact: Steve Orfield, Orfield Associates, Minneapolis, MN; (612) 727-2557.

MISSOURI

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

NEW YORK

Astoria: American Museum of Moving Images, NA,C. Contact: Wade Bray, Jaffe Acoustics, Norwalk, CT; (203) 838-4167.

OHIO

Columbus: Ohio State Office Tower (Office) NA, D. Contact: Chuck McGregor, Jaffe Acoustics, Inc., Norwalk, CT; (203) 838-4167.

Kettering: Lincoln Park Amphitheatre, NA,A. Contact: Chuck McGregor, Jaffe Acoustics, Norwalk, CT; (203) 838-4167.

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COMING SOON TO THE RENO NSCA SHOW...

The logo for NSCA-TV NEWS is displayed in white on a black, horizontal brushstroke background. The letters 'NSCA' are large and stylized, with the 'N' and 'S' having a circular cutout. Below 'NSCA', the words 'TV NEWS' are written in a smaller, sans-serif font.

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CLOSER LOOK

(continued from page 56)

systems have the HF diaphragm behind the woofer; it is in front on this one. Well, according to Mitchell, the CAT 40 is, in fact, time aligned at the crossover, thanks to a combination of group delay characteristics in the crossover network, and the location of the driver diaphragms. Thus, the imaging and dispersion should, indeed, be stable and smooth through the crossover region.

Frazier states the system is primarily for speech reinforcement, but we note that it has quite a wide bandwidth and may be suitable for many wide-range musical applications. Frazier does sell a CAT Subwoofer (40 to 100 Hz \pm 3 dB, 150W AES rated) to complement the CAT 40 for those applications where deeper bass is required. The CAT 40 is rated at 85 Watts, according to the AES standard. That is pretty much a thermal restriction, with peak power at some four times the 85 Watt level. In fact, Mitchell tells us he has been using a 500 Watt amp, and has only managed to do cosmetic damage to the system (on a particularly loud

bass note, the dust cap on the woofer banged into the back of the compression driver, denting itself).

The compression driver ought to be able to handle plenty of power, despite its relatively small diaphragm, since the diaphragm is phenolic and is fluid-coupled to the magnetic structure for additional cooling. (Perhaps it is the somewhat less transparent sound quality of phenolic diaphragms that leads Frazier to target this model primarily for speech reinforcement).

While not available at the time we wrote this column, a new data sheet which includes TEF measurements was supposed to be hot off the press by the time you read this issue of *Sound & Communications*. Apparently Frazier is serious about describing their products so that they (a) conform to AES standards, and (b) provide adequate information for the consultant to specify them.

From what we can determine, the CAT 40 should be an excellent choice for sound reinforcement where broad, uniform coverage is required. The back of the standard cabinet includes 1/4-inch by 20 holes to accommodate a 2-piece extruded aluminum moun-

ting bracket. Mounts are optionally available for drop ceilings, which complement the optional matching transformers.

The CAT 40 should also be ideal for suspension in gymnasium settings. Its enclosure provides proper baffling without need for "cans" that often don't go down very low in bass response, or costly custom-made baffle boxes that complicate installations. Since the dispersion is very wide, fewer units will be required in distributed systems.

Due to its light weight, however, the CAT 40 (particularly the carpeted, metal-grille version, which includes a carrying handle) may prove popular in portable systems, too. Another use we anticipate for the CAT 40 is to reproduce the surround sound in motion picture theatres (Frazier has a smaller model that is already popular in this application).

A compact, conical-horn loaded 2-way enclosure is something of an oddity in professional applications. From what we can see, Frazier has built a potentially useful loudspeaker system that deserves your *Closer Look*. ■

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What's So Great About The New Power Amp From HME?



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HME's compact new PA120 packs more watts per dollar than any other power amp in its class. With 60 watts per channel, this stereo power amp is ideal for churches, lounges and theatres.

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The PA120 won't have you pounding the pavement looking for fuses. An output protection relay circuit protects the PA120 from damage due to short circuits, and provides quiet turn on and turn off operation.

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WORLD HARVEST

(continued from page 47)

pin connectors. The stage mic set-up is designed so that when the sets are cleared the mic lines stay in the floor in conduit with amp connectors. The monitor position, usually center stage and at the back, has ample cable to move to either side for musical productions. The stage layout is as follows: 40 inputs under the band set in conduit, 16 inputs are under the singer set, six sets of six pairs are along the front of the stage with a monitor cable, and four inputs at the front of the pulpit area (two at each monitor speaker.)

The band consists of the rhythm section: drums (full trap set) percussion, bass, lead and rhythm guitars. The keyboards are piano, synthesizer, and Hammond Organ. The brass section: four trombones, five trumpets, five saxes and three flutes. The vocal section has 16 singers plus two soloists and the song leader.

The stage is 85 feet across and 22 feet in depth. Center stage and one floor up is the Baptismal area, revealed when the curtains are opened. To both

sides of the stage are rear screen video projectors that either show the words to the songs, or the video output from the production switcher. The house mixing station is at the rear and center of the lower section in the sanctuary. The lighting console is also located in this area (15 feet by 6 feet with a 42 inch wall) with custom racks and table top it gives a very neat high-tech look. Marcus had a canvas cover sewn with the Church logo on it which looks great and keeps out the curious when the space is not in use.

Installation

The World Harvest sound system was installed in two weeks, with the bulk done during the week of Thanksgiving. The first service was on Sunday, November 29, 1987, at 10 a.m. During the first week, Gepeco multi-pair cable was pulled through the conduit, and the underground tunnel (it feeds the TV engineering). Mike Grimm from C.S.S. Audio in Morton, Illinois, oversaw the final stages of wiring the house and monitor consoles, and hanging the first small cluster of speakers. The cable was pulled in three days, and the fabricating of the

angle iron that was to become a harness around the 10 stacks of speakers took longer than expected due to the other demands on the welders.

On Friday at noon, the last phases of setting the speakers in place began. The main group of speakers were much heavier and required more time to fly. The first cluster (Area 3) flew around 5:30 a.m. Saturday—we ended up using lots of manpower as the power winch (a 3,000 lb test) kept blowing the breaker—the largest and heaviest (1,800 lbs.) went up first. With the last of the speakers in place, and the Kimber cable being run by one crew, another crew worked on the endless ELCO connectors supplied from Pro CO. The author wired the distribution amplifier for the amps and the outboard gear at the house.

After telling the tired and nervous pastor for five hours, “just a few more minutes,” at 11:40 p.m., we fired up the system, played a CD, and proceeded to “smoke their socks off.” The system sounded great with a few minor wiring glitches. All speakers in phase, and with all amps cooking happily, we still had 10 whole hours till 4,000 people would be in for Sunday

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worship services. By this time the crew had been working around the clock since Friday.

Everybody was pleased things were working, but there was much left to be done. The rest of the night was spent watching the paint dry on the sets so mics could be placed on the band set—no small task. Just after 8:00 a.m. it was realized that the ELCO connectors for the monitor board had been pinned upside-down. In the time left, we could only hook up the lines between the house and monitor consoles, and the author mixed monitors as well as the house.

First service, 51 hours straight, no rehearsals, no real-time analyzer to pink-noise the monitors, so we improvised and by 10:10 we were ready to have Church. We got through the first service—no casualties—that was recorded by the television crew, for broadcast locally. That afternoon after a one and a half hour nap it was back to the ELCO's, getting the monitor board happening, mixing the evening service—a concert by a Texas based singer—that further helped to test the system. Just after 10:45 p.m. we turned out the lights and crashed.

The next day was spent finding tools and cleaning up a few loose ends.

The equipment package came from the Washington Professional Systems, a division of Chuck Levin's Washington Music. The system was installed with the help of Mike Grimm, the volunteer crew from World Harvest Church, and Marcus Vegh working around the clock to meet the deadline. What more could you ask for? A quality system, under budget, on time, and sounding good. ■

Sandy Dillion is currently Director of Audio and Video with Bethany World Prayer Center and has been a radio announcer for four years. He has consulted for CBN, Rock Church, Evangel Temple (video & audio) Bethany World Prayer Center, PTL TV, and the Jimmy Swaggart Ministries.

POWER AMPS

(continued from page 30)

presence lights, an operator can easily see which unit(s) in a bank of many amps is not functioning. Similarly, overload indicators are important as well.

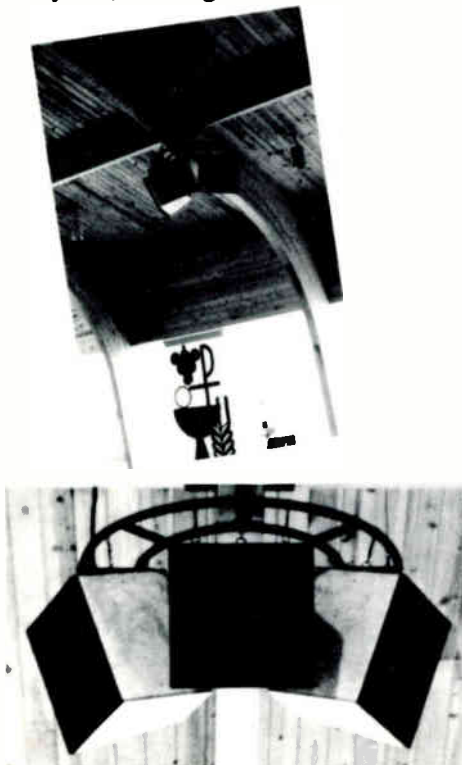
Few manufacturers list how their amps handle reactive loads, some critics said. Since most loudspeakers are very reactive and variances between models are vastly different, consultants would like to see specifications of power amplifier performance into reactive loads on data sheets.

Another request from a wish list included more manufacturer research concerning the effects of dynamic speaker loads on power amps. "I think the manufacturers are still looking at sine waves too much," McGregor said. "They should attack their designs from time delay rather than frequency delay."

While few contractors mentioned price, Altel Sound Systems Inc., New York, listed price as a top priority. Prices differ widely in regard to application, but in general Altel prices amps around the \$5 per watt range, according to Purchasing Manager, Jack Bilodeau. Serviceability is a key factor also, and many contractors are leaning towards power amps that easily slip out of racks for servicing.

Some contractors even review a manufacturer's attitude on system problems. "I like a manufacturer that

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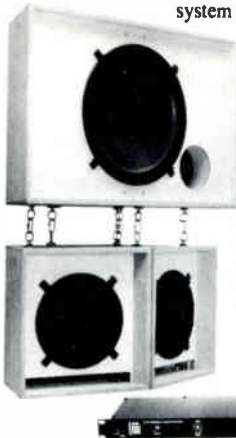


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wants to know what a problem is in a system even if their product isn't at fault—the kind of manufacturer who's concerned that one problem tarnishes the whole system," Shaw added.

One reason only a small group of amps are preferred by sound specialists is reliability and manufacturer back-up, according to all.

With most power amps offering similar features, reliability and after sale services are many times the deciding factor when consultants and contractors specify amplification. Clearly, the marketplace criteria for amplifiers are becoming size, efficiency, input features, and audio quality, versus output power per dollar. ■

CONTRACTING

(continued from page 60)

The total time required for installation and training of this phase of Silicon System's CCTV system took less than three weeks.

Perhaps the most interesting aspect of installation was the laying of 1,500 feet of cable from the two cameras in the back parking lot to the security office, "To lay the cables, we asked the installers to take the long way around," Meyers said. "That is, rather than dig directly through the asphalt parking lot, which would have been very expensive and an inconvenience to everyone, we requested that the cable be laid in the landscape soil surrounding the facility."

Thin, 18-inch trenches were dug into the ground to lay the cable, with a pull box located every 50 feet to ensure future identification of connection problems and maintenance.

Another aspect of installation was the placing of a "panic button" at the base of the camera pole in back of Building B. Should an employee encounter an emergency situation, pushing the panic button will initiate a P/A system that can be heard inside the security office.

Silicon Systems expanded its CCTV system in 1987. The company added eight more cameras, three more monitors, an additional digital multiplexer timelapse recorder and a video camera switcher—all stored in the security office.

Two cameras monitor the inside and outside of Silicon Systems' shipping door at the back of Building B. The camera outputs are simultaneously

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displayed on a single monitor using the digital multiplexer, but are not linked to a recorder.

The last six cameras are located in interior settings for a variety of purposes.

Four of these cameras are triggered by a motion detector and provide views of a company safe, the office supply center, the cafeteria and the interior of a gas blockhouse in back of Building A. One monitor in the security office displays the outputs from these cameras when activated. When more than one camera is triggered, the monitor displays the views via sequential switching.

The sixth interior camera is focused on a photocopier machine and its output is shown continuously on the fifth and final video monitor. A single time-lapse recorder can record the outputs from all six interiors cameras as they are all linked with the switching device.

In December, 1987, the company completed construction on a third building at its headquarters facility. Meyers expects to double the size of his CCTV configuration in 1988. ■

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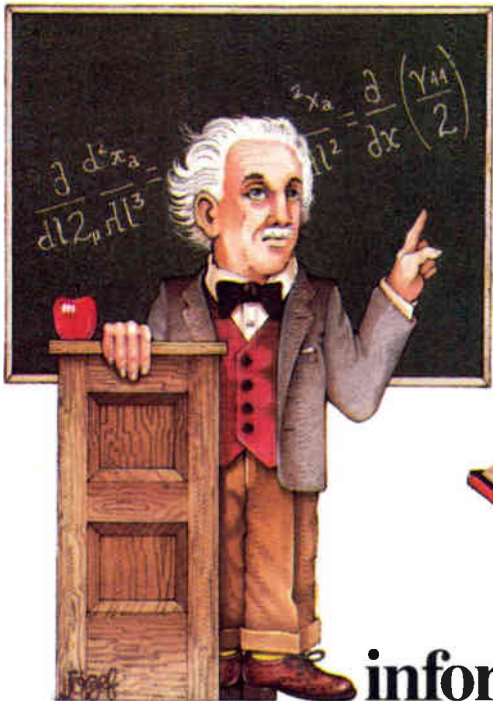
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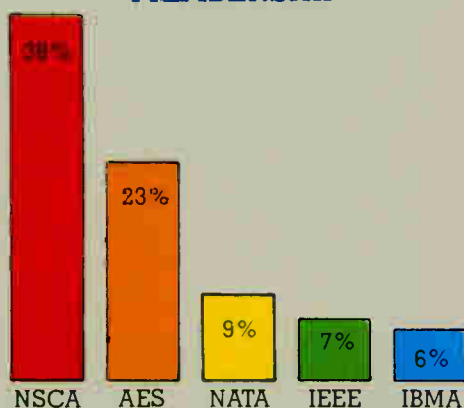
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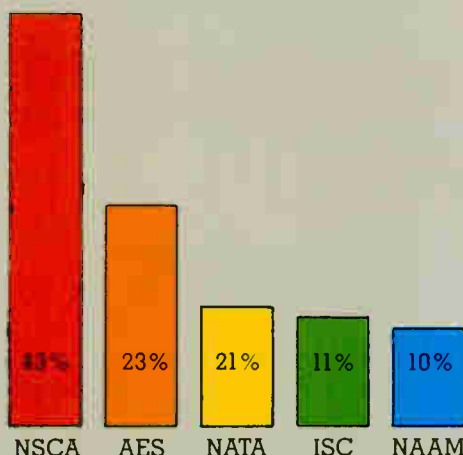
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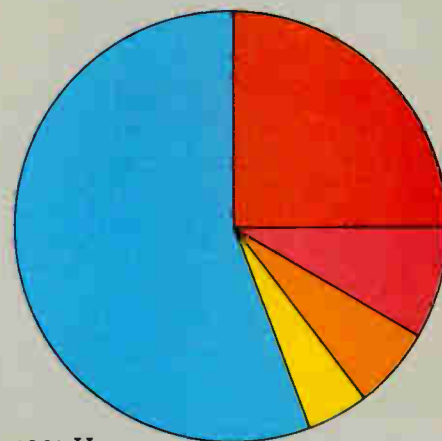
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CONVENTIONS ATTENDED



USE OF COMPUTERS



ly 4.9 percent did sales of tape cartridge, 4.5 percent engaged in SCA/satellite, and 5.2 percent checked music library rental/programming. Clearly, the vast majority of background music business done by our respondents was in system hardware.

Under "Equipment Brands," we asked two related questions: List the three top lines you are selling; and List the three manufacturers you have the best relationship with. One might expect the answers to the two questions to be the same, and in fact the result came very close to that. There were, however, vast fluctuations within individual responses.

When the results were tabulated, the "three top lines you are selling" came out to: TOA, Atlas/Soundolier and JBL. The three manufacturers with the best relationship were TOA and Atlas-Soundolier, with JBL and Electro-Voice tied for third place. (These results are pretty much consistent with last year's results.)

On an individual basis, however, many respondents listed their three top brands with totally different top relationship companies. For instance, one response read: Top selling — Dukane, Bunting, 3M; best relationship — Altec, TOA, Atlas. More typical were reversals of positions. For instance: Best selling — 3M, Muzak, AEI; best relationship — 3M, AEI, Muzak. Or: Best selling — Altec, JBL, Yamaha; best relationship — Yamaha, Altec, Comtek. Clearly, the relative placement of the companies often

depends on individual factory salespeople, reps or distributors and the nature of a particular sound contractor's business.

Surprisingly, however, it all balanced out in the end, with best sellers and best relationships somewhat in sync.

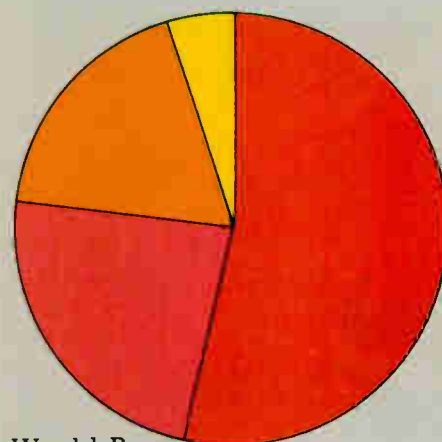
THE CONTRACTORS THEMSELVES

What are the interests of sound contractors? We asked our subjects what organizations they belong to. Sound contractors are a rather technical group. As might be expected, the biggest percentage, 37.7 percent, belong to NSCA. The next largest group, 22.8 percent, belong to the AES. Nine point three percent belong to the IEEE; six percent belong to the IBMA. Only .4 percent belong to the NCAC.

Of the conventions attended by our respondents, NSCA racked up the highest percentage, with 42.5 percent of the respondents attending the NSCA convention (although only 37.7 percent actually are members of NSCA). Twenty-two point eight percent attend the AES convention; 11.6 percent attend NATA; 11.2 percent attend ISC; 8.2 percent attend Commtext; and 6.7 percent attend IBMA. (Only 4.1 percent attend the SMPTE convention, although 4.5 percent belong to SMPTE.)

40% Use

- IBM-PC/XT/AT 62%
- IBM System 2 14%
- Apple 13%
- MAC 11%

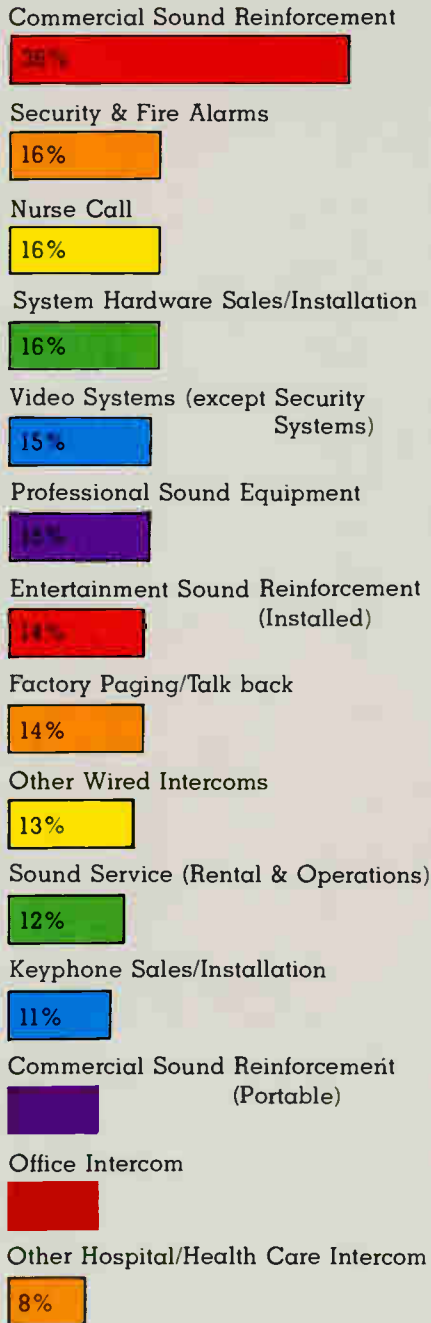


Would Buy

- IBM-PC/XT/AT 55%
- IBM System 2 23%
- MAC 18%
- Apple 4%

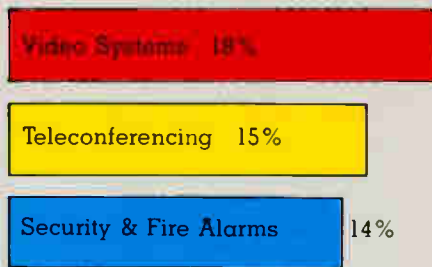
How do contractors work? Of those of our respondents using a personal computer (not including accounting systems), 61.8 percent use an IBM PC/XT/AT; 14.4 percent use an IBM System 2; 12.6 percent use an Apple; and 11.2 percent use a MacIntosh.

MOST IMPORTANT MARKETS IN 1987



Of those respondents planning to purchase a computer, 55 percent plan to buy an IBM PC/XT/AT; 23.4 percent plan on

MOST NEGLECTED MARKETS



the IBM System 2; 17.8 percent plan on a MacIntosh; and only 3.8 percent are planning to buy an Apple.

Sound contractors are a hard working lot. They gave their time and energy to filling out our survey forms (for which we are appreciative). They are making projections based on finessing the markets they serve; and they are attending conventions and reading the literature. The market shows no great flip flops from one year to another; it is a stable growing market.

CONTRACTORS SPEAK OUT

Sound contractors are a vocal lot. Respondents to our sound contracting survey were given a space on the survey for comments. Some of the comments are reprinted here:

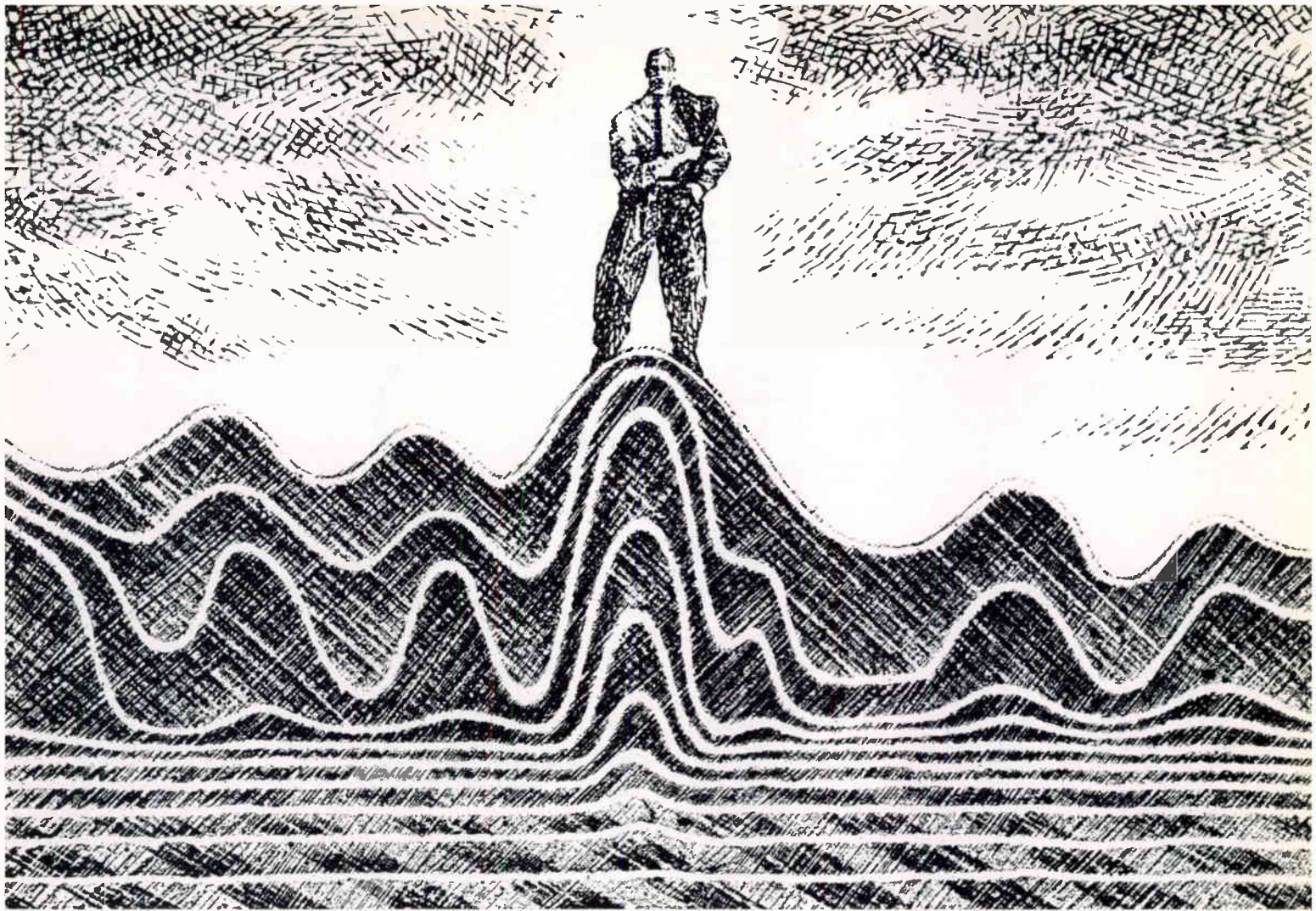
- "Suppliers very frequently do not keep their dealers informed on product availability, creating embarrassment and strained relations with customers — and loss of time on installations. Specifications on units are not reliable. We test every piece and allow lots of percent minimum and maximum. They could do better!"
- "The public is not educated enough about electronic systems, in general. That could make life a lot easier."
- "On a national, state or local level, there should be an exam or certification to qualified sound/electronic contractors so that the end-user knows that he is getting quality equipment, installation, and or service. The end user could also expect to pay more for a qualified technician."

"Sound contracting is a very lucrative business if you are able to deal with all the governmental b.s."

- "We've found in the BGM area a lack of promotional material from suppliers (producers) that is available for promotions like direct mail campaigns or any other promotion of BGM to the end user (prospective clients)."
- "There is a lot of money out there, and one must remember that after the sale the only thing left is service."
- "Weed out incompetents! A lot of systems make sound but are unintelligible and not engineered properly. Make the customer more aware of high quality systems that work."
- "There seem to be many well paid audio engineering firms with little practical experience. We need to work together to separate audio specs from electrical in contract bids. As an industry we should strive to educate the public on the benefits of our industry."
- "Quality control in all phases leaves much to be desired and affects our business."
- "I feel betrayed and angered by those manufacturers who thwart our efforts to abide by the copyright laws by integrating AM/FM receivers with their amplifier line. These companies apparently feel it's okay to use 'free' radio as an alternative to a commercial music supplier."
- "The sound industry as a whole still believes that profit is a dirty word. They sell equipment at a 10 percent or 20 percent markup, then pay themselves \$15 per hour as a job progresses. No other industry works so cheap."

Sound & Communications magazine appreciates the time our survey respondents spent filling out the form, and adding their own comments.

This report was written by the staff of Sound & Communications. Research assistant Daniel G. Fraas.



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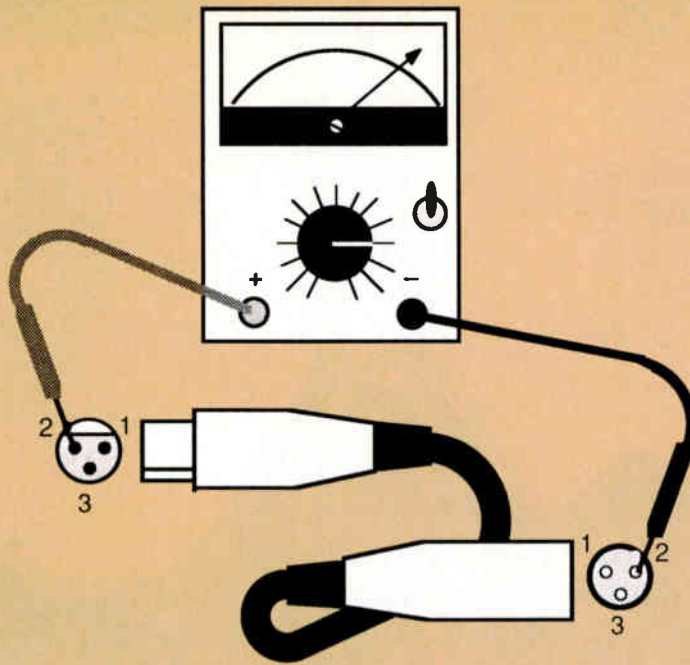


Figure 1. Continuity Measurement with a VOM

This installment describes the most common types of test equipment used in setting up and operating sound systems.

A full course in measurement and instrumentation is clearly far beyond the scope of this article. The examples

given here represent only a small sample of the possible uses for audio test equipment, and are intended to provide an introduction to the basic principles of sound system measurement.

The Volt-Ohm Meter

Volt-ohm meters (VOMs) are among the most useful

SOUND SYSTEM TEST EQUIPMENT

by **Gary Davis**
(A reprint from the Yamaha Sound Reinforcement Handbook)

Editor's Note: The Sound Reinforcement Handbook was written for Yamaha by Gary Davis and Ralph Jones and published by Hal Leonard Publishing Corporation at the end of 1987. The dedication reads: "This handbook is dedicated to the sound reinforcement industry, and to all those people who have worked so hard to bring better sound and music to the world." Sound and Communications magazine is pleased to reprint, by permission, Part II, Section 7, "Sound System Test Equipment." The Sound Reinforcement Handbook is copyright 1987 by Yamaha Music Corporation and Gary Davis & Associates.

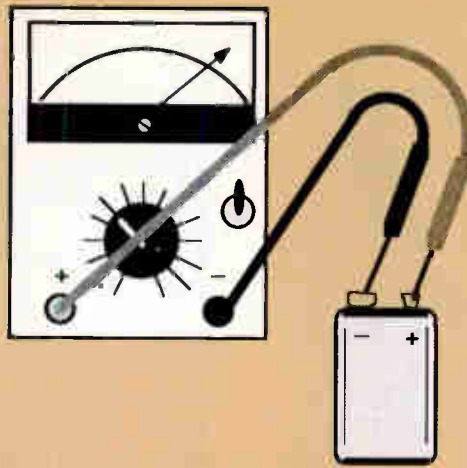


Figure 2. DC Voltage Measurement with a VOM

tools in the sound technician's tool kit. VOMs can perform a wide variety of tests, and are used in servicing all types of electronic equipment.

As the name implies, a VOM is actually two instruments: a voltmeter (which measures voltage), and an ohmmeter (which measures resistance). Both sections will incorporate switch-selectable ranges.

The voltmeter section of a

There is also a difference between "average" and "RMS" reading voltmeters. For the purpose of measuring pure sine waves, an "average" reading VOM is sufficient. However, the accurate measurement of the value of an audio signal, with complex waveforms, requires a true RMS detector circuit. Such circuits tend to be expensive, so many VOMs cut corners and use a less complex averaging circuit. De-

TEST EQUIPMENT

VOM usually is capable of both DC and AC voltage measurement. For audio purposes, the AC voltage section of the VOM should remain accurate throughout the full audio band (20 Hz to 20 kHz); some VOMs are not accurate above 1 kHz, however, so be sure to check the meter's specifications.

pending on the frequency and waveform, the "RMS" reading obtained with such meters on an audio signal can be inaccurate. For gross audio signal level measurements, it may not make a difference to you, but for precise measurements, you'll want to use a meter with a true RMS detector.

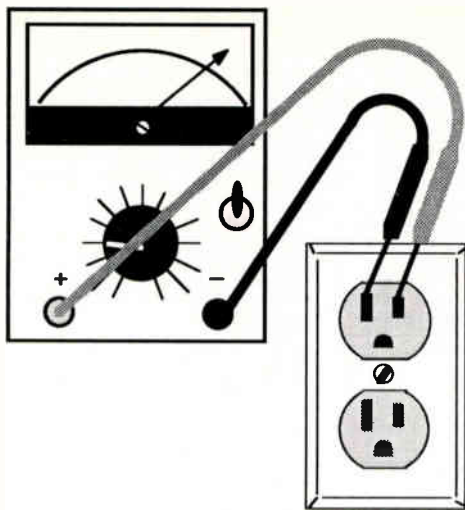


Figure 3. AC Voltage Measurement with a VOM

The most common type of display used in VOMs is the meter movement, consisting of a galvanometer-driven needle superimposed over a scale from which readings are taken. In digital VOMs (also called "DVMs"—an abbreviation for Digital Voltmeters, not doctors of veterinary medicine), multiple-digit liquid crystal displays are most often used (older types of digital meters may have seven-segment LED displays which draw more power).

VOMs require two wires, called probes, for connection to the electrical points that are to be measured. VOM probes are normally color-coded: The red probe is the "+" or positive connection, and the black is the "-" or negative. In some measurements, the polarity of connection is crucial to the measurement; in others, it does not matter.

Figure 1 shows the use of a VOM to measure continuity in a cable. This measurement

uses the resistance-measuring (ohmmeter) circuit of the VOM. Note that polarity of the probe connections does not matter. If more than a few ohms resistance are measured here, the cable conductors may be too small for the length of cable, there may be a frayed conductor (with broken strands), or a bad solder joint at one of the connectors. On the other hand, continuity and resistance measurements rely upon a battery in the VOM to provide a test voltage; as the battery ages, the meter must be recalibrated. Make sure you first "zero" the meter by touching the meter probes directly to one another and adjusting the calibration knob on the meter (nearly all VOMs have one) until 0 ohms resistance is indicated. If a zero reading cannot be obtained, replace the battery in the VOM.

Figure 2 shows the use of a VOM to measure a battery. This measurement uses the DC voltage-measuring circuit

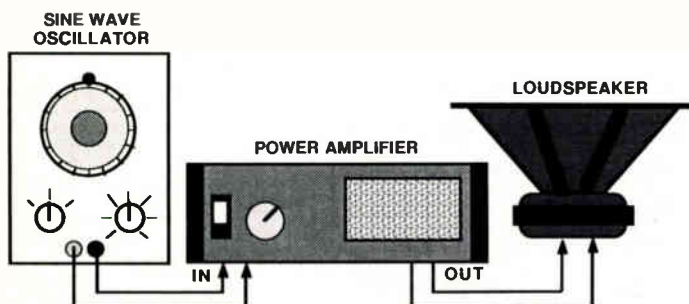


Figure 4. Driver Testing with a Sine Wave Oscillator and a Power Amplifier

of the VOM. Polarity of the probe connection is important in this case.

Figure 3 shows the use of a VOM to check the line voltage. This test uses the AC voltage-measuring circuit of the VOM. Polarity of the probe connection is not important, but it is very important to (1) be sure that the range switch of the VOM is set correctly (to "AC" and a sufficiently high voltage range); and (2) be extremely careful with the handling of the probes, to avoid electrical shock and to avoid short-circuiting the outlet by touching the probes together.

The Sine Wave Oscillator

A sine wave oscillator is a signal-generator that produces a sine wave output. Normally, both the frequency and the output level are variable.

detecting distortion—which will show up as an obvious change in tone quality. The change in tone is caused by added harmonics, which are products of the distortion. Some examples of uses of the sine wave oscillator are given below.

Figure 4 shows use of the sine wave oscillator to test a driver. By sweeping the frequency of the oscillator and listening carefully, you can find mechanical defects (such as a loose suspension), most of which will cause a distinct buzzing sound. To test for coil rubbing in a midrange cone type driver, set the frequency of the oscillator to between 5 Hz and 10 Hz; coil rubbing should show up as a scraping sound. An easier, and just as effective, technique is to gently press the cone in from the front, and push it out from be-

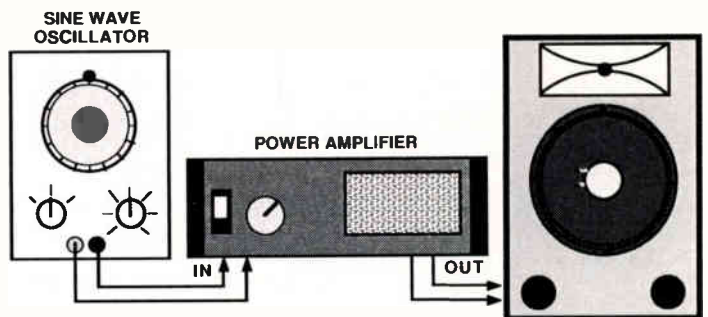


Figure 5. Loudspeaker System Testing with a Sine Wave Oscillator and a Power Amplifier

For sound system measurements, it is best if the oscillator covers the full audio range from 20 Hz to 20 kHz (actually, it's better to go beyond this range so that filter cut-off points or amplifier bandwidths can be accurately established). Some sine wave oscillators have output level controls that are calibrated in dBu (or dBm), and this feature can be very useful in audio work (although it is not essential). The distortion figure of the oscillator must be as low as possible.

Sine wave oscillators are used for a wide variety of sound system measurements which require a known signal source. Since the sine wave is the purest wave found in nature and has no harmonics, it is particularly useful for de-

hind (symmetrically) and to feel for any scraping (and listen for it, too).

In Figure 5, we replace the driver with a loudspeaker system. By sweeping the oscillator in this setup, you can detect not only driver defects, but also cabinet resonances, loose hardware, and other mechanical sources of distortion—all of which will tend to show up at low frequencies. You must be careful, however, not to be confused by resonances in the room (loose ceiling tiles or wallboard, fluorescent light fixtures, and so on). If the test can be done outdoors, of course, such spurious "sympathetic vibrations" can be eliminated. On the other hand, sometimes it is beneficial to run the test in the actual listening environ-

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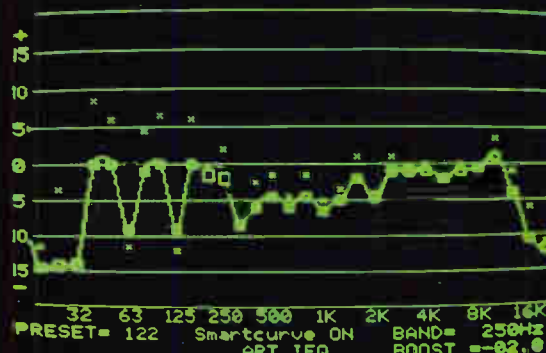
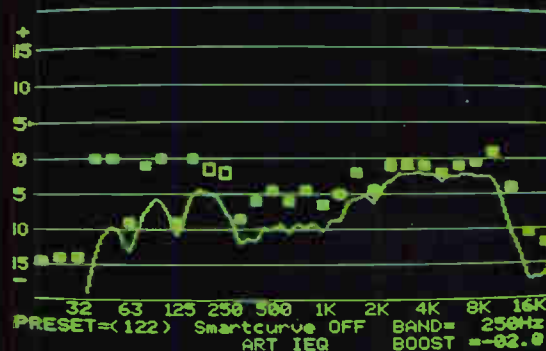
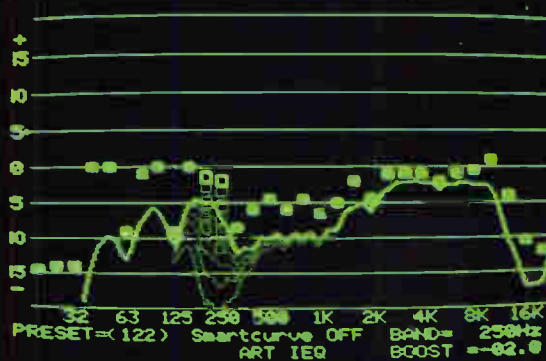
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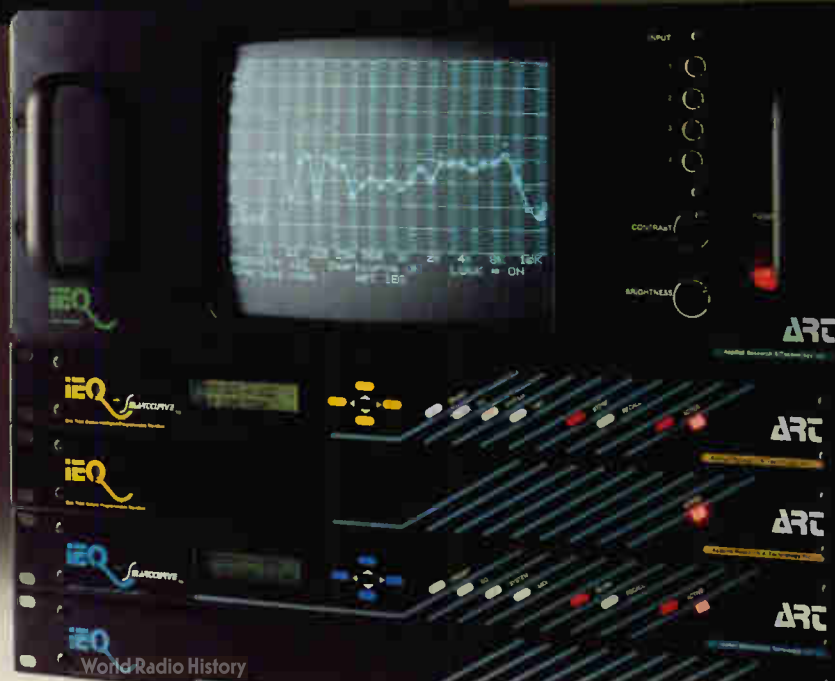
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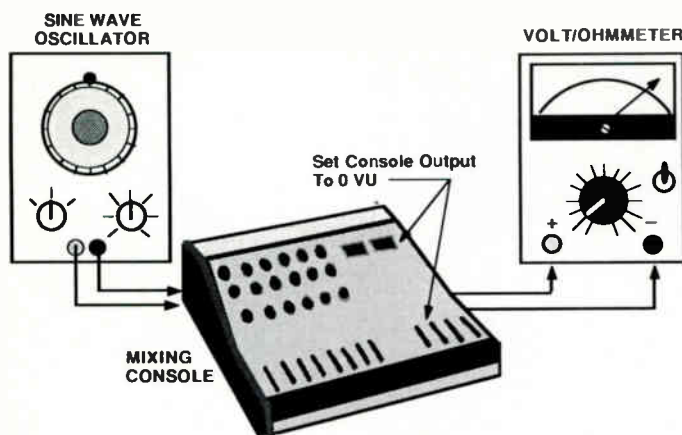


Figure 6. Measuring Nominal Operating Levels with a Sine Wave Oscillator and a VOM

ment so that the loose tiles, etc. can be found and dealt with.

Figure 6 illustrates use of the sine wave oscillator and an RMS-reading voltmeter (or VOM) to check the operating level of a mixer or other component employing VU meters. The normal frequency to use for this test is 1 kHz.

The system levels are first set so that the meter reads 0

VU. This is best done by starting with a known output level from the oscillator (generally 0.775 volt RMS for 0 dBu rated inputs, or 0.316 volt RMS for -10 dBV rated inputs), and then adjusting the level control of the equipment under test.

When the sound equipment's output meter reads 0 VU, the reading on the voltmeter is the nominal operating

level. If a dBu scale is not provided on the VOM, the equivalent value in dBu is readily calculated (see "Yamaha Sound Reinforcement Handbook," Part 1, section 8.7, "Operating Levels").

CAUTION: If the equipment has a transformer output, it probably should be terminated by a resistor equal to its rated load impedance (600 ohms, for example), and the speakers, if any, must be disconnected. Consult the equipment manual. With a 600 ohm termination, the "dbu" scale on the voltmeter will represent the output power in dbm.

A related test is shown in Figure 7; here we use the sine wave oscillator and RMS-reading voltmeter to test the maximum available gain of a signal processor. First, we set the oscillator output to a predetermined level (say, 0.775 volt RMS to test a line input). With all level controls on the equipment set at 10 (or fully clockwise), we measure the

output level of the equipment. The ratio of the output level to the input level, expressed in dB, is the gain of the device.

NOTE: The test signal level should not be high enough to overdrive the input of the equipment. If, for example, a microphone input is used, then a mic-level signal should be used for the test; using a line level input here would not yield valid results.

The Oscilloscope

The oscilloscope displays a

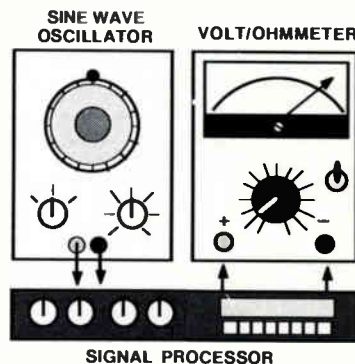


Figure 7. Measuring Signal Processor Gain with a Sine Wave Oscillator and a VOM

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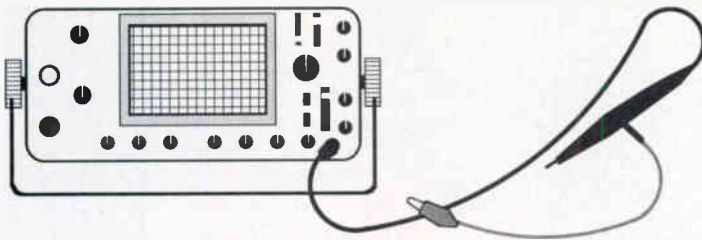


Figure 8. A Typical Oscilloscope and Probe

visual representation of an electrical signal. The signal is traced on the face of a phosphorcoated screen (a "CRT" or cathode ray tube) by an electron beam, appearing as a line of light on the screen.

Normally, the oscilloscope displays a signal as a function of time by sweeping the beam horizontally from left to right across the screen. When the beam reaches the right edge of the screen, it jumps back to the left edge and begins its transit across the screen again. The speed of the sweep determines the time interval that is represented by the width of the screen: the faster the sweep, the shorter the interval.

As in the case of the VOM, the oscilloscope is connected to the circuit points under test using a probe. An oscilloscope probe normally provides connections for both ground (or the reference point) and the signal to be displayed. Figure 8 shows a typical oscilloscope and its probe. Sometimes special probes are used for extended range measurements (*i.e.*,

greater sensitivity or very high frequencies).

The signal to be displayed is connected so that its instantaneous voltage deflects the beam in the vertical axis around a center line. Points above the line represent a positive signal voltage, and those below the line represent a negative voltage (referred to ground). For example, Figure 9 shows a typical oscilloscope trace of the output of a sine wave generator.

An oscilloscope can function as a form of voltmeter if its vertical sensitivity is calibrated. For example, look at the display of Figure 9. Note that the total vertical deflection of the sine wave is four divisions of the graticule grid (two above and two below the center line). If the vertical sensitivity of the oscilloscope is set at 0.25 volts per division, then the sine wave amplitude is 2 volts peak-to-peak. To obtain the RMS value, divide by two times the square root of two; the result is 0.707 volts RMS.

If we have an RMS-reading

voltmeter, or course, we can obtain this reading directly, without calculation. Measuring signal levels is in fact a relatively trivial use of the oscilloscope. The oscilloscope can tell us much more about a signal than can the VOM, and it is normally used together with the VOM and other test equipment to get a full picture of the behavior of a circuit.

For example, Figure 10 illustrates use of an oscilloscope, a sine wave oscillator, and an

resistor and repeating the test. The power output is the reading of the voltmeter squared, divided by the resistance value. If we read 45 volts RMS, for example:

$$P = 45^2 \div 8 \\ = 2025 \div 8 \\ \approx 250 \text{ watts}$$

Similarly, we can use the oscilloscope wherever we wish to be sure of the presence of a signal and the integrity of that signal. It becomes clear, for example, what portion of the measured signal is program,

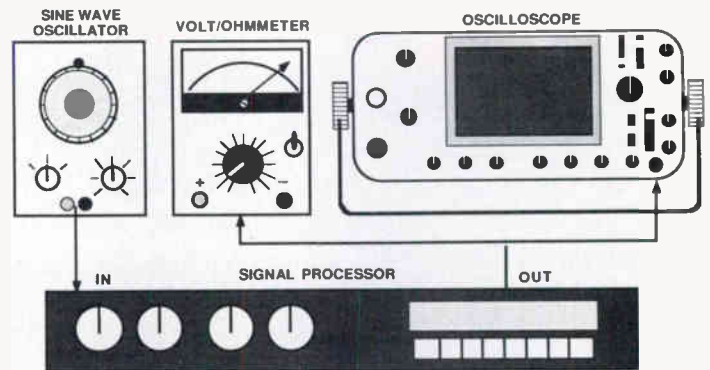


Figure 10. Measurement of Maximum Output Level

RMS-reading voltmeter to check the maximum output level of a signal processor. With the processor level controls (if any) set to maximum, the oscillator output level is adjusted just until the sine wave appears on the oscilloscope to be clipped. Backing off the oscillator level to just below clipping, we read the maximum signal level in RMS volts on the voltmeter.

NOTE: The VOM and oscilloscope will normally have very high input impedances. This test should be done with a load termination across the signal processor that is equivalent to a practical "real world" load if the processor is normally terminated. Otherwise, the measured clipping point may be higher than it would be under actual operating conditions.

If the signal processor in Figure 10 is a power amplifier, we can use this test to determine its maximum power capability into 8 ohms by loading the output with a high-power, non-inductive 8 ohm

and what portion is residual hum and noise.

The Phase Tester

Phase testers are used to determine the polarity of a circuit. Phase testers work by emitting an electrical pulse of known polarity (usually positive-going) which is connected to pass through the circuit under test. The output of the circuit is connected back to the measurement input of the phase tester, which compares the received signal against the pulse that the phase tester is emitting.

Often, phase testers give readings using two lights labeled "+" and "-" or similar nomenclature. If the pulse coming into the measurement input is in phase with the emitted pulse, the "+" light will flash; if it is out of phase, the "-" light flashes.

Figure 11 illustrates use of a phase tester to check the throughput polarity of a signal processor.

Phase testers are also sometimes used to check the wir-

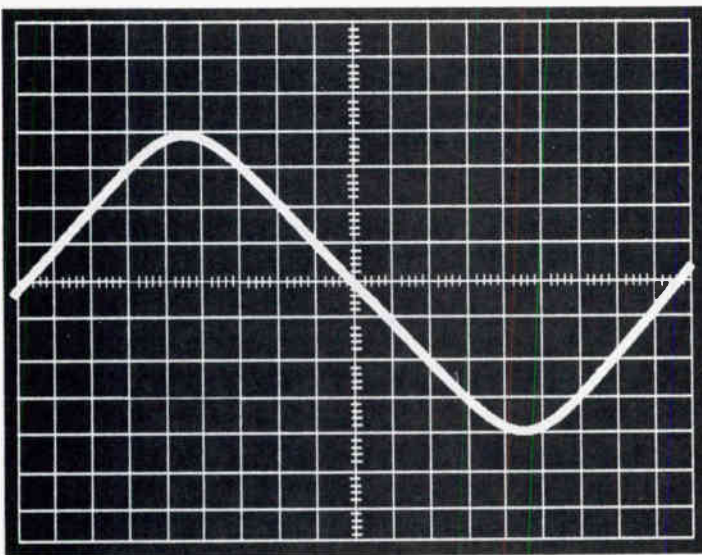


Figure 9. Oscilloscope Display of a Sine Wave



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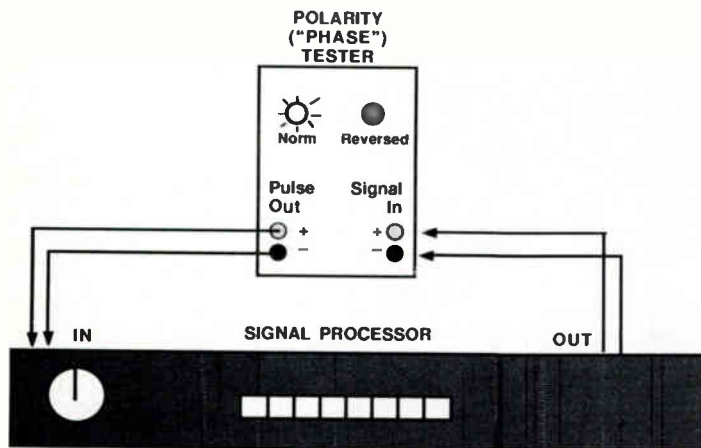


Figure 11. Checking the Polarity of a Signal Processor

ing of loudspeakers to make sure that they are in phase with one another. In this case, a microphone is used to capture the loudspeaker output, as shown in Figure 12.

Some cautions are in order regarding the use of phase testers. They are relatively sensitive devices, and will give spurious readings under a variety of circumstances. It is important when using a phase tester that you be aware of the

following quirks, in order to guard against incorrect readings:

1. Some phase testers are highly level-sensitive: If the input level at the measurement input does not fall within a specific range, the readings may be unstable or inconsistent.

2. Devices exhibiting a non-linear phase characteristic, limited frequency response, or a substantial amount of pure

delay will confuse phase testers, resulting in inconsistent readings.

3. In testing groups of speakers, each speaker must be tested independently, with the others turned off. If one speaker in a group of four is out of phase, and is tested while the others are also reproducing the test pulse, the acoustic signal from the other speakers will "swamp"

that of the out-of-phase unit, making it appear to be in phase. This effect is most noticeable at low frequencies, where you may not need a phase checker anyway because your ears can usually hear the problem. ■

Part 2 of this article will appear next issue and will cover other items of interest in addition to a summary of the entire article.

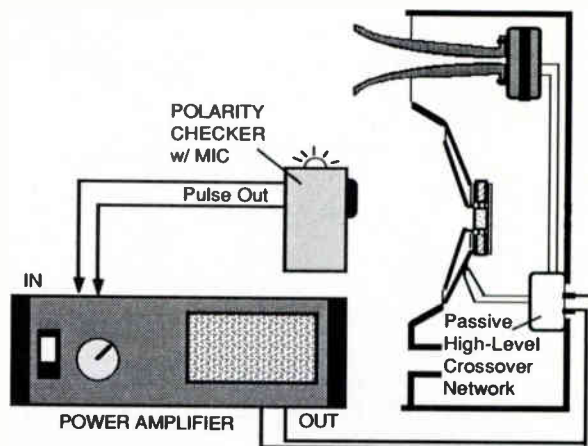


Figure 12. Checking the Polarity of a Loudspeaker

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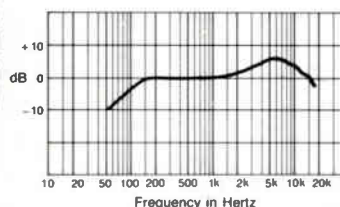
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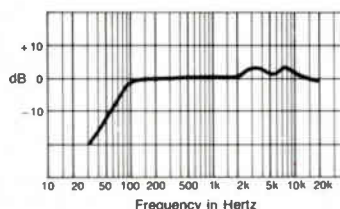
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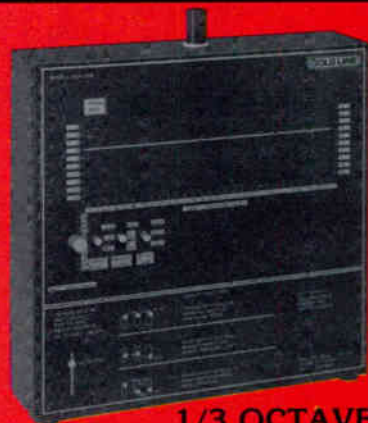
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I just read the most fascinating, and frustrating book. It said... well, read the next review in *Sound & Communications*. I can't wait to tell you all about it. ■

Ted Uzzle is a member of AES, the Acoustical Society, and SMPTE. He is director of marketing development at Altec Lansing

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CONTRACTOR PRICES

Circle 233 on Reader Response Card

FACES AND PLACES

New Sales Engineer at Systems Wireless

Bill Winn has joined Systems Wireless, Ltd. as sales engineer for wireless microphones, wireless headsets and intercom systems. Winn has over 10 years experience in audio, and was recently on the road as monitor mixer for Whitney Houston. In addition, he has experience as production manager for television specials and has done road work for several major performers.

Winn is responsible for sales efforts of Systems Wireless wireless products as well as intercom systems, with a special emphasis on live media applications.

TOA "West Coast" Open for Business

Toa Electronics, Inc. has a new location in Richmond, British Columbia. The facility was opened "in order to improve service to accounts in the lower Mainland, Vancouver Island and the B.C. interior," according to the

company. Harry Boyce is managing the new office. Boyce was previously at both A&B Sound and Mother's Music. He also has experience in the design and construction of recording studio and disco systems.



RONALD L. EBERSOLE

Ebersole Joins Astatic/C.T.I.

Ronald L. Ebersole has been appointed Sales Manager of the Land Mobile Radio Division of Astatic/Conneaut Technologies, Inc. The appointment was announced by Adolph Santorine, CEO of the company. Ebersole previously served The Astatic Corporation for 16 years in various positions, and for the last four years was

Sales Manager of the OEM Division.



LEN CHARYAK

Charyak Is Distributor Sales Manager

Len Charyak has been named Distributor Sales Manager for Bogen Communications, Inc. His primary responsibility is for all Bogen distributor sales and marketing activities, including sound and intercom products and the MPD line of battery holders. He reports to David A. Chambers, National Sales Manager.

Charyak was previously Vice President, Marketing for Bird-Eye Security International, a security systems contractor.

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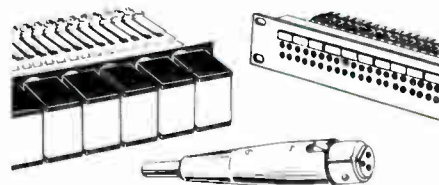
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REP NEWS

Aiphone has awarded honors to several of its reps for achievement in 1987. The "Bent Oar Award" went to **Forti Associates** for exceptional efforts in sales, marketing, technical service and customer relations. Rep of the Year award went to **Alby Currant Sales** as the representative who exceeded quota by the greatest percentage. **Forti Associates** and **Murphy & Cota** won the Million Dollar Club award for achieving \$1,000,000 in sales for that year. The Quota Busters award went to **Alby Currant Sales**, **Forti Associates**, **Earl & Brown Co.**, and **Mel Foster Technical Sales** for reps who exceeded quota. And special achievement awards went to **B.C. Electronic Sales** ("Communications Award") and **Murphy & Cota** ("Customer Service Award").

DOD Electronics has presented sales awards to several of its representatives. **Gary Castelluccio Associates** took top honors, taking three awards: the DigiTech Products Sales Award, the Sales Representative of the Year Award, and the Gold Club Award. **MBT Associates** won the Most Improved Territory Sales Award. **Crescendo and Associates** received the DOD Rack Signal Processor Sales Award and the Audio Logic Sales Award. And **Elliot Goldman**, representing the New England area, received the FX-product sales award for the most sales of FX products by any representative firm.

The **Electronics Representatives Association** again presents its services at a convention. The ERA brings its informational and lines-available services for electronics industry manufacturers to the NSCA Convention in Reno. Manufacturers stopping by the ERA exhibit booth will receive a complimentary copy of the 1988 edition of the Locator directory and will be able to use ERA's computerized Lines Available service.

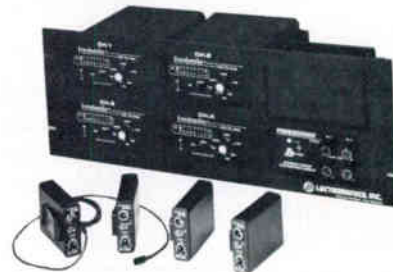
Ron Ridderhoff, previously of Darnell Sales, has joined with **Dave Miller** and **Matt Johnston** to form **MDR Sales, Inc.** They are representing **HM Electronics** pro audio products in Michigan.

Panduit Corp. has appointed **Cody Associates, Inc.** as its exclusive sales representative of the full product line in western Pennsylvania, western Maryland and all of West Virginia.

Wireless Solutions

Multi-channel headaches?

This is the solution. The PRO 4 channel system provides 4 simultaneous channels without intermodulation or crosstalk problems. The front-end and IF filtering in the R185 receiver offer the highest selectivity of any wireless receiver in the world. The DM4 distribution module provides single or dual diversity antennas/s, filters the signal with helical resonators, and maximizes the isolation between receivers.



Multiple PRO 4 channel systems may be stacked for as many channels as you need. Discrete or mixed balanced outputs are provided. Reliable performance with no headaches.

Need a different hand-held?



The H185 plug-on transmitter converts any standard microphone to wireless operation. This means you can use your best or favorite hand-held microphone . . . wireless. The typical frequency response is 50Hz to 18KHz \pm 1 dB, so that the wireless will not change the sound of your microphone or the EQ settings of your sound system. The H185 gives you the freedom of choice with a very compact and attractive plug-on transmitter.

No AC power available?

In spite of its tiny size, the CR185 miniature receiver offers broadcast quality audio with a balanced XLR audio output. It operates from an internal 9 volt battery, external 12 volt DC or 110 volt AC with the supplied adapter. A 6-pole helical resonator front-end, double balanced diode mixer and crystal IF filtering provide outstanding selectivity. This is the finest mini receiver in the world, and in fact outperforms our competitor's full sized units.



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PRODUCTS IN REVIEW



Panasonic CD Player for Background Music

Panasonic Industrial Company Audio-Video Systems Group has unveiled two compact disc players configured for a variety of professional audio applications, including automated background music playback. The Model SL-4700 features a removable magazine for six CDs. Up to 36 steps can be programmed within the unit for instant access to any track on any of the CDs. The SL-4300 is a single platter model with a dedicated rear panel socket that allows multiple players to be connected together for automated series play. Both units can be mounted in standard 19 inch rack

systems and feature four times oversampling digital to analog converters per channel.

Circle 1 on Reader Response Card



Gold Line's Reverberation Time Meter

Gold Line has introduced a portable reverberation time meter. The GL60 meter measures reverberation time at frequencies of 125, 250, 500, 1000, 2000, and 4000 Hertz.

Among the other features included in the GL60 are three different sensitivities and a display that measures

seconds from .1 to 10 seconds in 100ths of a second. A sharp handclap, picked up by a built-in microphone, will activate the meter. Powered by two 9 volt batteries, the GL60 has a suggested retail price of \$399.95. Special contractor prices are available.

Circle 2 on Reader Response Card

Symetrix Adds to SPL Computer Line

The Model 572 SPL computer is the latest addition to the SPL computer product line of Symetrix. The 572 is an ambient noise sensing automatic level controller that uses existing speakers as noise sensing transducers, even with background or foreground music. The 572, according to the company, can detect silence between musical selections, or create silent passages when necessary. When teamed with its companion product, the Model 573 Speaker Interface, the 572 is intended for installations where a

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sensing microphone and wiring are impractical.

The unit waits for a silent passage to make ambient noise SPL measurements and can be set to automatically fade out the music, measure ambient noise, then fade the music back in. Controls are provided to set the time between fadeouts, as well as the rate at which gain changes are made. The Model 573 interface provides the necessary relay switching, impedance matching and level shifting, allowing the 572 to take its measurements from speaker lines with any number of speakers of any impedance, transformer coupled or direct coupled, 25 V or 70 V.

Circle 3 on Reader Response Card

McKenzie Acoustics Adds Two Models

McKenzie Acoustics has added two new models to its flagship line of

Studio 7 Series loudspeaker chassis. The C12-200L and C12-200B are both 200 watt medium resonance bass drivers. 2½-inch voice coils are wound on ventilated high temperature Kapton to handle and dissipate heat generated. A single coil suspension system is used. McKenzie is distributed in the U.S. by Waldom Electronics.

Circle 4 on Reader Response Card



Audio-Technica Shotgun Microphones

Two shotgun microphones are part

of Audio-Technica's "40 Series" and indicate what the company calls "an approach to bring exceptional transformerless performance down to a manageable size and equally manageable price."

The AT4071 and AT4073 line plus gradient microphones contain polarized capacitor elements and feature 56 and 62 mV/PA open circuit output voltages respectively.

Audio-Technica states that it has developed a unique interference tube design for the series, with an acoustically tapered sideporting system to control low frequency directivity at a reduced length. The placement of the capsule is entirely within the tube. Both the diaphragm and side ports are exposed to the same acoustic environment. Standard features include a foam windscreen, and integral second order 150 Hz hi-pass filter.

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Circle 234 on Reader Response Card

a closer look

by gary d. davis



Cetec Raymer 9000 Series Modular Power Amplifiers

The literature on Cetec Raymer's 9000 Series of power amps announces that these amps "outperform the imports." The 9000 Series consists of modular mixer power amplifiers: the

Model 9006 providing up to 60 watts of output power; the Model 9012 providing up to 120 watts. Both power amps blend and control up to six independent input signals. Features include two separate muting functions. Sources fed to particular input module

accessories are muted by short-circuiting at Mute Terminals located at the rear of the unit. A second mute buss is programmable from Cetec Raymer modules only.

The 9000 series mixer power amps have output terminals to match 4- or 8-ohm speaker systems. Speaker distribution systems may, alternatively, be connected to the 25- or 70-volt terminals. Both units can be rack mounted using the Cetec Raymer rack-mounting bracket accessory.

Other features include built-in locks on the front panel controls; an adjustable EQ bypass control on the rear panel; a remote master volume control on the rear panel; standard screw terminal mute connections; and an automatic reset thermal overload on power transformer.

Cetec Raymer says its 9000 series modular amplifiers "are another example of our dedication to designing and manufacturing reliable, affordable, high performance products for the paging/music sound industry."

Comments

This month's *Closer Look* focuses on a new line of industrial mixer/power amplifiers from Cetec Raymer, the commercial sound products division of Cetec Corporation.

As the press release indicates, Cetec Raymer is promoting the 9000 Series to be, in part, a "made in the USA" alternative to competing foreign products (we leave it to the reader to discern precisely which products those might be). The fact that these amplifiers are of domestic origin may or may not be a major selling point for you, but rest assured that the line has other points to recommend it, as well.

The line consists, at present, of two models: the Model 9006, rated at 60 watts RMS, and the Model 9012 at 120 watts. Each is a monophonic six-input unit, featuring a built-in output transformer with 25- and 70-volt taps for distributed constant voltage. A direct output, capable of driving a 4-ohm load, is also provided.

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The remarkable new 4650



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Circle 231 on Reader Response Card

proven quite popular in engineered sound systems, the 9000 Series employs input ports that accept a variety of plug-in modules. Cetec Raymer is presently shipping two such modules: the CRX Aux Module, and the CREM-11S low-impedance Mic Module (electronically balanced). By the time that you read this, Cetec tells us, several other input modules will be available. These are to include the CRH-31S transformer-input Mic Module; the CREL-12S electronically-balanced Line Module (with adjustable gain); the CRL-12S Line Module (a transformer-isolated version of the CREL-12S); the CRFM-01 FM Tuner Module (a tuner on a card); the CRS-03S Tone Generator Module (for chimes and other types of alerts); and the CRT-01 600 ohm Line Output Module. (The 9000 Series also accepts modules by TOA Electronics.)

Generally, the specs seem reasonable for this type of product. THD on the amp is listed at 0.02 percent at 1 kHz at rated output. S/N ratio (noise floor?) for the amp (we assume with one input module or another) is listed at 90 dB with the master fader down, and 77 dB with the control at maximum; 105 dB S/N for the power amp alone. The Cetec spec is not particularly clear or comprehensive in the noise area.

Beyond the modular input design, however, the 9000 Series offers a number of other features that contractors should find quite attractive. To discourage unauthorized "fiddling" with gain settings, for example, the front-panel controls feature locking nuts that are accessed by popping off the knob. Once the control has been set and locked, the knob may be reinstalled (we don't think that's such a good idea to reinstall the knob once the shaft is locked, since someone is bound to try to turn it, possibly causing damage). Separate muting busses, which appear on rear-panel screw terminals, allow remote muting of all inputs at once from either of two locations. Similarly, the master gain may be remoted simply by connecting a 10k ohm linear potentiometer across a pair of screw terminals.

The front panel includes master bass and treble controls, both of which are shelving filters with a ± 10 dB range. On the rear panel, however, a screwdriver trimmer (labeled "EQ Bypass") allows the installer to limit the range of these controls. When the

trim is set fully counterclockwise, the tone controls act normally; when it is set fully clockwise, they are entirely defeated. Intermediate settings allow the end user a moderate degree of tone control.

Further convenience features include a rear-panel low-cut switch to compensate for low-end buildup in 25- and 70-volt systems; a preamp out/power amp in loop (with built-in link switch) for external signal processing; an aux out to drive other amplifiers; and a bridging input/output that functions as a mixing bus. This last port may be used either as an output to a tape recorder or as a buss input from

another 9000 Series amplifier.

The 9000 Series amplifiers are equipped with a grounded, unswitched rear-panel convenience outlet, and primary protection is provided by a fuse. The power transformer is protected against thermal damage, and the protection circuitry is self-resetting.

Clearly, Cetec Raymer has done its homework. The list of features offered by the 9000 Series adds up to a pretty attractive proposition for sound contractors—which is why we think that this product line deserves your *Closer Look*.

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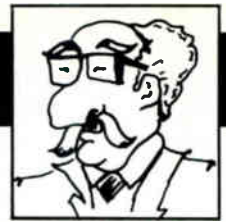
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Dear Dr. Wokka



Dear Dr. Wokka,

I'm the owner of a very successful sound equipment rental company. To date, I've designed and built many of my own systems which I use on a regular basis. They sound great and pack well in a truck. Also, a famous manufacturer is now making some special components to my specifications. Is there any jeopardy in this practice? I mean, is there any ethical or legal problem with doing this? Lastly, I'm now being pressured to sell

these systems. How can I go about selling and marketing them?

D. B. Koole
Audio Anaesthetists
Hollywood, CA

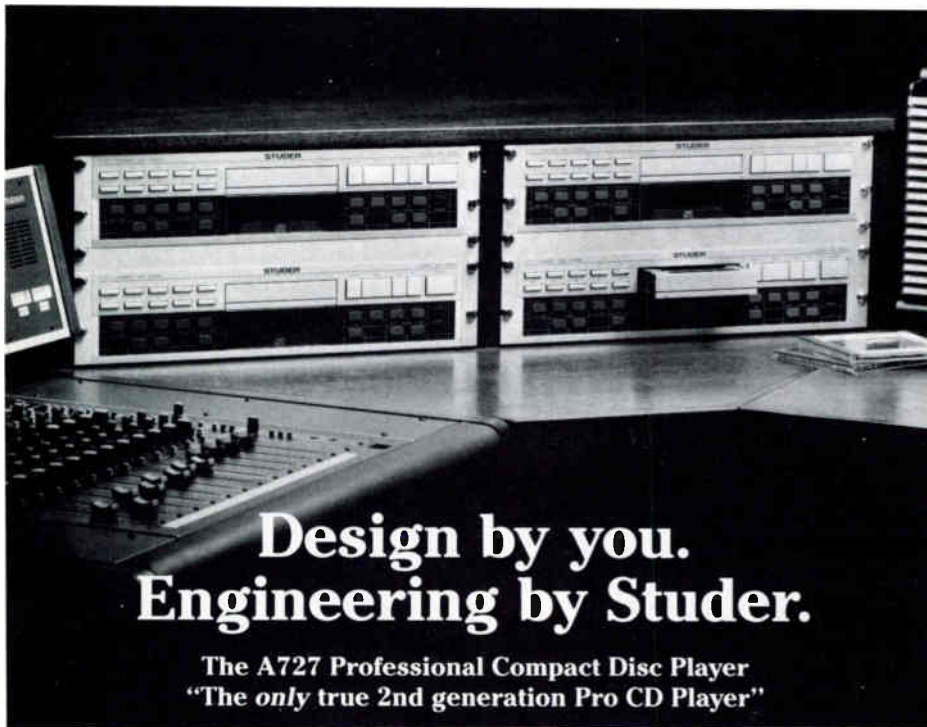
Dear Mr. Koole,

Unfortunately, you are guilty of violating one of the most sacred unwritten laws of the audio industry. Never, never should anyone but a fully qualified *Great Man of Audio Science*, like myself, ever attempt (or even con-

sider) trying to design a speaker system, much less a component. These things are much too complicated and difficult for normal persons to understand. It's the equivalent of attempting to design an atom bomb with a grade-school education; naughty, naughty. By continuing your current practice, you are unknowingly committing an act of the highest scientific heresy, destined to doom your career forever. Cease your work now and follow my advice.

You have two alternatives for proceeding with what appears to be a noble plan. The first one is to become a *Great Man of Audio Science* yourself; a foolish quest for anyone not so destined. First, you must attain several Doctoral degrees via at least 15 years of study from a small select list of Great Universities. Once properly educated, you must learn to look like a GMAS, and you must learn to speak like one. For instance, improper pronunciation of "assume," "obviously" and "equation" will get you booed from the lectern. In other words, you must be a *Great Man of Audio Science* to become one, something not easily grasped by those "outside." Sound impossible? It probably is.

Your second and most attractive alternative will now present itself. First, how do you know your designs sound good and work properly? Only scientifically correct measurements can determine what sounds good and what doesn't. Using your ears and your opinion of sound quality is very dangerous and extremely unethical. How do you know if your designs are valid? Do you know the equations of structure and resonance of a loudspeaker diaphragm? Can you solve the wave equation? Have you presented a proper scientific paper on your work? Do you realize that *not* presenting papers on your designs makes them virtually invalid? What if your design somehow works but does not obey the *Great Laws of Physics*? What if it catches on and, by some fluke, you are successful? One look at the current "TOP 40" will tell you that this is indeed possible in America. Your uninformed creations could be embraced



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STUDER REVOX

Circle 220 on Reader Response Card

by a public of enraptured loudspeaker consumers and could undermine the entire *Great Men of Audio Society* (GMAS). Then where will you be? Can you see where this is leading?

Your second and certainly most attractive alternative to your problem is to enlist the professional services of a member of GMAS. I, The Good Doctor Wokka, am, to my knowledge, the only member currently available for such a service, having left myself open for such a need. Your design can be "blessed" by the right qualification and changed to obey the *Great Laws of Physics* transcending naive subjective opinion and fortuitous Edisonian bumbblings. I have, by the way, run across numerous designs which do not obey the *Great Laws*. Of course, I have dutifully seen to it that they be changed to do so, keeping the flame of ethics alive in our industry.

In smartly choosing the second alternative, you'll be sure to have good sleep at night. My fees are not negotiable, can be paid in small monthly installments, and royalties will not be excessive enough to lead to a ruinous profit-and-loss profile. If you like, indisputable endorsements and test data can be published herein, assuring you of a great commercial advantage over your competitors. The extent of this can be worked out with the advertising manager of this Journal. I know you'll make the right choice. You do your job and let the *Great One* do his!

Next Column: Why AlnicoV speakers always sound better than "ceramic" speakers. ■

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And the Nady 1200 Series Wireless sets the industry standard for full-feature, top-end wireless performance.

Wireless manufacturers make many confusing claims regarding system specifications. Take our suggestion: listen to a Nady 101/201 or a Nady 1200 side-by-side with any other wireless on the market – regardless of the claimed specs – and you'll be impressed with the extra 15 dB dynamic range you get with Nady Wireless.

The Nady IR-300 is a Large-Area Infrared system with a unique modular design for easy, efficient installation in any size facility. You don't have to run AC to power the emitters. And you can add to the system as needed in the future. Best of all, you can have a Nady IR-300 infrared package for one-third to one-half less than the competition gets for the same area coverage.

So, the next time you need wireless or infrared, try the systems approach. The Nady Systems Professional Audio Line.

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Nady 1200 Wireless System. The newest generation of top-end Nady Wireless Systems, with the best specs in the business. Full output features for total flexibility. Sophisticated front-end circuitry for maximum multi-channel capability, and True Diversity for drop-out free performance. Features a completely redesigned Hand-Held Transmitter with user-switchable elements. Receiver rack-mounts. List price from \$1,599.



Nady IR-300 Large-Area Infrared Systems. Unique modular design for easy, efficient installation in any size facility. You don't have to run AC to power the emitters. And you can add to the system as needed in the future. Choice of user-friendly receivers. Best of all, you can have a Nady IR-300 infrared package for one-third to one-half less than the competition gets for the same area coverage.

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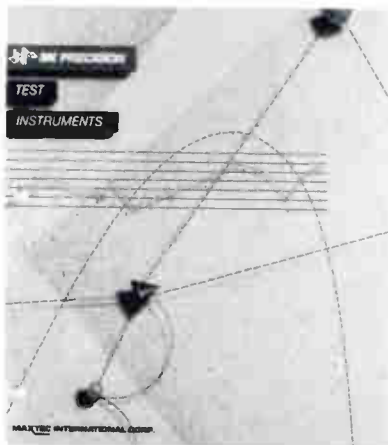


Javelin Electronics Security Handbook

The CCTV/Security Management handbook is now available as a product through Javelin Electronics. The handbook was originally designed as a resource package for internal security seminars. It comes complete with lens selector, engineering template and software, and is a guide for architects

and other security professionals, assisting the "advanced user in every phase of design, setup, and maintenance of a fully functional security management/CCTV system." The price is \$95.

Circle 7 on Reader Response Card



B&K-Precision Catalog Covers Company's Line

The B&K-Precision Division of

Maxtec International Corp. has released a new 68-page catalog covering the company's line of electronic test instruments. The Test Instruments Catalog BK- 88 provides performance and mechanical specifications and describes a complete line of product accessories. There are 18 major new products featured in the catalog.

Circle 8 on Reader Response Card

Corning Single-Mode Fiber Brochure

Corning has updated its brochure on its line of Corguide single-mode optical fibers to include additional measurement data and tightened product specifications. The brochure summarizes features and benefits of SMF-28, SMF-21 and SMF/DS single-mode fibers. New information includes bend performance, mode-field diameter and cut-off wavelength specifications. Corguide single-mode fibers are now available in 25 kilometer unspliced lengths.

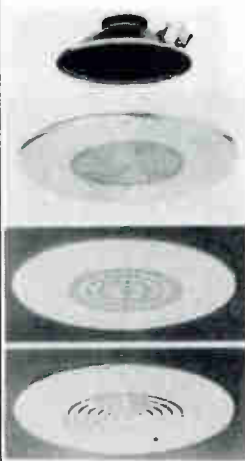
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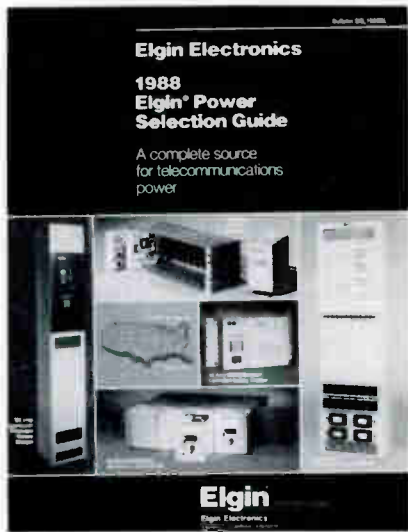
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Elgin Electronics Power Selection Guide

The 1988 Elgin Electronics Telecommunications Power Selection Guide lists the electrical and mechanical specifications for key system power supplies, 24 and 48 VDC power supplies, 24 and 48 VDC battery charger/eliminators, ringing generators, converters and inverters. Power systems from 50 to 4,000 amps, single and three phase, are presented, with emphasis on microprocessor controlled charging systems.

Circle 10 on Reader Response Card



Marconi Instruments' Color Brochure

Marconi Instruments has released a four-color brochure describing its 2440 Series Microwave Counters.

Features, typical applications, and specifications of the 2440 and 2442 microwave counters are detailed in the six-page brochure.

Circle 11 on Reader Response Card

QSC Audio Offers End User Brochure

QSC Audio Products has a sales brochure available on the MPS 2300 Music and Paging System. The brochure is written for the business owner and is presented in terms and language for the end user to understand, according to QSC.

Circle 12 on Reader Response Card

University Sound Issues Short Form Catalog

University Sound has issued a 16-page catalog showing its line of microphones, special environment speakers, horns, drivers and other PA equipment. The catalog is available to sound installers, consultants and users of commercial sound products.

In other news, University Sound has begun publishing "Contact," a monthly newsletter written for those in the commercial and institutional sound business. According to W. Douglas Wilkens, marketing manager, "Each issue contains information about new products, ideas for solving problems, and data on new dealer sales aids...."

Circle 13 on Reader Response Card

"How-To" Guide from Amtel

Amtel Security Systems has published a design guide called "How to design a security and parking system." The guide is designed for owners, developers, managers and architects of condominium and apartment buildings, and discusses some of the problems and budgetary constraints faced by these structures. Reference templates, survey forms, checklists, typical layouts and a sample outline for bid specifications are also included.

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BUSINESS FRONT

(continued from page 14)

assume a base salary of \$20,000 plus a commission equaling 3 percent of gross sales, with annual sales of \$200,000:

Base:	20,000.
Commission:	
3% of 200,000:	6,000.
Total Remuneration:	26,000.

Next year the salesman hits his stride and actually *doubles* his gross

sales to \$400,000:	
Base:	20,000.
Commission:	
3% of 400,000:	12,000.
Total Remuneration:	32,000.

Increase in sales (and presumably profit) to company: 100%

Increase in salesman's remuneration: 23%

Method 2, Draw Against Commission, does of course overcome the

previously mentioned disproportion between efforts and salary, but by its very nature implies impermanence, often leading to insecurity and pressure upon the salesman: When does the draw end? Has anyone ever had to give it back?

Method 3, Base Plus Varying Percentage of Gross Sales (according to profit), represents some sort of compromise, but still does not reward the salesperson in direct proportion to his efforts. Depending on how it is implemented, this method can also give rise to some bookkeeping nightmares.

One method that seems to overcome most of the aforementioned disadvantages, while combining the best of those formulas, is that of Salary *Versus* Commission (whichever is greater). This commission is then linked to profit rather than gross sales. The weekly salary is adjusted periodically to the salesman's performance and realistic expectations, and is geared slightly below *anticipated* gross profit, allowing for adjustments should the completed job come in higher or lower than anticipated. (Assuming, as every good contractor should, that you recap, or cost-account, every job upon completion.)

Monies due the salesman on long-term jobs are thought of as being deposited in a paper "bank," and are a guide to an equitable weekly salary. A statement is issued monthly to the salesman, and jobs completed that month are posted showing the *actual* profit realized, which may be more or less than the anticipated profit. If you wind up the month owing the salesman more than he has been paid, a bonus check is then issued rather than having to pay a huge lump sum at the end of the year. Should he wind up owing *you* money at the end of the month, that amount is carried forward to the next month; you can set a limit on how far you will allow this number to go negative.

(For some reason a mark-up of 50 percent (33 $\frac{1}{3}$ percent profit) seems to have been adopted as a base-line margin in our industry. A commission of 30 percent of the profit is equal to 10 percent of gross at this 50 percent mark-up, which most will agree represents an equitable commission; therefore a commission equal to 30 percent of gross profit may work well for you. A greater or lesser profit will of course be reflected in the salesman's

(continued on page 68)

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Circle 222 on Reader Response Card

New Installations With JBL Products

JBL Professional has reported several new installations using their products. The Griffith Park Observatory in Los Angeles installed four JBL/UREI 6260 power amplifiers to power previously installed JBL 4311 monitors.

The Capitol Center in Landover, Maryland installed JBL and UREI equipment. The Capitol Center is home for Washington Bullets basketball and other sporting events.

The W. Edwards Conference Center in Brighton, Michigan installed JBL video projectors and ceiling speakers. The equipment was installed at a General Motors training division and

Altec Lansing Reports

Chambers, Inc. is installing Altec Lansing sound products in the Phoenician Golf and Tennis Resort, a reported \$300 million project.

Altec Lansing's Korean distributor, Dong Hwa Electro-Sound Co., Ltd., and the Han Moo Development Co., Ltd. are installing Altec Lansing sound products in the Korean World Trade Center and Hotel Complex in Seoul.

Renkus-Heinz Installed in Orange County

The Orange County Performing Arts Center's Segerstrom Hall has installed Renkus-Heinz midrange compression drivers and constant beamwidth horns. The system includes 12 SSD 5600-8 midrange compression drivers, 6 CBH 250-6 constant beamwidth horns and 6 CBH 250-9 constant beamwidth horns, and was installed by Otto K. Olesen Electronics of South El Monte, California. "The revision, as a completed project, has been a significant improvement," said Philip Mosbo, Director of Theater Operations.

allows the center to be a complete training operation with satellite downlink.

JBL also reports the recently completed installation at the Thomas Road Baptist Church (home of the evan-

gelist Jerry Falwell). The system was sold through American Audio in Madison, Wisconsin. In the installation, the signal to every individual horn in the house is independently one-third octave equalized.

QSC Reports New Installations

QSC has reported on recent sound installations using QSC Products:

The University of Nevada in Las Vegas installed a sound system at the Sam Boyd Silverbowl which uses Apogee Sound tri-amped cabinets with 15 QSC MX 1500 amplifiers for the main cluster. Additionally, two QSC MPS 2300's have been installed for music and paging at the Silverbowl. One is part of a distributed system for the private box seats; the other is at the box office for the announcing of upcoming events. The installation was handled by Thomas Gregor Audio.

Midwest Communications in Edgewood, Kentucky has taken delivery of 98 QSC 1200 amplifiers and 42 model 3200 amplifiers for a sound masking

installation at the State Office Tower in Columbus, Ohio.

Thirty-three QSC 3200 amplifiers were installed at the new fieldhouse at the University of Wisconsin at Stout. MTS/Northwest Sound of Minneapolis designed the system.

The sound system at Bradley Civic Center in Milwaukee, installed by American Audio Systems, is using 50 MX1500 amplifiers.

The renovation of the Capitol Theater in Manitowoc, Wisconsin included a sound system powered by QSC amplifiers; the installation was handled by Phil Henrickson Sound.

An MPS 2300 music and paging system has been installed in Jimmy Buffet's nightclub, the Margaritaville Cafe, in Key West, Florida.

Core Systems Installs at Omni, Ramada

Core Systems, Inc., the Houston based sound, light and video contractor, has designed and installed systems in the new Omni Hotel in San Diego and The Ramada Six Flags outside of St. Louis, Missouri.

The Omni installation was for public areas including the entry lobby, registration, restaurant, ballrooms, meeting rooms and nightclub. Equipment used included the JBL AE8130 HT flush-mount ceiling speaker and BES C70D ceiling tile speaker in

meeting rooms. The meeting rooms and ballrooms used Room Audio Director combining systems. The restaurant used AEI background music with a separate paging system. The entertainment system in the nightclub features the Meyer Sound Lab precision dance floor system.

In the Ramada installation, Core says it was given a budget of \$60,000 to bring life to a room that was changing from live music to a disc jockey format. A JBL system was provided for the dance floor.

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BUSINESS FRONT

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commission in exact proportion to the company's profit on the job.)

In Conclusion. Throughout this article we have been using the term "salesman" referring to a male or female salesperson. This title leaves little doubt as to what this person does for a living, yet I have never seen a business card stating something like:

ABC SOUND COMPANY

John Jones

Salesman

It seems that this person is a Sales Engineer, Marketing Representative, Account Representative, Sales Coordinator, Systems Engineer, anything but a salesman. This proliferation of titles is, I think, more important than ego; in actuality it reflects the many hats that the knowledgeable sound and communications salesperson has to wear.

These are unique people. Choose them carefully, train them well, encourage their efforts and give them the same opportunity that you would want for yourself; for they are the keys to our success. ■

BASIC PRINCIPLES

(continued from page 22)

in some venues and by certain riggers and fire marshalls due to its ability to withstand greater heat than a polyester sling before failure in the event of fire. When using wire rope around a beam, however, the bend radius often equals the diameter of the wire rope. This results in a efficiency rating of 50%—the strength of the basket (both legs) would be virtually the same as that of a single wire rope. *Wire rope beam-wraps need to be padded carefully.*

The two ends of the sling are then coupled with a ½" 6 x 19 wire rope sling assembly using a 5/8" screw-pin shackle having a working load limit (rated capacity) of 6500 pounds at an assumed 5:1 design factor.

Important: Carefully adjust shackles and slings to assure that the load is carried by the end and the pin of the shackle. Do not allow the shackle to be turned so as to load the sides, as the shackle will be weakened considerably.

The wire rope has a rated capacity of 4600 pounds at the same 5:1 design factor. This sling section may be omitted in venues with low enough ceilings

for the chain hoists to bring the loudspeakers to trim.

The chain hoist hook connects directly to the wire rope sling eye. Chain hoists come in a variety of capacity ratings and climbing speeds. Because we need to hang in many different locations, we have no desire to lift the chain hoists into position each time by hand. Rocky Paulson of Stage Rigging modified the CM hoists to operate upside-down and climb the chain. We choose a brace of Rocky's 1-ton hoists. The rated capacity of the hoist is for lifting purposes and includes a generous design factor. The CM hoists also include a clutch which will slip if the hoist is overloaded. Both hoist hooks should be equipped with working safety latches, or be safety-wired (moused) closed to prevent the slings from slipping out of the hook before commencing a lift.

Below the chain hoist, the loudspeaker grid is carried by a two-leg SpanSet sling assembly to support the grid front and back.

Important: Do not use a single sling to support a load carried on two points—the sling could slip in the hook.

Assuming a 45 degree load angle for each sling leg, the load angle efficiency is 70%. Each sling leg has a rated capacity of 5280 pounds, therefore the sling capacity becomes 7390 pounds, or 3695 pounds per leg.

The sling attaches to forged carbon steel ¾" shoulder eye bolts using 5/8" shackles, described previously. Each eye bolt is limited to a rated capacity (tension) of 1300 pounds at a 45 degree pull angle. This tension will be realized when each eye bolt is loaded to 900 pounds because of the 70% load angle efficiency. Clearly, the eye bolt is the weakest link in this rigging chain.

Our loudspeaker grid design has been certified by a licensed structural engineer and welded by certified craftsmen. Each loudspeaker hangs from three points using ½" shoulder eye bolts and load-rated carabinders. The eye bolts are the weaker element, having a rated capacity of 2200 pounds for a straight pull. We have chosen Concert Series loudspeaker systems, which incorporate three top attachment points, each of which has a rated capacity of 1000 pounds at an assumed design factor of 5:1. [Many manufacturers offer similarly constructed cabinets; check for further informa-

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Don't miss the June issue of **Sound & Communications Magazine**

BASIC PRINCIPLES

(continued from page 68)

tion on data sheets, and ASK QUESTIONS.]

Knowing the number and weights of the loudspeakers and the grid, the tension on each part of the two-leg sling can be calculated. Assuming a total weight of 1250 pounds, each leg of the sling must carry 625 pounds. Given the load angle efficiency of 70%, each sling, shackle and eye bolt will be tensioned to 884 pounds—well within the 1300 pound rated capacity of the eye bolts.

Rules for Safe Lifting:

1. Do not overload any piece of equipment.
2. Sling the material to be lifted properly. Do not allow slings to be placed against sharp objects or rough or cutting surfaces.
3. Always align lifting equipment over the center of gravity to enable a straight vertical lift. Never attach a hoist or lifting line to the load at an angle.
4. Always use properly-installed load-rated hardware and fittings. Double-check all connections before lifting.
5. Carefully inspect all lifting equipment—everything in the rigging chain—before making a lift. Replace any worn or defective equipment.
6. Never lift or support overhead loads from an open hook. Always use safety hooks, latches or other devices when material is being hoisted overhead.
7. Use Tag Lines to control any load which may become unmanageable during lifting.

Conclusion:

Safe sound system rigging is the application of known and simple engineering principles along with a healthy dose of common-sense and know-how to a relatively uncomplicated set of problems. There are no viable shortcuts in rigging equipment, tools and techniques—the potential losses resulting from property damage and personal injury following the failure of second-rate hardware or faulty rigging practices can be staggering. Safe sound system rigging is no accident. ■

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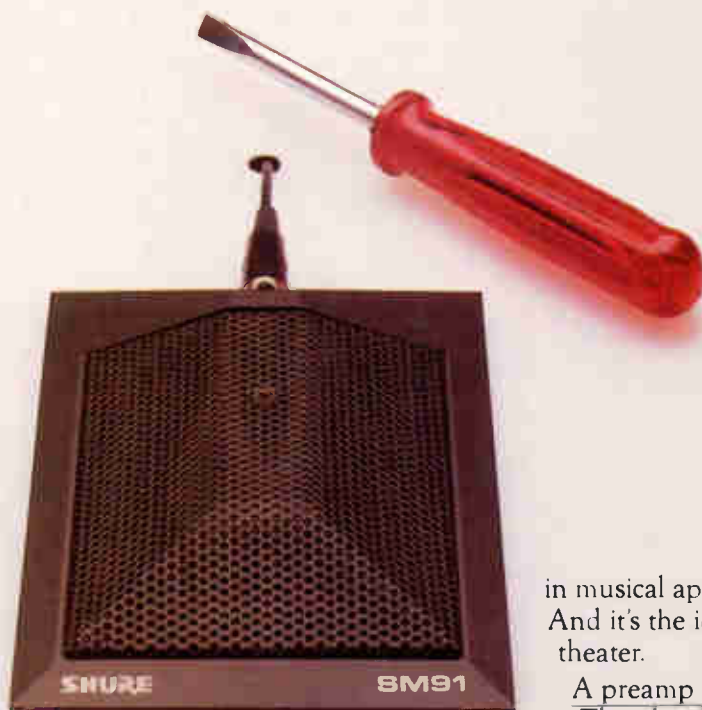
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