

Installation Profile: The Jack Murphy Stadium

SOUND & COMMUNICATIONS

FOR CONTRACTORS, SYSTEM MANAGERS AND SPECIFIERS

SEPTEMBER 1986



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**Sound
Power
Levels**

**Relationship
Marketing**

**The History &
Development of
MICROPHONES**

**Interfacing
Microphones
with
Electronics**

**Lab Test Report:
Harris/Motorola P-TEC/5 Loudspeaker**

Feedback: Reduce the Problem, Not the Volume

Al Watson Tells What the NEW 1772 Can Do For You



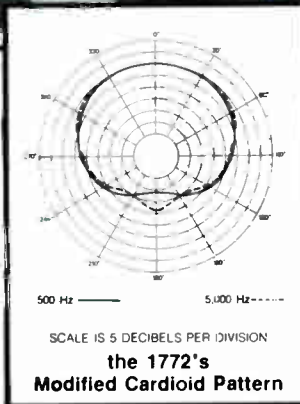
Al Watson

- one of the earliest to recognize the benefits of holographic interferometry and apply laser technology to the study of diaphragm motion
- developer of a proprietary electret charging process that avoids material degradation and provides an exceptionally stable charge of either negative or positive polarity
- a member of IEEE, AES and ECS, Watson holds numerous U.S. Patents

relating to microphone design and has brought more than twenty dynamic, condenser and electret microphones to the marketplace, including the RE34 mike/line level condenser and the RE 18 Variable-D® dynamic

• when not scuba diving, programming (Al's an "apprentice" hacker) or building his completely "self-sufficient" home, Watson can be found at Electro-Voice where he's chief engineer of the microphone group

Nothing's more annoying than a sound system that brings the program to a "screeching" halt. All too often ordinary microphones pick up loudspeaker output and re-amplify the sound. The system begins to ring and keeps right on howling until the volume is reduced. But turning down a system designed to amplify the speaker's voice is hardly an effective answer. You could defeat feedback with expensive equalization. Or you can simply use the new EV 1772 cardioid condenser vocal microphone... the mike designed for sound reinforcement systems where reflection and speaker placement demand superior gain-before-feedback.



How does the 1772 eliminate feedback problems?

Better than any mike in its class.

First, the response curve of the 1772 is exceptionally smooth and, unlike many microphones, free of peaks that can trigger feedback. Second, the 1772's directionality has been carefully tuned to reject off-axis sound from room reflections and speaker systems, offering high gain with little risk of feedback.

Finally, the 1772's innovative transducer position allows unusually close miking. Since the user's voice is more intense, system gain is increased dramatically. The bass boost that results from close miking is rolled off through a sophisticated network of electronic filters. Sound remains crisp and clear, even in large rooms where "boominess" can destroy intelligibility.

What about the 1772's output sensitivity? How hot is it?

The 1772 is so hot . . .

that it provides a 7 dB advantage over most dynamic mikes. At -49 dB, the 1772 boosts vocal and sound sources of low signal strength to achieve maximum output from minimum power. And with battery or phantom power, the 1772 is compatible with any system.

And what about distortion and handling noise? Can the 1772 eliminate these annoying performance problems?

No problem(s).

The 4.5-V battery in the 1772 provides a wider dynamic range than any competitive condenser. (Most use only a 1.5-V battery.) And with 137 dB of

headroom, the 1772 reproduces the highest sound pressure levels without overload or distortion. Internal low-frequency filters combine with condenser design to minimize handling noise. And an integral windscreen — a truly superior design — takes the "pop" out of close-up use and reduces wind and breath distortion.

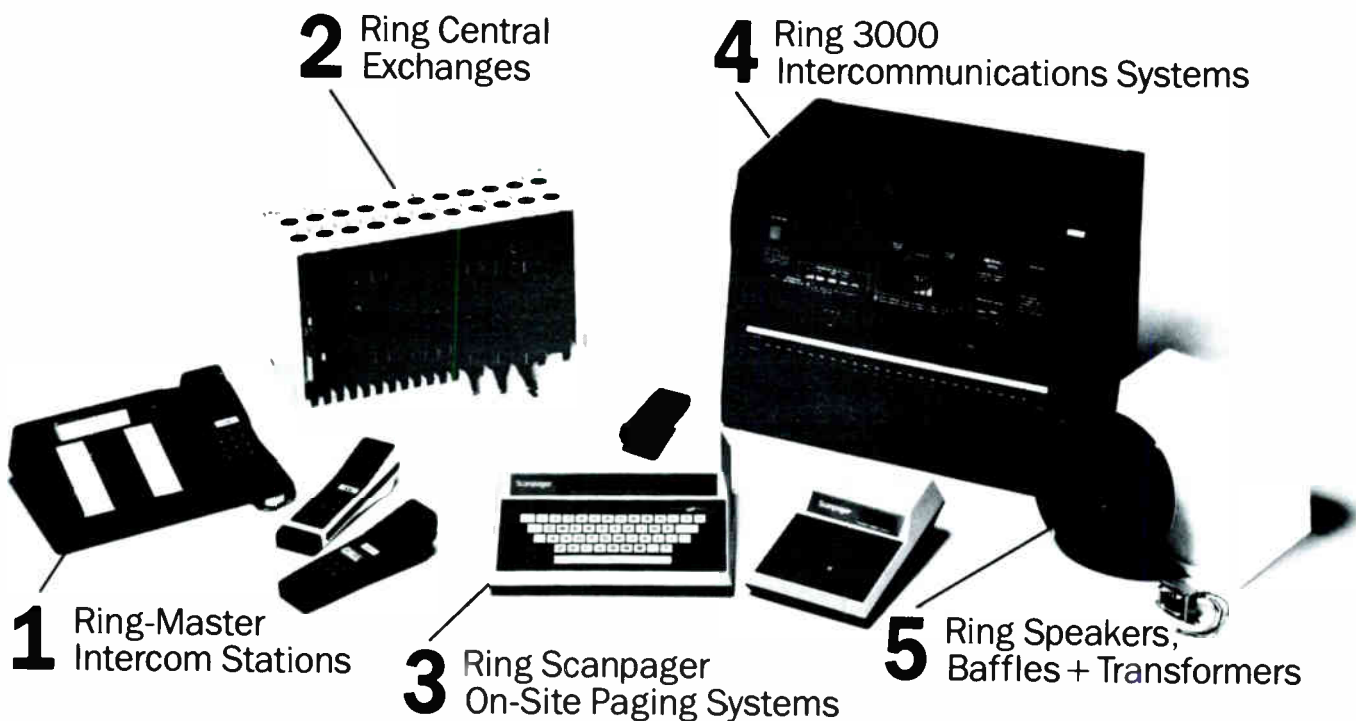
Simply stated, the new 1772 microphone is an exceptionally effective tool for stage, choir, podium or pulpit . . . in any hand-held or close-talking application where high sensitivity and superior gain-before-feedback are desired.

The next time your system starts to ring and howl, think about your choices. You can turn down the volume. Or you can "turn on" to the all new 1772 from Electro-Voice and eliminate feedback problems forever. To learn more about what 1772 can do for you, write Al Watson at Electro-Voice, Inc., 600 Cecil St., Buchanan, MI 49107.

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SOUND & COMMUNICATIONS

Volume 32 #9
September 1986



16

DEPARTMENTS

- 8 Newsletter
- 35 Products in Review
- 39 A Closer Look
by Gary D. Davis
- 41 Datafile
- 42 Faces and Places
- 42 Ad Index
- 43 Rep News
- 44 Supplies/Services/Support
- 46 Contractor Close-up
- 47 Datebook
- 49 Classifieds

FEATURES

- 16 THE HISTORY & DEVELOPMENT OF MICROPHONES** by Jesse Klapholz
From the 1800s to the 1980s, Jesse Klapholz traces microphone technology from its beginnings in the telephone industry to the radio, motion picture, and sound reinforcement industries.
- 22 INTERFACING MICROPHONES WITH ELECTRONICS** by Jon Sank
Varying electrical characteristics of different types of microphones and how their performance may be affected through their interaction with electronics is discussed.
- 26 INSTALLATION PROFILE: JACK MURPHY STADIUM** by Mike Klasco
The Jack Murphy Stadium in San Diego, CA, is the home of the Padres and Chargers. Earlier this year Mike Klasco and Wavelength, a local sound contractor was hired to redo the existing PA system. Klasco talks about the installation and the problems they were confronted with and how they were solved.
- 32 THE LAB TEST REPORT: HARRIS/MOTOROLA P-TEC/5** by Farrel M. Becker
The Lab Test Report this month is on the Harris/Motorola P-TEC/5, a paging speaker which uses piezoelectric technology.

COLUMNS

- 11 Sales & Marketing**
Chris Foreman explains relationship marketing and why it can be an important tool in your sound and communications contracting business.
- 12 Consultant's Comments**
Defending the position he took in last month's column, Marc Beningson shows why it is important for a contractor to bid as spec'd by showing the various selection criteria his consulting firm has for crossovers.
- 14 Theory & Application**
A follow-up to "Sound Intensity and Power," June 1986, this article explains the concept of sound power in more detail.

ON THE COVER

This month *Sound & Communications* takes a look at the history and development of microphones. The microphone on the cover is a Kellogg carbon-type microphone circa 1920s. In its day the Kellogg mic was used primarily for radio broadcasting. See story page 16. Microphone courtesy of Jon Sank. Photo by Doug Hanewinkel.

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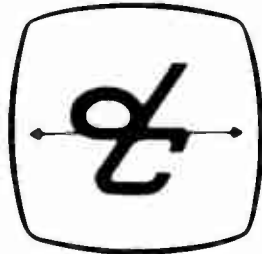
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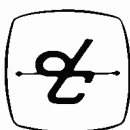
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Circulation audited by
Verified Audit Circulation Corp



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COMMUNICATIONS
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Sound & Communications • Music & Sound Output
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SONY CORPORATION OF AMERICA FORMS SECURITY SYSTEMS COMPANY

The formation of Sony Security Systems Company, a new company dedicated to the sale and marketing of security products in the United States, was announced by Sony corporate executives in New York. The announcement coincided with the unveiling of the WatchSensor™ integrated intelligent security system and the introduction of an expanded line of Sony WatchCam™ security products at the International Security Conference held recently in New York. "The security market is highly specialized and requires an equally specialized organization to penetrate it," noted John Garrison, newly appointed president of Sony Security Systems Company. "The goal of Sony Security Systems Company will be to capitalize on Sony's expertise in CCTV technology and cultivate professional distribution channels to bring innovative products to markets." The new company is headquartered in Paramus, NJ. Garrison, who was previously director of marketing for Sony's Consumer Display Products Division, announced that Mac Inoue former product planning manager for that division, has been named vice president of product development for the Security Systems Company.

MEYER FORMS SEPARATE DIVISION FOR ITS SIMCAD DEVELOPMENT

Meyer Sound has formed a new corporate division to pursue research and development of its SIMCAD™ analysis and equalization of reinforcement loudspeaker systems, as the company's SIM project enters its second phase of development. Former Bruel & Kjaer engineer Andre Perman has joined Meyer to head the new research division under the direction of President John Meyer. The system which Perman is charged with designing will incorporate substantial automation of testing and equalization procedures, thus requiring a minimum of operator training. The first such SIMCAD system will be delivered to the Jubilees Auditorium in Calgary, Alberta, Canada ('Jubilee Update', Sound & Communications, July 1986). Specified and ordered by Rick Packer, the Jubilee system will be permanently installed on-site. Packer intends to use it for testing and equalization of the Jubilee's Meyer sound system, during concerts in the presence of an audience. Both the sale and installation of the Jubilee SIMCAD system will be handled by Meyer's Canadian distributor, Gerr Electro-Acoustics, Ltd. of Toronto.

CROWN LEAVES HI-FI TO CONCENTRATE ON PRO & COMMERCIAL MARKETS

Crown International Inc. has announced the discontinuance of its high-fidelity product line in order to concentrate on new opportunities in the professional sound and microphone markets. Greater efficiency and compatibility between Crown's industrial products and the professional and commercial sound markets led to the sound component manufacturer's phase-out of high fidelity products, the company reported. General Sales Manager James S. Beattie said, "Discontinuing our high-fidelity product line will open up new opportunities to better serve the professional and microphone markets, which are better suited for future growth and investment. In the second quarter of 1986, Crown reported record shipments of professional microphone, amplifier products and industrial products. The company expects substantial growth throughout all product divisions in the coming year.

VALLEY AUDIO OF NASHVILLE OPENS NEW OPERATION IN ATLANTA

Bob Todrank, president of Valley Audio and Valley Design of Nashville, TN, has announced the formation of an Atlanta, GA, branch. The company, founded in 1973, has been providing professional audio sales and service to the recording, broadcast, industrial, sound reinforcement, and video marketplaces. The new Atlanta office is formed from a merge of Valley Audio with Interface Audio. Negotiations have been completed for a merger with Ridge Nye of Interface Audio. "We are especially pleased to have Mr. Ridge Nye providing his management and technical skills to our new office in Atlanta," said Todrank. "I am also delighted to have Tom and Kathy Fonner as qualified sales people for the Atlanta office."

TRILLIUM TELEPHONE SYSTEMS AND TELECO USA SIGN PACT

Trillium Telephone Systems Corp. has announced the signing of an agreement with Teleco USA Inc., under which Teleco will market Trillium's line of key systems to Teleco USA dealers nationwide. The agreement is valued at \$8 million. Greg Hawkins, Trillium's vice president of sales and marketing, said, "The Teleco USA organization brings Trillium needed distribution in many markets where we are weak today. Additionally, many Teleco USA dealers are currently carrying our product line so the fit is good. Teleco USA has demonstrated that they are a force in the market and will provide a solid channel for us in the future. We view this as an essential move in solidifying our position as the leading small key system manufacturer."

DOD ELECTRONICS ADDS ROBOTIC ASSEMBLY TO ITS SALT LAKE CITY FACILITIES

DOD Electronics of Salt Lake City, UT, which last year installed Computer Aided Design (CAD) capabilities to its facilities here, has now added Computer Aided Manufacture (CAM) to help implement those designs. The first such CAM installation is the new Amistar automated circuit-board insertion machine. According to DOD Vice President John Johnson, "The Amistar boosts our productivity so we can better compete with foreign and domestic manufacturers. We figure the Amistar can do the work of 20 or 30 assembly workers. Now, we can assign those workers to more productive duties." Allowing faster response time during peak production demand periods, the CAM system will reportedly help DOD better meet product delivery needs. The company, which manufactures DOD signal processors, DigiTech pedal and rack-mounted digital effects and Audio Logic Professional signal processors, sees its investment in future competitiveness as compatible with its products.

EASTERN ACOUSTIC WORKS EXPANDS PRODUCTION CAPABILITIES

Eastern Acoustic Works Inc. is undergoing major expansion of its production and engineering facilities and personnel as a result of its rapid sales growth, the company reports. According to Frank Loyko, vice president of marketing, "First half of 1986 sales exceeded even our most optimistic projections, resulting in a 153-percent increase over the same period in 1985. Our net shipping increased over 106 percent over the first half of 1985, straining our current production capabilities to the maximum. The short fall in shipments resulted in large increases in our back orders and delivery times. We are taking steps now that should eliminate the delivery delays by the end of September." President Ken Berger has announced the appointment of Gary Dietrich to oversee the expansion effort from his new position as production director. He previously spent 13 years at H.H. Scott, where he held the position of production supervisor. Among other projects, he will be responsible for the 40-percent increase in production personnel planned to be in place by the end of August. EAW has also added 4,000-square-foot of shop space to its Framingham, MA, production facility, and a large in-house, high-tech spray paint booth and a third computer-controlled woodworking workstation.

PIRELLI CABLE'S OPTRONIC SYSTEMS NOW A SEPARATE CORPORATION

Pirelli Cable Corporation has announced that its Optronics Systems Division of Meriden, CT, has formed a separate corporation in order to more effectively address the growing fiber optic networks and security systems market. Stan Johnson, vice president and general manager of the former Optronics Division, has become president of the new corporation as of August 1. Pirelli Corp. Optronics Systems will operate as a wholly-owned subsidiary of Pirelli Enterprises Corporation, a holding company for all U.S. Pirelli cable-related interests.

by Chris Foreman
Panasonic/Ramsa

RELATIONSHIP SELLING

What is relationship selling? A relationship sale is one you make with a long-term customer, or with a prospect you want to become your long-term customer. Even when that customer is a company and not an individual, you're selling a relationship whenever you expect repeat business or referrals and anytime someone within the customer's company actually helps you make the sale. In a very real sense, whatever product or service you sell is only a tool that enables you to sell your primary product, the relationship between you and your customer.

Why is every sale a relationship sale? It's difficult to imagine a sale where a human-to-human relationship is not involved, at least indirectly. Even if you're using a computer to order parts via modem from a supplier's computer, there's a human relationship in the background. And the very existence of these relationships suggests that they can be cultivated, optimized and made into an important component in the overall sales process.

The Advantages of Selling Relationships

Only the true long-term sale is a relationship sale. Yet, even short-term, one-time sales involve a relationship which can help sell the product or service. If the college student selling magazine subscriptions door-to-door can strike up a

conversation with the prospect, a relationship has been started and, even if the conversation is totally unrelated to the sale, the student will have a much better chance of selling the product.

For sales that are more complicated than this example, the tables are turned. The relationship becomes the primary product and the original product or service becomes a tool used to make the sale. By taking this point of view—that is, by focusing on the relationship—you work hardest on that part of the sale that holds the most promise for repeat business, referrals, and long-term customer satisfaction.

How to Sell Relationships

A good sales relationship is a complicated and constantly changing situation but, in the sense that it is similar to a social friendship, it is actually very simple. A good sales relationship is created by a win-win sale (one where both the buyer and the seller perceive a win from the sale) and is maintained by a combination of after-the-sale service, continuing customer communications and additional win-win sales. Here are some specific ways to create and maintain good sales relationships.

(1) Sell Yourself and Your Company

Your customer wants to be confident in you and your company. You inspire that confidence by selling yourself and your company to your customer. This is

true relationship selling because you aren't selling any product or service, only a relationship between your customer and you.

To sell confidence, unlike some other products, you must have it in inventory. That is, you must have confidence in yourself and your company. One mistake many salespeople make in selling confidence is to expect perfection from their companies. When his company makes a mistake, particularly one which affects one of the salesperson's customers, he loses confidence in his own company and thus loses the ability to sell himself and his company to his customers.

A better attitude is to expect mistakes every now and then and to learn how to recover from them. No customer expects you or your company to be perfect. Customers do, of course, expect you to minimize mistakes and, when mistakes happen, to rectify them quickly and effectively. If you and your company have a good record (and a good attitude) towards mistakes, you should have no trouble selling confidence to your customers.

(1) Win-Win Selling

A win-win sale is one where both buyer and seller believe they have won in the sale. For example, the buyer should believe he/she paid a fair price and got a good product or service. The seller should believe he/she made a fair profit and sold a product or service that will not require extensive after-the-sale service.

A good product or service at a good price is not the only possible win. Psychological wins are also possible and these may be even more important to the sales relationship than the original product or service. An exceptional sound system in a new theater may bring the theater owner reviews of great acoustics on opening night. Compare the benefit of the owner's pride with the benefit of a few percent better price and you begin to see the importance of relationships in selling.

Winning is equally important to you as a seller. It may be tempting to allow yourself to lose in order to make a sale by drastically cutting your price. That kind of tactic may help sell a product or service but it does not help sell a relationship. Why? Because it leaves a bad taste in your mouth which hurts one half of the relationship and because it establishes your reputation with the customer as a price-cutter and that hurts the other half of the relationship. Remember that a win-win sale is a win-win sale. Both you and the customer must perceive a win if you are to build a relationship.

(3) Little Things Mean a Lot

There are small things you can do for your customer that will help in a big way to build the relationship. I'm not talking about sending out birthday cards (although every insurance salesperson in the world seems to believe in this). I'm

talking about little things that are practical and useful. Like keeping your customer up to date on new products or services that could benefit him.

Be selective here, don't automatically send out literature on each and every new product to each and every customer. But, if you find out about a new miniature microphone that could solve an aesthetic problem for your customer at a local church, *you are doing a favor for your customer by notifying him of that new product.* Even if you don't make an immediate sale, you have planted a seed for a future sale and you have nurtured a continuing relationship by merely remembering the customer's needs at an appropriate time.

(4) *The Value of Honesty*

Honesty is a trust builder. Be honest with your customers, even when you must tell them something negative. If you don't have the desired product in stock and you can't get it for six weeks, admit it and offer, but don't push, an alternative. If your installation team made a mistake and will have to come out to redo part of a system, admit the mistake, apologize and come out yourself to supervise at least part of the redo. If someone in credit bills your customer twice for the same sale, admit the error and tell your customer that you stood watching over the shoulder of that credit person to make sure the mistake was corrected

(do this so you can say it honestly).

When you admit an error like this and follow up with a solution (as appropriate), you build trust. Anyone who has ever tried the alternative, covering up problems, knows that it is extremely difficult and that most customers eventually see through the cover-ups anyway!

There's another kind of honesty that can be just as difficult but that pays off at least as well in the long run. I'm talking about saying "no" to your customers when they want to purchase something that really isn't right for them. I've always appreciated the waitress who would admit that "the meatloaf isn't all that great." Your customers will appreciate you, at least in the long run, when you, like that waitress, counsel them not to buy the wrong product or service, even when it's something that would make you a good commission. Don't push this too hard. If a customer insists, even after your counselling, sell him what he wants. Then be prepared to come in diplomatically (don't fall into the "I told you so" trap) and help him out if the purchase doesn't live up to his expectations.

(5) *Know When to Apply Pressure*

I am about 90 percent a low pressure salesman, yet I know that there are times when I must apply a little more than my average amount of sales pressure.

For one thing, I know I must not appear to be uncertain of my own product or service, and I must be very positive about its benefits to my prospect.

In addition, when my customer is teetering on the brink, but just can't seem to make the decision, I sometimes step in and make it for him/her by saying something like, "You need to buy this, Frank, it's right for your company and I know you'll be glad you did it. Sign here."

I'm taking a big risk when I do something like this but, if I've read my customer right (true indecision), it almost always pays off. After all, I'm involved in a true win-win sale which means my customer will benefit from my proposal. Thus, a little push on my part will be appreciated later by me and by my customer. And, the fact that I have truly generated a win for my customer will help build the kind of trust I want in a sales relationship.

(6) *Maintain Appropriate Contact*

Continued customer contact is one form of service after the sale. The advice here is to make it appropriate. As an example, don't phone your customer and take his/her valuable time unless you have a specific purpose. "Just keeping in touch" isn't good enough in a business relationship.

What is an appropriate reason for calling your customer? That's easy during the sales negotiation

process (here's another idea), during an installation (we'll be there Tuesday) and immediately after the sale (thanks for the order). Six months later, when you think it's time for a follow-up call, do something more than just ask, "How's it going?" Bring your customer a piece of industry news; tell him/her you saw a technical article of interest to him/her and you're sending a copy. Tell him you're representing a new product line and you want him to have a catalog. In other words, it's important to keep in touch, but make the contact purposeful and useful to the customer. This lets them know you appreciate the value of their time, and that helps build respect in the relationship.

Do the same with other forms of contact. Mail appropriate literature to appropriate customers (with that new computer data base you've just purchased this should be easier than ever). Use telemarketing in an appropriate manner. And, for goodness' sake, plan your personal sales visits in an appropriate way for the purpose of maintaining relationships that need this kind of face-to-face personal contact that a phone call or mailing can't provide.

Here's another tip that'll help out in that all-important after-the-contract-is-signed ceremonial luncheon. Take your boss along! Chances are, your customer contact is a high-level executive in
(continued on page 48)

Crossovers

by Marc Benington
Jaffe Acoustics

EQUIPMENT SELECTION AND THE DESIGNER

Last month's column discussed several aspects of equipment selection as part of a consultant's design process. It is possible that the article's conclusion—the contractor should be prepared to bid and supply equipment exactly as specified—may not have been well received by all readers. I am prepared to back up this conclusion by pointing out that a product with a similar performance specification to the one specified is *not* necessarily a substitutable equal. Often, there are other features of a device that influence a consultant's selection.

As an example, let's look

The sound system designer must consider the differences and select the product that is most consistent with the system design philosophy.

at the crossover network. With over two dozen manufacturers producing crossovers, it is clear that there must be different approaches to crossover design and configuration. All crossovers perform essentially the same function—dividing

a full spectrum of sound into two or more frequency bands through the use of electronic filters. Since many products have similar performance specifications, it stands to reason that sound system designers must place priorities on other features that are consistent with their design philosophies. The following represent some of the criteria at Jaffe Acoustics, Inc.

(1) The crossover should be a unity gain device when all outputs are set at full level (zero attenuation). A crossover is a filter set, not a preamplifier. When a crossover is used as a gain stage, the noise component of the crossover input is amplified as well. Further, a loudspeaker system is not well designed if the crossover must be run as a gain stage in order to get an acoustically balanced output in the near field of the loudspeaker system. Of course, given actual driver efficiencies, the crossover will be operated with some attenuation—and not unity gain—in all but at least one frequency range.

(2) Gain controls must have repeatable settings. Precision stepped attenuators are ideal, but click-stops and DIP switches are also acceptable. Stepped attenuators ensure that the settings established during system tuning and balancing are permanently maintained. Gain controls on a crossover do not need to be changed once the system is correctly balanced. Inaccessibility to these controls is

important, to keep the system tuning from being changed by unauthorized personnel. Internally mounted, rear panel mounted, or screwdriver accessible controls are the best methods. Security covers are also acceptable, but they do not provide any protection when removed.

(3) In a permanently installed system, crossover frequency is a fixed parameter, based on driver selection, so that crossover frequency does not need to be field selectable. Easily accessible plug-in circuit cards or headers with fixed frequencies are the best solution in a permanent system. Internal DIP switches are an acceptable semi-fixed alternative. Although many manufacturers provide a blank frequency card to permit the contractor to install any frequency, sometimes desired frequencies may not be attainable with standard resistor and capacitor values. It is the sound system designer's responsibility to ensure that the specified frequency can be provided by the specified crossover network.

(4) The use of anti-aliasing filters in digital audio equipment has reopened, to a large extent, discussions on filter types, that is, their order (slope) and alignment. The pros and cons of the different types of filters will not be discussed here. However, a crossover network that has plug-in circuit cards available for different types

of filters provides the system designer with the most flexibility.

(5) Line fuses should never be internally mounted. A resettable circuit breaker mounted on the front panel, with a red LED to indicate when it trips would be ideal. For those manufacturers who use a rear panel mounted fuse holder, a clip for holding a spare fuse is a desirable feature.

(6) Input and output to any signal processor in a permanently installed system should be by a barriered terminal strip. In a rental or road system, a variety of connectors may be useful, but in a permanent system, connectors only provide one more set of connections which can fail or be miswired. Inputs and outputs should always be balanced, although isolation transformers should be optional and installed as the system design requires.

In actuality, there is no single product that satisfies all these criteria. Therefore, the sound system designer must consider the differences and select the product that is most consistent with the system design philosophy. As responsibility for the design integrity rests with the system designer, it is the system designer who must have the final say in the products used to execute the design. The contractor should understand this and be prepared to bid on and supply equipment exactly as specified.



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World Radio History

by William R. Thornton, Ph.D., P.E.
Thornton Acoustics & Noise

SOUND POWER LEVELS

This article, the second of a series dealing with acoustics and signal processing, will explain the concept of sound power in more detail. Theory & Applications in the June 1986 issue covered sound intensity which is used to compute sound power.

Recall that power is force times velocity, i.e. sound pressure multiplied by area times particle velocity. For an omnidirectional loudspeaker, the oscillating pressure wavefronts spread out in spherical surfaces. Each wavefront has an associated sound pressure and particle velocity. Their product yields sound power. It is independent of distance

and environment for most practical cases. When pressure and velocity are in phase, the acoustic far field exists.

In this far field, a simple relationship exists between the intensity and sound pressure.

$$(1) I(r,f) = P(r,f)^2 / (\rho \cdot c)$$

where:
 $I(r,f)$ = intensity,
 $P(r,f)$ = sound pressure,
 ρ = density of air,
 c = speed of sound.

This relationship can be used to obtain approximate sound power. Intensity and pressure are a function of distance, r , from the source and frequency, f . Sound pressures are measured at

various spatial location around the source, and the spatial average is calculated. Sound power is computed by multiplying this result times the associated area. In equation form, this is:

$$(2) W(f) = [P(r,f)_1^2 \cdot A(r)_1 + P(r,f)_2^2 \cdot A(r)_2 + \dots + P(r,f)_n^2 \cdot A(r)_n] / (\rho \cdot c)$$

Consider equations (1) and (2) for a point source, e.g. an omnidirectional loudspeaker. If the speaker is outdoors with a sound power level of 120 dB, the sound pressure level varies in an orderly fashion in the far field. At one meter, the spherical surface surrounding the speaker has an area of 12.56 square meters and a sound pressure level of 109 dB. At two meters, the surface area increases to 50.24 square meters, (a fourfold increase) but the sound pressure level decreases by 6 dB to 103 dB. Why? Because sound power and sound pressure levels are related by:

$$(3) W(f) = [P(r,f)^2 / (\rho \cdot c)] \cdot A(r)$$

where:

$W(f)$ = sound power in watts,

$A(r)$ = area in square meters,

$P(r,f)$ = sound pressure in microbars,

r = distance in meters,

ρ = density of air,

c = speed of sound.

Increases in area are offset by decreases in mean square pressure. Sound power at each frequency is a constant, $W(f)$. The logarithm of this is equation (7) in *Theory*

& Application in the June issue.

Equations (1), (2), and (3) provide a conceptual model which distinguishes sound pressure from sound power in the far field. Without backloading effects, the sound power is constant if the sound source output is constant. For example, a loudspeaker located in a theater will have a constant sound power, assuming a constant input such as white noise.

How does backloading occur? When strong reflections strike the speaker, the output is reduced. A typical situation is a speaker which is located near a hard reflecting surface. An extreme example is a speaker inside a hard rigid box. Strong reflections result in a very small net intensity, i.e. almost zero, which results in near zero power. The sound power can not be computed using the sound pressure because the far field does not exist. Because of the strong near field effects, other methods, such as the sound intensity method, must be used.

This simple tutorial explains the differences between pressure and power. When measuring the output of devices such as a loudspeaker, these notions must be recognized if the correct power output is to be measured.

Bill Thornton, president of Thornton Acoustics and Noise, holds a B.S.M.E and an M.B.A. from the University of Pittsburgh and an M.S.M.E. and a Ph.D. in Mechanical Engineering from Purdue University.

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SOUND & ***COMMUNICATIONS***

**It's Not Just a Magazine,
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By definition, the word microphone has two meanings: it is an instrument for intensifying weak sounds. And it is a device for transforming sound waves into electrical impulses. While the first definition might seem to have no bearing here, it was Sir Charles Wheatstone, in 1827, who used it to describe an all-mechanical vibration stethoscope—the origin of the word *microphone*. In 1878, David Edward Hughes discovered the telephonic properties of the variable-contact pressure transmitter and used the word *microphone* to describe the transducer.

From that time on the word microphone has been used to describe many inventions. During the early days of radio, broadcast studios were started all over the country. It was mainly the great need for many varied microphones for these studios that has provided us with condenser, dynamic, lavalier, and directional microphones.

In The Beginning...

Prior to the introduction of the microphone, the telephone was developed. Many great inventors worked in the area of telecommunications including Emile Berliner, Amos Dolbear, Thomas Edison, Elisha Grey, Henry Hunnings, and, of course, Alexander Graham Bell. In 1887, the U.S. Supreme Court decided, through a series of appeals, that Bell invented the telephone. Berliner and Edison filed for patents on carbon microphones within two weeks of each other in April 1878. And law suits emerged which were all settled out of court through patent rights acquisitions. Soon the carbon microphone became the standard transducer in telephony and later in the early years of radio.

By the mid-1920s the development of the condenser microphone and the electronic vacuum tube amplifier paved the way for sound on film recording. The first high quality, wide-range condenser microphone was developed by E.C. Wentz at Bell Labs as a measurement standard in the late 1910s. In order to satisfy the high-quality microphone requirements of the rapidly growing radio broadcast and recording industries, Western Electric introduced the 394 condenser microphone; subsequently, RCA came out with the 11A condenser mic. With the introduction of condenser microphones, the problems of signal-to-noise ratio and frequency response associated with the carbon microphones, then in general use, were overcome.

The omnidirectional dynamic microphone was developed by Wentz and Thuras in the late 1920s, and introduced as the Western Electric 618-A. Actually, the original dynamic or moving coil techniques were patented by Ernst Siemens in 1874. He even specified the diaphragm to be the frustrum of a cone, which was used in many other inventions. Nonetheless, the 618-A was the first practical *dynamic* microphone. Because of the simplicity of the 618-A as compared to the condenser mi-

BY JESSE KLAPHOLZ

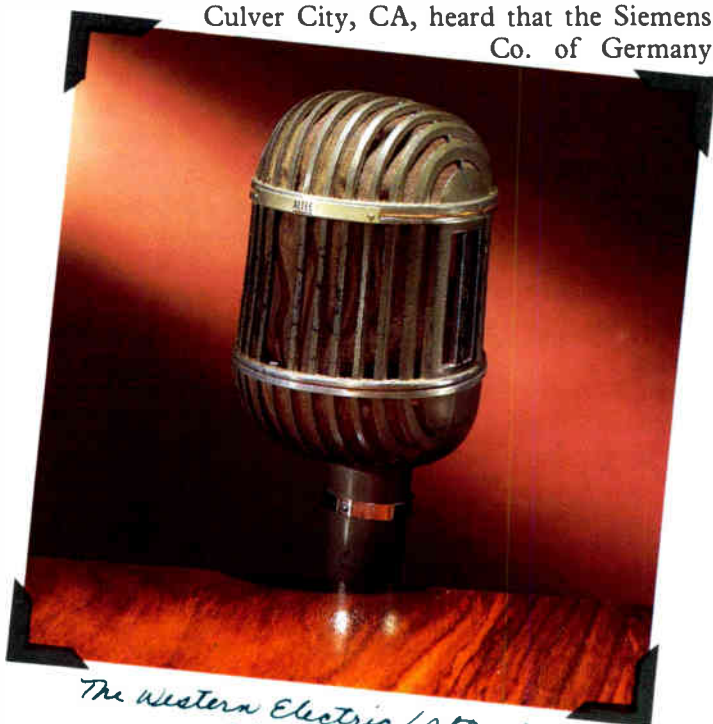
The History & Development of

MICROPHONES

crophone and amplifier, the omni-dynamic mic proved to be more practical for many applications. Although the 618-A was considered to be an omni mic, the microphone becomes very directional in high-frequency range. Western Electric developed a dynamic mic in the late 1930s that was omnidirectional to 15 kHz. Called the 630A, it was better known as the Eight-Ball Mic, because it resembled an eight-ball right off a pool table.

The Early Movie Years

In the early 1930s, the movie industry was making strides in developing recording techniques for film scores. Yet, at that time only a small selection of microphones was available. So when MGM Studios in Culver City, CA, heard that the Siemens Co. of Germany



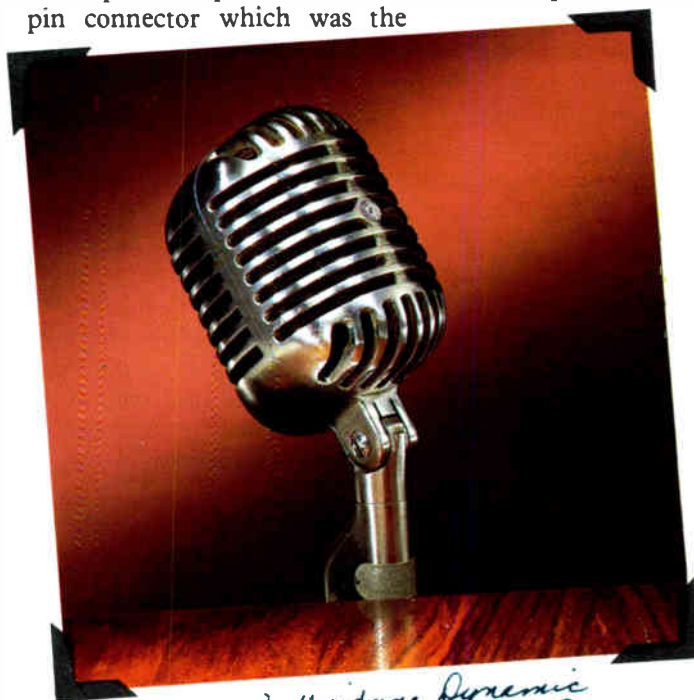
The Western Electric/Atac 639, circa 1939.

had developed a cardioid microphone, a sample was immediately requested. The Siemens cardioid mic was first used on "Naughty Marietta" with Jeanette McDonald and Nelson Eddy.

The Siemens mic was much larger than the dynamic or condenser mics the studios had at the time. Since McDonald had a weaker voice than Eddy, the Siemens mic was first placed in front of McDonald in an attempt to achieve a better balance. Naturally, Eddy was in a quandary over why McDonald got the new mic and he insisted on one too—refusing to record until he got a Siemens mic. The next morning when recording resumed, Eddy was provided with a Siemens mic replica built by the studio's prop shop and which contained a small omni mic inside—thus marking the beginning of audio sugar-pills.

During this time, the equipment used was very heavy and bulky; every attempt was made to reduce size and weight. One area of such attempt was in microphone and camera connectors. James Cannon of Cannon Electric Co. in Los Angeles, CA, supplied connectors for the

auditorium/projection room communications systems. Cannon, known as an ingenious person, was asked to develop a microphone connector. He came up with a six-pin connector which was the



Shure's Unidyne Dynamic microphone, circa 1939.

prototype of his famous P-type connector. It became an immediate success. Later, a small, three-conductor, camera motor cable connector was developed, and from 1929 on, the Cannon plug was history.

Even though there were several advancements in microphone technology, the early models had not proved themselves reliable enough for broadcast work. But, in 1929 and 1930, at NBC's installation of new audio facilities for its Chicago Civic Opera House broadcasts, the 18 carbon microphones were replaced by three parabolic sound reflectors used in conjunction with a condenser microphone. This was the first application of highly-directional microphone techniques. NBC subsequently used these parabolic dishes in both the Philadelphia and New York Metropolitan Opera Houses and in its Times Square studio. In 1939, Mason and Marshall of Bell Labs reported on the design of a tubular directional microphone which used a single element and acoustical tubes of varying lengths to achieve a highly directional pickup pattern. This tubular design paved the way for the shotgun mics we are familiar with today.

The Olson/RCA Legacy

Perhaps the two most famous microphones to be commercialized were developed by Harry F. Olson at RCA. They were the 44A,B,BX velocity ribbon microphone series (1930-1940), and the 77A, B, C, D, and DX unidirectional ribbon microphone series (1931-1937). These vintage microphones are still in great demand; the 44A could be found in many NBC studios, and the 77DX is currently used on NBC's "Tonight Show" and on "Late Night with David Letterman."

When Olson developed the velocity mic it was a large step forward in microphone technology; it was the first high quality directional microphone. The effective solid angle of sound reception for the figure-eight velocity mic is one-third that of the omnidirectional mic. This means a reduction of 5 dB in the effective sound pickup of reverberation and other unwanted sounds. The directional properties of the velocity microphone were found to be useful in reducing effects of reverberation and increasing the intelligibility of reproduced speech.

The next logical step was the development of the unidirectional or cardioid pattern. Olson's 77A, which was introduced in 1933, consists of mini- and bidirectional capsules whose outputs are combined so that they yield the cardioid pattern. The cardioid pattern also affords the same effective angle of sound reception as the figure-eight, and hence the same advantages with the addition of a front-to-back rejection characteristic.

Sound Reinforcement

While RCA's microphone development efforts were concentrated more towards broadcasting/recording applications, Western Electric, in 1939, introduced the 639A unidirectional microphone with sound reinforcement applications in mind. The 639A consists of a ribbon velocity element and a dynamic pressure element, whose outputs are combined so that they yield a cardioid pattern. Marshall and Harry of Bell Labs reported in 1941 that due to the reproducing characteristics of

monaural sound systems in use, directivity needed to be supplied by the microphone in order to produce a more natural balance of direct-to-reverberant sound. They further stated, "This [feedback in a reinforcement system] is merely a special case of extraneous noise, and its effect can generally be reduced by directivity in the microphone."

Marshall and Harry implemented two field tests on the 639A mic, one of a broadcast of a 30-piece orchestra and another of a sound reinforcement system. In the studio, the 639A allowed for an ideal acoustical location of the mic and it was commented that the bass reproduction was much clearer than with other mics. Marshall and Harry attributed the clarity of bass to the suppression of reverberant bass energy pickup, where the studio's acoustical treatment was deficient. The 639A was installed at the House of Representatives, in Washington, D.C., where feedback conditions were so severe that other types of microphones had proven inadequate in providing sufficient reinforcement. The 639A has a six-position switch that yields omni, cardioid, several types of hypercardioid, and figure-eight patterns. In the House of Representatives, the hypercardioid afforded an increase of 5 dB in the system gain—wherein was the difference between success and failure of the entire installation.

In the late 1930s, Benjamin Bauer of Shure Brothers developed a new cardioid dynamic microphone that used a single element and acoustic means to achieve its direc-

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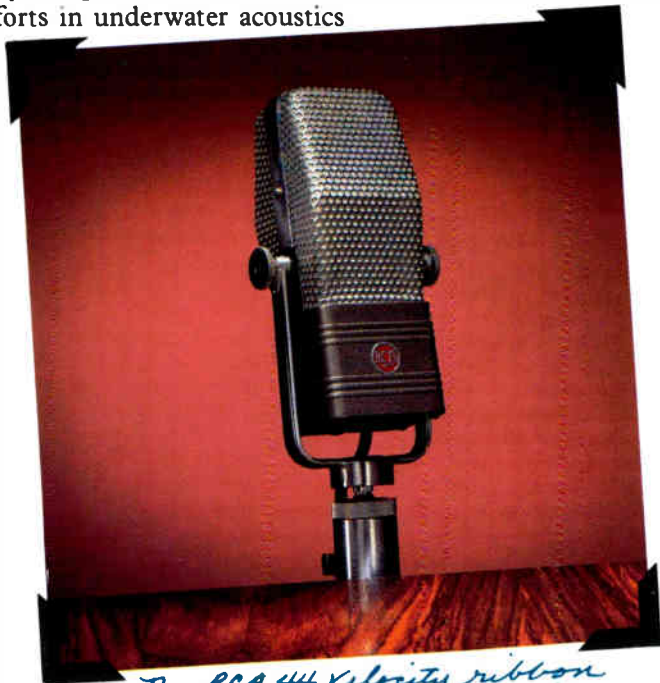
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In the late 1930s, Benjamin Bauer of Shure Brothers developed a new cardioid dynamic microphone that used a single element and acoustic means to achieve its directional pattern. The Shure Unidyne made its debut in 1941 and was a turning point for microphone design, manufacture, and reinforcement applications.

Crystal Microphones

In 1880, Jacques and Pierre Curie discovered the piezoelectric effect. Piezoelectric crystals were first used by Langevin in 1917, in connection with his research efforts in underwater acoustics



The RCA 44 Velocity ribbon microphone, circa 1930's.

using ultrasonic transducers. In 1919, using Rochelle Salt, Alexander Nicolson first demonstrated a variety of piezoelectric devices, including loudspeakers, phonograph pickups, and microphones. Problems of manufacturing crystals with uniformity and the necessary shapes prevented the commercial production of any of these devices. Almost 10 years later, C.B. Sawyer and C.H. Tower developed processes to manufacture uniform complex-shaped piezo crystals. This led the way for many piezoelectric or crystal transducers, as they were first called.

Electrets

Work on electret condenser microphones dates back to as early as 1928. These microphones used permanently polarized wax plates. Eventually, microphones with wax electrets were offered commercially by Bogen (1938 to 1940) under the name No-Voltage Velotron. The first large-scale application of electret transducers was during WWII, when wax-electret microphones were used in Japanese field equipment. The wax-electrets, however, did not catch on due to their instability and very small capacitance which complicates the mic-preamp design. From 1948 through the early 1960s, work continued in electret microphone technology, turning up materials such as acrylics, ethyl cellulose, polystyrene, vinyl poly-

mers, and ceramic electrets.

In 1962 and 1965 electret microphones in which the diaphragm was composed of a metalized thin foil of Mylar or Teflon, respectively, which had been converted into an electret were proposed. Finally, in 1968, Sony brought out the finest electret condenser microphone. Later, around 1971, Primo Company Ltd. introduced an electret mic with a monolithic IC preamp. Foil-electrets are manufactured in countless numbers; the Japanese production of electrets alone is estimated to exceed 20 million units per year.

The Future

Once the past has been clearly laid out before us, the future is easy to imagine. Many inventions of the future will be stolen from early predecessors. Those who worked in the labs in the 1800s and early 1900s left us with a long list of inventions to be implemented with modern materials, and new electronic and manufacturing technologies. These *new* devices can be categorized into mechanical and non-mechanical transducer systems. Diaphragms made from materials yet to be patented will use various modulation and sampling techniques to convert their motion to digital data. Optical A/D microphones are currently being developed. On the horizon we see the technologies of fiber optics, lasers, and interferometers applied to the electrical and digital transduction of acoustical phenomena.

"There is room for improvement in even the best microphones....Possibly an understanding of the limitations can be had by considering that, for perfection, a microphone should possess no inertia, and should produce an output directly proportional to the air pressure applied." Although this quote is from the book, *Public Address Systems*, by James R. Cameron published in 1935, it still holds true today.



The RCA 77 unidirectional ribbon microphone, circa 1930's

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The RCA 44 and Shure 55 courtesy of Jon Sank. The RCA 77 and Western Electric/Altec 639 courtesy of David Starobin. Photos by Doug Hanewinkel.

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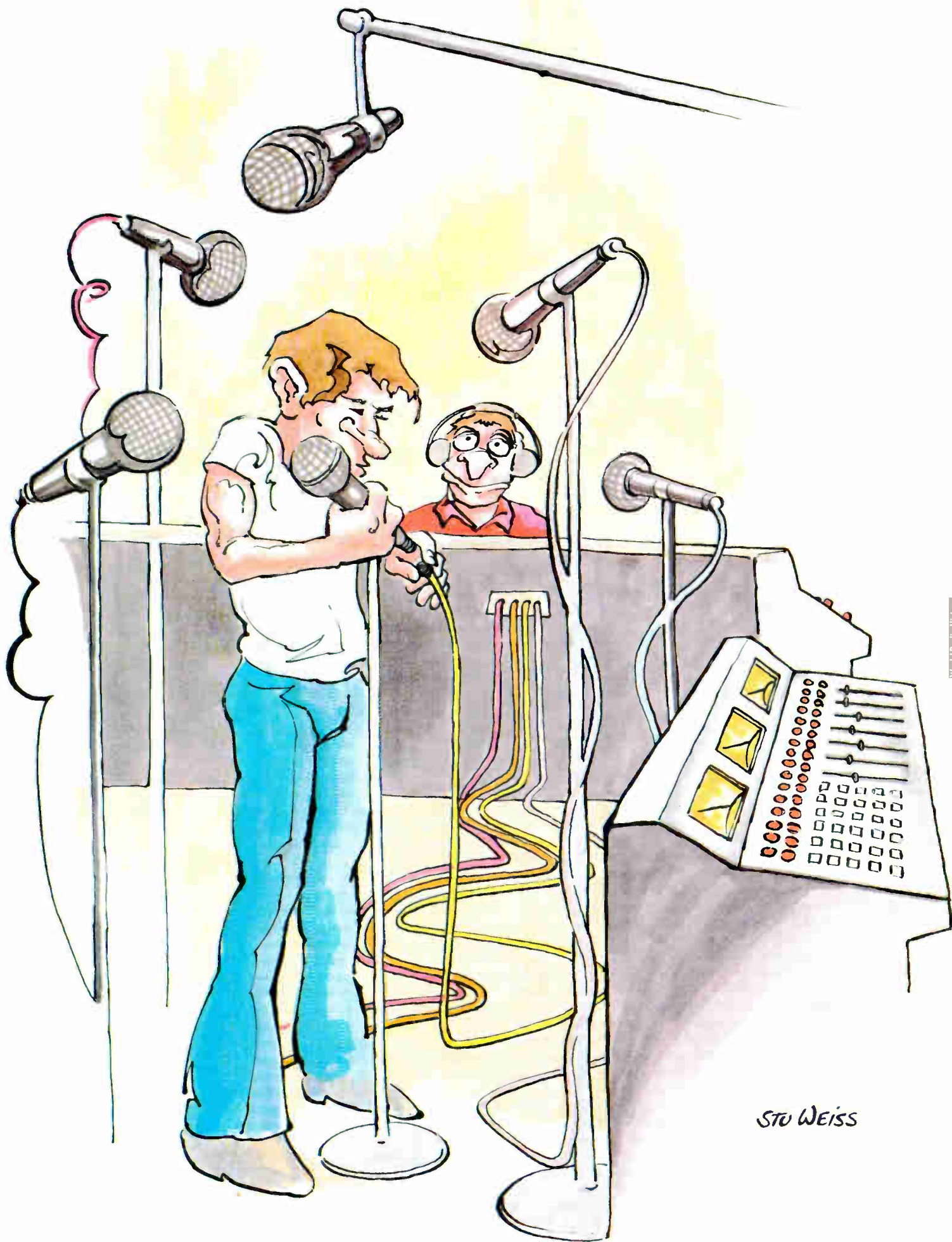
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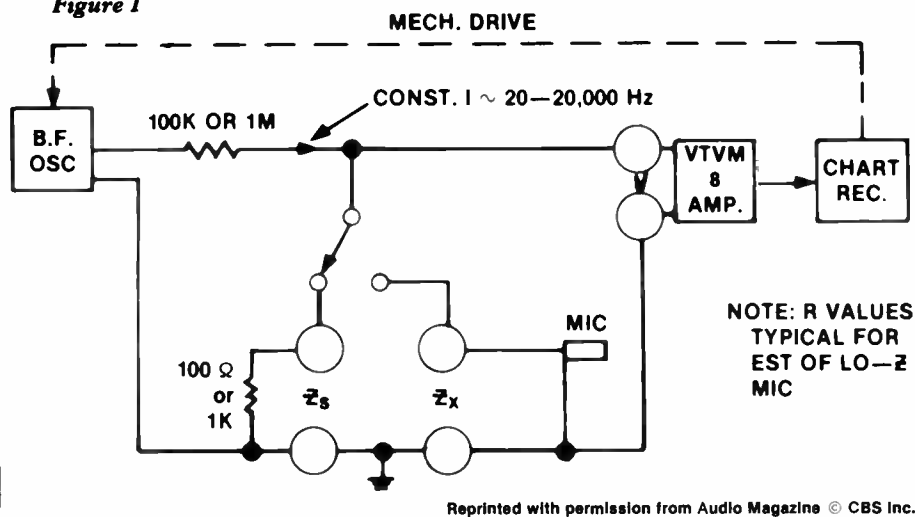
MANUFACTURERS' DATA ON MICROPHONES are given for idealized open-circuit load conditions, according to the applicable EIA and ANSI standards for testing and rating microphones. In the real world, open-circuit conditions do not exist; the microphone is loaded and does transfer a minute quantity of electrical energy to the electronics. The input circuit may present a load which could equal any value from a matched load up to many times the microphone impedance.

Microphones may exhibit impedance variations over the audio frequency range of 20 to 20,000 Hz which depart considerably from the rated nominal value at 1,000 Hz. To obtain rated performance from a microphone with varying impedance, the load resistance must be high compared to the highest value of microphone impedance. It is usually difficult to determine the actual microphone impedance from specifications alone. I suggest that you measure it when in doubt. As long as you keep the applied audio in the millivolt region, there will be no danger of driving ribbons out of their gaps. Most other type transducers cannot be harmed. A simple test circuit is shown in *Figure 1*.



by Jon Sank

Figure 1



In professional audio systems we are usually concerned with only low impedance microphones having balanced outputs, because long cables generally have no loading effects. The common mode rejection (CMR) reduces noise picked up in the cables, depending on the electrical balance of the amplifier input circuit.

To give some perspective, let us review the general impedance characteristics of the microphones in common use. Condenser microphones, which contain integral preamplifiers, generally exhibit a constant, resistive impedance versus frequency. Values encountered may be anything from about 60 to 600 ohms. Generally speaking, these microphones may be operated into matched loads or higher values with impunity. It is a better practice to avoid loads of less than a couple of thousand ohms for two reasons. First, some microphones will show an increase in impedance at high or low frequencies. This may be related to an output coupling condenser or leakage inductance of the output transformer in the microphone. Low resistance loads may cause frequency response variations. Second, at high sound pressure levels, a low resistance load may cause distortion in the microphone's electronics.

Omnidirectional moving coil (dynamic) microphones have highly damped mechanical systems and very uniform impedance versus frequency. The values vary from about 125 to 300 ohms. (We are speaking of contemporary products, of course, which are rated at 150, 200, or 250 ohms. Old Western Electric microphones, for example, were rated at 30 or 50 ohms.) Omni mics may be connected to

matched loads or higher with negligible effect on performance.

Cardioid and figure-of-eight (unidirectional and bidirectional) ribbon, printed ribbon, and moving coil transducers have resonant mechanical systems with light damping. The impedance rises to a peak at the resonance frequency, which is in the 20 to 200 Hz region. Maximum impedance may range from 500 or 600 ohms for a dynamic mic, to 1,500 ohms for a bidirectional ribbon. The latter value represents a bizarre case, an RCA 77-DX polydirectional ribbon mike set for figure-of-eight pattern. It is still popular in studios, but it is most often set for the cardioid pattern, where the impedance does not exceed 1,000 ohms. These directional mics should be loaded with a relatively high resistance to avoid variations in frequency response. A well-regarded mixing board has an input resistance of 2,500 ohms which is generally satisfactory for these directional mics as well as the condensers and omni dynamics.

Occasionally you may encounter a piece of equipment, such as a consumer tape recorder, which has unbalanced low impedance microphone inputs. If you want to use more than 25 or 30 feet of cable, I suggest that you use balancing transformers. The commonly available line or cable type mic transformers have an impedance ratio (typically) of 200:50,000 ohms. These should be used with only high impedance inputs which have actual resistance values of 500,000 ohms or higher. Note that the load presented to the mic will be 2,000 ohms or more when used correctly. If this transformer were connected to a low impedance input of, say, 2,500 ohms actual

resistance, the mic would be loaded with too low an impedance, as the transformer secondary would see a virtual short circuit. The correct choice is a low-ratio, well-shielded audio isolation transformer which is specifically designed for use with microphones. If satisfactory gain is obtained with direct unbalanced microphone connection, then use a 1:1 ratio transformer (200:200 ohms). If gain is too low, use a step-up transformer such as 200:600, 200:1,500, or 200:3,000 ohms. Choose the lowest ratio which offers enough gain, trying to keep the impedance looking into the primary at 2,000 ohms or higher.

To keep the CMR high usually calls for grounding the primary center tap, but a well constructed transformer may not need a grounded center tap. (Indeed, some do not have center taps at all.) A leading manufacturer (Jensen) offers diagrams showing correct grounding of the center taps and internal shields of their transformers. In addition, they recommend including switches in certain ground connections so that the user can quickly change grounding to solve noise problems, an asset in portable equipment. I find that these switches are handy in permanent installations as well, because noise conditions vary from day to day, probably in relation to changing currents in AC power systems. It is also possible to connect one mic to two inputs, and do a variety of other things by using special kinds of transformers. (Jensen sells a variety of transformers with detailed circuit diagrams showing how to use them.)

Interfacing microphones with electronics is easy if you observe these guidelines and use extra care with cables, transformers, and grounding.

Jon Sank, who was responsible for many of RCA's microphone designs during the 1950s to the early 1970s, is a principal of Cross Country Consultants. Sank is also a contributor to Audio magazine and a member of Sound & Communications' Technical Council.

For Further Reading

Sank, J.R., "The Complete Microphone Evaluation," *Audio*, April 1977.

Sank, J.R. "Equipment Profiles" on microphones, *Audio*, various dates, 1977-1986.

Sank, J.R. "Microphones," *Journal of the AES*, Vol. 33, n7/8, July-August 1985.



For years, the loudspeaker voice paging marketplace was treated like an unsophisticated after-thought to internal communication systems. At Harris/Dracon we began changing that approach when we introduced the industry's first multi-featured, expandable, factory prewired system in 1976.

Since then we've been able to develop a voice paging line that serves all market segment needs—from 6 watts up to unlimited power systems. Each designed with a singular purpose: to keep installation and engineering to a minimum while offering easy future expansion.

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This approach makes expansion simple. It makes adding more sophisticated features simple. And it makes the installation technician's job simple.

With our full line of telephone associated loudspeaker paging systems you can have performance quality, very low distortion, limited lifetime warranty, speakers with volume control and tapable 70V speakers. (Plus all our speakers have two-way operation which means inventory efficiencies for you and makes office re-organization inexpensive for your customers.)

Our latest technological advance is a special ceiling baffle* design that revolutionizes the installation of the loudspeaker network. Our new lightweight P-TEC/5 line also offers the new piezo speaker—a breakthrough technology made possible by Motorola engineers and exclusive to Harris/Dracon for voice paging application in the U.S., Canada and Mexico.

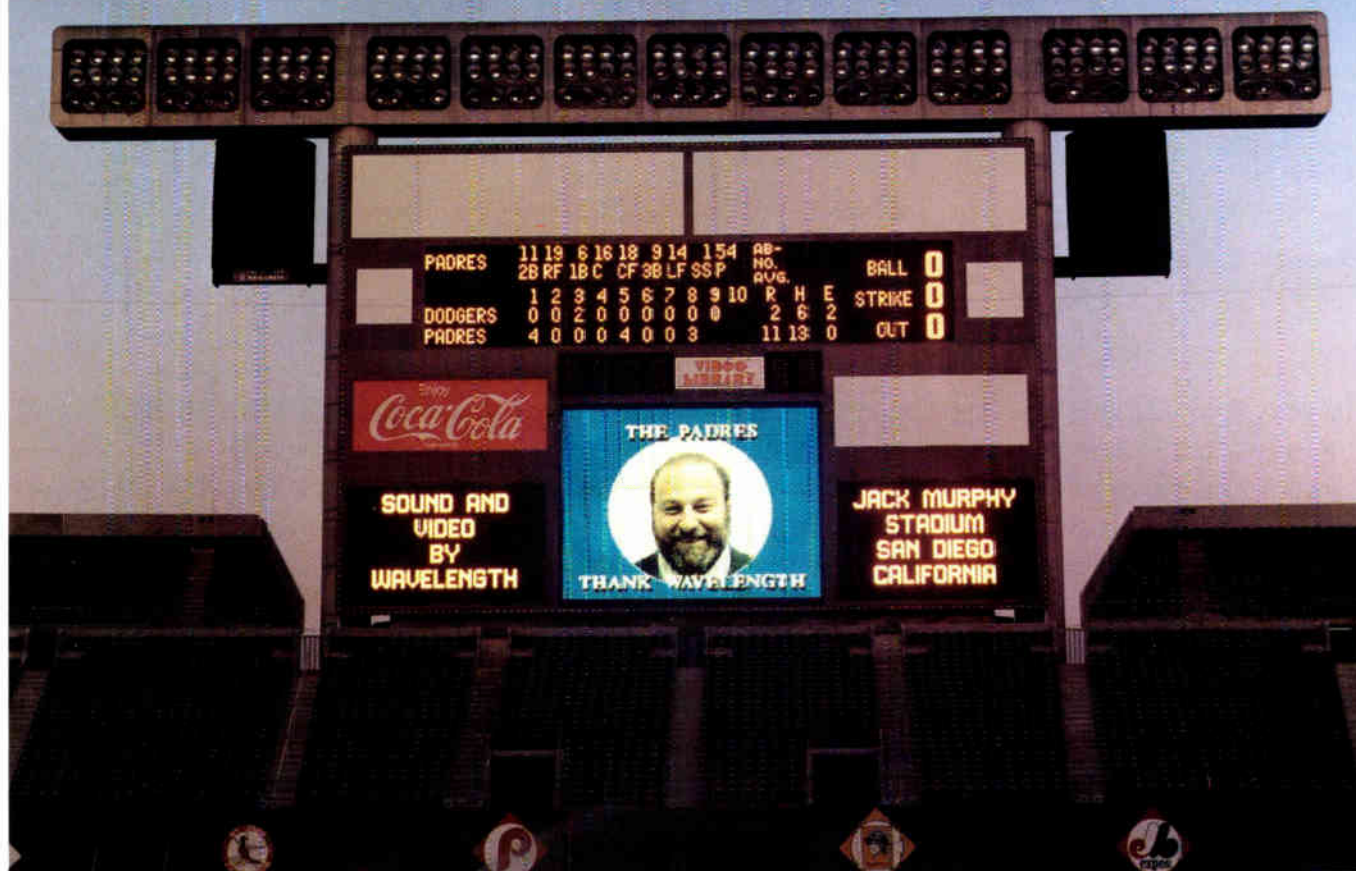
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*Patent pending

Installation Profile



Jack Murphy Stadium

by Mike Klasco

Last winter I received a phone call from Wavelength, a sound contractor in El Segundo, CA, asking if I could help out with a sound system for a baseball field. Images of Little Leaguers came to mind; but no—this was for the Jack Murphy Stadium in San Diego, the home of the Padres and the Chargers.

It seemed since \$3 million was being spent on a giant Diamond Vision large-screen TV and on video production equipment, a few thousand dollars could be found to fix up the PA system.

The improvements were prompted by the 1988 Super Bowl which is to be hosted by the Stadium, and the Padres' recent successful season. What specifically initiated the sound project

was that the main speaker cluster was on top of the signboard and had to be moved, as this was going to be the location of the Diamond Vision display.

Although the original sound system had gone through a number of revisions, nobody was happy with it. I had never been to the stadium, so I called a friend in San Diego and asked about the PA quality. His response was, "What PA?" This was not promising!

The main problem with the system was a lack of power available to the speakers, and an inadequate voice band maximum acoustic output. The power limitation was external to the amplifiers. The amps were located at the control room, with a 1,500-foot run to the main speaker cluster. The

DC resistance of a 4 ohm impedance driver measured over 20 ohms. The amps were expending most of their power keeping the speaker wire warm. Numerous schemes had been tried over the years to solve the line loss problems, but none were successful.

Installed in 1968, most of the equipment was tube circuitry. It must have been a tough decision back then, between big, hot tube amps or marginally reliable transistor amps. Some of the old tube amps have been replaced with BGW and Crown units.

The parking lot, the outside circumference of the stadium, and one level of the seating used a distributed sound system. Except for a Mark-Teknik digital delay line, old Philips tape loop delays were used.

Images of Little Leaguers came to mind—but this was no Little League baseball field. It was the Jack Murphy Stadium, the home of the Padres and the Chargers.

The main system used a single cluster above the scoreboard. The original bass drivers had been replaced by JBL 2245s a year earlier. The original mid/high frequency compression drivers had also been replaced at that time with JBL biradial/constant directivity series equipment.

When I arrived at the stadium, the crowd had not yet arrived. We fired up the sound system and took a walk around. The distribution and quality were okay, but a maximum sound level of only 72 dBA could be reached in the seating. Not very hopeful for a stadium with a seating capacity of 50,000 noisy, enthusiastic Padre fans. Later, during a game, I measured crowd noise peaks at over 90 dB. With such an enthusiastic crowd, it was often impossible to tell if the sound system was operating.

The Redesign

The first revision in the system was going to be an amplifier room near the

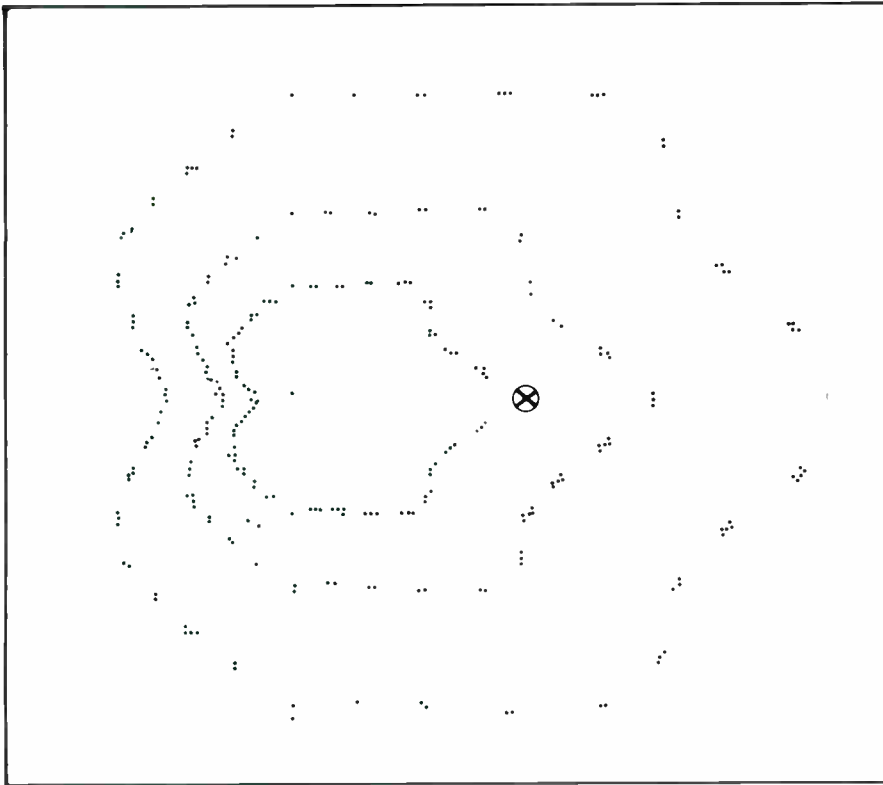
new main cluster. The main cluster was going to be relocated to the side of the signboard (at home base). A BGW 750 would drive each pair of JBL 2225 15-inch bass drivers in each of four theater horns. These boxes were RCA variations of JBL-style 4550 (short horn/double 15-inch woofer, vented below 90 Hz). Previously, a transformer coupled, single BGW 750 drove the entire low-frequency system. With a relatively short run between the speakers and the amps, we used direct coupling with 10 gauge wire.

The mid/high frequency drivers and horns also did not have enough power, both due to not enough amplifiers and the long wire run. A channel of a BGW 750 was used to drive each compression driver. The acoustic output and reliability of the JBL compression drivers and horn was going to be just adequate below 1,000 Hz, and the pattern and smoothness of the RCA horns were not very good past 500 Hz. Picking up 3 dB by doubling up on com-

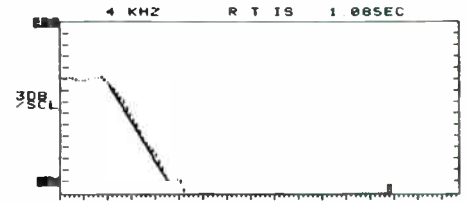
pression drivers with Y adaptors was not a sonically attractive or cost effective option. I looked over the EAW, Turbosound, and Community Light & Sound mid-bass/mid-range horns. They all checked out quite nicely, with the Community being the most expensive and the best. The budget was available, so I spec'd in three Community M4 drivers and two 60x40 horns and one 40x20 horn. The RCA bass bins would be used up to 400 Hz. The JBL horns and drivers would be crossed over at 1,000 Hz, above their excursion failure mode region, increasing power handling to 150 watts, thermally limited. The Community mid-range system was being used in its hot range. With the 40x20 horn, the efficiency was about 120 dB at 1 watt/1 meter (400-1,000 Hz). Power handling was 200 watts continuous. The stadium had two Crown PS400 amplifiers, which we used for the Community equipment. The 40x20 horn was aimed at the far

(Left) The installation Diamond Vision large screen television prompted the PA system renovation. (Below) The control room with production and audio equipment.





Sound intensity contour plot simulation of Jack Murphy Stadium using ONLP computer program.



Reverberation plot of 4 kHz octave band.

end of the stadium, which also had the greatest crowd density/noise ratio. The Crown PS400 was used bridged for this application. The other Crown PS400 was used in the stereo mode to power the other two Community horns.

As the main cluster was relocated to the side of the signboard, a second cluster enclosure was constructed to match the working cluster for aesthetic reasons. A small array was installed for coverage of the seating in the shadow of the signboard. This subsystem used a DeltaLab delay line.

The Philips tape loop delays were replaced with Klark Teknik triple tap digital delays.

Ashly parametric equalizers and three-way 18 dB per octave crossovers

No moving parts—no maintenance required

Solid-state, Natural Voice Digital Message Repeater



Shown: DMR cartridge and main frame.

The compact DMR unit measures only 8 x 4.8 x 2.4 inches.

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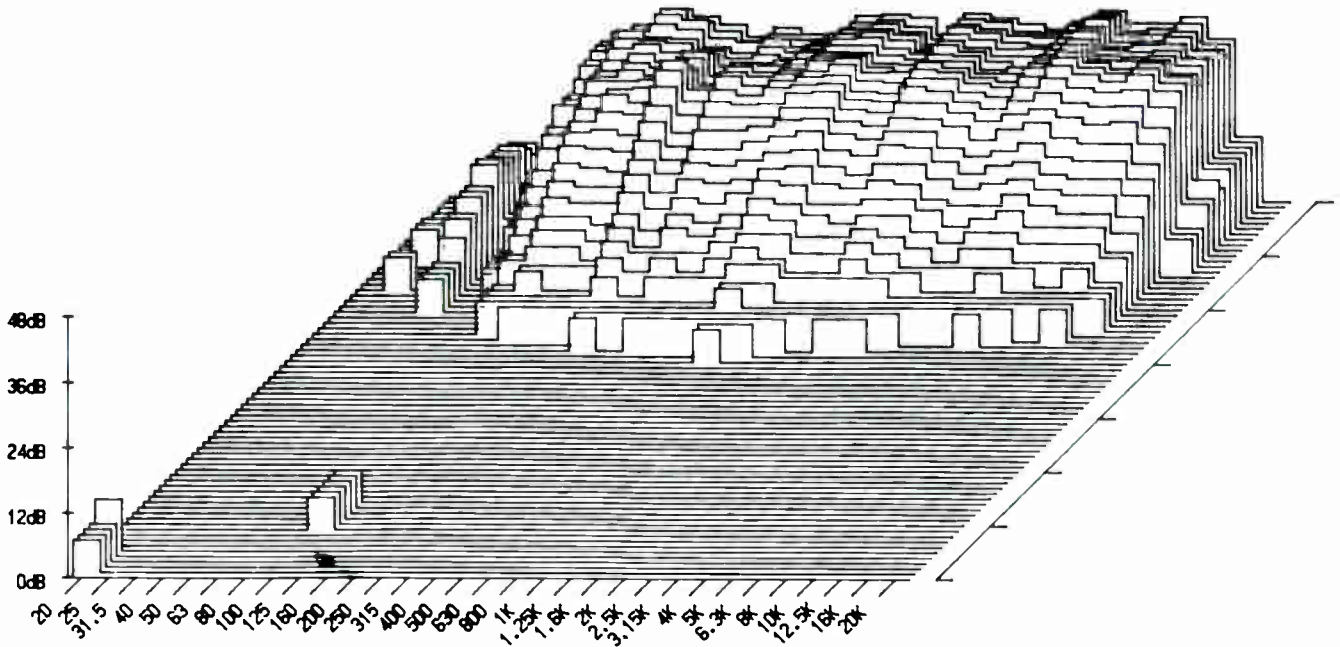
The DMR consists of the message cartridge and the controller main frame. The complete unit is very compact—only 8 x 4.8 x 2.4 inches. Standard message length is up to 60 seconds; longer message time is available. Models are available for multi-message random access. The DMR is an Underwriters Laboratories recognized component.

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Circle 212 on Reader Response Card



Third octave spectral decay plot using the Sigma system.

were used. Overload protection was provided by a Urei limiter, modified Electro-Voice STR Speaker Sentries and non polarized motor starting capacitors were used on the mid and

high frequency drivers for protection from DC, hum, and other low frequency equipment.

A complete computer simulation was prepared before finalization of the

design to map the sound intensity coverage. The software program used was ONLP, which runs on Apple compatible computers (such as the IQS and Sigma systems).

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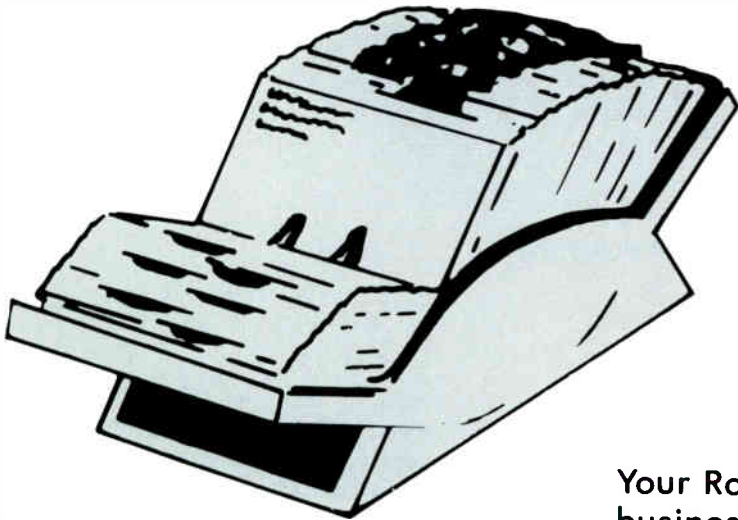
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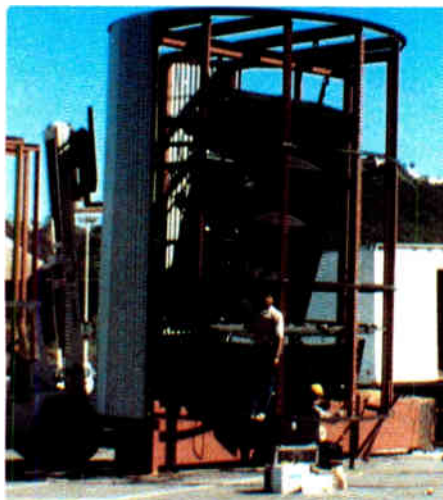
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What specifically initiated the sound project was that the main speaker cluster was on top of the signboard and had to be moved, as this was going to be the location of the Diamond Vision display.



audio/computer test set. The time delays were calibrated with the Sigma's time/energy digital oscilloscope function. The sound system's

Mike Klasco, president and founder of Menlo Scientific, has recently been working on the sound system for the 1988 Olympics in Seoul, Korea. Klasco, an Audio Engineering Society member who holds a B.S. in Industrial Technology from New York University, is currently working toward a PH.D. in Signal Processing Time Compression from that school.

overall balance was set by the Sigma's real time one-third-octave analyzer and pink noise generator. Using the IQS 401 high resolution FFT analyzer plug-in, the parametric equalizers and electronic crossovers were set.

The real test was seeing if the sound system could be heard over the crowd. The renovated sound system was capable of reaching peaks of over 96 dBA—over 20 dB improvement, and quite audible over even the most enthusiastic fans!

The Front End

The front end was a 12 channel Ramsa board, which replaced an old RCA broadcast console. A Technics turntable and TEAC tape decks were installed. Numerous sub-systems feeds were interfaced, such as for the press boxes, snack bars, network feeds, parking lot, etc.

Testing

The reverberation time was measured with a Sigma RS-4000

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The Uher 6000 open reel recorder is ideal for security surveillance work ■ All functions are solenoid controlled, easily adaptable to remote control for playback or long-term monitoring, recording or logging.

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HARRIS/MOTOROLA P-TEC/5 CEILING LOUDSPEAKER

by **Farrel M. Becker**
AUDIO-ARTISTRY

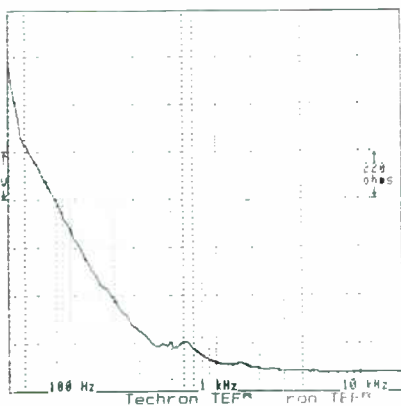
A piezoelectric loudspeaker for voice paging? Piezo tweeters are common, but they are not very useful for paging systems. Harris, however, is marketing a revolutionary new piezo loudspeaker that *does* meet the needs of voice paging—the P-TEC/5.

The P-TEC/5 is unique in its use of a piezoelectric element as the loudspeaker's motor. In place of a conventional magnet structure and voice coil, the P-TEC/5 uses a pair of extremely

thin piezo ceramic elements arranged in a fashion that is similar to the bi-metal used in thermostats. When a voltage is applied, the elements flex in opposite directions causing the center of the assembly to move in and out. A small conventional loudspeaker cone (three inches) is attached to this moving center. The combination results in a loudspeaker suitable for voice paging that, along with its enclosure, weighs only about six ounces.

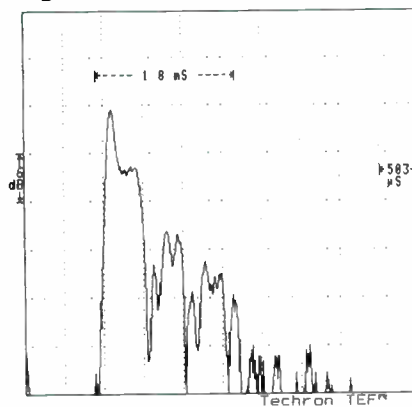
The loudspeaker and enclosure are an integrated system. The enclosure is an eight-inch diameter plastic dish with an inverted cone-shaped diffuser mounted in front of the cone. Two metal spikes are provided for mounting the loudspeaker to an acoustical tile ceiling. A 100-kohm potentiometer is mounted in the side of the enclosure and wired as a pad. This permits each individual loudspeaker to be set at an appropriate drive level (instead of

Figure 1



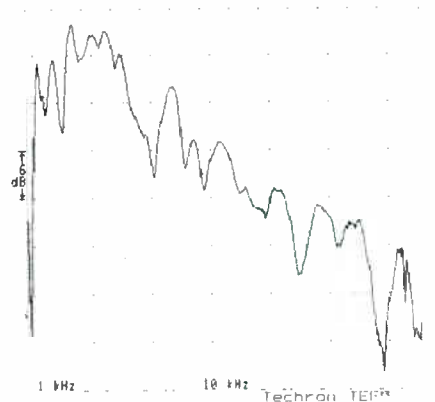
Magnitude of impedance, 0-20 kHz, 7 Hz resolution.

Figure 2



On axis ETC.

Figure 3



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



transformer taps as in a 70-volt system). I would prefer to have the potentiometer mounted internally to prevent unauthorized adjustments by the general public. A 1/4 watt, 100 ohm resistor is wired in series with the loudspeaker/potentiometer combination.

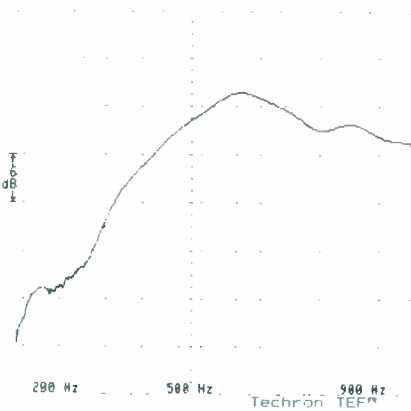
The loudspeaker itself has a polarity marking on one of its terminals (within the enclosure) but there is no polarity indication on the spikes. Once the

spikes have been pushed through the ceiling panel it is impossible to determine the connections for proper polarity. In a large distributed system, having the loudspeakers connected with random polarity could cause a severe degradation of the sound.

I found the mounting procedure to be quick and easy. The spikes are pushed through the ceiling tile, retaining clips are slipped onto the spikes, and the wiring is then attached to the

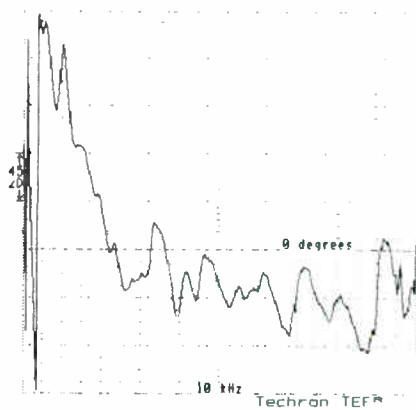
clips. The clips are similar to Fahnestock clips in the way they connect the wire. I have personally always found Fahnestock clips to be clumsy and, at times, difficult to work with. They do get the job done, however. Moving the loudspeaker from one location to another is equally fast and simple with the added benefit of not having to replace the ceiling tile. The two small holes left by the spikes are virtually invisible.

Figure 4



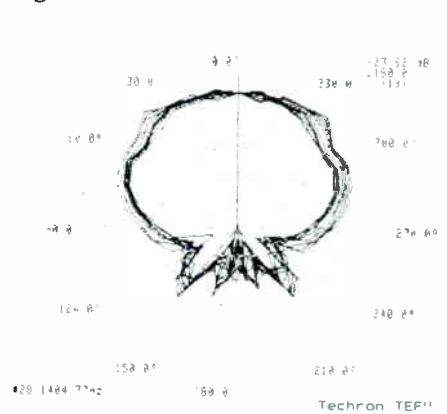
On axis frequency response, 100 Hz to 1 kHz, 150 Hz resolution.

Figure 5



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

Figure 6



2 kHz octave band polar response, composite of frequencies (50 Hz steps), 10 degrees/data point, 6 dB/division.

The impedance of the P-TEC/5 is also unusual as far as loudspeakers go. *Figure 1* shows the magnitude of its impedance as a function of frequency. The impedance at 1 kHz is 140.2 ohms rising to 743.1 ohms at 100 Hz. To an amplifier this loudspeaker looks very much like a capacitor up to about 5 kHz and then becomes resistive at about 93 ohms. An amplifier with good stability under capacitive loads is a must.

Figure 2 is the on axis Energy Time Curve (ETC) of the P-TEC/5. The unit rings for well over the 1.8 mS indicated. This ringing is evident over the loudspeaker's useful range, up to approximately 5 kHz. This ringing, or *time smearing*, leads to a loss of clarity in the sound produced by the loudspeaker. Still, for most paging only situations, this should not be a problem.

The anechoic on axis frequency response from 0 to 20 kHz is shown in *Figure 3* with low frequency detail shown in *Figure 4*. (All of the acoustical measurements were performed with the loudspeaker mounted in the center of a typical two-by-four-foot acoustical ceiling tile.) The phase response of the loudspeaker is shown in *Figure 5*.

The loudspeaker's usable response

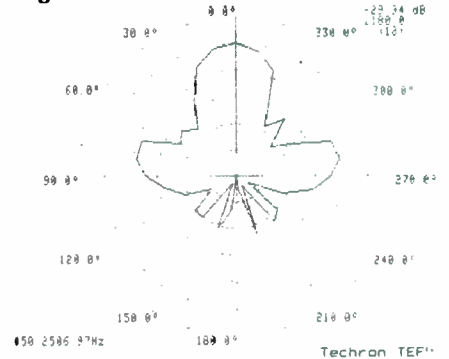
lies between roughly 500 Hz and 5 kHz. While the P-TEC/5 does not sound very good on music (except possibly for AM radio) it is quite sufficient for voice paging applications. When used with telephone paging systems, its frequency response will closely match that of the telephone system and should sound fairly good.

The 1 watt/four foot sensitivity at 1 kHz is 85.2 dB. The EIA rating is 37.7 dB. I was not provided with any power handling information, but I have seen a reference to a 50 watt rating. The 1/4 watt series resistor would seem to limit power handling somewhat. However, with paging being intermittent by nature, the loudspeaker should be able to handle the power required for normal paging levels.

The directional characteristics of the P-TEC/5 are shown in the polar plots of *Figure 6*. *Figure 6* is a composite of the polar plots for the frequencies (in 50 Hz steps) that lie in the 2 kHz octave band. The pattern gets a bit wider at about 1 kHz and goes into periodic lobing above 2 kHz. *Figure 7* illustrates the lobing a 2.5 kHz. The Q for the 2 kHz octave band is 7.15.

Figure 8 is the ETC obtained 30-degrees off axis. Not surprisingly it shows a great deal of time smear as did the on axis ETC.

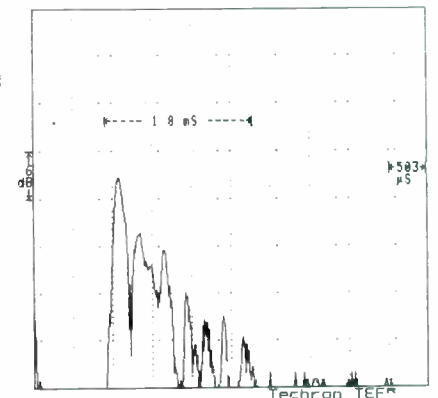
Figure 7



2.5 kHz polar response, 10 degrees/data point, 6 dB/division.

The Harris P-TEC/5 is certainly a very interesting loudspeaker. In voice paging applications where a large number of loudspeakers must be installed in an acoustical ceiling, the reduction in the amount of work involved in installing the loudspeakers will be quite significant with the P-TEC/5. Also, in an open plan office situation, where changes in the layout may frequently be made, the ability to move loudspeakers quickly and easily is a great advantage. The P-TEC/5 should prove popular with contractors installing voice only paging systems.

Figure 8



ETC 30 degrees off axis.

Farrel M. Becker, a consultant for Audio Artistry, specializes in live sound for the performing arts. Becker started working with TEF technology in 1979 and now teaches the fundamentals of TEF in Techron training program.

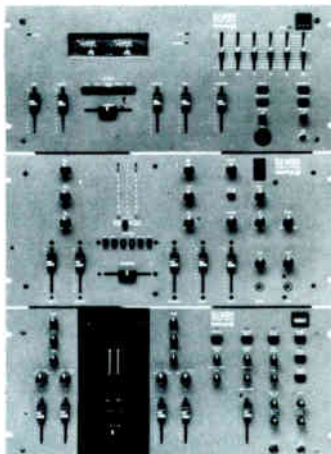
Author's Note: Special thanks to Keith Jebelian of Techron for supplying the software to generate the polar plots.

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PRODUCTS IN REVIEW



BIAMP INTRODUCES STEREO DJ MIXER SERIES

Biamp Systems, Inc. has released three stereo DJ mixers for the recorded entertainment market—the DJ 3001, DJ 4001, and DJ 5001.

The DJ 3001 is aimed at the mobile application and smaller permanent installations. It includes a six band graphic equalizer, two phono and two line inputs, stereo main program and tape outputs and full metering and peak indication. The suggested retail is \$499.

The DJ 4001 is the newest model of Biamp's 4000 Series. 5532 op-amps are used throughout the phono section for low noise and distortion. LEDs on the main program output and the cue buss facilitate visual beat synchronization before fading between selections. Suggested retail is \$699.

The DJ 5001 features nine selectable inputs; three phono, five line and one switchable between the two. There are two stereo and one mono outputs, all floating and balanced. The light send is transformer isolated. Two DJ mics have independent level controls. Suggested retail is \$899.

Circle 16 on Reader Response Card

DUKANE'S MODULAR COMMUNICATIONS SYSTEM

The Communications Systems Division of Dukane Corporation has announced MACS—a Modular Administrative Communications System designed to economize and simplify communications in schools, universities, correctional facilities and other institutions.

MACS is a true multi-link system with the ability to handle multiple

simultaneous conversation paths. Multi-link technology eliminates delay of important messages caused by line tie-up.

Each MACS system consists of one or more administrative control stations, any desired number of remote stations (speakers or call-in switches; voice or push-button operation), and a central equipment cabinet with built-in self diagnostics. A basic small facility system includes 16 remote stations with three audio links (simultaneous talk paths). MACS can incorporate up to 12 audio links for 128 lines of two-way communication.

MACS administrative control stations, with slide out operator's guides, are compact enough for desktop use. Equipped with speaker microphones



and handsets, the stations are user programmable for two to five digit architectural dialing. Additional user programmable functions include station capture capability, split coverage, distribution of optional program sources, (radio, cassette) zone paging, all page, and master clock.

To distinguish between normal and emergency calls, each MACS communication/call point (speakers, call-in switches) can be programmed for two or six priority levels. All calls and call priorities are displayed at administrative control stations.

Circle 17 on Reader Response Card

INFRARED CONTROLLER FOR CONFERENCING

FSR, Inc. has announced the production of an eight to 15 channel infrared controller, the IRC-50. To be used in boardrooms, conference rooms, training centers, or hotels, the system has an operating range over 50 feet.

The IRC-50 infrared system consists of a transmitter, receiver, and decoder.

The decoder, which snaps into a standard mounting track in the equipment rack, receives the signal from the receiver through a mic line, and decodes the signal to activate one of eight or 15 relays.

The receiver in most applications will pick up the signal without aiming. Custom engraved transmitter keys are also available. Multiple receivers can be used for large auditoriums or boardroom applications.

The system allows for an LED to be connected on the rack decoder card to allow a complete walk test of the IR system without actually hooking up the controlled items.

Circle 18 on Reader Response Card

SENNHEISER WIRELESS STEREO HEADPHONES

Sennheiser Electronic Corporation has introduced the SI/HDI 234 wireless stereo headphone with infrared stereo transmitter. The combination SI/HDI 234 HiDyn transmitter and headphones incorporate Sennheiser's developments in infrared and circumaural Open-Aire® headphone technology.

The SI-HDI 234 headphones feature individual right and left volume controls. Weighing 13 ounces and powered by a standard nine-volt battery, the HDI 234 with SI 234 transmitter features selectable stereo, mono or two-channel reception.

The compact SI 234 transmitter can be connected to any high-fidelity in-



stallation, including standard stereo television sets and compact disc (CD) players.

Circle 19 on Reader Response Card

DOOR ANSWERING DEVICE FROM VIKING ELECTRONICS

Viking Electronics has introduced a hands-free door answering device mounted in a weather resistant enclosure—the W-1000. The unit comes with a metal baffle plate, door bell button, and PVC box with gasket for surface mounting. It is designed to install on an unused trunk line of either an electronic, 1A2 type key system or multiple line "No KSU" phone. The W-1000 may also be used as a dedicated internal intercom by connecting to a standard single line telephone. Pressing the door bell button on the W-1000 generates an incoming ring signal on either the key system or the single line telephone. Lifting the handset allows the outside visitor to conduct a hands free conversation. The ring-in feature may be bypassed if the user prefers to connect directly to an existing door bell system. The W-1000 comes complete with power supply and sells for \$129.

An option companion product RC-2 is also available which will allow the user to enter a code directly into the dialing pad. This code will trip a relay for activating door strikes, security gates, etc. The RC-2 sells for \$140.

Circle 20 on Reader Response Card



TAPE-ATHON LAUNCHES MESSENGER III SYSTEM

Tape-Athon Corporation has announced its all-new Messenger III Message Insertion System. The System is designed for use in public address, telephone, storecasting, safety and traffic control applications.

The compact rack mountable system uses standard audio cassettes, automatic reverse, automatic timer, LED level indicator, built-in monitor, manual override, and plug-in cassette transport drawer.

The Messenger III is capable of handling multiple messages, and will make up to 12 automatic insertions per hour. Messages may be of any length. If used in conjunction with a music

source, the system will slowly fade out the music and play the pre-recorded announcement. The system will then automatically switch back to the music when it reaches a 10 to 20 second silence at the end of the announcement.

Circle 21 on Reader Response Card

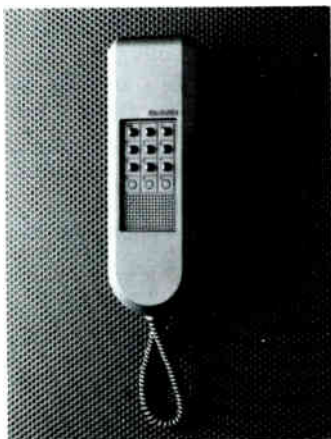
TOA FOREGROUND SPEAKERS ALSO FOR BROADCAST & A/V

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

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

The F-Series enclosures are constructed on acoustically efficient, scratch-resistant material and are available in white, gray, and red.

Circle 22 on Reader Response Card



SIEDLE DEBUTS TWO-WIRE INTERCOM STATIONS

Siedle Intercom/USA has introduced the HT511-01 and HR511-09 two-wire apartment intercom stations.

The two-wire intercom station in the apartment is the counterpart of the entryway speaker. Its first function is to handle voice traffic, and second, to release the door. The third is to signal

the person from the front door.

This new development of the HT511-01-09 provides the possibility of adding a door ajar light. In any apartment, when the front door is open, a light on each phone will go on.

HT511-01-09 are also compatible with the Siedle flat screen video intercom.

Circle 23 on Reader Response Card



DAX MIXING CONSOLES FOR STUDIO AND LIVE SOUND

The DAX Audio Group has introduced the 23 Series of professional stereo mixers. The Series is available with 12 and 16 input channels.

Some of the features include: (input channels) balanced mic (15 V phantom power provided on XLR-type connectors) and line level inputs (phone), input preamp in/out jack (R.T.S., one-quarter-inch phone), peak LED indicators, monitor, reverb (all 23 Series consoles have built-in reverb featuring the Accutronics-type 9 tank), effects send, three-way EQ, pan, and slide faders. Master control features include switchable metering (rectangular LED ladders are switchable to monitor all master output functions), panable effects return and panable reverb, slide fader master output controls for Sub 1, Sub 2, monitor and main. Rear panel connections include both balanced (XLR-type) and unbalanced (one-quarter-inch phone) line level outputs on all main output functions (Sub 1/Sub 2, monitor and main), plus patch facilities (R.T.S. one-quarter-inch phone) for both Sub 1 and Sub 2.

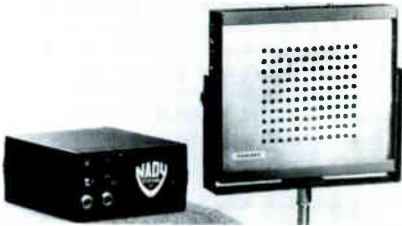
Circle 24 on Reader Response Card

NADY INFRARED SYSTEM COVERS LARGE SPACES

Nady Systems has introduced the IR 300 Infrared Transmission System for coverage of large areas such as

theaters, auditoriums, and churches. The system is portable, and can be tripod or wall mounted.

The IR 300 System consists of two separate components: a Nady IRCU 300 Power Supply/Infrared Control Unit; and a Nady IRT 300 Infrared Transmitter. The separate Line In and



Mic In connectors accept audio information from amplifiers and mixing boards or a directly connected microphone.

The IRT 300 Infrared Transmitter/Emitter uses 120 IR emitting diodes that yield sufficient power to cover approximately 4,000 to 5,000 square feet. Up to four transmitters can be connected to the control unit for a total coverage of 20,000 square feet.

The IR 300 System operates on infrared light FM modulated on several frequencies. The System is available with wide band modulation of ± 40 kHz on 95 kHz and 250 kHz, making it compatible with lightwave receivers from other manufacturers. A single system can be set up for mono transmission, while a dual system will provide stereo sound. For multi-channel operation, the system can be ordered with narrow-band modulation on channels 0 to 11 (from 55 to 585 kHz, with 40 kHz channel spacing).

Circle 25 on Reader Response Card



TELEDEX DEBUTS MLT MICROPROCESSOR PHONES

Teledex Corporation has announced

the MLT line of microprocessor-controlled telephone sets.

The MLT-E, or executive set, provides one- or two-line usage, and can be used for stand alone operation or within a network of Teledex MLT sets.

MLT-E features include an integrated speakerphone and a user-selectable library of six messages which can automatically be sent to a secretary. It has speed dialing of 36 numbers with an LCD directory presentation, and

automatic redialing of the last number dialed.

The MLT-S, or secretary set, works with MLT-E telephones or any 2500 type set. The telephone allows a secretary to answer up to 32 other sets. The MLT-S identifies which extension is being answered and the owner of the extension. If the extension is an MLT-E, the MLT-S displays an itinerary message which has been input by the owner so it appears as if that telephone owner has a secretary.



38 Revox Industrial and A/V Audio Recorders

Thirty-eight? Where are the other thirty-five?

No need to show them. They all look pretty much the same as the three basic transports shown: PR99 MKII, PR99 Playback Only, and B77 MKII. But, with all our special versions, modifications, and options, you can order a Revox to fill virtually any application. The "menu" includes:

- Auto-reverse 4-track playback for background music
- Auto repeat for loop play
- Alternate recorder control for logging
- Voice activated start
- Any two adjacent speeds from 15/16 to 15 ips

Other choices include balanced or unbalanced in/out, rack mount or cabinet, consoles, transport cases, monitor panels, vari-speed—the list goes on! PR99 MKII models also feature real time counter, autolocate, zero locate, and loop functions. And all three transports offer a die-cast chassis, full logic controls, servo capstan motor, and solid Swiss-German engineering.

If you need audio recording of any kind, give us a call. If we don't have what you need, we'll get cracking on #39.

STUDER REVOX

Studer Revox America

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Circle 211 on Reader Response Card

The MLT-S has an LCD display for line identification and itinerary messages for the answered MLT-E set. It provides intercom access and secretary messaging to all networked MLT-E telephone sets.

The MLT-C console is designed for use as a centralized reception console or personalized message center, and provides individual answering for an entire company as well. It works with up to 32 incoming lines and eliminates the need for 1A2 key system equipment and cabling.

MLT-C features include incoming line identification, a hold button with a hold-reminder tone and held-call line identification, and on-hook dialing. It provides handset or headset options, and 36 speed dial numbers with storage of up to 56 digits.

Single unit prices for the MLT-E and MLT-S start at \$495 and \$595, respectively. The MLT-C costs from \$625 to \$1,745 depending on options.

Circle 27 on Reader Response Card

SOUND PRODUCTS/3M DEBUTS CABINET SPEAKER

Sound Products/3M has introduced a new Pro Series Model MS-100 Cabinet Speaker for foreground music.

The new industrially-designed speaker system can be used in restaurants, lounges, retail stores and other commercial applications. High power capacity, reliability and wideband frequency response of 50 to 22,000 Hz are offered in a black vinyl-clad cabinet.

Suggested list price for the MS-100 speaker is \$199.90.

Circle 32 on Reader Response Card

BLONDER-TONGUE DEBUTS TWO APARTMENT AMPS

Blonder-Tongue Laboratories, Inc. has introduced two new broadband indoor distribution amplifiers specifically designed for apartment complex applications. Both the ACA-30-300 and the ACA-30-450 models are used in CATV and SMATV RF distribution systems which use a cable drop as a signal source.

The ACAs have a flat operating gain of 30 dB which can be adjusted down to 22 dB with the unit's variable attenuator. ACA amplifiers exceed FCC

specs for both conducted and radiated interference even at full output level. A push-pull hybrid IC module enables the ACAs to operate at high output levels while retaining low distortion characteristics.

The ACA amplifiers have an aluminum chassis designed to provide heat dissipation allowing operation at high ambient temperatures (+60°C/+140°F) without degradation of performance or reliability.

Circle 33 on Reader Response Card

COMCENTREX ELECTRONIC KEY TELEPHONE SYSTEM

Plant Equipment, Inc. has introduced the ComCentrex Electronic Key Telephone System. The system incorporates solid-state digital technology, and is available in desk-top or flush-mount console sizes from 30 to 150 lines with single or dual operator circuits. ComCentrex is designed for traders turret systems, centrex and executive suite systems, E911 and utility dispatch systems. A 12-pair console cable is used regardless of line size. ComCentrex is compatible with any installed 1A2 keyset or single line telephone set using A-lead control. All line keys are momentary in their operation and use dual LEDs for I-USE and I-HOLD indication. An optional call-sequencer is available for systems up to 120 time.

Circle 31 on Reader Response Card

MULTI-ZONE PAGING AMPLIFIER WITH ALL CALL

Viking Electronics, Inc. has introduced a low cost four zone paging amplifier with All-Call. The paging amplifier, model PZ-4, is designed to be connected to an unused line/trunk input on any electronic or 1A2 Touch-Tone® key system as well as to non-K.S.U. telephones.

By the user touch toning the appropriate single-digit code, the PZ-4 permits the user to move between zones and All-Call without hanging up. The complete system includes four paging amplifiers, intercom decoder, U.L. power supply, 600 ohm balanced talk battery feed, and one paging horn.

The system's wholesale price is \$148.

Circle 30 on Reader Response Card



EAW SHIPS HIGH OUTPUT, LOW PROFILE MONITOR

Eastern Acoustic Works, Inc. is now shipping the third member of its Forsythe Series Compact Stage Monitor Systems model SM202P which is said to utilize dual 250mm (10-inch) drivers for higher output and more gain before feedback.

The SM202P's performance starts with its RCFN481 high frequency compression driver and optimized coverage pattern horn, which mate with the dual low frequency drivers through an advanced Forsythe designed third order crossover with asymmetrical slopes precisely aligned to the drivers' responses. This enables the SM202P to offer flat frequency response (± 2 dB) over the entire vocal band (150 to 12 kHz) without external equalization, according to EAW.

The SM202P's use of two high efficiency high pressure die-cast RCF L10/561 250mm (10-inch) drivers for low frequencies provides considerably higher efficiency than any design based on a single 12 or 15 inch driver, according to the company. The SM202P's 103 dB SPL sensitivity (1W at 1m) and 129 dB SPL (at 1m) maximum output is all usable as there are no peaks to create misleading high specs. Also, the smaller diameter diaphragms of the SM202P provide smoother response above 800 Hz where the main components of vocals are located.

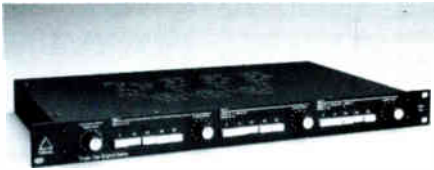
The SM202P's dual low frequency driver, high tech compression driver, and complex crossover network all combine to give the SM202P the highest power handling of any monitor in its class, 400 watts in accordance with the AES long term power test. The system also features a 4Q load to the amplifier for maximum output with all modern amps.

Circle 26 on Reader Response Card

PRODUCTS IN REVIEW

a closer look

by gary d. davis



DeltaLab's ADM 465 Digital Delay Line

DeltaLab, the Pro Audio division of Analog & Digital Systems, Inc. (ADS), has introduced the ADM 465 Triple Tap Digital Time Delay. This one-input, three-output delay is designed for installations that call for multiple delay taps.

Features of the ADM 465 include 20 Hz to 20 kHz bandwidth, 90 dB dynamic range, XLR inputs and outputs, and 155 mSec of delay at each tap adjustable in 5 mSec increments for a possible 465 mSec of maximum delay. As with all DeltaLab digital delays, the 465 employs Adaptive Delta Modulation (ADM).

DeltaLab has included a tamper resistant cover to help prevent unwanted changes of control settings.

The ADM 465 carries a suggested list price of \$899.



Comments: The DeltaLab ADM 465 Triple Tap Digital Time Delay is clearly designed for professional use. Its one input/three output configuration enables the unit to provide incremental delays to different zones of a sound system. Each of the three outputs has an associated bank of five push buttons (5, 10, 20, 40, 80 mSec), which can be engaged to add up to a total of 155 mSec. However, the output delays are added so that, for example, if 15 mSec is selected for output 1, and no delay is selected for outputs 2 and 3, the latter will also have 15 mSec delay. The typical application involves speakers at

increasing distances from the main cluster, so that additional delay can be added as required for each output. Thus, the maximum available delay for output 1 is 155 mSec, for output 2 is 310 mSec, and for output 3 is 465 mSec. Since the speed of sound at sea-level, standard temperature is about .885 mSec per foot, the ADM 465 can be used to delay speakers beyond 500 feet from the main cluster.

The unit includes a control signal output (labeled *Parallel*) and a control signal input (labeled *Couple*) so that multiple units, including older DeltaLab models, can be configured in a master/slave setup where more than three zones are involved. The control signal basically allows the master to simultaneously control the output level of all units; delay times must still be set individually for each output. The control I/O is via one-quarter-inch T/S phone jacks. The main audio input and outputs is via 3-pin XLR type connectors, with differential balanced circuitry.

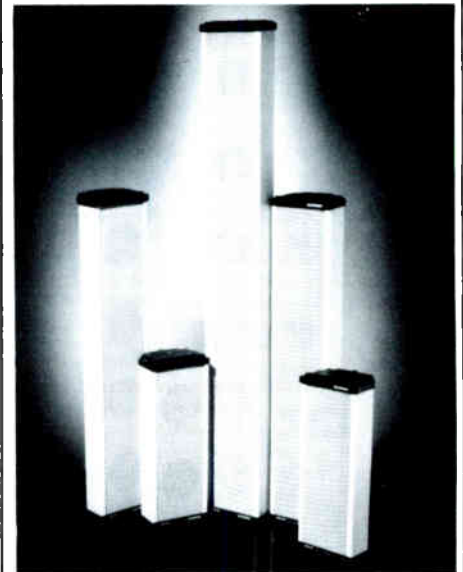
You may be curious as to whether this is a 14 bit or 16 bit digital system. I was, so I called DeltaLab's Jim Ruse. And guess what? It's a 1-bit system! This unit's Adaptive Delta Modulation (ADM) works on a completely different principle than almost everyone else's digital delays, which use Pulse Code Modulation (PCM). The single bit samples the audio signal at a much higher rate than the typical 44 or 50 kHz sampling rate of 20 kHz bandwidth PCM devices. In fact, the ADM device's actual clock rate will vary with the signal (this is the *adaptive* part of the process).

How good does the unit sound? Well, that's a subjective question at best. I have not actually heard the unit. It is rated at 0.2 percent THD at 1 kHz, 0 dBm signal level. However, as a result of the very high sampling rate associated with the Adaptive Delta Modulation, no elaborate multi-pole filters anti-aliasing filters are needed. Without the usual 48 dB/octave, 60 dB/octave, or steeper filters, there is

less phase shift than a conventional delay line (and ostensibly better sound quality).

This compact (one unit high), rack-mountable, security-coverable unit is clearly packaged for professional use. If you're in the market for a delay line (not an effects unit), I feel the ADM 465 bears *your closer look*.

Circle 28 on Reader Response Card



Paso's Hexcolumn Loudspeaker Series

Paso Sound Products recently introduced a new generation of high performance and high efficiency column loudspeaker systems called Hexcolumns. The Hexcolumns, named for their computer designed hexagon-shaped steel enclosure, are engineered and built to exacting tolerances, according to Paso. The enclosure shape and high compression cabinet increase efficiency and directivity of the column systems. The Paso Hexcolumns are said to approach the efficiency of a reflex horn. Eleven Hexcolumn models, in a variety of configurations, permit use in many applications.

Comments: Column speaker systems have long been popular for sound reinforcement systems. Their shape

allows for easy *camouflage* in the typical club, small stage, or meeting room, and their wide uni-planar directional characteristics allow for controlled sound coverage. Many columns (including some of the Paso Hexcolumn series) use two or more of the same size direct radiator (cone type driver) to generate the sound in a given column. These direct radiators typically are full-range speakers. The geometry of their arrangement in the column is responsible for the narrow dis-

persion in one plane and the wide dispersion in the other plane. Horns are another means to provide directional control, but a horn-loaded speaker system that covers the same frequency range will typically have to be at least a two-way system. And the enclosure may have to be considerably larger to obtain the same coverage. Horns have often won the battle because they tend to be much more efficient than columns, which means that either more columns or larger power

amps are needed to equal the SPL generated by a horn-loaded speaker system. This is the area where Paso claims to have made a major improvement in its Hexcolumn series.

According to David Moore of Paso, the company relied upon a computer to optimize the enclosure design for high efficiency. The result was an increase from 8 percent for the typical column to a claimed 18 percent for the Hexcolumns. While Paso does not spec a standard sensitivity, they do offer a four-foot, on-axis, full power SPL rating of 110 dB. When we mathematically correct this for a 1 watt, 1 meter condition, the equivalent sensitivity is approximately (not exactly) 89 to 92 dB, depending on the model.

The speakers in the Paso Hexcolumn line all utilize the same cabinetry—only some are longer than others. There are four basic Hexcolumn series. The “high efficiency” series utilizes 5-1/2-inch drivers and has a rated bandwidth of 90 Hz to 14 kHz (+/- 3 dB), and carries power ratings of 20 to 60 watts. The “high performance” series utilizes these same drivers with the addition of piezo-electric tweeters, which gives them a rated bandwidth of 100 Hz to 20 kHz, and power rating of 50 to 100 watts (depending on the model). These specs apply to the direct-coupled models. Models with 25 V or 70 V line transformers are rated at a little higher bass cutoff frequency. Incidentally, David Moore told me that Paso manufactures all components in-house, including the transformers, so everything is ostensibly matched. Another of the Hexcolumn series for “critical applications” utilizes four-inch drivers with smaller magnets in longer columns. These models have very narrow vertical dispersion (18 degrees) and are optimized for the voice range (180 Hz to 12 kHz). The impedance of the direct-coupled units is 8 or 16 ohms (depending on model).

Given their sturdy packaging, the consistent profile and appearance of the different size columns, the variety of models for specific jobs, the claimed higher efficiency, and the fact that they carry a five-year warranty, I feel the Hexcolumn line bears *your closer look*.

Circle 29 on Reader Response Card



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New Video/VCR/Cable-TV Accessories Catalog

Carter-Craft has made available its new Accessories Catalog for video, VCR and cable TV. This new catalog provides photographs and complete descriptions of all Carter-Craft accessories for the video/VCR/cable TV markets, including: TV stereo simulators-converters; video/VCR special kits; care, maintenance, safety products; splitters and band separators; coaxial switches; coax cables; video cables; adapters and connectors; wall plates and connectors; and signal amplifiers and adapters.

Also featured in the catalog are Carter-Craft's new Gold line of accessories designed for video and sound recording. Each accessory has gold-plated connectors to minimize picture interference and maximize signal reception.

The catalog is free.

Circle 9 on Reader Response Card

New Catalog Features Fiber Optic Installation Technology

A new 16-page catalog featuring the advanced generation of the Fo-Com II™ factory pre-assembled multi-duct system and a wide ranging selection of accessories for the installation of fiber optics, has been published by The George-Ingraham Corp.

The design, advantages, and application guidelines of Fo-Com II are described in the new catalog. Fo-Com II is said to eliminate complicated and costly field handling of fiber optic innerduct and cable pulling problems.

Other product offerings included in the catalog are the innovative Snug-Plug™ duct sealer/organizer and an assortment of conventional duct, innerduct, fittings, adapters, and accessories.

Circle 10 on Reader Response Card

Everything You Always Wanted To Know About Microphones . . .

The English version of Dr. Gerhart Bore's book *Microphones*, published by Georg Neumann GmbH of West Germany, is presently being distributed by Gotham Audio Corporation.

The book, which covers basic information about microphones and their operating principles, is available at \$2.50 per issue (for shipping and handling).

Circle 11 on Reader Response Card

Solid State Systems Publishes Consultant Liaison

Solid State Systems, Inc. has published a consultant information guidebook to promote product knowledge from both a marketing and technical point of view. Called *The Consultant Information Reference Guidebook*, the book contains information on ACD Management Information System statistic capability available on the CEO™/ACD product line, and system feature capability of the JR. EX-EC® (a 248 port digital PBX). Also, overviews of Solid State Systems' STS-16® ACD and Watt-Shaver® energy management equipment are included.

Circle 12 on Reader Response Card



Brochure Features Permanent Wire Marker Benefits & Uses

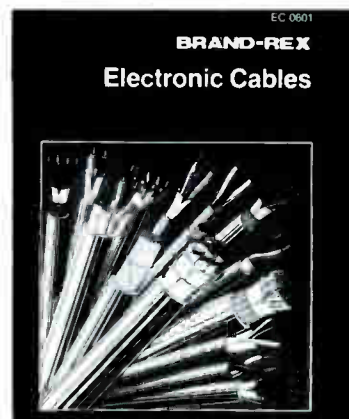
Partex® Marking Systems Ltd. has published a full-color brochure which provides technical data and physical properties of its permanent wire and cable marking systems. It provides information for contractors, engineers, and specifiers in their search for better

solutions to electrical system maintenance problems.

The brochure describes the characteristics of the three available types of Partex markers—clip-on, sleeve-type and cable tie.

The catalog is free.

Circle 13 on Reader Response Card



New Literature Describes Single Outlet Cable System

The Brand-Rex® Cable Systems Division of BRIntec Corporation has released a new eight-page brochure describing Tri/Con™ and Duo/Con™, the single outlet cabling system.

The four-color brochure describes design and use of the cabling system in detail. This U.L. listed cable system may be installed independently of existing cable systems, or may be linked to existing power or communications cable.

Tri/Con™ is three cables in one: electric power, video, and data and communications. Duo/Con™ includes only video and data and communications circuits. The systems require one stud space, boxes and multiple or overlapping wiring systems.

Circle 14 on Reader Response Card

Dalis Industrial's 2,000 Page Catalog Now Available

Dalis Industrial Electronics has released its new full line electronic components catalog free of charge to the trade. The catalog features up-to-date technical information on over 65 major lines of cables and regulators from some major lines as Belden, Sola, Premier, Bud and Switchcraft. The catalog also lists relays and industrial chemicals such as cleaning solutions. Many of the items in the 2,000-page catalog are for industrial use.

Circle 15 on Reader Response Card

FACES AND PLACES

Altec Lansing Names Nail as Production Engineer

F. Davis Merrey, Jr., president of Altec Lansing Corporation, has appointed Clark D. Nail as manager, production design engineering for the company.

In his new position, Nail is in charge of technical and engineering support for Altec's electronics and acoustical manufacturing operations, and supervises a group of industrial engineers.

He holds a B.S. degree in industrial engineering and management from Oklahoma State University and is working on an M.B.A. Nail previously worked for the manufacturing operations at Texas Instruments, Inc. and Fife Corporation.



CLARK D. NAIL

JACQUELYNN HEBROCK



Audio-Technica Appoints Hebrock Product Manager

Audio-Technica U.S., Inc. has announced the appointment of Jacquelynn Hebrock as product manager. Her duties will include acting as liaison between sales and engineering departments in product development, and coordinating package design and graphics.

Before joining Audio-Technica, Hebrock was a graduate assistant at The University of Akron, where she received her M.A. in arts management. Previously, she was a marketing representative for a Tandy Corporation/Radio Shack Center in Oklahoma City, and a quality control technician and marketing services engineer for Audio Dynamics Corporation/BSR U.S.A. in New York.

AVS Appoints McKenna National Acct. Manager

Advanced Voice Systems, Inc. (AVS) has named Myra M. McKenna national account manager. She will be responsible for servicing and marketing major accounts for the voice mail company.

McKenna formerly served as account manager at AVS before assuming the position of national account manager. Prior to joining AVS, she served as an account representative for GTE Sprint.

McKenna earned her B.A. from Temple University and is a member of Independence/Women in Communications.

Mitek Names Taller Group Marketing Director

The Mitek Group (MTX Loudspeakers, American Acoustics, and Magnum) has named Bob Taller to the newly created position of group marketing director.

Taller, a former sales and marketing executive with Keycom Electronics, a division of Honeywell, Inc., will be responsible for developing all marketing strategies and overseeing all related marketing activities. Also, as Mitek Group companies continue to expand global product distribution, Taller will be responsible for all international sales development.

AD INDEX

<u>RS#</u>	<u>Company</u>	<u>Page</u>
208	Altec Lansing	21
201	Amek Consoles	III
	Audio Engineering Society	48
222	David Clark	6
210	Comtek	29
216	Conquest Sound	18
214	Eddcor	14
200	Electro-Voice	II
206	Harris	25
219	Hitachi	40
221	Jeron	43
212	MacKenzie	28
207	Panasonic Ramsa	13
203	Quam-Nichols	5
209	Ring Group of N. America	3
202	Shure	IV
211	Studer Revox	37
	TOA Electronics	7
220	Uher	31
215	White Instruments	45

REP NEWS



The third annual James B. Lansing Award, for outstanding achievement in overall sales and new market development, was presented to Jerry Hogerson, president of Star Enterprises (center) by JBL Professional's President Ron Means (left) and Vice President of Sales Ken Lopez (right).

Cetec Gauss has announced the appointment of two new factory representative firms: **Brian Trankle & Associates** of Hillsborough, CA, will cover northern California and northern Nevada; and **Richard S. Pass Associates** of Langhorne, PA, and Alexandria, VA, will handle Virginia, Maryland, eastern Pennsylvania, Delaware, and the District of Columbia.

Cornell Electronic Products, Inc. has named two sales organizations for its line of electronic signaling products. **Kodo Associates** of Minneapolis, MN, will represent the Cornell line in Minnesota, North and South Dakota and western Wisconsin. And **W. A. Hendrickson & Co.** will be responsible for selling the line throughout New England.

TOA Electronics has appointed **LCA Sales Company** of Tuckahoe, NY, as its sales representative of TOA's Commercial Sound Division. LCA will cover the metro New York and northern New Jersey areas.

Aiphone Corporation has appointed **Earl & Brown Co.**, a commercial sound and security products rep firm based in Portland, OR, as its commercial sound representative in the Pacific Northwest.

The company, which has been in business since 1927 and has a branch office in Redmond, WA, will cover Oregon, Washington, northern Idaho, and western Montana.

Williams Sound Corp. has presented sales awards to **Secom Systems** of Atlanta, GA, and to **Ted Firaneck Sales** of Pontiac, MI, for outstanding sales improvement.

Elgin Electronics has appointed three new telcom power sales representative firms to its expanding sales organization.

Ramco Communications, Inc. of Redmond, WA, will market Elgin power products in Washington, Oregon, Idaho, and Arkansas. **Telco Sales, Inc.**, White Bear Lake, MN, will cover Minnesota, Wisconsin, North Dakota, South Dakota, Nebraska, and Iowa. And **Logan Sales Co.** in Santa Clara, CA, will represent Elgin in northern California.

ADA Signal Processors, Inc. has appointed **Dave Gonden** its western U.S. marketing representative. Gonden will oversee ADA's western sales, customer service, and artist relations program.

McGohan Electronics of Bensenville, IL has appointed **SAGA** of Oswego, NY, to represent the McGohan line in upstate New York.

Mike Erlich, principal of **Erlich Sales Associates**, recently announced the appointment of his firm as representatives for **Galaxy Audio Visual Inc.** and **National Viewtech Corp.** Erlich Sales Associates, based in Farmingville, NY, covers the northeast U.S. from Virginia to Maine.

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• Doctors' In-Out Registers
• Clinic Call/Room Status



FSR Introduces Priority Encoders for Mics and Paging

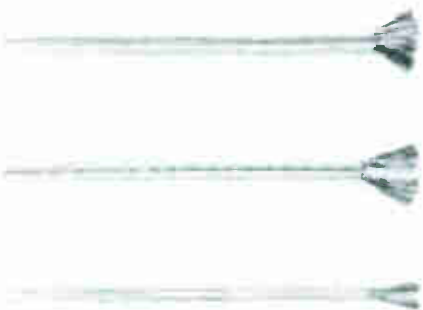
FSR, Inc. has developed two new priority encoders to handle priority schemes for audio and video applications.

The PE-8, a first-come-first-serve type (game show) encoder, is designed primarily for microphone use. The FSR unit allows the first person speaking to use the microphone without interruption.

The PE-8B is a priority paging scheme that assigns a priority to each channel. This lets the first person block out the others until a higher priority overrides him. This is particularly useful for emergency messages in hospitals, prisons, etc.

Each encoder sells for \$130.

Circle 1 on Reader Response Card



Marshall Electronics' Clear Runner Cables

Marshall Electronics, Inc. has announced a new line of superflexible, heavy-duty power speaker cables. The new cables, named Clear Runner, are designed for use with the professional and consumer audio systems. These power speaker cables feature high-density copper multi-strands in three configurations: 10-awg, 12-awg, and 16-awg; superflexible transparent clear PVC jacket; and feature low signal loss performance.

Circle 2 on Reader Response Card

High Output Line Powered Ringer From Dees Communications

Dees Communications Engineering has announced the addition of its High Output Line Powered Ringer. The Ringer plugs directly into the telephone line and produces 110 dBA sound level. The unit is also said to be suitable for outdoor installation.

Circle 3 on Reader Response Card



Custom Audio Programming for Telephone Systems

Telephonetics International, Inc. has introduced to the contracting industry a customized audio service for telephone systems called "More than just music on hold." The package includes an industrial cassette deck and professionally produced promotional messages with music that are played to callers on hold. Businesses can use this service to reach callers with sales and service messages and to provide a positive and professional business image. The annual service, including monthly production changes, costs \$1,445.

Circle 4 on Reader Response Card

Melco Line Status Monitor for Monitoring Off-Premise Locations

Melco's new line status monitor, the LSM-30, provides visual indication of the status of up to 30 lines or stations. If a line or station is in use (off-hook), the corresponding lamp will light steady on the display. If a line or station is receiving ringing, the corresponding lamp will flash.

The LSM-30 enables the operator to identify the status of lines or stations so that calls can be processed in a professional and efficient manner. It can be used for remote monitoring of off-premise extensions since it is cost-effective to install—using only one or two-pair cable. Also, the LSM-30 can be used with Melco Service Observing Systems, so that an observer can immediately identify the status of a line or station before accessing it for observation.

The LSM-30 consists of a control unit which mounts in the telephone equipment room and a display unit which is designed for desk or counter use. Both are covered by a manufacturer's warranty.

Circle 5 on Reader Response Card

Wireless Interconnect for RTS or Clear-Com Intercoms

Swintek has introduced the Mark SP-300 Series wireless interconnect to be used with two-channel, hardwired intercoms manufactured by Clear-Com and RTS Systems.

The Mark SP-300 is used in any location where a three pin XLR patch is located. Just connect the antenna, flick on the power, and select channel 1 or 2. All you have to do now is put the rechargeable H6900 Nicad battery or nine-volt battery stack into the remote Mark 200D satellite unit and connect a headset.

Circle 6 on Reader Response Card



New Line of Touch-Tone® and Rotary Toll Restrictors

Viking Electronics has introduced a line of low cost, line powered toll restrictors for use with electronic or 1A2 key systems as well as single line Touch-tone® or rotary phones.

The T.T. Series of toll restrictors can provide various modes of restriction including 1 and/or 0 on the first digit, and calls greater than seven digits. Some models will even allow 1-800 and calls through WATS® resellers while restricting AT&T long distance and operator assisted calls.

The T.T. Series is small enough to mount inside the telephone and require only three wires for installation. Trade prices range from \$46 to \$68.

Circle 7 on Reader Response Card

New Cable Tie Aids Organization & Storage Problems

Playback, Inc. has introduced Cables-Away, a durable Neoprene and Velcro strap that stretches to fit any size cable. The bright colors make them easy to spot, and re-useable Velcro is cost and time saving.

Circle 8 on Reader Response Card

3M Platinum Series for Business Foreground Music

Sound Products/3M has introduced its Platinum series of foreground music.

The series offers extensive music libraries tailored for businesses. It features top recording artists, including contemporary, classical, country, easy listening, jazz, blends, oldies and specialty music.

Matching the music tempo to the energy, age and sophistication of the audience is simplified in the Platinum catalog. Music programs are numbered from 100 to 900 to indicate tempo. The lower program numbers indicate slower tempos and higher numbers indicate faster tempos.

Circle 34 on Reader Response Card

Brim Debuts Low Cost Commercial Coaxial Cable

Brim Electronics, Inc. has announced the introduction of an inexpensive commercial RG 59/U coaxial cable (Brim BC59/U).



Brim BC59/U is composed of a 22 awg solid copperweld inner conductor with a cellular polyethylene dielectric, four 28 awg drain wires over an aluminum polypropylene tape shield, for 100 percent shielding coverage, and then a black PVC jacket overall.

The cable is rated for 500 volts maximum, 75 ohms, and an operating temperature of 80 degrees C.

Circle 35 on Reader Response Card

Woods Electronics 600-ohm to Line-level Converter

Woods Electronics Inc. has announced its model TCM-600, a 600 ohm to line-level converter, which provides coupling of dial access phone paging systems to the PA amplifier. The TC-600 accepts signals from a 600-ohm, 0 dBm source and converts to single-ended output. A screwdriver adjustment is provided which allows the output level to be adjusted from 0 to 2 volts P-P, thus permitting connec-



tion to virtually any mic or line level input. The TCM-600 has a frequency response of 300 Hz to 3 kHz. No battery or power supply is required. The TCM-600 is priced at \$14.50.

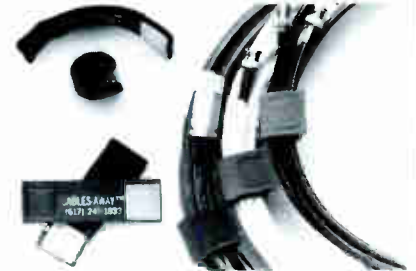
Circle 36 on Reader Response Card

Grounding Wafer from Pilgrim Electric Company

The Pilgrim Electric Company has introduced the Grounding Wafer™, a thin plastic spacer that slips over the blades of a standard three-prong, 120-volt electric plug and makes secure contact with the ground pin

(less than 5 milliohms resistance)—without tools and without wasting an outlet.

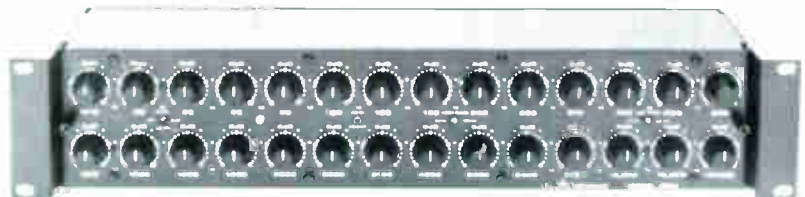
This Wafer provides the grounding of wrist straps, table mats, field service kits, and other static control equipment. It can also be used with telephone/data line transient voltage surge suppressors and other devices requiring a firm electrical ground.



The Wafer has a six-inch long, 20 gauge lead wire and comes with an insulation displacement connector IDC which can be used to splice to the lead wires of anti-static equipment.

Circle 37 on Reader Response Card

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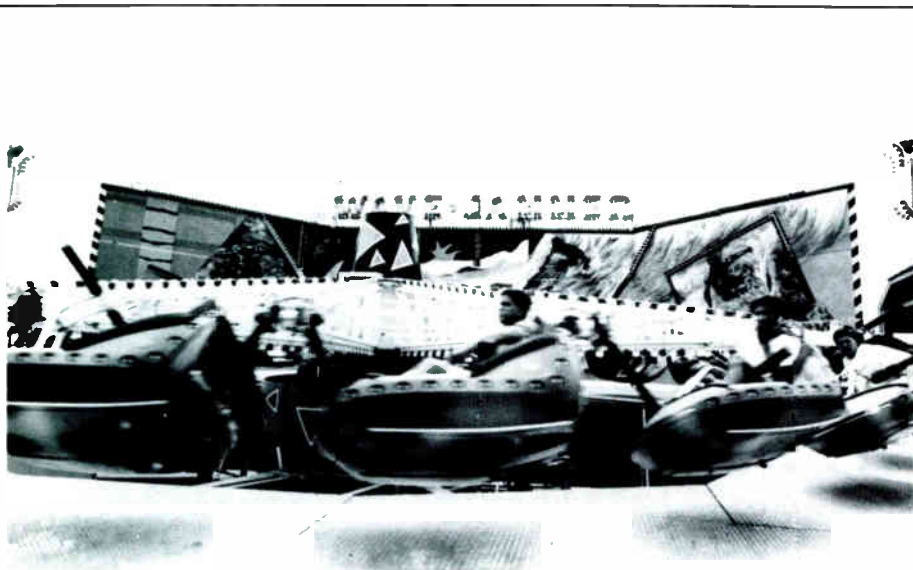


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Circle 215 on Reader Response Card

CONTRACTING CLOSE-UP



Caraway Sound Down on the boardwalk

Caraway Audio has completed its first amusement park ride sound installation at the Santa Cruz Beach Boardwalk. The ride, imported from France, is called the Wave Jammer, and Caraway had to consider not only the noise from the Wave Jammer, but also the noise and elements from the nearby beach.

"Since the Santa Cruz Beach Boardwalk is situated right on the beach, with the surf only 200 yards away, we

were faced with additional problems concerning the elements," remarked Doug Caraway, owner of Caraway Audio. "The speakers are unprotected and right out in the open. We needed something that could take the moisture, salt air, and sun exposure and still deliver top-quality audio reproduction."

Caraway installed six TOA F-300W three-way speaker enclosures which feature plastic cabinets and aluminum

cone tip ends that would help stop the spread of corrosion. With the proper water sealing, the set-up will "last for one to three years which makes replacement costs not staggering." Four of the speakers are attached atop the ride's backwall and two enclosures are mounted toward the front of the attraction. Volume controls allow the front speakers to be attenuated according to crowd size.

"Since the TOA F series are essentially three-way studio monitors inside a sealed polypropylene enclosure, we felt with a little internal waterproofing these speakers would give the ride's sound system the high quality audio desired," Caraway said.

Driving the Wave Jammer's sound system is a Hill DX 500 power amp chosen for "its stability and the fact that the fans are powered by a thermal switch instead of a power switch. This means they don't sweep in as much debris, thus keeping the system clean," said Caraway.

Caraway chose a TOA D-4 mixer to handle the various program inputs because he needed a one line input, one line output mixer.

"The technical folks at the Boardwalk we worked with on this project were so impressed with the results, they're planning on replacing a lot of their old horns and various cones with the F series enclosures," Caraway added.

Resort Sound

SOUTH OF THE BORDER

Randy Loyd Enterprises of Denver, CO, recently installed a new sound system in the El Cid Resort in Mazatlan, Mexico as part of a \$1 million renovation of the facility's sound, video, and lighting systems.

According to Randy Loyd, "The project took one year of planning and is the most innovative facility in Mexico."

Randy Loyd Enterprises specified and installed 12 Model 3800 and two Model 3500 QSC Series 3 amplifiers in the 1500 Discotheque. Tom Dellinger, service manager at Randy Loyd Enterprises, said the reason why the amplifiers were chosen was because "they were the biggest ones. But the main reason was their serviceability. We haven't had any trouble since they were installed last December."

Also installed were Panasonic color cameras, black and white triple monitor and a color monitor, a Panasonic 6810 video cassette recorder, Video Tech Switches and a Pioneer Video Laser Disc. The company also custom built power panels, a master power panel and a zoom control.

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September 8-10	NCC-Telecommunications Conference Program & seminars.	Philadelphia, PA	AFIPS (800) 622-1986
September 17-18	Sound Engineering Seminars In audio & acoustics.	Pheasant Run Resort Chicago, IL	Syn-Aud-Con (714) 728-0245
September 23-24	SMATV/MATV/CATV/TVRO Technical Seminar Sponsored by Blonder-Tongue.	Rockville, MD	Blonder-Tongue (201) 679-4000
September 23-26	Intelligibility Workshop Covering three spaces with low, medium, and high reverberation.	Chicago, IL	Syn-Aud-Con (714) 728-0245
September 29-30	9th Kentuckiana Sound Seminar Exhibits & seminars.	Indianapolis, IN	Andy Baker & Assoc. (317) 253-9667
September 30-October 1	Chesapeake ERA Electronics Show Exhibits & seminars.	Greenbelt, MD	ERA (301) 235-1942
September 30-October 2	Practical Telecommunications Grounding.	Chicago, IL	abc Teletraining, Inc. (312) 879-9000
October 1-2	Sound Engineering Seminars In audio & acoustics.	Rodeway Inn Minneapolis/St. Paul, MN	Syn-Aud-Con (714) 728-0245
October 2-3	ESSC Regional Conference Seminars & products.	Columbus, OH	Bob Barba (312) 593-8360
October 6-8	U.S. Telecommunications Suppliers' Association Conference.	Seattle, WA	USTSA (202) 872-1200
October 6-9	EIA Fall Conference Meetings & seminars for EIA members only.	San Francisco, CA	EIA (202) 457-4900
October 7-9	Computers & Communications Security '86 Workshops & seminars.	New York, NY	ISSA (312) 299-9311
October 13-17	Sound Intensity Measurement Course.	Seven Springs Convention Center, Champion, PA	AVNC (412) 265-4444

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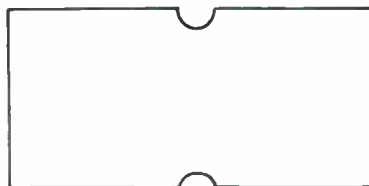
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SALES & MARKETING

(continued from page 11)

his/her company. So is your boss. Bringing these two similar-level executives together will make both feel more a part of the company-to-company relationship and can't hurt your position in either company.

How to Un-Sell Relationships

After all that advice on how to make and keep good sales relationships, here are a few should-be-obvious things to avoid.

(1) *Neglect to return your calls.*

(2) *Don't answer your mail.*

(3) *Don't worry about literature requests.*

(4) *Neglect small parts orders.*

(5) *Hide everything* (This product I'm selling you is about to be discontinued by its manufacturer.)

A Personal Story

A few months ago, my wife and I bought a new car, a 1965 Ford Mustang (yes, '65—not '85). It was a two-owner car that was almost entirely original, in surprisingly good shape and quite drivable. As you might guess, however, being a 21 year-old car, it needed some work.

One of the first things we needed was new shift linkage. Going from auto parts store to auto parts store, my wife stumbled on a man who actually gave her some good advice and didn't treat her like an air-head.

Because of this good advice, my wife asked the man if he knew of a mechanic in the area who specialized in working on vintage Mustangs. He told my wife of one place about two hours away and said he didn't know of any place closer. "However," he said, "I do some engine work on the side. And I know someone who does great transmission work."

Now, we weren't about to let some parts-store salesman work on our classic car, but when he offered to come to our house and take a look at the car, we agreed. "We can't bring it to you" we said, "because the linkage is so bad we can't shift it!"

The man, I'll call him Andy, came to our house one evening and was very enthusiastic about the car. "I love old

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cars like this," he said, "and I rebuild engines for racing."

Then he offered to take a look at the linkage. He got out his jack and jacked up our car. "I see the problem. I'll have it fixed in a flash," Andy said. I was surprised at this because a local service garage had worked on the linkage twice with no improvement and had told us to go buy a whole new shifting system. Andy, however, had it fixed and working smoothly in about 10 minutes. I was impressed to say the least. "Don't expect this to last forever," he told us. "You really do need new linkage. But this'll get you around for a while."

Then Andy talked to us about the engine and what could be done to rebuild it (it had 131,000 miles on it and was running a bit rough). He talked about his friend who worked on transmissions and said he would set things up to get the whole mechanical system rebuilt if that was what we wanted. "It's worth it," he said, "considering

what you paid and the cost to rebuild I could put this car on my flatbed, take it to Florida and double your money easy!"

Andy's friendly, low-pressure tactics, his willingness to help us out with the linkage problem even though we had not made any kind of commitment to buy anything from him and his obvious expertise with cars and engines sold me and my wife, and we asked him to go ahead and do the engine and set up the transmission work for us.

Even though I don't believe anyone ever taught him how, Andy is a natural relationship salesman. I honestly believe that the relationship he has formed with my wife and me is more important to him than the money he will make from the work he is doing for us. That relationship has prompted him to argue with me over a particular part (a special kind of electronic distributor) he wanted to install on our engine and to help us out with our second car when the starter failed.

Andy's intuitive relationship selling tactics include low-pressure sales efforts, real honesty, small favors that mean something, appropriate communication (he calls when he has something to tell us) and pressure when it's needed. Not bad for an auto-parts store salesman!

If you're a natural relationship seller like Andy, keep it up and work on fine-tuning. In my opinion you've got a head-start on everyone else! If you're more like me and have to work on good relationship selling, do so—it's well worth the effort. Believe it or not, it even makes selling more fun!

Chris Foreman is marketing manager for Panasonic/Ramsa. Prior to that, he was with Pierce-Phelps Audio Division and Editorial Director for Sound & Communications.

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Circle 201 on Reader Response Card

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