

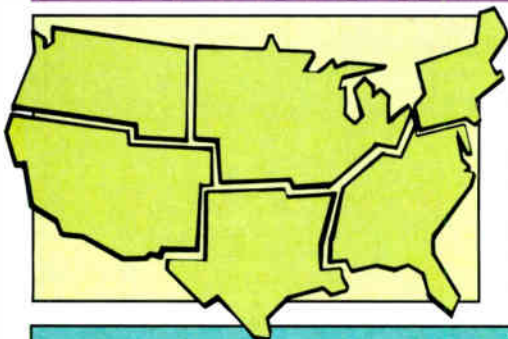
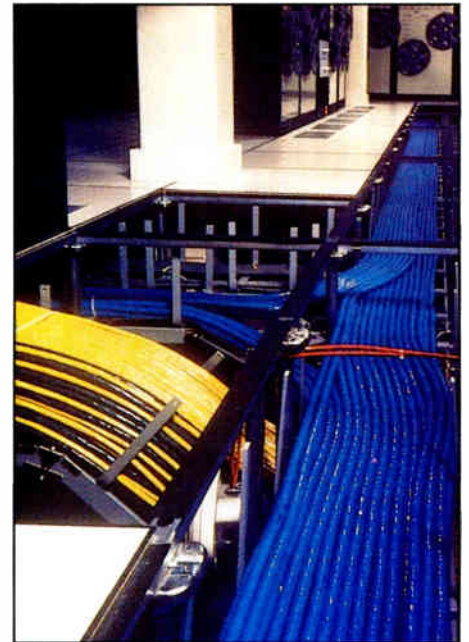
# SOUND & COMMUNICATIONS

Volume 35 Number 4

April 1989

## SKYWALKER RANCH: CUSTOM CABLE

George Lucas' Skywalker Ranch is home to what has been described as the most complete film post production facility in the world: Sprocket Systems. A division of Lucasfilm Ltd., Sprocket's 240,000 square-foot building houses a dozen rooms, including seven studios, a Foley room, an ADR room, recording studio, and a comprehensive sound effects library. Sprocket's engineers worked closely with installers David Carroll Electronics to design an audio system featuring over 500 miles of custom-manufactured audio cable. We profile this complex installation, from initial planning to final testing. **42**

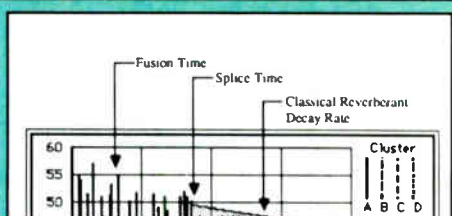


## THE FOURTH ANNUAL SURVEY OF THE CONTRACTING BUSINESS

For the fourth time, Sound & Communications presents its annual survey of the Contracting Business. The survey was sent to a random sampling of our sound contracting readership. Once again the response was overwhelming, and included hard data on sales figures, markets served, markets neglected, markets targeted for future growth, and more. **38**

## SOFTWARE REVIEW: BOSE MODELER, PART II

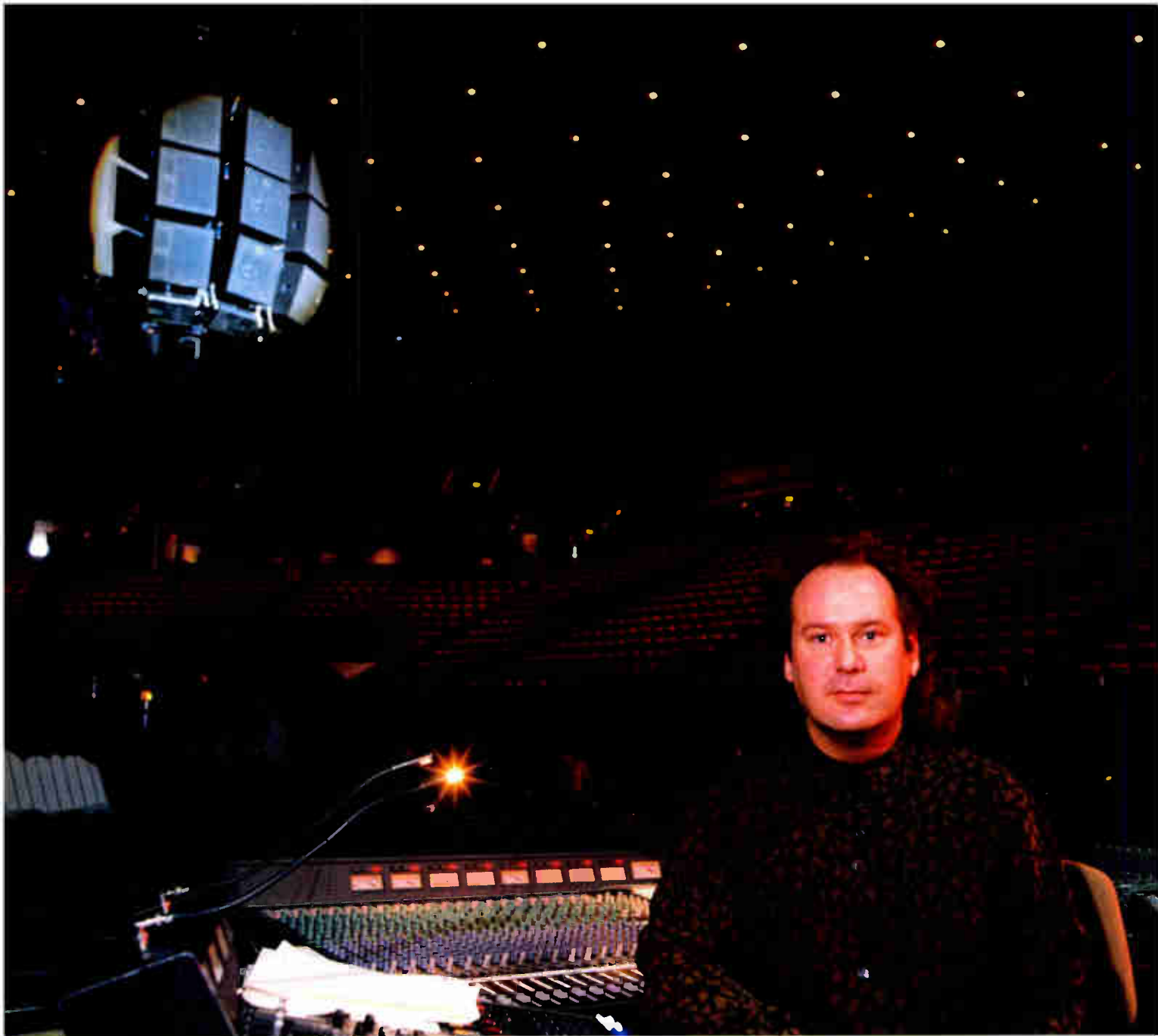
In the second part of our review of Modeler, we explore the prediction capabilities: SPL variations, uniformity of coverage, localization, reverberation time, reflection analysis, and more. We take a depth look at this innovative program. **32**



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## UNDERSTANDING REVERBERATION TIME

The first of many formulas introduced to predict the reverberation time (RT) of a space, the Sabine formula for RT60 is at the top of a theoretical and mathematical argument that is still not entirely understood. How can we reach a better understanding of what reverberation is, and of the various formulas for "predicting" its decay time? **28**



## Rob Colby, sound engineer for Prince, recognizes a breakthrough when he hears it.

That's why he's using the Electro-Voice MT-4 Manifold Technology<sup>®</sup> concert sound system on the recent world tour.

Rob says:

"The MT-4 was the only system we looked at that has the power to punch out over the audience level in full-bandwidth fidelity, without blare or distortion. Also, it never requires major equalization changes from one venue to the next. Plus, it's so compact, we can fit an entire PA into one truck. It configures well, and provides predictable, coherent aiming night after night. It's a fantastic system."

Small enough to conform to the most stringent restrictions, compact enough to array and transport

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The MT-4 is the system that's shattering sound-system myths around the world. Give us a call today for more information.

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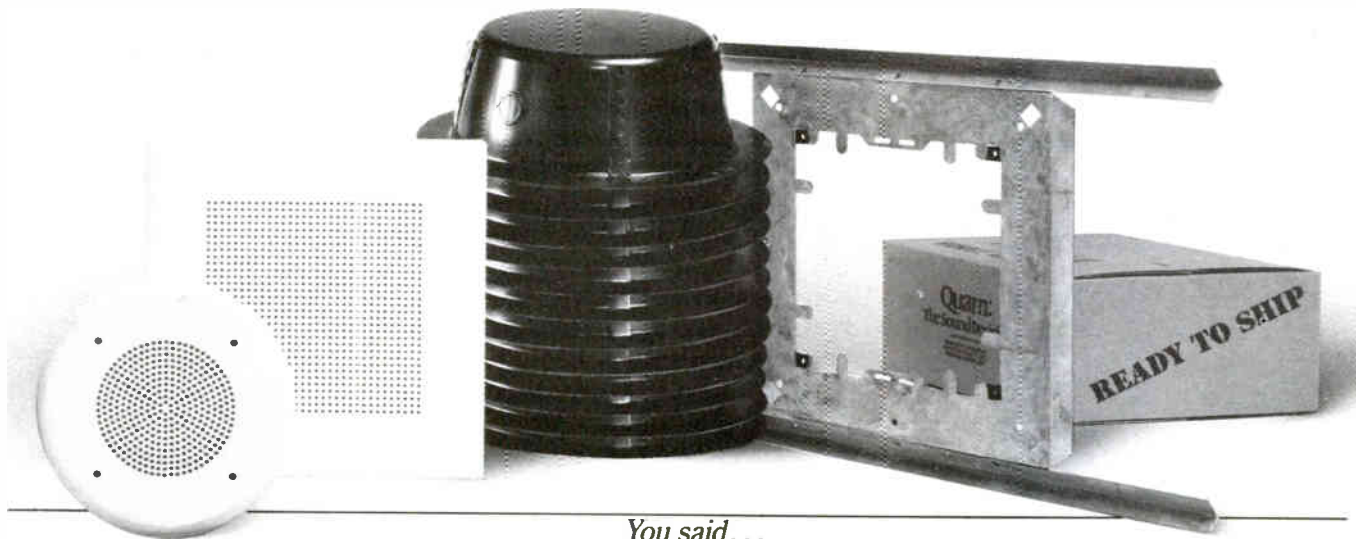
World Radio History

# YOU KNOW US FOR SPEAKERS.



## THE FACT IS, WE'RE LISTENERS.

*Speakers started our business more than 50 years ago. Listening keeps us prospering today. Developing products and services you need. Continually introducing improved techniques. Providing you with the tools to be a leader in your market.*



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### **"GIVE ME BAFFLES THAT REALLY LAST."**

Quam's do. The tile-matching, white powdered-epoxy finish of our full-range series of 8" and 4" baffles provides durability far superior to enamel or lacquer. They stand up to handling during shipping and installation, and maintain their fresh look.

### **"BACKBOXES TAKE UP TOO MUCH SPACE."**

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### **"MOUNTING ASSEMBLIES ON CEILING TILES TAKES TOO MUCH TIME."**

The design of the Quam SSB-2 Speaker Support Bridge saves you substantial time. It eliminates the need to cut a close-tolerance round hole in the ceiling tile. Locking tabs on the bridge's center plate prevent movement during installation. And the SSB-2 accepts most of the industry's popular round or square baffles, with or without backboxes.

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*So while speakers started it all, listening keeps us—and you—prospering. And we'll continue to listen—and respond to what we hear—while we refine and enhance our current products and create new ones to meet your evolving needs.*

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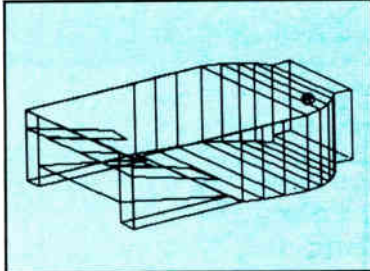
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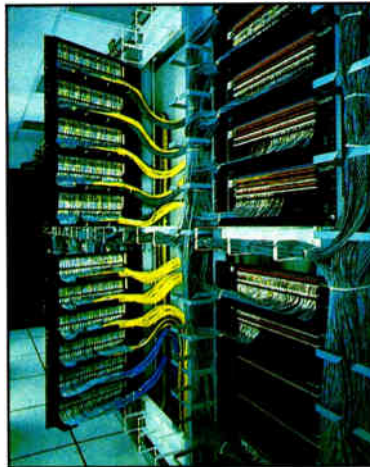
# C O N T E N T S

Volume 35 Number 4

April 1989



32



42

## FEATURES

### 28 A Better Understanding Of Reverberation Time

By Jeff Dale

A look at the Sabine formula for RT60, and how can we reach a better understanding of reverberation, and the various formulas for "predicting" its decay time.

### 32 Software Review: The Bose Modeler Design Program, Part 2

By Mike Klasco

The second part of our review of this innovative and ambitious program, including an examination of Modeler's simulation capabilities.

### 38 The Fourth Annual Survey of the Contracting Business

By Bill Intemann

Sound & Communications presents its fourth annual Survey of the Contracting Business. Sales figures, markets served, markets neglected, markets targeted for future growth, and more.

### 42 Skywalker Ranch's Star System

By John Valentine

Sprocket Systems at Skywalker Ranch has been described as the most complete film post production facility in the world. A profile of this complex installation, from initial planning to final testing of the more than 500 miles of custom-manufactured audio cable.

### 49 The Importance of Good Cabling

By Gary D. Davis

Regardless of the quality of mics, mixing console, amplifiers, or loudspeakers, an entire system can be degraded or silenced by a bad cable. Here are some factors to keep in mind when selecting quality cable.

## COLUMNS

### 12 Sales & Marketing

A Seminar

### 18 Theory & Applications

By Marvin Caesar

### 26 Ask Dr. Wokka

By Dr. Wilhelm Wokka

## DEPARTMENTS

### 9 Newsletter

### 52 Update

Contracting Close-up	52
People	55
Products	58
Literature	63
Calendar	67

### 69 Classifieds

## SOUND COMMUNICATIONS

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### Coming in May. . .

Our preview of the upcoming NSCA convention and exhibition: schedules, seminars, new products, and more. And the next installment in our series of sound system design software reviews. Don't miss it!

# THE NEXT STAGE IN WIRELESS

## Stage 22: True Diversity Wireless With dbx\* At A Price That Won't Hold You Back

Stage 22 is the first affordable *no compromise* true diversity wireless system for musical performance and sound reinforcement.

Samson True Diversity technology with built-in dbx Noise Reduction yields superb high-fidelity wireless sound in every application.

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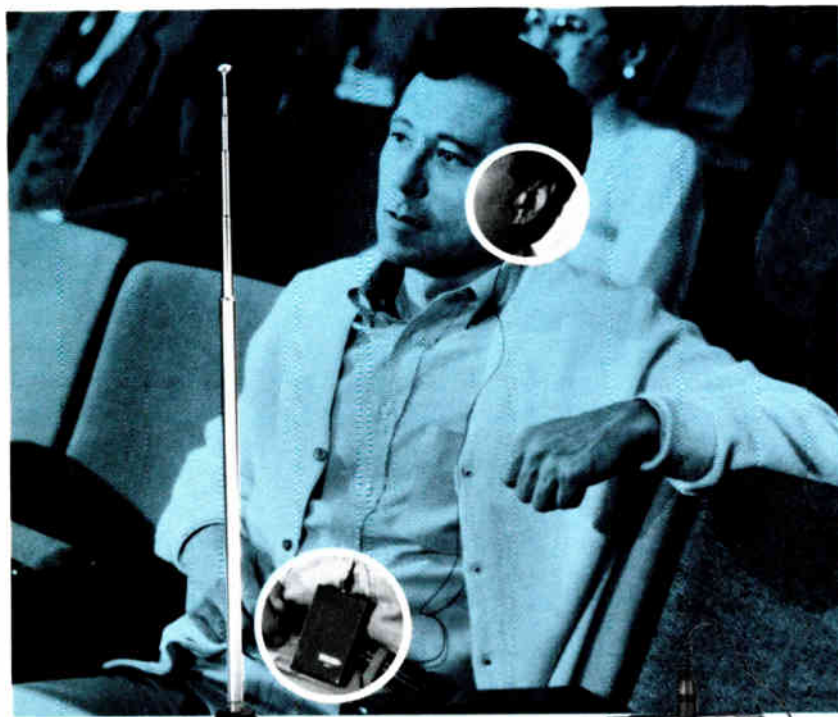
Stage 22 is available with the Electro-Voice N/Dym 757 microphone sold exclusively in wireless by Samson.

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# Trouble-Free Sound System Planning with a Direct-to-the-Ear Listening System



Developing a sound system for churches, theaters, auditoriums or amusement parks that benefits **everyone** in the audience is simplified when Telex Sound Enhancement is part of the project.

You can overcome acoustical barriers, crowd noise and other noisy distractions with this wireless personal FM sound system. It can enhance listening for anyone, including those with a hearing impairment, by bringing the speaker's voice directly to the ear.

Telex Sound Enhancement systems consist of a base station transmitter and any number of multi-channel tunable or economical single channel personal receivers. The base station plugs easily into any existing sound system and transmits the speaker's message to each personal receiver and then to the listener's ear via a comfortable foam cushion earbutton.

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At Peavey, quality is not just another trendy buzzword. It's a hard, quantifiable fact. Throughout the entire purchasing, assembly and shipping process, skilled technicians monitor the performance and reliability of our products against the toughest standards in the industry. It's no accident that every day our products reach new heights of excellence.

While other companies come and go, Architectural Acoustics has the unyielding Peavey commitment to customer service and follow-up support. Year after year, you can depend on Peavey Architectural Acoustics.



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# THE IEQ WITH Smartcurve™

Not Just Another Programmable Equalizer With MIDI™

The IEQ with Smartcurve™ is a programmable, high performance graphic equalizer that includes a video output. For those who wish to enjoy the video output of the IEQ, ART makes the IEQ Video Monitor.\* Smartcurve™, proprietary software developed by ART gives you instant actual frequency response as easy as the push of a button.

The IEQ Family consists of both the 2/3 octave and the 1/3 octave graphic equalizers. Both types come in two varieties, Controllers and Satellites. A Controller is a self-contained programmable intelligent graphic equalizer capable of controlling 15 satellites at once. IEQ Satellites are exactly the same unit except the front panel controls are eliminated.\*

#### IEQ Model Specifications:

##### Controller & Satellite

- 128 battery backed presets
- MIDI
- Frequency Response  
20Hz-20kHz  $\pm$  0.5dB
- THD -  $\leq$  .009% @ 1kHz, 0dBm typical
- Dynamic Range -  $\geq$  100dB typical
- Balanced inputs and outputs

##### \*IEQ Video Monitor Features

- 19" rack mountable
- NTSC compatible monochrome monitor
- 4 Selectable inputs
- Standard RCA jacks for easy connections

It Has To Be A Work Of . . .

# ART

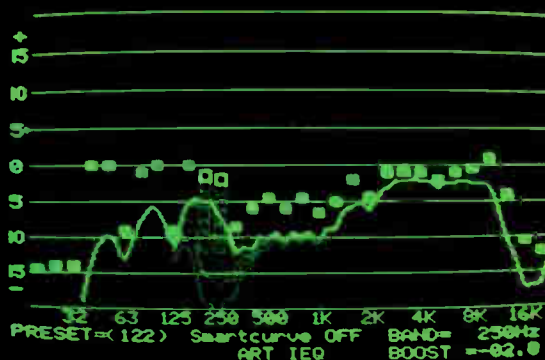
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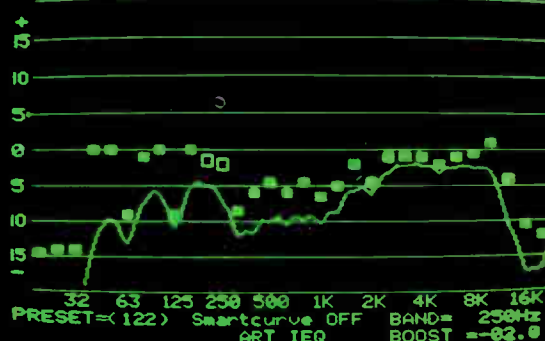
## 1 See the Sound

This is a video output of the IEQ as the unit is being adjusted. The sliders can be moved  $\pm$  15dB in 1/2dB steps to get the exact response you need. With the simple push of a button, complex equalization can be done in seconds with incredible accuracy.



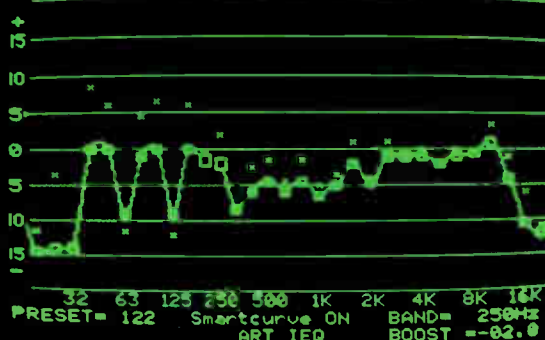
## 2 Hear the Sound

The power of the IEQ readily becomes apparent as the video display plots the frequency response due to the slider settings. The IEQ offers high quality constant "Q" equalization. The video graphic display shows the correlation between the sliders and the frequency response.



## 3 Perfect Sound

Turn Smartcurve™ on and perfect equalization is at your fingertips. Note the difference between the second frame, (Smartcurve™ OFF) and this frame. The position of the sliders represent the actual frequency response of the EQ. Interaction between bands is virtually eliminated. Incredible! Just think, now when you adjust the EQ you get exactly what you need. The "perfect" EQ? Let your eyes and ears decide.





# NEWSLETTER

## **RING COMMUNICATIONS DISTRIBUTOR FOR S.T.R.**

Ring Communications, Ronkonkoma, NY, has been appointed an authorized distributor for the entire line of S.T.R. video and intercom systems. The S.T.R. line offers a line of apartment house, home and office intercom and video intercom products.

## **AEI SIGNS CONTRACT WITH TOTAL SOUND**

AEI Music Network Inc. has signed a contract with Total Sound Inc. (TSI), San Jose, CA., to consolidate sales of communication, data and music services in nine western markets. The agreement grants TSI exclusive dealership of AEI's direct broadcast satellite (DBS) and the company's traditional on-premise music service. The agreement also provides that, after an initial transition period, AEI will be TSI's exclusive music and equipment supplier in the DBS, SCA and On-Premise markets.

## **INTEGRATED SYSTEMS BY RICH OFFERS SYSTEM SALES**

Reuter's Holdings has discontinued all nonfinancial market system sales of Rich Inc. System sales are now being offered through Integrated Systems by Rich (ISR Inc.), owned and operated by the Rich family. Areas of system integration include professional audio, video, acoustical design and custom Millwork.

## **GENTNER IN THE NASDAQ MARKET**

The common stock of Gentner Electronics Corporation began trading in the NASDAQ on March 3, 1989. Gentner's entry into the NASDAQ market provides brokers and others with immediate access to the best bid and asked prices throughout the trading day, according to William V. Trowbridge, chief operating officer for Gentner.

## **PEIRCE-PHELPS MOVES D.C. BRANCH**

Peirce-Phelps, Inc., headquartered in Philadelphia, PA, recently moved its Washington, D.C., regional branch office from Rockville, MD, to Gaithersburg, MD. The 11,000 square-foot office includes assembly/installation space, warehousing and service, in addition to the sales operation.

## **PETCOM DEALS WITH U.S. SOUND CONTRACTORS**

Poetker Communications Ltd. (trade name—PETCOM), of Kitchener, Ontario, will deal on a factory-direct basis with U.S. sound contractors because of the recently ratified Free Trade Pact between the U.S. and Canada. The Pact accords U.S.-made status to Canadian products, and is designed to remove all import tariffs between the two countries. PETCOM will now have a nationwide network of factory-trained area sales representatives to implement the factory-direct policy, which will include substantial cost reductions at the contractor level.

## **GENERAL INSTRUMENT AGREEMENT TO SELL SYTEK TO HUGHES**

Syteck, Inc., a company in which General Instrument owns a majority interest, and Hughes Aircraft Company, a unit of GM Hughes Electronics Corp., have made an agreement for the acquisition of Sytek by Hughes. The agreement is subject to approval of the Sytek shareholders and certain governmental approvals. General Instrument will receive approximately \$50 million in cash for its interest in Sytek.

## **BELDEN BREAKS GROUND ON NEW ENGINEERING CENTER**

Belden Wire and Cable has begun construction on a new 69,000 square-foot Engineering Center adjacent to its corporate headquarters. The center will employ more than 100 full-time product and process engineers, compound/material development engineers and technicians. The engineers will be responsible for new product/materials development as well as the design and testing of new processes and production equipment.

# NEWSLETTER

## **PIRELLI CABLE MAKES A MOVE**

Pirelli Cable Corporation has decided to move its headquarters from Union to Florham Park, NJ. The new offices, located at 325 Columbia Turnpike, will be designed to house approximately 80 administrative personnel. The company's present building at 800 Rahway Avenue formerly was occupied by research laboratories and other operations which have been moved to South Carolina as part of a corporate-wide decentralization program.

## **ACA DESIGNS SYSTEM FOR FLYING TRAINING UNITS**

Alerting Communicators of America (ACA) has designed a large outdoor warning siren system for Nellis Air Force Base, Las Vegas, NV. The system will be used by the "Home of the Fighter Pilot," a diverse number of flying training units. The system provided by ACA consists of five Alertronic 4000 omni-directional electronic sirens controlled by ACA's Compulert one-way radio system. The base's Fighter Weapons School gives an elite group of top fighter pilots experience in weapons systems and tactics.

## **LINCOLN TELE AND ANIXTER JOIN VENTURE**

Lincoln Telecommunications Company (LTEC), Lincoln, NE, and Anixter Bros., Inc., Skokie, IL., have formed a joint venture for the distribution of voice, data, and power wiring systems products. The joint venture, which is to be called Anixter-Lincoln, will take over the operations of LTEC's supply subsidiary, Lincoln Telephone Service and Supply (LTS&S) and the Anixter operations in Nebraska, South Dakota, North Dakota, Wyoming, Montana and Idaho.

## **NEW ENGLAND DIGITAL WORKSTATIONS SALES RISE IN EUROPE**

New England Digital Corporation workstation sales are accelerating throughout Europe and in all market segments, according to the company. New England expanded its sales and marketing group in Europe three months ago, and is now seeing the results of its three-month investment.

## **VAUGHN ACQUIRES ARIZONA TAPE DUCPLICATING**

Vaughn Communications Group, Minneapolis, MN, has acquired Phoenix-based Arizona Tape Duplicating, Inc. (ATD), a videotape duplicator. All ATD employees have joined the Vaughn staff. Former ATD President, Steve Moore, will act as a consultant for the Vaughn Duplication Division. The Phoenix branch of Vaughn Duplication Services and ATD will move to new facilities located at 3802 East University, Suite 6, Phoenix, AZ. Vaughn Broadcast Rentals, Phoenix, will also move to the new facilities. The merger will not affect rental operations.

## **LIGHT FORCE LAUNCHES LANTEK IN US**

Light Force has been appointed exclusive Citronic distributors for the Lantek brand name in the United States. Citronic is a British audio manufacturer that produces a range of DJ mixers, pro-audio mixers, amplifiers, signal processors and DJ mixing consoles. Light Force will directly market the lines through its dealers nationwide. In Mexico, Light Force will use its Mexican representative, Marjoy Lighting.

## **HARRIS WINS RADIO SYSTEMS CONTRACT**

The U.S. Air Force has awarded a \$3.2 million contract to the Long-Range Radio Division of Harris Corporation to upgrade two radio sites in the Western Space and Missile Command. The contract calls for replacement of transmitters, receivers and control systems at Vandenberg Air Force Base in California and Wheeler Air Force Base in Hawaii. These stations provide voice and data communications with ships and aircraft in support of satellite and missile programs conducted from Vandenberg and Cape Canaveral.



# Warning: To Avoid Risk Of Shock,

## Ignore This Amp-To-Amp Confrontation.

**L**et's be frank. We're out to change your idea of what — and who — makes a professional power amplifier. So if you just bought a Crown MacroTech, turn the page — this comparison won't be a polite one. But it will stick to the facts.

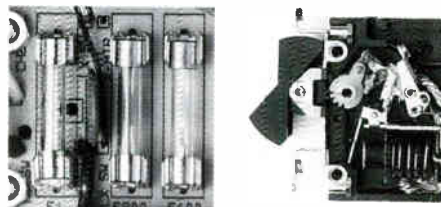
A look inside these two amps will give you a better idea of why BGW amps like the GTB Grand Touring Amplifier are built like no others in the world. And raise some questions about Crown MacroTechs.

mass of metal absorbs thermal transients without straining the fan. And without quick changes in transistor temperature. That's important: Transient musical loads put the worst kind of stress on power transistors. The effects of thermal cycling fatigue may not show up until after the warranty, but they can destroy lesser amps. Meanwhile, BGWs keep right on delivering clean, reliable power.

BGW pioneered DC speaker protection in 1971. We stopped using relays years ago, when they no longer met our reliability standards for BGW amps. The GTB, like all BGWs over 200 Watts, uses solid-state Thyristor Crow Bars to keep DC from ever reaching your valuable speaker cones or compression drivers.

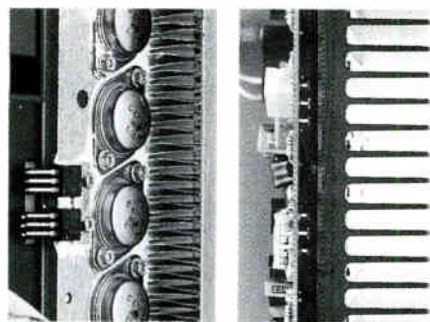
### REAL SPEAKER PROTECTION

Most amps today are direct coupled, so a blown output transistor (the most common failure) connects the power supply directly to the speakers. Earlier MacroTechs had no protection against DC. Now Crown has learned their lesson — or have they? The sensing circuit and relay they now use shuts off the power transformer, but allows the filter capacitors to discharge stored DC energy directly into your drivers — risking real damage.



*Left: Time is money, and with Crown's MacroTech you can lose plenty of both: You have to pull it out of the rack every time a fuse blows.*

*Right: The GTB's power switch is also a rocker-actuated magnetic circuit breaker. You can reset it in a second if power lines hiccup.*



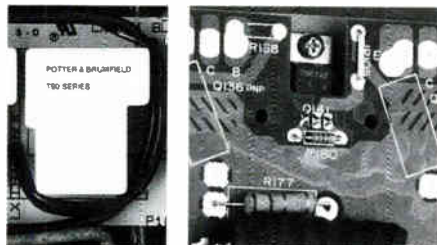
*Left: The MacroTech uses mostly air to dissipate heat, not metal. The closely spaced fins are vulnerable to airborne dust and dirt.*

*Right: BGW uses ten pounds of aluminum to absorb thermal transients, extending power transistor life.*

### TAKING THE HEAT

If the MacroTech heat exchanger reminds you of an air conditioner, you've grasped its design. This approach works, at least until dust and dirt clog the fins. But as soon as the air flow slows or stops, temperature rises. Soon after that, the Crown shuts off — it could even fail.

The GTB uses massive extruded aluminum heat sinks with widely spaced fins. The



*Left: Crown uses a slow-acting, less reliable relay. It can allow the filter capacitors to discharge stored energy directly into your drivers.*

*Right: BGW's modular power output section protects your speakers against DC damage with an instantaneous Thyristor Crow Bar. And the module is easily replaced in the unlikely event of failure.*

### MAKE YOUR OWN COMPARISON

Before you buy or spec your next power amp, call us at **800-468-AMPS** (213-973-8090 in CA). We'll send you tech info on BGW amps and the name of your nearest dealer. He can arrange a demo of any BGW model against any amp you choose. Then you'll be able to appreciate the advantages of BGW engineering with your ears, as well as your eyes.



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# Exploring New Markets

*Editor's note: The following is a transcription of a seminar held at last year's NSCA convention. The moderator was Vincent P. Testa, publisher of this magazine, and the panel included Ron Means, president of JBL Professional; Bob Reim, president of Acromedia; Ron Wiggam, president of Pro Media; and Jesse Klapholz, technical editor of this magazine.*

**Testa:** This panel will take a look at the different ways of exploring and identifying new markets, with the hopes that our panel members will share with us some of their accomplishments and experiences along those lines.

Let's begin with the Sound & Communications Annual Sound Contracting Market Survey. The results of this year's survey [1988] will appear in our next issue [May 1989], but I do have some advance numbers that I thought I'd share with you.

One of the things I found interesting in the report was the size of the businesses: the majority of companies in this market reported having between four and ten employees; the average size of a single job in dollars was \$16,500. And the number one new market contractors are looking at to increase their business is video, followed next by teleconferencing, with security and fire alarm coming in third.

While it's very difficult to get the traditional video contractor to explore the value of audio, it doesn't surprise me that the sound contractors are willing to explore video as an area of expansion. I think the sound contractors have shown themselves to be very open to exploring

new markets in general.

Ron, can you explain how you at JBL go about exploring a new market?

**Means:** We consider it very important first to define what our markets are. That's important in any business. It may sound obvious at first, but a lot of us tend to get the business and not really define what we're doing or focus on the businesses that are generating the most profits. In the contracting business, where we have all spent a number of

ring. Not that you shouldn't take advantage of every opportunity, but you should try to focus and plan the business, and organize a structure that can more effectively promote your business and your services into those industries. That focus can include product groups that range from video and fire alarm to, obviously, sound systems.

Geographic area is another consideration. Many contractors decide which areas they can most effectively service,

**Try to answer a few basic questions: who is already in the market, who is doing that kind of business in your area, and how well are they doing it.**

years, the most obvious ways to categorize or segment a business are by geographic area, by vertical market, and by product groups.

The vertical markets can vary greatly. For example, you might decide to break up into the church sound business, hospital or health care markets, and the boardroom business. Some people are only in the church business, and they split that market vertically into Fundamental churches, Catholic churches, and other religious organizations for which they package and design different types of sound systems. The benefit there is that if you segment by vertical market, you can begin to have some expertise in those areas, and perhaps even focus certain sales people and certain engineers in those directions.

It's very important to plan ahead and not just sit back waiting for the phone to

and focus on those markets. If you add a geographic area to your business then how do you support your efforts in that area? You've got to structure your company so that you don't have people running all over the place and duplicating effort.

**Testa:** Pro Media has been in business more than 15 years. How do you go about getting into a new market? Do you identify a need in a particular area?

**Wiggam:** We take a look at a market, and try to answer a few basic questions: how easy is it to enter that market, who else is already in that market, who else is doing that kind of business in your area, and how well are they doing it. Some markets you have to deny yourself because there are already a lot of good people doing good business in those areas.

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standpoint, the large surveillance system market would probably be the one we are looking into now that we haven't addressed before. Promedia concentrates heavily on large sound reinforcement systems, entertainment show systems, rentals, general box sales and products in the broadcast and recording areas.

It's very important to do a great deal of analysis and planning before you enter a market, although we know that a lot of markets are entered just by seeing something happen out there and presenting a bid. The key is to be able to do it well and to be profitable.

**Testa:** That's interesting. Pro Media is apparently very specialized, as are many of the contractors out there. But there are two schools of thought, and there are a lot of contractors out there who feel that diversification is the way to go. Bob, your operation is more diversified than Ron's. Do you find yourself spreading into several markets as a hedge against the bottom falling out of any one in particular?

**Reim:** We do indeed. Most contractors during their normal day-to-day business life are too busy to plan. We've learned our lessons. So once or twice a year we go away for a few days, and we sit down and say where do we go from here? And how successful have we been in the past? Basically we always work from what we know and do best. That is a base of strength.

We started in the industry 14 years ago, and we were very comfortable with pro sound — commercial sound. That's what made us comfortable, and we built from that base. As the years went on, we went into video and many other markets. Now, we divide all of our basic markets into separate profit centers. And within our company we have a group of individuals who are responsible for each of these profit centers.

With today's computers, and proper bookkeeping techniques, you can tell if you make or lose money on any given

job. We do it on a weekly, quarterly, and yearly basis. And those things we're making money on, we continue. If we have something marginal, we let it slide. Obviously we have the ability to resurrect it at any time, but it must be profitable.

One of the most important things we've done in our planning is to define the things we should not be doing. Some people here are in the rental business, some are in interconnect telephone,

**We divide all of our basic markets into separate profit centers; Those things we're making money on, we continue; those that are marginal, we let slide.**

others are in energy management. Most of these we know we don't want to be involved with, so we made a concerted effort to plan out the areas we do not want to conduct our business in. And thus we focused on five major areas, and in those areas we do reasonably well.

History has shown that business has cycles. So if 2 or 3 of the areas are having a mediocre year, the other areas seem to always pick it up and ride in with it. And because we are diversified, we have been reasonably profitable over the years. However, we follow the basic philosophy that you have to crawl before you walk and you have to walk before you run. Even though we start a new

area of business, we start slowly and we build up. And when it's profitable, and when we can bring more people in, then and only then do we go into other areas of business.

**Testa:** I think a point has to be made. So many of you are into this because it's something you grew up with, or fell in love with. It sounds romantic, but you fall in love with the products you're selling or the market you're servicing and that can be a trap. It's important to deal with your business as a business. You have to look at it from a profitability standpoint. You can't always say "I love sound reinforcement, I love going out there and working with those live acts." If you're not putting bread on the table to the degree that you need to in order for your business to grow, you need to begin to identify some other markets. Again, there are two schools of thought here; One is identifying a need and filling it. The other is to create a need in your market place. Once you've created the need, then you go out and fill it. Have any of you experienced that?

**Wiggam:** The AV market — there was one case where I saw the market around 15 years ago when it was very small but growing. It looked to me as though the boardrooms were going to be quite a growing market and seeing that, we started to set up the plan, the people, and actually concentrated on not only seeking the market but creating and developing it as well. And that's one case where the plan did pay off.

Recently, in the last few years, we looked at teleconferencing in the same way. And gave up on it. For us, teleconferencing did not progress as we had anticipated. There's something else to bear in mind: you need the right personnel when you're getting into a new market. You have to be very assured you have the talent on board. You can't really take on the job and then develop the personnel within the job — that's not the proper approach.

**Testa:** In both situations [A/V and



teleconferencing], I don't think it can be disputed that those are areas for business. The key is timing. When is the right time to enter a market? How does one recognize that the timing is right? We all know that teleconferencing is on our future, that it's a market we're all going to have to be in. The question remains, when do you make that jump? Is there anything that you can recall that has forced you into a market?

**Reim:** A lot of times a manufacturer will come out with a product that you quickly recognize will have an impact on your market.

We started a separate teleconferencing division about 2 years ago, a stand-alone group, and in 2 years we've moved up the ladder and have pretty much been very successful with it.

But dividing up a market is really a very basic decision, in that your company has to run in the black. The mother's milk of any company today is money, and you have to maintain a cash flow.

With that in mind, we divide our market place into three basic common denominators. The first is what we refer to as public works. In those areas, funded by some type of county or government agency, the work is very competitive and the profits are relatively low. But there's a built-in cash flow. You do X number of dollars and percentage of business in this area, and you're going to have cash flow every month. Next we get into the commercial area or pro sound. Usually a little more lucrative, but you work a lot harder for your buck. Last but not least, and probably the most lucrative business you can get into today, is design build. And design-build fast track construction can be very profitable for you, if you have the right plan, the right people, and the right attitude.

So we divide all of our businesses up into one of those three categories. Then as the new products or new opportunities come along we put them into one of those categories, always building again from

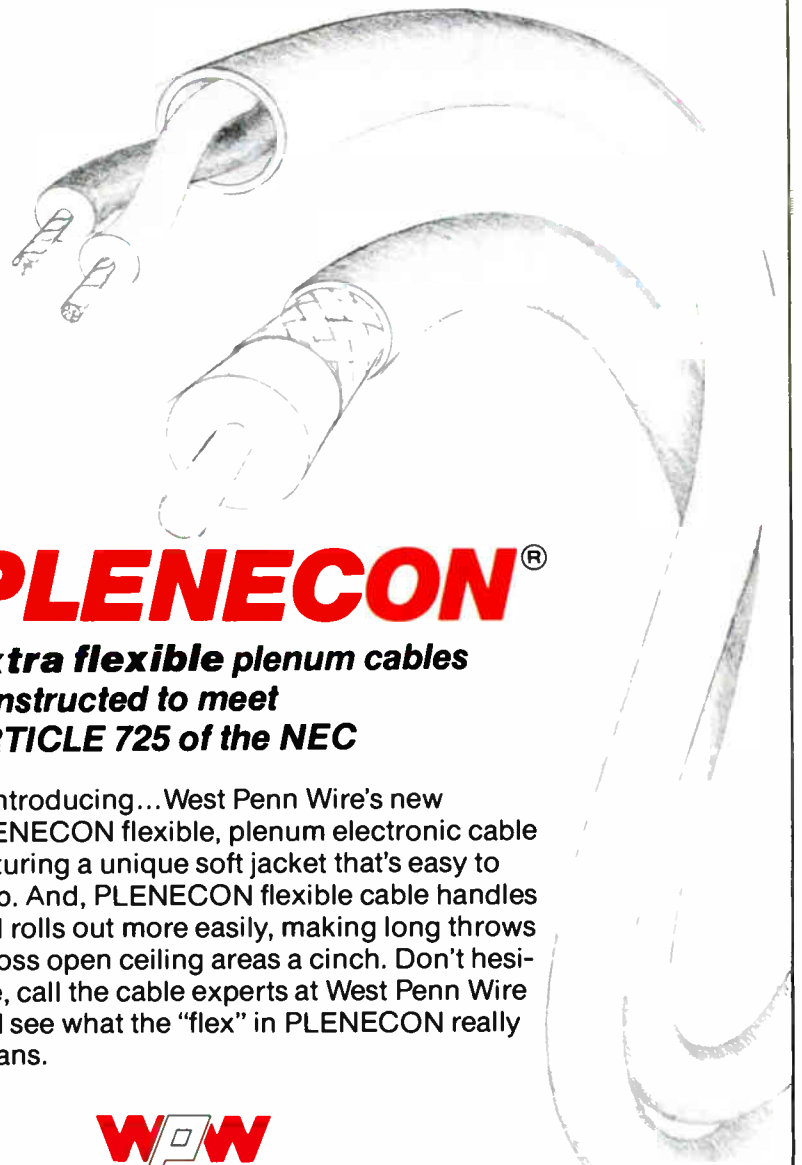
the basis of strength.

**Testa:** It's important to key in on keeping open to the markets around you and responding to new products that can open up a category. For example, consider the advent of MIDI technology, and

the advent of SMPTE. Are these areas that contractors should be paying attention to right now?

**Klapholz:** There's a demand in the marketplace for more people to have automated control of their systems. The

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MIDI technology in the MI business certainly has afforded that. And made it really economical for the contractors to take advantage of those kinds of products. Then there's the computer market, with RS422 and different serial communication protocols — there's a lot of technology becoming available very rapidly. And it's becoming more economically feasible for contractors to take advantage of that kind of technology.

I think it's important when you talk about marketing and you talk about technology to first access the technology pool, access the depth of technology that is available in other fields and incorporate that into your business.

**Means:** We all — manufacturers and sellers or resellers of the product — are being dazzled by the new technology that is coming of age within this industry. I think there are many, many applications in this market for products we've developed primarily for other markets, especially as these vertical markets in our business begin to merge.

The differences between the markets are becoming grayer. Ten or fifteen years ago the sound contractor and the music store didn't bump into each other too often. They appear to bump into each other much more often now. The music directors in general, and specifically in this church market, are becoming more educated, learning more about high technology, how to use MIDI and sequencing — some have studios in their homes. And when they want to make a presentation they have a lot more tools available. They know what can be done, and they know what can sound good.

And they are a little disappointed with the older style of design in the systems; it sort of straps them in from a creative standpoint. There's a lot more demand for higher quality systems, unleashing more of the creativity in the music end of that part of the business. So they tend to gravitate toward places of business they're familiar with. And they are familiar with music stores. Music stores have salesmen.

A lot of us in this business are afraid to call ourselves salesmen. A lot of us prefer to have field engineers out selling, or people that don't really want to be called salesmen. And I think that's something we ought to address — taking a more aggressive selling approach — because our competition in that part of the market, whether we want to admit it or not, is to an extent that MI or music store.

Those guys are becoming more technically oriented. They still don't have the expertise that everyone in this room has,

## Many contractors are beginning to pre-design sound systems for architecturally repetitious buildings. You do not have to re-invent the wheel for every job.

the ability to properly design an acoustical system to match the acoustical environment. But they sure have the tools out there: the sophisticated, computer-controlled products that these music directors are familiar with and are looking for.

So I think it's certainly something that we in this industry need to become more aware of, to understand how it works, to be able to make that type of product available during the overall presentation. And I think we need to have the skills to make that presentation more professionally than a music store owner.

**Testa:** Say a contractor has decided to enter a new market. He's opened his eyes, he's targeted the market, he

knows what he wants to go after. What's the first thing he does? Does he run an ad in the yellow pages? Does he pick up the phone and call a printer and do a direct mail piece? What does he do to break that new ground?

**Reim:** It all depends on how you're going to market your product or services. We at Acromedia are basically a systems contractor. We try to provide our clients with a total systems service capability. When you talk about new products, you're talking about the leading edge of technology. When you're at the very leading edge of technology occasionally you get cut. And we don't always want to get cut. We want to be at the forefront but not at the leading edge.

It's not uncommon for us to go to other companies. They become subcontractors to us, a part of our team. If we're putting in a large system, and the client says they want a microwave length from point A to point B, we probably could do it. But someone else could do it better, cheaper, with a higher degree of success than we could. So we'll get a good, qualified subcontractor. Sometimes, we learn their profession and in time will do it ourselves. Other times it's such a rare event, such a specialized technology, that we'll just subcontract it to someone else.

The distillation of new technology comes in many, many ways. But it's important that you approach it in an organized manner. You cannot get financially hurt if you do your homework.

**Wiggam:** I agree with Bob. You shouldn't be doing what you don't do well. If you allow yourself to enter one of those areas, the best way is to affiliate or go in joint-venture with someone who is the pro in that field, or very talented in that field. And gain from that experience rather than taking the full responsibility of a new market or a new challenge onto yourself.

**Testa:** So the contractor has to step back and take a look at his operation and decide whether he wants to be a specialist or whether he wants to spread

himself into two or three markets, in which case the suggestion would be to get out there and sell, and sell aggressively, and make yourself known as a player in that ball game.

What I'm hearing from the panelists here is the importance of self-analysis, of stepping back about every month or so and looking at your business. I wonder how many of you take the time to do that on a regular basis, seeing where you are now and looking five or six months ahead. I think that's going to be demanded of you in the next couple of years. We're going to see new markets like video and teleconferencing become more and more important.

And unless you're there and ready to meet the challenge somebody else in gonna be, and I think that's really the point.

**Means:** I'd like to add one more thing. Vinny, you mentioned that the average size job was around \$16,000. I know a lot of contractors who feel they can't afford to do a \$16,000 job. And there are probably many others who can't afford to do that quarter of a million dollar job or that million and a half dollar job.

That's another thing that has to be addressed in your own business. What is the size of the job? What will your cash flow and your cash generating abilities allow you to do? It is extremely possible to make money on the \$16,000 job. However, with a large company, with a lot of overhead, it becomes more of a task to make money at a \$16,000 job.

Companies who have a structured business-plan approach will take a look at those jobs, and decide that while they are very profitable from a percentage standpoint, they have a lot of overhead associated with them. If you have to re-invent the wheel for every \$16,000 job, and you have a high overhead rate and you apply your overhead properly to every job, it's going to be difficult to make a profit.

What many people are beginning to do is prepackage jobs. They'll define a market, like the church market (which

we keep coming back to because it's a clearly defined vertical market), and predesign sound systems for certain architecturally repetitious buildings. We all know the pie-shaped churches with the low ceilings, we all know the rectangular-shaped systems and so forth. A lot of the design work, especially with the help of computers, can be done very profitably if the work is done once and then adjusted

and tweaked for each specific job. Every job is not designed from scratch.

So again, in putting together the business plan, it's important to decide the relative sizes and ranges of jobs that can be done profitably. And nothing replaces having some good financial management within the company to help put those plans together. ■

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## Crossing The Lines: Systems Interface

BY MARVIN CAESAR

*Editor's note: Inevitably when a system is to be wired that incorporates many functions and features, the mix between pro and hi-fi gear becomes an issue. These varied formats have un-balanced inputs and outputs; and their levels are typically lower than pro gear. The matching of levels — both coming and going — is often not properly addressed in multi-media systems. This short-cut results in headaches for the user that are easily avoidable. If the entire system is matched to a balanced pro-level format, then any piece of equipment can be used without distortion, hum, buzz, noise, or poor levels. Besides matching levels, impedance may become a factor as well. These often overlooked, and easily manageable details, can make the difference between an amateur and professional installation. This article offers a tutorial overview of these issues with a new unit from Aphex as an example interface.*  
-J.K.

**I**nterfacing high impedance, unbalanced audio signals to professional balanced equipment. It's something every audio engineer has had to deal with — some more often than others.

In sound contracting, it may arise from a requirement to locate audio components far apart that were intended to be connected only by short RCA-type patch cords. It may be for a studio client who has a favorite effect box designed

*Caesar is president of Aphex Systems, Ltd., North Hollywood, CA.*

strictly for Hi-Z musical instrument signals. Sometimes, it's a need to connect special-purpose equipment — say, a cassette deck or loudspeaker equalizer — that's only available (or a lot less expensive) in a "consumer" model. In video post-production, it's the need to interface 3/4" and 1/2" editing and dubbing decks to the patch bay or control console. And in low-budget or "semi-pro" studios, it's a requirement for intermixing tape machines, outboard equipment, etc. — some equipped with traditional balanced lo-Z connections and others with low-level, hi-Z unbalanced inputs and outputs.

But whatever the reason behind the need, the final answer is too often a highly compromised, ad hoc improvisation. For example, when connecting a consumer-type cassette deck to a recording console, the standard approach is simply to wire one side of the balanced feed to the deck's circuit ground, and hope that the record level attenuators can reduce the +4dBm level to avoid distortion in the deck's electronics. The fact that this technique throws away many of the benefits of low impedance and all the benefits of balanced lines seems to be lost on those lucky practitioners who don't have problems with hum and noise.

A more "enlightened" solution may be attempted when, for example, the requirement is to connect an FM tuner to a lounge's PA system for off-hours background music. Typically, the tuner (or preamp or tape deck) may be situated for easy access by the bartender, while

the remainder of the system is located near the dance floor. Because of the hostile electrical environment, the installer may elect to use signal transformers at one or both ends of the connection, hoping to avoid ground loops and noise pickup.

A full discussion of grounding techniques is beyond the scope of this article. But the standard texts on the subject usually assume that the desired signals are supplied on balanced lo-Z lines — with separate, electrically isolated shields. In more and more situations, this is not the case leaving the system designer or installer with the job of finding a workable way of interconnecting inputs and outputs that were never intended to be compatible.

There are basically three ways to connect a balanced line to an unbalanced hi-Z input: direct, transformer-coupled, and electronically converted. Each has its uses, its advantages, and its drawbacks.

### DIRECT CONNECTION

The direct connection simply applies the plus and minus legs of the balanced signal to the hot and ground input terminals of the unbalanced equipment. As mentioned earlier, the line immediately becomes unbalanced because the minus side has a low-impedance path to ground, while the plus side doesn't. This might not be so bad if "ground" was a perfect zero-impedance, constant reference potential everywhere in the world. Alas, this is not the case: two pieces of equipment — especially if they are located some distance apart and plugged into

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different AC branch circuits — are very likely to “see” different ground potentials. And in an unbalanced connection, this difference can appear directly in the signal path, typically as a nasty hum. However, if you’re lucky, this method may work acceptably.

You should keep in mind these considerations with direct connections:

Connecting a balanced line to an unbalanced input can effectively short-circuit one side of the line driver to ground. Most drivers will tolerate a shorted output, but this isn’t a particularly healthful mode to operate them in. A series resistor preferably at the end of the line — may be advisable to reduce the load on output devices.

Despite the prevalence of high-impedance bridging inputs on pro gear these days, you may find that terminating the line with 600 ohms (or something greater) at the input to the unbalanced device may improve noise performance.

It may also flatten the high end response of transformer-coupled circuits.

Excessive signal level may overload the input to the unbalanced device, requiring padding. See the following section for more discussion of this.

### TRANSFORMER CONNECTIONS

Transformers, with their ability to isolate inputs and outputs as well as convert impedances, simplify many of the aspects of interfacing pro and consumer gear. A transformer-isolated, “floating” signal line with a properly grounded shield will give excellent immunity to hum and noise pickup.

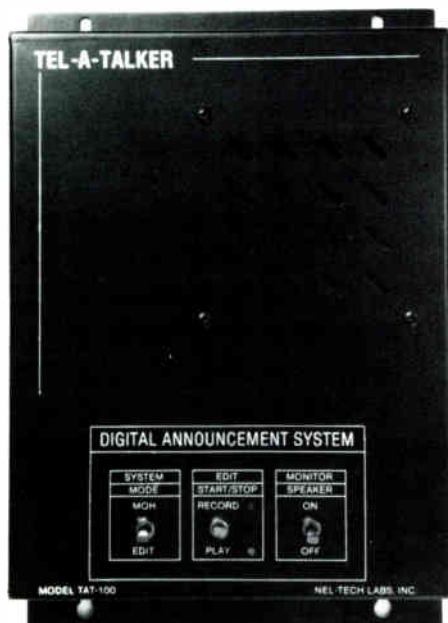
One precaution should be observed, however. The typical lo-Z to hi-Z transformer, such as a microphone input transformer, provides a large voltage boost in the process of converting impedances. When driving a high-impedance consumer-type input which ex-

pects a nominal level of -10 dBv, this is exactly the opposite of what’s needed. A 1:1 transformer, by contrast, will provide circuit isolation and balanced-to-unbalanced conversion without increasing signal level.

In fact, depending on the design of the hi-Z gear’s input stage, it may be necessary to pad the input signal somewhat, since a “hot” line level peaking at perhaps +15dBm or higher may well drive the consumer gear into serious overload. Reducing the component’s input level setting may not help, since there may be gain stages ahead of the control. The safest approach is to check the equipment specs or schematics, or put a scope on the output and look for signs of clipping. A simple resistive pad can be purchased or fabricated to attenuate the signal 10-20 dB and simultaneously terminate the lo-Z if desired. Note that the transformer should of course be at the



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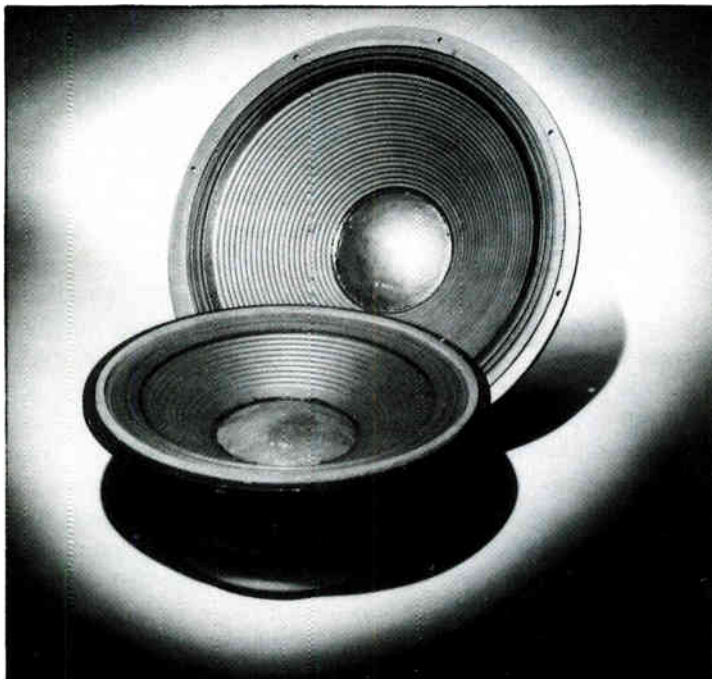
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driven end of the line, to preserve the benefit of balancing as much as possible.

When driving lo-Z from an unbalanced hi-Z output, the transformer should be chosen to provide impedance conversion (typically 10K to 500 ohms), in order to avoid overloading the hi-Z output.

This will, however, result in a considerable voltage step-down, requiring a line amplifier with 20-30 dB of gain to boost the balanced signal back to + 4 dBm. Obviously, this boost should be applied before lines of any length are driven, for optimum signal-to-noise ratio.

For the past decade or so, the trend in critical professional applications has been away from the use of transformers. Being electromagnetic devices, they can distort transient signal wave-forms through phase shift, saturation, overshoot, and ringing. Choosing high-quality transformers, loading them with the proper resistive impedance, and avoiding excessive signal levels can minimize

these effects.

### ELECTRONIC CONNECTIONS

For demanding signal conversion applications, electronic level conversion and balancing provides the best performance and greatest flexibility. Both sides of the interface are allowed to operate at optimum signal levels, and the interfacing is accomplished without the use of transformers. Other features (such as gain trimming) can be easily provided.

Electronic interfacing solutions are available via such units as the Aphex Model 124. Some of its notable features include:

*True instrumentation-type line receivers:* this circuit is more complex than a simple differential amplifier, but provides superior common-mode rejection (better than 45 dB) for improved noise immunity.

*Servo-balanced inputs:* this design allows input signal excursions well beyond

the power supply rail voltages without overloading the first stage or reducing headroom. Common-mode input range is over 200 volts RMS.

*Servo-balanced outputs:* allows unbalancing the output simply by grounding either leg — without any loss in signal level or headroom, and with no risk of damage due to short circuiting of the output.

*RF filtering of all inputs and outputs:* eliminates noise and interference from out-of-band signals.

*Direct-coupled transformerless design:* preserves perfect square wave response without phase or amplitude distortion. 65 ohm balanced output impedance allows driving several 600 ohm lines in parallel.

*65-ohm unbalanced output impedance:* allows driving a virtually unlimited number of hi-Z inputs in parallel, for applications like cassette duplication.

*Selectable balanced input impedance:*  
(continued on page 27)

## “...SOUNDSPHERE LOUDSPEAKERS ARE THE REASON FOR THE CLARITY OF SOUND?”

*Don Hartley/President • Dynamic Sound • Exeter, NH*

Comments Mr. Hartley on the Sun Foods store, “The Lowell store has approximately 76,000 square feet and is the largest supermarket in New England. It contains 24 checkout counters....

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...The size of the store and the use of Soundspheres have caused many supermarket competitors throughout the United States to evaluate this store, and we have received numerous phone calls about the sound system since it works so efficiently and about its clarity where you have all concrete walls, concrete floors and open girders in the ceiling. We have given all of them the same answer that it is very obvious the Soundspheres are the reason for the clarity of sound!”

**We strongly recommended Soundsphere #110's.**

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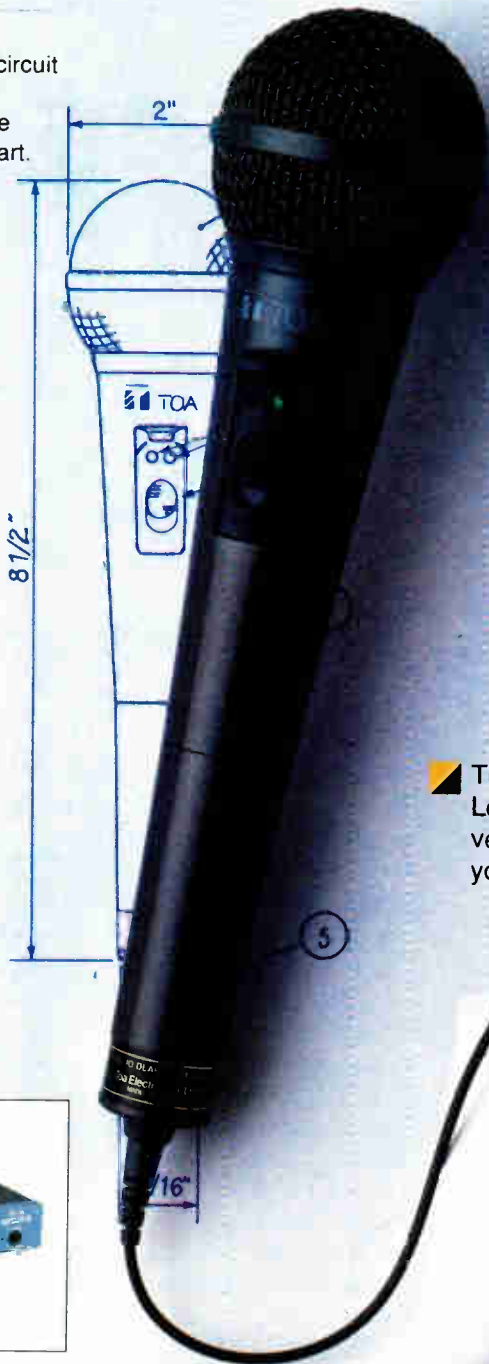
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## Ask Dr. Wokka

by Dr. Wilhelm Wokka

Dear Dr. Wokka,

I'm an electric guitarist, and I've recently built vented boxes for my Blintz Hydronoravic Expotaxial Neodumbic Flaturadiator bass drivers. They sound "boxy," even though I've used the best design techniques known to man (such as the "golden rectangle" rule) and the optimum sizes and venting required.

Mom and Dad didn't mind lending me the money to build them (Dad's loaded!), and I know that with the success my group is sure to have, I'll be able to pay them back soon. We'll have a showcase next year at the Troubador that I'm certain will mean instant chart position (assuming I can get rid of that boxy sound, which I know rad heavy-metal fans will just hate). The rest of my electric guitar setup is great, using your sweet 1600 loudspeaker, which I built and am using from 25 HZ on up.

What can I do to eliminate this annoying sound quality? Your quick reply is requested in this matter.

"Kill"

(aka: Reginald S. VonFauntleroy)  
The Satans of Sex  
Hollywood, CA

Dear Mr. Kill,

I'll just never understand you jazz musicians and your new styles, but good audio transcends the art, doesn't it? What you're describing is a common problem, solvable only by *Great Men of Science* like myself. There are two deadly forces at work here. which plagues all of

audiodom; symmetry and resonance. How I hate these demons. I have pledged myself to fight to the end...ah, well...anyway...resonances and symmetry will ruin your life if you let them. Let me explain. Symmetry causes resonance, plain and simple. The following equation shows the various resonant modes possible in any symmetric enclosure. This equation was stolen from my desk years ago and I now find it everywhere in the literature without so much as a footnote. (Is there any wonder I occasionally lapse into fits of bitterness?)

$$fb = 6725/X$$

(where X = box dimension and fb = resonant frequency)

Above this frequency, the box will exhibit an infinite number of annoying harmonics, guaranteed to drive you crazy. However, for reasons unknown, electric guitarists seem to revel in the resultant dissonances and actually seek them out in their equipment. The equations for the upper frequencies are secret, but would be useless to anyone reading this magazine anyway. *Only Great Men of Science*. . .never mind.

In a speaker box, opposite sides provide the ideal mechanism for air to resonate. Making the box non-cubic provides only more different opposing sides for air to resonate across and more resonances to blur the sound. (Everyone knows that cubes sound better than any other box shape). So then what everyone does is line the sides (glass fibers) only to find out that they can't violate the laws of speakers. The

result: poor taciturn response and unacceptable volatile deviation, easily measurable in our labs. Pencils of sound run amok!

Big problems, right? Wrong. All you have to do is make certain your box has no that are parallel, equal in size, or made out of the same material. Then fill it completely with with turkey feathers from the Palm Dale bulge region of California, to a density of eight pounds per cubic foot.

It may sound simple but it's not that easy. The correct box design takes years to perfect, but is well worth the wait. For example, I once did a design for Rick Prince, bassist of the legendary blues band, The Allstars, here in Philadelphia. Rick wanted the same setup as yours for his classic Fender jazz bass, but I'm sure he plays much louder than any of you "heavy metal" jazz musicians (the blues are very heavy).

My total consultation took almost two years, but the design was worth it. It is now in constant use, to the delight of Allstars fans across the nation, not to mention in Europe (where they are now in semiretirement, Cote D'Azure, France).

What you should learn from all this is the following:

- 1) Resonance is evil.
- 2) Symmetry is evil.
- 3) The elimination of these evils will lead to good sound.

So the next time you see what looks like bad workmanship and poor design, remember; you may just be looking at a *Great Work*. ■

*Dr. Wokka is an instructor and mentor at the Philadelphia College of Musical Knowledge.*

## THEORY & APPLICATIONS

(continued from page 24)

switchable from the front panel, 100K for bridging, or 600 ohms for line termination.

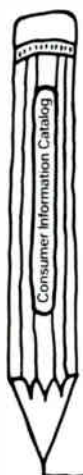
**2-channel bi-directional conversion:** a full set of stereo inputs and outputs for simultaneous lo-to-high and high-to-lo interfacing.

**Adjustable balanced output level:** nominally + 4 dBm; gain can be adjusted + /- 6 dB from the front panel. Peak output level is + 25 dBm.

With these features and virtually "straight wire" noise and distortion performance, the Model 124 represents a "no-compromise" approach to solving the interfacing problem. ■

### Editor's Note:

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# A BETTER UNDERSTANDING OF REVERBERATION TIME

BY JEFF DALE

**W**hen most of us are involved with situations involving reverberation in rooms of various sizes, the Sabine formula for RT60 comes to mind. But this simple relationship is the tip of a theoretical and mathematical iceberg that is still not entirely understood. Actually, the Sabine formula is the first of many such formulas introduced to predict the reverberation time (RT) of a room. This article is an attempt to reach a better understanding of what reverberation is, and of the various formulas for “predicting” its decay time. It will also introduce the concept of modes or standing waves in enclosures, and their relationship with RT.

For the sake of clarity, we need to first define three easily confused terms — reverberation, resonance, and echo — as they relate to room acoustics. The first two terms are also

*Dale is an acoustical consultant in Philadelphia, PA.*

used almost interchangeably in literature, although related, they represent two different concepts.

Reverberation is the persistence of sound in a room after the source has stopped, and is due to delayed sound reflections reaching the listener. Reverberation to us will be a diffuse field, an even spread of frequencies throughout all parts of the room without significant local concentrations.

Resonance is related to natural energy of vibrations. All objects have a frequency where excitation will cause the greatest response; and after excitation stops, the vibrations will continue to decay for some time. In room acoustics we have the phenomenon of standing waves at certain frequencies due to the room size and air coupling. A resonant cavity is formed to enhance certain frequencies occurring in the initial tone by constructive interference, similar to that of an organ pipe. The simplest example

of this is blowing into some empty soda bottles, each one has different dimensions, and thus a different resonant frequency is characteristic of each one. Of course rooms have many resonant modes of vibration, but this will be explained later.

An echo is a single strong reflection of sound, usually from a hard wall, floor or table. A sound arriving more than 50 ms later than the source (and is not significantly diminished) will be defined as an echo. References indicate that reflections arriving less than 50 ms after the original are perceived as reinforcing it. Echoes are part of the reverberant field, but are undesirable since they tend to cause acoustic chaos.

Any discussion of reverberation must begin with an enclosure. Natural reverberation cannot be obtained in an open air setting. The ceiling and walls of an enclosure provide the delayed reflections that contain the sound energy that

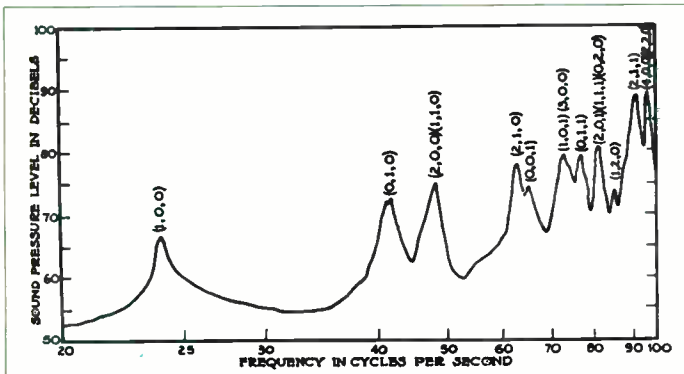


Figure 1. Sound pressure level at one corner of a room shown as a function of the frequency of the sound generated by a loudspeaker in another corner. The normal modes of vibration corresponding to these frequencies are specified by the numbers within the paranthese above the peaks.

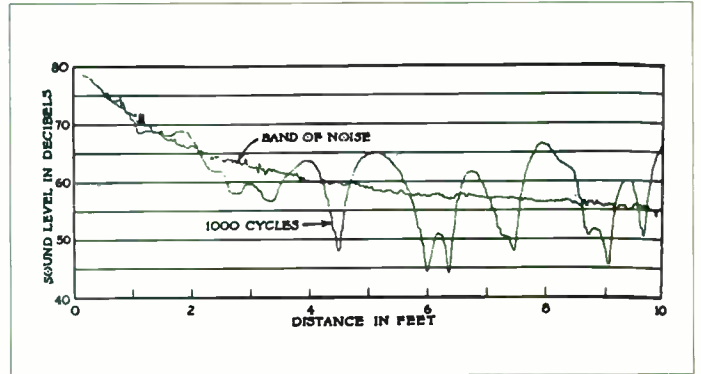


Figure 2. Sound pressure level versus distance from a loudspeaker in a room, along the axis of the speaker. One curve shows the pressure distribution for a 1000-cycle tone. The other curve shows the pressure distribution for a sound containing many frequencies.



develops a reverberant field. The surfaces also absorb some of the sound energy (transforming it into wall vibrations or heat), and some is transmitted through the wall. This is not the place for a detailed explanation of sound absorption and transmission coefficients; for the purposes of this article, we only need to keep in mind that smooth reflecting surfaces will produce echoes, and that absorptive ones will produce a dead room or anechoic chamber, with very little or no reverberation.

Reverberation theory was developed by W. C. Sabine, who gave us the first equation for predicting reverberation time. The basis for his equation starts with a simplified energy equation for a room:

$$E = E_0 e^{-t/k}$$

which states that the sound energy at any time in a room is an exponential decay of the original energy, dependent on time in seconds and a room time constant (for now just k). Sabine plugged

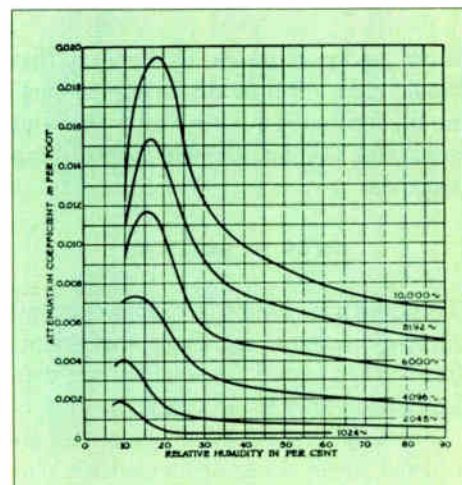
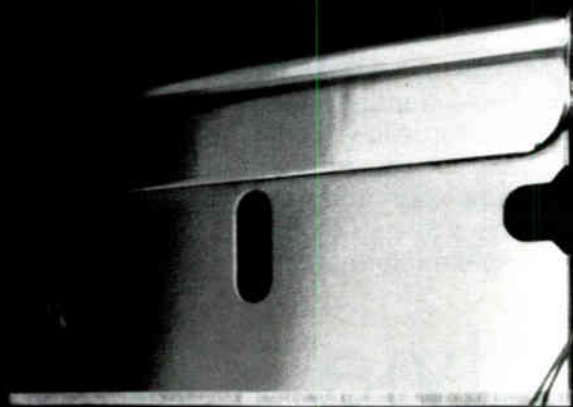


Figure 3. Values of the attenuation coefficient  $m$  as a function of relative humidity in different frequencies.

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in values for initial and final energy that would allow for a 60 dB change in loudness, expanded the value  $k$ , and separated out time to yield the following equation:

$$RT60 = .049 (V/A)$$

This equation came from Sabine's many measurements on the Fogg Auditorium, and he then tested the equation on other spaces to verify its accuracy.

From the first equation we see that an original sound never mathematically disappears, it just decays below the limits of human audibility. From the second equation we see that increasing surface

area or absorption will lower the reverberation time. Increasing the room volume will provide more airspace for the reverberant field. The Sabine equation is valid for the already mentioned diffuse field.

Sabine also found that for most situations the RT did not change as the listener or source moved about the room. The following equation is a modification (by Knudsen) of the second equation to include the decay of sound by absorption of energy by the air mass through which it propagates:

$$RT60 = .049V/A + 4mV$$

This is more pronounced at higher frequencies and certain humidities. We will not go into this in detail, plots of the constant  $m$  can be observed in Figure 3.

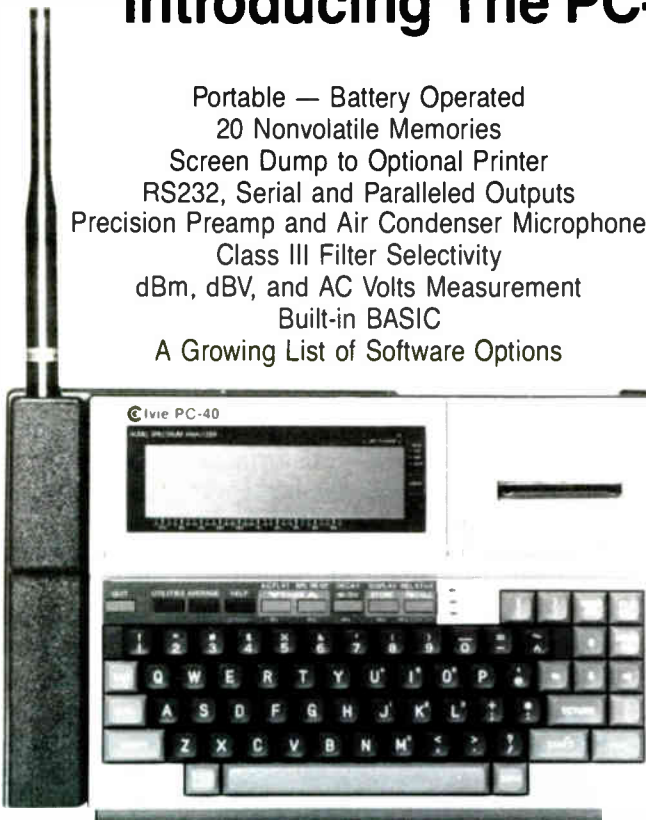
C. F. Eyring introduced the next widely-recognized equation to average the absorption on the walls:

$$RT60 = .049V/-S \log(1-\alpha)$$

This is to be more accurate with high overall absorption in the room. Actually, it reduces to the Sabine equation for low absorptions. Care must be taken with the absorption terms in the denominator since some are normalized (cannot exceed 1) while some can reach infinity.

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The literature provides enough data, opinions, and arguments to fill many pages, but again a detailed discussion on absorption is not within the scope of this article.

In 1959, D. Fitzroy presented a new reverberation formula, but with a special twist:

$$RT60 = .049VxVx^2 + y^2 + z^2/S^2 A_xA_y A_z$$

This formula took into account unequal distribution of the sound absorption material, by relating the absorptivity of a pair of walls to the total absorptivity of the room. Earlier equations average the absorption over the whole surface area;

thus hard walls or highly absorptive areas are averaged into the whole, de-emphasizing their pronounced effects. In most concert halls, the audience is the greatest absorber, usually concentrated on the floor. Classrooms, hallways, and gymnasiums tend to have absorption centered on an acoustical tile ceiling.

This concentration of absorbing material on one or two surfaces led to gross errors in earlier mentioned formulas. Fitzroy cited rooms of unequal absorptions and showed that his predicted values were close to those actually measured. His equation does not make the earlier work of Sabine, Knudsen, Eyring and many others ob-

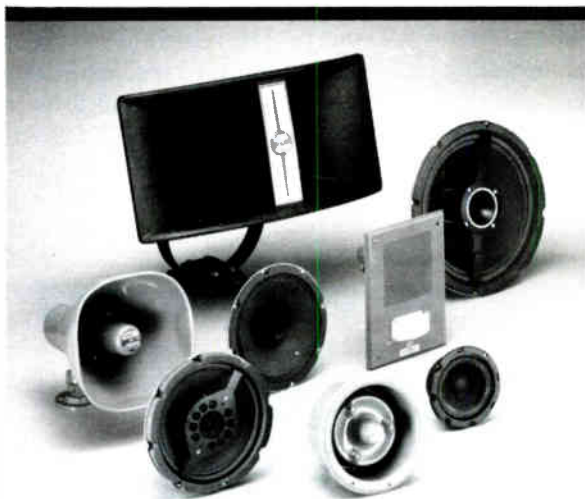
solete, it is just another step in reaching a full understanding of the science of room design.

Besides reverberation time, another term has been developed to judge a hall's acoustics: *liveness* is the ratio of early sound to the reverberant field. Early sound is defined as those reflections heard less than 50 ms after the direct arrival, while the reverberant sound contains all subsequent arrivals. This has been done to separate the early arrivals that have undergone few surface reflections and help to localize and reinforce its source from those that have struck many surfaces and blend together into a field.

*(continued on page 67)*



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April 1989 31



# THE BOSE MODELER DESIGN PROGRAM, PART II

BY MIKE KLASCO

Last month we talked about the structure of the Modeler, and the steps needed to create a room model. This month we will talk about the Preferences Window and how its many parameters can be set to change both the resolution and computation times and the resultant types of information that can be calculated, displayed, and printed.

## SIMULATIONS

With all the sophisticated graphics, the rotating three-dimensional wire frame models and so on, you don't want to forget what you really are using this program for—to predict and refine sound system designs. So below is the most important part of the program, the "what if" simulations. This part of the program operation is basically concerned with functions that allow the user to make parameter changes. Although the advanced graphics do help in the transfer of complex information to the user (or client) and aid in the intuitive formulation of the design.

*Klasco is president of Menlo Scientific, Berkeley, CA.*

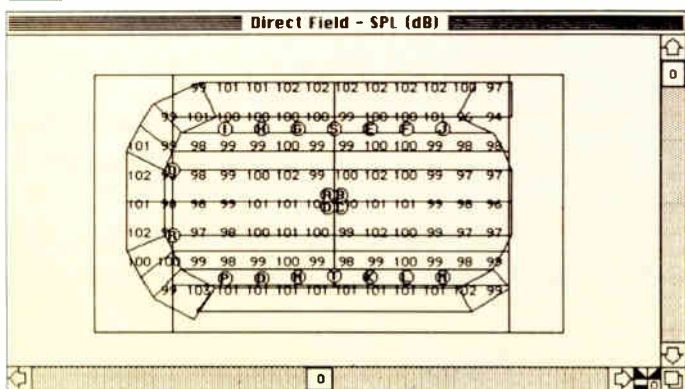


*Bose Modeler Design Program.*

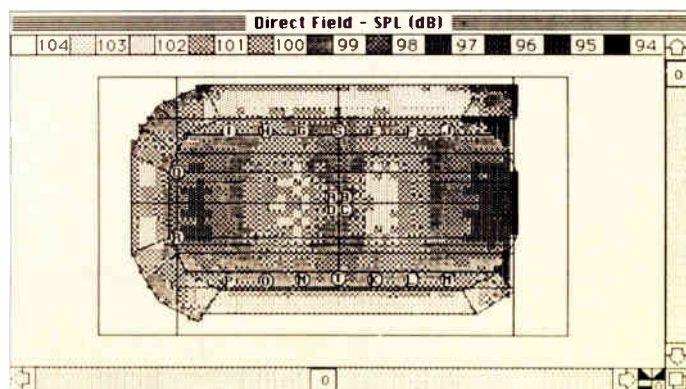
A key aspect of the program is the Preference Menu, which lets the user manipulate a number of the operating parameters related to the time domain: the number of reflections calculated, the acceptance time relative to the first arrival for direct and reflected sound,

obstruct on/obstruct off settings for factoring shadowing effects, and so on. Direct, Reflected, and Direct Plus Reflected settings are provided to determine which of these conditions will be used for the simulations. Other settings are for Grey Field/Numeric Field (grey field is a field of grey shading), Power Sum or Coherent Sum determines how the energy from various speakers will be added, depending on if the sound source is a distributed system or split cluster versus a time coincident array. Floor/Seated/Standing settings can be selected for the simulations.

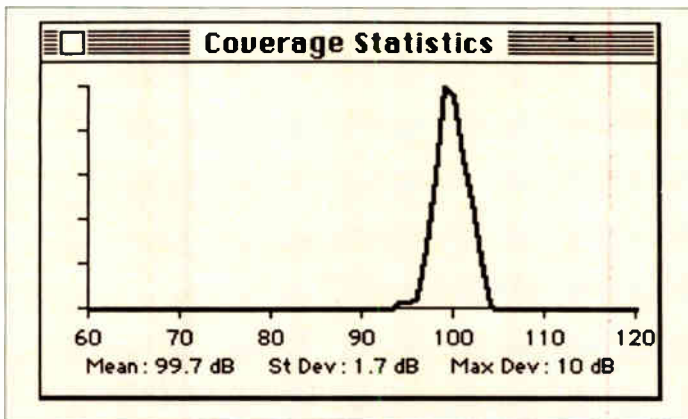
AutoGain is a unique feature that if selected automatically balances all of the speakers for uniform sound level. This feature is handy for the initial level setting. In Max SPL the sound system is brought up to the maximum sound level as limited by the first speaker to reach full power. The relative levels assigned to each speaker are maintained. Amplifier power is assumed to be adequate to reach each speaker's full output. The loudspeaker data-base contains the maximum power specification for each



*Direct field computations shown as a numeric map.*



*Direct field computations shown as a map of gray shading.*



*Coverage Statistics: SPL histogram of direct field computations.*

### SPL PREDICTIONS AND MAPPING

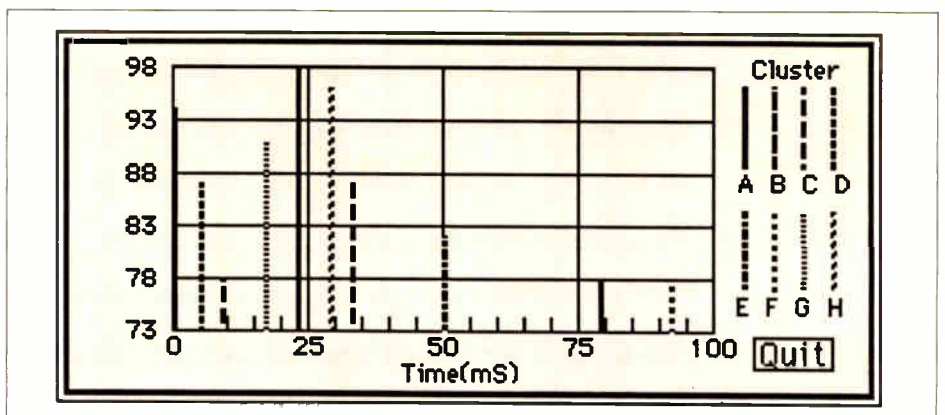
Once the room model is complete, spot-checking is used to get a feel for the levels at strategic points. After the preliminary aiming of the speakers, the mouse is clicked at strategic points and the sound level numerically appears. After any aiming corrections to balance the coverage, a full numeric view of your coverage pattern is plotted. A sound intensity grey scale is also included and can provide an intuitively satisfying representation of room coverage. A one pass/two pass option allows the user to find the hot spot using the spot-check function (which is much quicker than having the program find the hot spot). The plotting time of the grey scale images can take a few minutes if you have a Mac Plus, or just a few moments on an accelerated Mac. Plotting time versus resolution can be traded-off by user-controlled parameters. The direct sound coverage can be superimposed on the room model in any plane. With a little

entry, and if the user wishes he may adjust that number to compensate for power compression and/or limited power amplifier output capabilities for example.

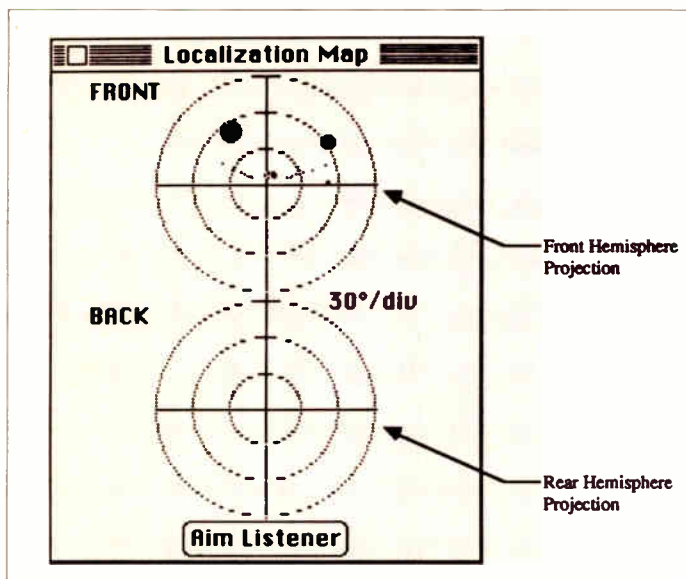
The pull-down menus also offer several other useful preference settings. First one may choose between English and metric settings. An especially useful feature is the toggle between watts and dBw units. With this mode one can simply work in dB differences between sections and the program will make the necessary power-limited changes. A commonly overlooked setting is the dB setting that sets the increment between grey scale steps. Another is the pixel setting which determines the size of sample taken for SPL Map calculations. In complex shapes this setting can be critical if 1 dB resolution is sought after for example. Diagonal lines which intersect sample blocks may give what appears to be erroneous answers. This may require a simple change of these settings or a minute shift of the room model. The pixel setting may also be set for a coarse resolution, 20 pixels for example, to allow for sped-up calculation; then lowered to 6 pixels for finer resolution after several

simulations have been run.

After the preliminary settings are made in the Preference Window, the simulations can be run. Various "what ifs" can be tried (such as different locations of clusters or speakers of different directivity) to optimize the performance. The simulations provide numeric and/or graphic results, but the program does not attempt to "rate" the data. After the user is satisfied with the sound system layout the simulations may be printed.



*Time arrival computations of direct sound. The legend on the right hand side of the display correlates the spikes to their respective sources.*



*Localization Map: computations of direct sound (dot size represents the normalized sound pressure level from a particular source.*

entered in a dedicated column on the speaker spreadsheet. The SPL readout can be set as direct only or as direct plus a specified number of reflections which can be power-sum or coherent-sum. This display can be used to model intelligibility from a level and directional precedence point of view. The SPL readout can be compared to the LPrev for a signal-to-noise ratio.

The delays predicted by the computer model should not be used as “cast in concrete” time delay settings. However, you will have a pretty good starting point for setting the time delays. Delays should be set by instrumentation during the “proof of performance” phase of the installation.

experience, you can use this to check for excessive spill-over.

The coverage statistics function display shows the uniformity of coverage in a room with a single curve. The higher the Q of the curve the more even the coverage. As the speakers are re-aimed in the design process, the curve should become sharper. Maps show an intuitive approach. This display actually maps a real specification. Standard deviation and maximum deviation are the two

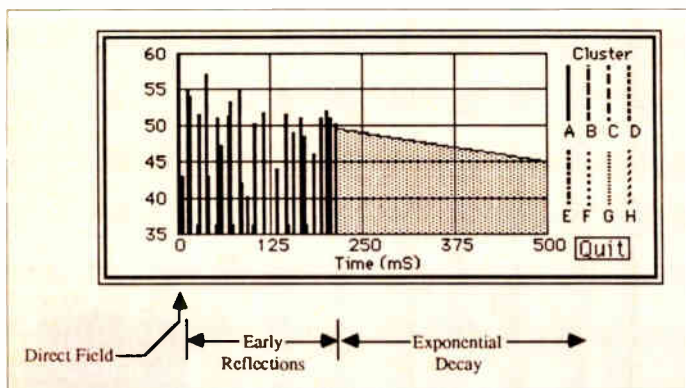
parameters calculated and displayed by this window.

**TIME ARRIVALS**

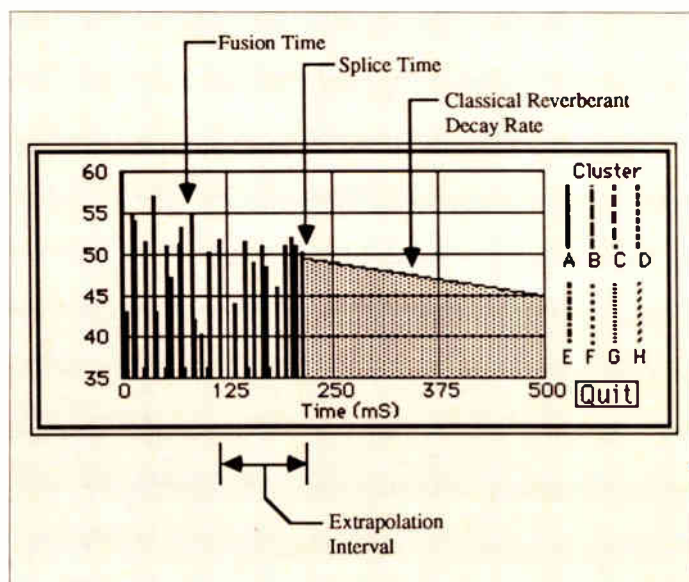
The time arrivals of any sound (as per the preferences window) can be displayed at any point in the room. Each cluster is keyed on a legend. After you have noted the time differential, the delay time compensation required can be

**EARLY REFLECTION ANALYSIS**

This energy versus time graph shows the discrete arrival times of the early reflections and their intensity levels. Used in conjunction with Trace Reflection plots, the path of the reflected sound can be traced and problems with beams and other obstructions can be determined. The program takes into account



*The Hybrid Energy Decay Curve and its components (above). An example of early reflections, extrapolated late exponential decay, and various times used for extrapolation (right).*





the surface materials in the ray trace bounce path. This feature (which incorporates a priority function) is unique in the personal computer domain and rare in the main-frame world. In fact, Modeler is unique in its ability to map multiple sound sources three-dimensionally with obstructions, time limits, order-of-reflection limits, modeling of absorption, and in its ability to view the ray paths three-dimensionally as they are computed.

A user-definable order of reflections can be calculated, although computer processing time increases significantly and the display becomes very busy (refer back to hardware requirements). With a little experience this module can be a powerful tool for predicting early reflection problems, flutter echoes, slap back, etc. and a simulator for testing solutions. These programs may be usable for the design of architectural acoustics.

### LOCALIZATION MAP

This function displays the direction and level of the sound arriving at any listener location, and is helpful in setting time delays and levels, as well as aiming for split clusters and distributed systems. A system may also be analyzed for spatial and directional realism. This display alone is perhaps half of the intelligibility story: it integrates the level, timing, and direction of the source (if input as a speaker) and the system with all early reflections from the source and the system.

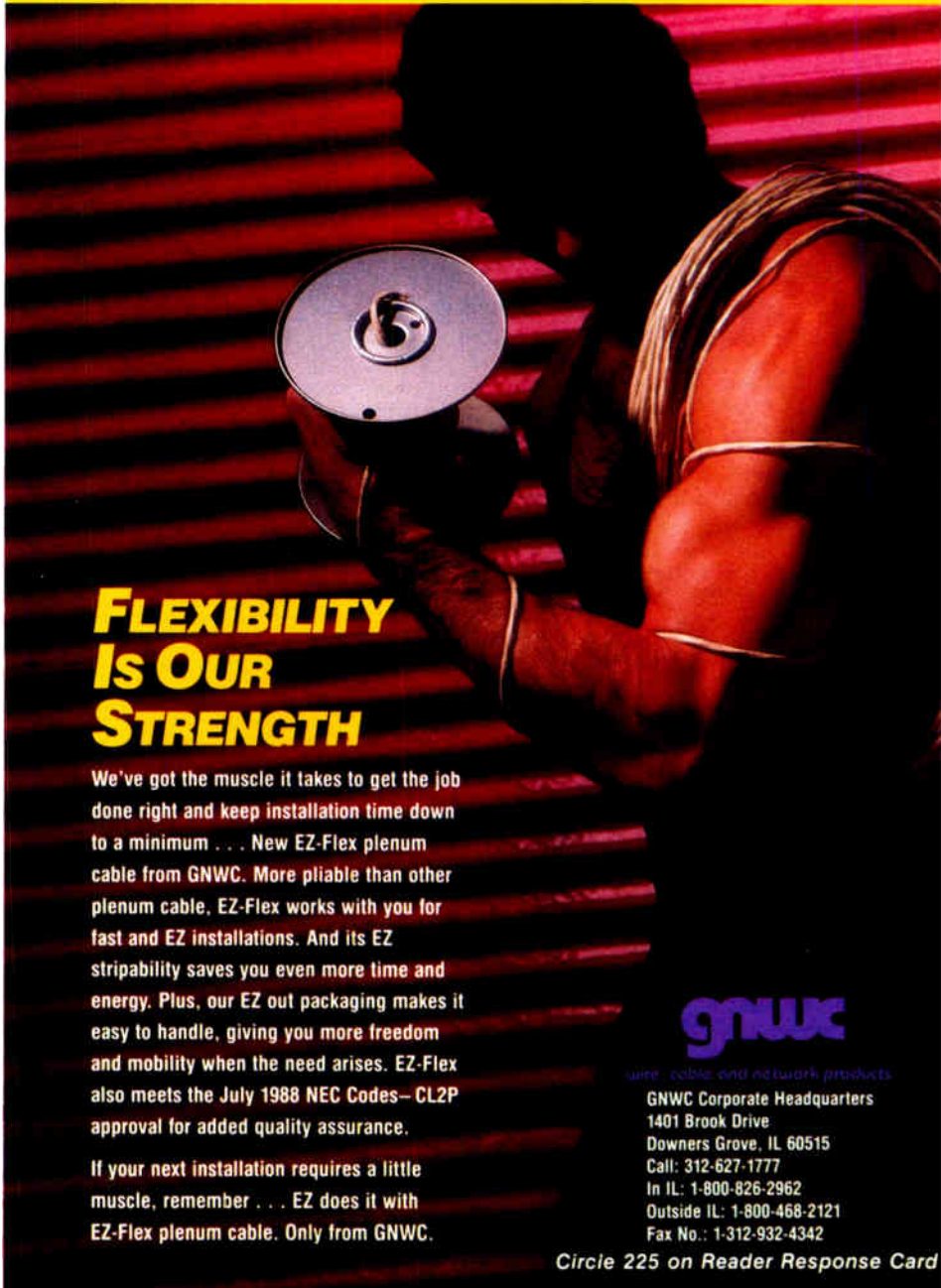
### REVERBERATION TIME

The Sabine reverberation time equation is used by Modeler. The reverberation module is integrated with the rest of the program, so after the surface materials are assigned, and room volume has been entered, the RT60 for each octave band is automatically calculated and displayed. Modeler does not support the Fitzroy or Eyring equations, preferred for spaces with uneven distribution of absorption and those con-

sidered to be acoustically "dead." Some software programs (Headware's Acoustics II, for example) calculates Sabine, Fitzroy, and Eyring, and recommends (by octave band) the most appropriate.

Nonetheless, the Sabine method assumes an even distribution of absorptive material, and moderate RTs at a minimum. Therefore, if a room clearly has concentrations of opposing absorptive

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and reflective surfaces, one may expect higher RTs than those calculated by Sabine.

Two factors quite often overlooked by designers are high-frequency absorption in air and additional absorption of people. Modeler automatically adds high-frequency absorption based on 50 percent relative humidity at 70 degrees Fahrenheit. Using the priority function, absorption of people can be factored-in using either the supplied seating entries or adding the absorption of standing people.

Of note here are the materials data library functions. Modeler comes with a spreadsheet-style data-base of 30 materials. This data may be changed and modified by the user at will. New libraries may be set up, and libraries may be customized on a per-design basis. Once a library is selected, a material is simply selected in the room editing mode (as discussed last month). However, in this phase the designer may wish to input more audience or other additional absorption the design may require.

Modeler does provide two other options: LPrev and LPmod. The classical LPrev is a simple calculation that is a function of the acoustical power of all sources and the room constant. This calculation is a simple model that does not consider the directional characteristics of the source(s) and what level of first-reflection attenuation is achieved by the seating and/or audience. The Modeler's LPmod is a combination of ray-tracing and statistics. This function implements a modified acoustical power figure by cal-

culating the total power of each source using a technique of tracing 648 rays from each source and measuring the attenuation by the absorption coefficient factor. The power is the sum of all rays after one reflection. While calculating, the program will abort this function if no plane is encountered by one of the 648 rays. This simply ensures that the calculation is not based on any non-attenuated rays, for example. Thus, the room must be fully enclosed.

This method is especially useful when modeling sound systems, as one general technique of sound system design is to aim a source of some specified directional characteristic at an audience-which absorbs most of the energy. The LPmod can be added to an NC number (if measurable or otherwise specified) for the total "noise" SPL. Using this model, intelligibility can be gauged on a

ascertained outside of Modeler.

**PRINTOUT QUALITY**

Resolution is printer-dependent: Modeler is limited only by the quality of your printer. Two levels of graphic quality can be selected, trading off speed for quality. Numerous other options are provided to enable control of the printouts to enhance and coordinate the presentation. Aside from printing out the graphs and data, Modeler can perform a presentation of the results. This is more or less like a built-in slide show.

**CONCLUSION**

Modeler emerged in 1986 with advanced graphics, a slick user-interface that utilized windows, pull-down menus, a mouse, and several acoustical software innovations. Closer inspection revealed that while a lot of hard work had gone into building this house, some furniture was missing. Today, Modeler is a fuller, more balanced member of a family of programs. Earlier features have been expanded upon or streamlined. Software innovations, such as small-computer implementation of complex ray-tracing (speeding up a process that previously could take up to several days), localization maps,

Physical Data								
Absorption		Material	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
Riming Data		Velour - 10 oz - 50% Fullness						
		<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>						
1	Brick Unglazed		0.03	0.03	0.03	0.04	0.05	0.07
2	Carpet on Conc.		0.02	0.06	0.14	0.37	0.60	0.65
3	Concrete Block - Unpainted		0.36	0.44	0.31	0.29	0.39	0.25
4	Velour - 10 oz - 0% Fullness		0.03	0.04	0.11	0.17	0.24	0.35
5	Velour - 10 oz - 50% Fullness		0.07	0.31	0.49	0.75	0.70	0.60
6	Velour - 18 oz - 50% Fullness		0.14	0.35	0.55	0.72	0.70	0.65
7	Concrete		0.01	0.01	0.02	0.02	0.02	0.02
8	Gypsum over 2 x 4 - 16" o.c.		0.29	0.10	0.05	0.04	0.07	0.09
9	Glass		0.35	0.25	0.18	0.12	0.07	0.04
10	Water		0.01	0.01	0.01	0.01	0.02	0.02
11	Linoleum		0.02	0.03	0.03	0.03	0.03	0.20
12	Wood Parquet		0.04	0.04	0.07	0.06	0.06	0.07
13	Plaster		0.01	0.01	0.02	0.03	0.04	0.05
14	Plywood Paneling		0.28	0.22	0.17	0.09	0.10	0.11

*A variety of surface materials (and their associated octave band absorption coefficients).*

signal-to-noise ratio basis by comparing the direct-field SPLs of various locations to the LPmod. Distances from the loudspeaker location to these areas are easily compared to the critical-distance. However, even though the critical-distance calculation is trivial it must be

and device/environment dependent reverberant-field SPLs, contribute greatly to the utility of Modeler. An engineering design manual (in addition to the present Modeler instruction manual) is being prepared to act as a reference for  
*(continued on page 68)*



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# THE FOURTH ANNUAL SURVEY OF THE CONTRACTING BUSINESS

BY BILL INTEMANN

**S**ound contracting remains primarily an industry of small businesses, but it is an industry with an ever-increasing diversification not often found in the small business sector. Commercial sound reinforcement systems are still the most important part of a contractor's business, but there are very few contractors who are not involved in at least one other market segment.

These are among the conclusions drawn from our fourth annual survey of the contracting business. The surveys were sent to a random sampling of our sound contracting readership. Their responses, summarized in this report, give us a more clearly focused perspective on the sound and communications contracting community.

## BUSINESS

In this section, we asked contractors to tell us about their businesses: geographic location, number of offices and employees, gross income, and more.

Once again, we've heard from a geographically representative sample of the industry, with little change here from previous years. One notable exception: the number of contractors responding from the economically troubled South Central area has decreased, possibly a reflection of the hard times that have befallen the oil industry in that region.

This is still overwhelmingly an industry of small businesses. The majority of

contractors, 66 percent, report having one office. Of the remainder, 25 percent have one branch office, 6 percent have two branches, and only 3 percent reported having three or more offices.

Another indication of business size is the number of full and/or part-time employees on the payroll. Almost 63

comes to business size is the amount of income that business generates. More than two-thirds of our respondents stated their company's gross income to be under \$1 million: nearly 70 percent of all respondents fall into this category. 56 percent report income under \$500,000. 23 percent of all respondents reported gross sales of between \$1 million and \$5 million, with only 8 percent reporting sales of more than \$5 million.

We were curious about the impact personal computers have had on the way sound contractors conduct business. Nearly 86 percent report using one or more PC's (not including business accounting systems). Of all contractors using PC's, the majority, 68 percent, use IBM (or IBM-compatible) machines.

## MARKETS

We asked contractors to tell us about their markets: how many different markets they serve, which of those markets are most important, which are most neglected, and which markets they've targeted for future growth.

The overall market was divided into five sections: sound reinforcement, local wired intercom, background music, interconnect, and other (including video, security, sound masking, and teleconferencing). There were 26 subsections in all.

Once again we were impressed with the diversity of this industry; only a relative handful of respondents reported involvement in a single market area. The vast majority of contractors report

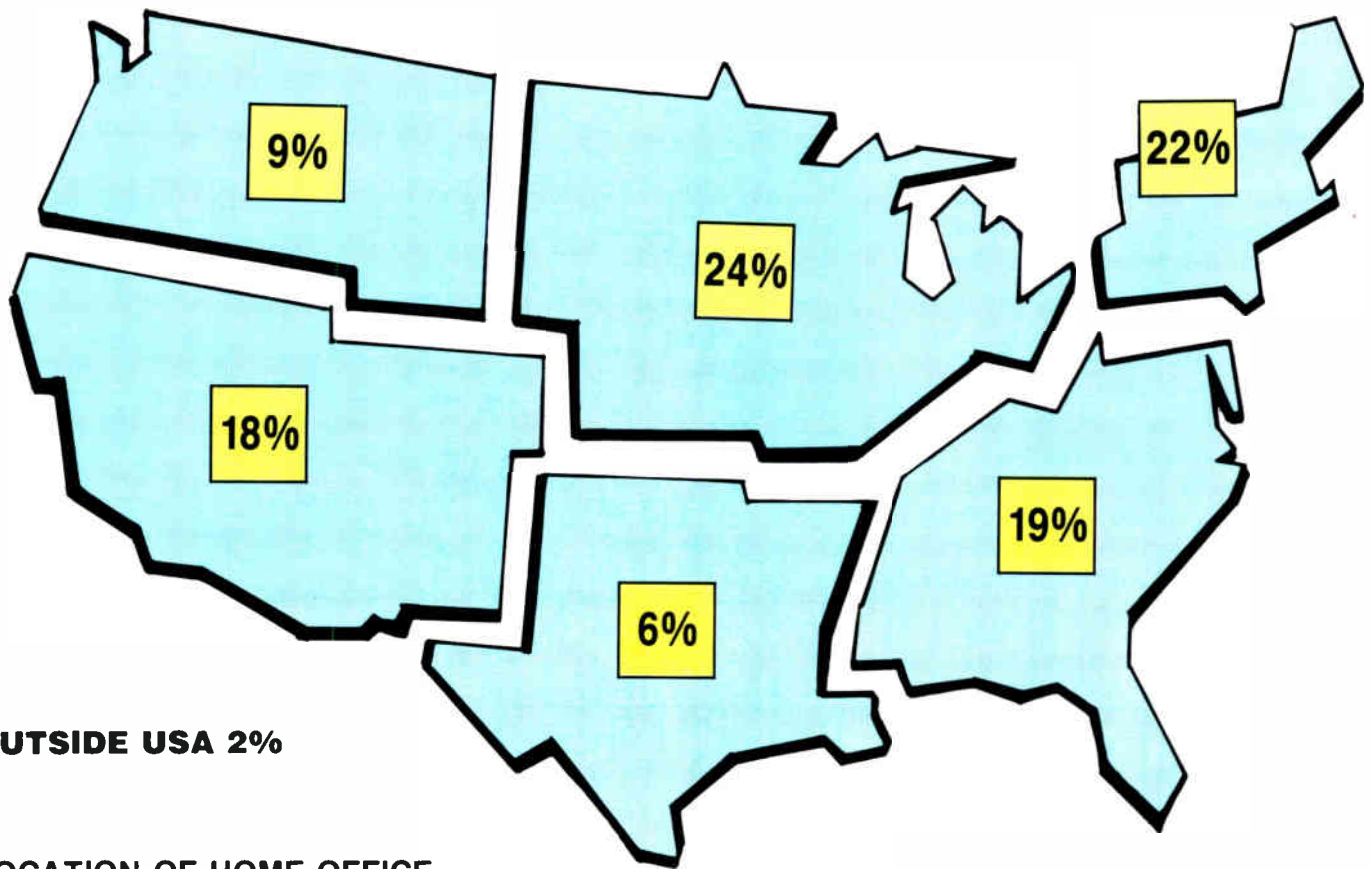
### Top Markets Served

- 1 Sound Reinforcement (All Types)
- 2 Video Systems
- 3 Factory Paging
- 4 Business Music Systems
- 5 Business Intercom
- 6 Nurse Call
- 7 Other Wired Intercom
- 8 Alarm and Security
- 9 Sound Masking
- 10 Keyphone

percent of our respondents reported they have fewer than ten employees, with 21 percent reporting between 10 and 25 employees. A total of 84 percent of all respondents have 25 or fewer employees; of the remaining 16 percent with 25 or more employees, 12 percent said they have between 25 and 100, 1 percent reported having between 100 and 200, and 3 percent reported having 200 or more workers on staff.

However, the bottom line when it

*Intemann is managing editor of this magazine.*



**OUTSIDE USA 2%**

### LOCATION OF HOME OFFICE

marketing efforts in at least two or three different categories, with some companies apparently prepared to “do it all.”

Sound reinforcement remains by far the single most important market for sound contractors. This section (which includes installed and portable commercial and entertainment sound, sound system rental, pro sound, and MI), received more than twice the response of any other section. Because of this response, we have listed this entire section as the number one market served; the remainder of the list details by subsection

the next most important markets for contractors.

Sound masking was named the number one market segment most neglected by contractors, followed closely by factory paging, alarm and security, video systems, and teleconferencing.

Many of these “most neglected” segments may see more attention being paid to them in the future. Our number one most neglected market was also named the number one market in which contractors would most like to expand. Sound system rental was next, followed by

teleconferencing, video systems, and alarm and security.

### INSTALLED SYSTEMS

In this section, contractors were asked to report on the average dollar size of the systems they install, along with the largest dollar size and typical time from order to completion.

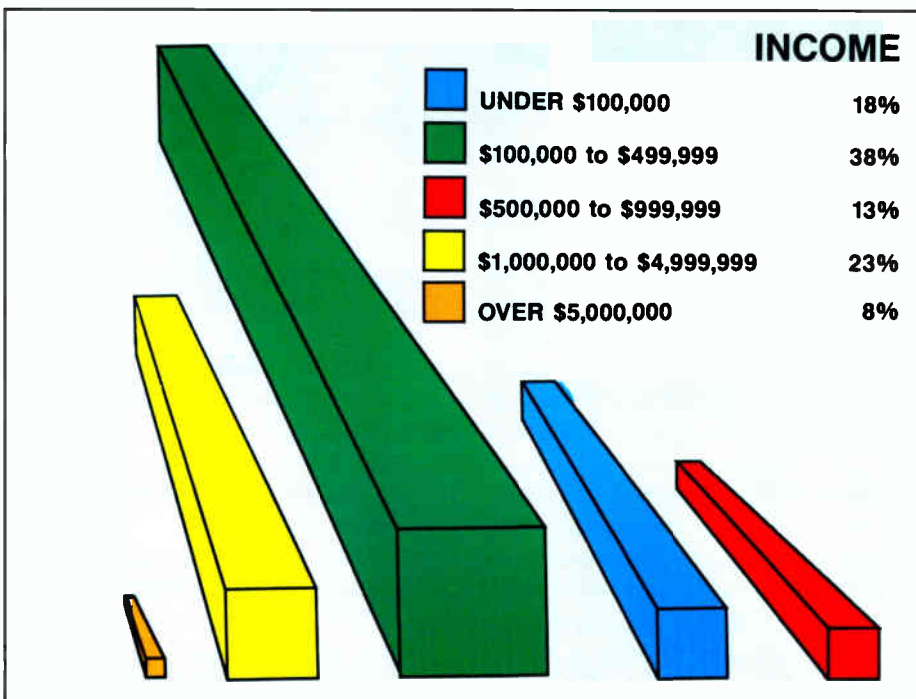
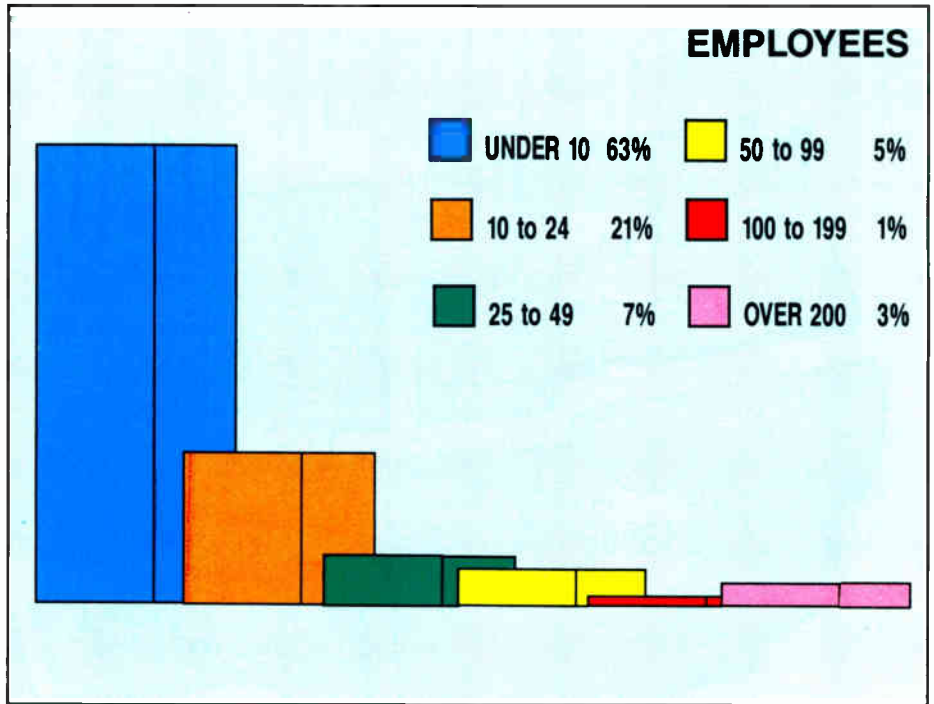
They reported that the average dollar size for systems installed in the past year was \$13,078. But most contractors reported doing at least one job in the course of the year that was much larger

than that: the average for the largest dollar size of systems installed in the past year was \$116,112. A few fortunate contractors reported doing single installations valued at well over \$1 million, but this is certainly the exception rather than the rule as less than a third of our respondents reported gross yearly sales in excess of \$1 million.

Average time from order to completion? Around 2.5 months, or 79 days (just about the same as last year's reported average, 80 days).

**EQUIPMENT BRANDS**

Manufacturers looking for new dealers seem to be finding them: the average number of lines contractors are authorized to sell is 29. This number has been increasing steadily since we took our first survey in 1986, when contractors reported being authorized to sell 24 lines.



We asked contractors to list the brands that accounted for the largest proportion of their sales. For the fourth consecutive year, TOA Electronics was named top brand, followed by Electro-Voice in second and Atlas/Soundolier in third (JBL Professional was a very close fourth).

Not surprisingly, contractors are on very good terms with these best selling manufacturers. When asked to name the manufacturers with whom they have the best overall relations, contractors once again placed TOA Electronics in first place, followed very closely by Electro-Voice in second, with JBL Professional edging past Atlas/Soundolier for third place.

**ORGANIZATIONS AND CONVENTIONS**

The National Sound and Communications Association (NSCA) is clearly the



premier organization for the sound contractor, with more than twice as many contractors belonging to the NSCA (and attending its annual convention) than the second place Audio Engineering Society.

Interestingly, this year marks the entrance of the National Association of Music Merchants (NAMM), both organization and convention, to the top five in each of these categories. This is a reflection of our inclusion this year of a random sampling of MI dealers who consider at least part of what they do to be

*A Northeast Contractor:* "With the many changes and improvements in equipment manufacture and use, it would be an asset to have regular seminars sponsored by manufacturers, giving an in-depth presentation on the proper use and application of their equipment."

*A Southeast Contractor:* "The coming year will see a recession that will squeeze out those [contractors] who do not give a superior level of service."

*A Southwest Contractor:* "The continuing projection of the equipment as the

### BEST SELLERS

- 1 TOA Electronics
- 2 Electro-Voice
- 3 Atlas/Soundolier
- 4 JBL Professional
- 5 Shure Brothers

*A Southwest Contractor:* "Contractors should be more concerned with room acoustics; if the room itself sounds good the system will sound that much better."

*A South Central Contractor:* "Contractors must find where their strongest markets are, and the markets they feel most comfortable with. Too many contractors are attempting work that they don't understand and are not capable of doing."

*A Northeast Contractor:* "I will not buy from distributors who are also contractors. If I do, I am contributing to a competitor — if I can't get an item

### MARKETS TARGETED FOR EXPANSION

- |                       |                      |
|-----------------------|----------------------|
| 1 Sound Masking       | 4 Video Systems      |
| 2 Sound System Rental | 5 Alarm and Security |
| 3 Teleconferencing    | 6 Factory Paging     |

sound contracting; but it's important to note that nearly twice the number of respondents reported attending NAMM's conventions as reported belonging to the organization, so NAMM's conventions are clearly of interest to at least a portion of the sound contracting community as well.

### CONTRACTORS' COMMENTS

We'd like to close our annual report on the sound contracting business with some comments from the contractors themselves.

answer to all problems must lessen; educating the operator is of paramount importance."

*A North Central Contractor:* "The audio, telephone, and security industries are overrun with technicians who take little or no pride in their work. They storm in and out, leaving the evidence of their poor workmanship behind: a system destined to fail."

*A Southeast Contractor:* "Churches need adequate, articulate systems, but seldom know where to turn for the design, specification and installation of such systems at a nominal cost."

### BEST RELATIONS

- 1 TOA Electronics
- 2 Electro-Voice
- 3 JBL Professional
- 4 Atlas/Soundolier
- 5 Rauland-Borg

factory-direct (or from a non-installing, non-competitive distributor), I use something else."

*A Southeast Contractor:* "With the sophistication and price of sound equipment on the rise, the education of many installers is greatly lacking."

*A South Central Contractor:* "The most neglected area is system operator training. Where is there a school for reinforcement technicians to learn both installation and operation?" ■

### MOST NEGLECTED MARKETS

- |                      |                       |
|----------------------|-----------------------|
| 1 Sound Masking      | 4 Video Systems       |
| 2 Factory Paging     | 5 Teleconferencing    |
| 3 Alarm and Security | 6 Sound System Rental |

# SKYWALKER RANCH'S STAR SYSTEM

BY JOHN VALENTINE

**D**eep in Northern California's rural Marin County, George Lucas' Skywalker Ranch is set in a landscape of lush rolling hills, colorful wildflowers, and sparkling lakes. The 2,000-acre ranch is so remote, it has its own fire department. It is also the home of what has been described as the most complete film post production facility in the world: Sprocket Systems.

A division of Lucasfilm Ltd., Sprocket's 240,000 square-foot building houses a dozen rooms, including seven studios, a Foley room, an ADR room, recording studio, and a comprehensive sound effects library.

The architectural layout of Sprocket Systems, marked by old-fashioned country charm, hardwood floors, cathedral wood-beamed ceilings and sun roofs, attest to Lucas' desire to have his guests and employees feel comfortable and relaxed. The design and layout of the technical system, however, is anything but old-fashioned. Tom Scott, Sprocket's director of engineering, and chief engineer Wayne Wagner worked closely with installers David Carroll Electronics to design an audio system featuring over 500 miles of Belden custom-manufactured audio cable.

## The Installers

David Carroll Electronics (DCE), Berkeley, CA, had proven its engineering capability with Francis Coppola's Zoetrope studio and other recording facilities in the San Francisco area, and

*Valentine is director of marketing for Belden Wire & Cable, Richmond, IN.*



*Skywalker Ranch, home to one of the world's most complete post production facilities.*

was selected by Sprocket as the prime contractor. A member of the Northern California Film Community, DCE president and owner David Carroll has over 15 years of design and engineering experience. He describes DCE as a company of system installers and designers, specializing in custom electronic work, circuit design, and cable assembling for broadcast studios as well as film and video post production facilities. DCE played an important role in the technical design of the facility. Brainstorming sessions in the early stages of planning wiring runs, equipment placement, and overall layout helped DCE and Sprocket

engineers avoid many design problems experienced in past studio installations. Among the most important design challenges were insuring future studio flexibility and avoiding early obsolescence.

## The Cable Selection

"Cable is not necessarily the most glamorous part of an installation, but it's absolutely crucial that it be selected, designed and installed correctly or it will continue to be an irritation to the engineers who must use it on a daily basis," said Sprocket's Wagner.

The installation required thin flexible multi-pair cable with unique electrical



performance characteristics and the availability of specific colors and specified pair counts to match equipment needs.

Dissatisfied with the standard cable available from cable manufacturers, DCE and Sprocket consulted with Belden application engineer, Paul Miller, to design a customized cable for the installation. The end result was a family of 22 AWG multi-pair (1, 4, 8, 16, and 26) audio cables, individually shielded (with Beldfoil) and Datalene-insulated (0.010-inch wall thickness). The outer jacket consists of a thinly extruded soft vinyl. The inner conductors are color-coded based on the EIA Resistor Color Code, an electronic industry standard. Sprocket engineers believed this would reduce installation errors by allowing an engineer to determine a pair's number by relating its color to the color code most familiar to the industry, rather than cross referencing to a chart. The outer jackets were also color-coded based on the number of conductor pairs.

Quality control during the manufacturing process was extremely important because of the installation conditions. For instance, the cable size had to be strictly adhered to in order to fit correctly in the cable trays. Standard multi-pair audio cable would not have fit. By changing the size of the outer jacket, DCE saved 20 percent in the overall tray fill factor. Another critical cable criteria was its electrical performance. Because of the long runs (hundreds of feet for some routes) low capacitance was desirable to assure undistorted signal travel. Ease of stripping and termination were also vital because of the thousands of terminations required.

"Typically, when you order a custom

item, you can get it designed just the way you want, but you don't necessarily get the reliability that you would with a production item purchased off-the-shelf, one that has been made successfully for years. We approached Belden because we knew we could optimize our chances of getting the product which would most closely approach our ideal," said Mas Rossmassler, general manager of DCE.

When designing a unique installation as



*Sprocket Systems features three mixing rooms; audio mixing consoles, divided into three sections (dialog, sound effects, music), are equipped with up to 112 tracks.*

complicated as Sprocket Systems, there are no traditional blueprints to follow. Rather than developing a drawing that shows 5,000 lines traveling from point-to-point, DCE developed a wire list which included a description of every cable to be installed. It listed the source and destination, the cable length, and the

termination type. Almost every cable run had differing variables (length, termination) so that each run required its own instructions; resulting in a wire list of approximately 3,500 cable runs.

In order to develop this list, DCE had to physically measure the distance of each cable path from the source to the final destination. Due to the number of turns required in the cable routing, each varying radius had to be calculated correctly or the cable length would be wrong. The measurement of cable in runs requiring 90 degree turns could vary as much as one foot per turn. For instance, cable laid on the outer diameter of a turn might measure 24 inches, while the cables on the inner diameter might measure only 12 inches. Depending on the number, angle, and direction of turns involved, accumulated length differences could add up to several feet. If these variables were not taken into consideration at the outset, the whole run would be off.

### The System Design

Sprocket Systems houses a dozen rooms and hundreds of pieces of audio playback, processing, and recording equipment. Although approximately 500 miles of Belden cable was needed to connect all of the equipment, the organizational system design developed during brainstorming sessions with DCE and Sprocket engineers is very simple, offering operators accessibility and system design flexibility.

To program the signal flow throughout the building, DCE and Sprocket engineers chose a star system consisting of three cross-connect control rooms located strategically next to pre-mix and



final-mix rooms throughout the building: the central machine room, east local, and west local cross-connect rooms.

Each control room features a wall of ADC Ultra Patch panels and a patch bay. Every piece of installed equipment is wired to the back of these Ultra Patch panels. Jumper cables on the front of the panels control the signal routing. The cross connect wall consists of two panel sections: the top half is wired to the patch bay, the bottom half is connected to equipment located throughout the building. A custom wall-mounted rack hinging system, designed by Carroll, allows access to the back of the panels.

Equipment signals are transferred to patch points on the patch bay through jumper wires on the front of the cross connect. These jumper wires also allow equipment assignment to be moved within the patch bay, without having to pull and re-run cable lines. Day-to-day signal changes occur on the patch bay by moving the patch cords from point-to-point. The process is similar to a telephone operator's patch board.

Each of the cross-connect machine rooms (central, west, east) controls the equipment and mixing studios in that

area. The control rooms are linked together with tie-lines or hiways of Belden 26-pair, individually shielded audio cable. The star system allows the mixing of two or more films simultaneously. The tie-lines enable the east and west mix rooms to share the equipment in the central machine room. This is usually necessary when a production job requires more channel space than is available in the local machine room.

The system design, with all of its simplicity and flexibility, raised some initial doubts among Sprocket engineers. "We've rarely used a panel system in the past because it can be un-yielding and difficult to work with," explained Scott. "I'd never have considered it for as big a project as this. If it wasn't for the hinging system David [Carroll] designed, we wouldn't have considered a panel rack system because there would be no access to the back, which is essential."

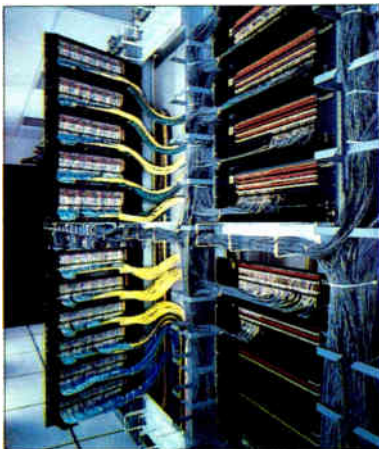
### The Installation

Before installing any cable, DCE completed the mechanical installation. They built the cross-connect wall rack and installed open cable trays below the raised computer floors. The trays, which

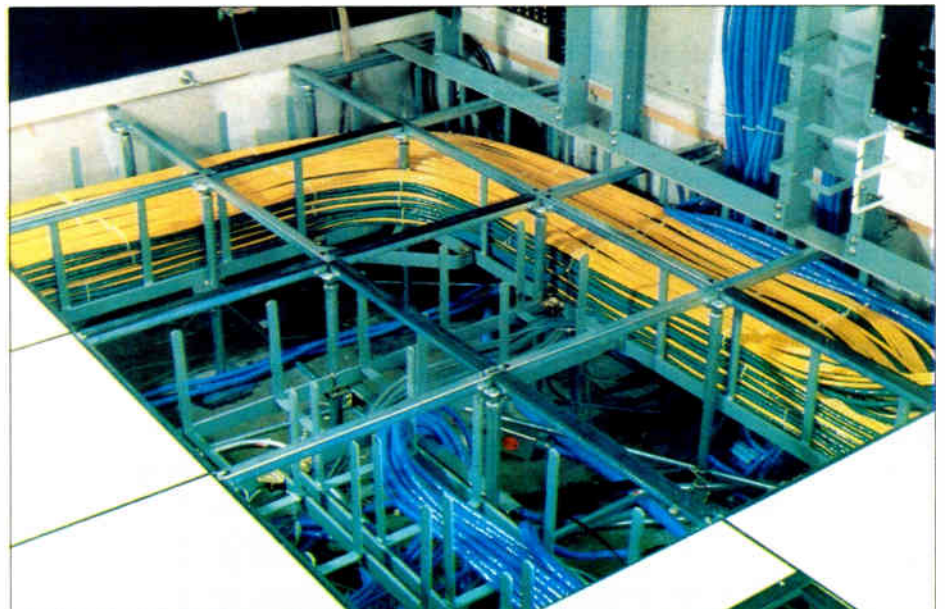
measure up to 18-inches wide by 10-inches high, snake throughout the building at various levels.

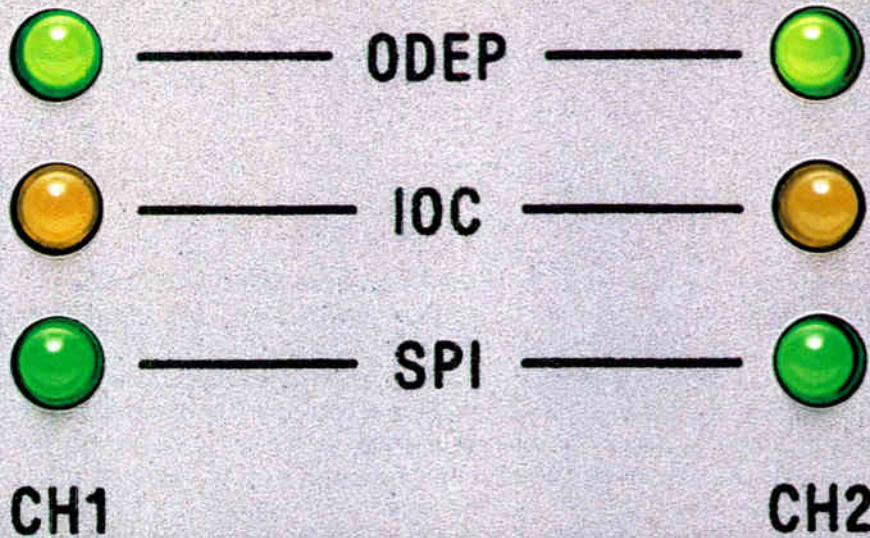
While the mechanical assembly was taking place at Sprocket Systems, Carroll began prefabricating cables at his warehouse in Berkeley. This process included cutting-to-length, stripping, and terminating the 3,500 cables documented on the wire list. Cables attached to the ADC Patch panels were terminated, insulation displacement style. All other cables were terminated crimp style with multi-pin Elco connectors. The cables were then subjected to continuity and short tests. This procedure reduced the amount of on-site debugging required. According to Carroll, it's a much more difficult process to locate a problem area once the cables are installed.

Cables designated for the cross-connect wall were shipped with an Ultra Patch rack attached to one end and Elco connectors on the other. Each panel was shipped in a separate box. DCE installers simply mounted the panels in the hinged mounting racks and fed the cables through their designated tray paths. This procedure greatly simplified the installation process. Once cables were attached



Each machine room (above) features a wall of Ultra Patch cross-connect panels, hinged for ease of access. Cable lengths in runs requiring 90 degree turns (right) could vary by as much as a foot.





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to the designated piece of equipment, the crew worked backwards to position each individual cable perfectly flat and straight. The cables could not cross or they would not properly fit into the trays. Some of the cable runs, such as those for the patch bay, contain as many as 420 cables inside a single cable tray.

Long runs (over 100 feet) were simply unreeled into the cable trays, terminated and attached on site. The jumpers on the cross-connect were terminated and installed on site by DCE technicians.

Wiring the Solid State Logic (SSL) mixing consoles proved to be the biggest challenge for DCE: the consoles require more wire connections than any other piece of equipment. It's in these boards that all inputs converge, and the sound is manipulated, creating the final mix that

will eventually be heard by theater-goers.

When installing the cable connecting the SSL consoles to the local cross-connect, DCE worked off of a separate wire list produced by Sprocket engineer Brian Kelly. Each mixing console has its own patch bay credenza. Every wire in the console corresponds to a jack point on the credenza, allowing signal changes by pulling and plugging the patch cords. The credenza, a custom wooden cabinet, hand-made by Robert Carroll, David's brother and associate, is then wired to the local cross connect.

Any concerns that the custom-manufactured flexible cable wouldn't withstand the wear and tear of an installation as well as standard cable were laid to rest: "It worked quite well. We yanked it through runs where it had to



*The audio cable travels throughout the building in open trays below raised flooring.*

# SPECO

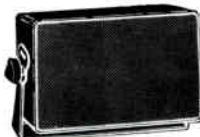
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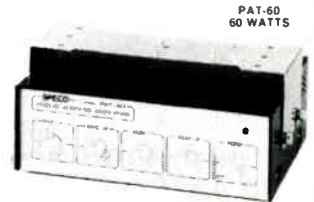
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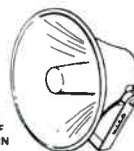
WB8-10F-70



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be lubricated, pulled, and stretched-it never tore," said Carroll.

Once the cables were installed, the system was tested using an Audio

Precision System One. The comprehensive audio test system has a routing switcher, which when plugged into a console, allowed Sprocket to test 24 channels simultaneously in about 30 seconds. All of the cable lines were tested for level loss, frequency response and phase.

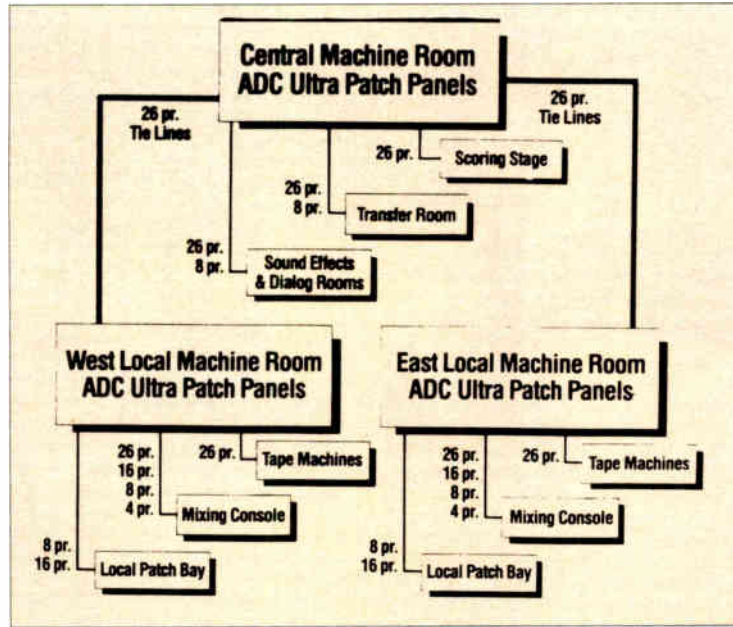
The next step was for Sprocket Systems to begin work. Because most of the cable was tested prior to installation, Lucasfilm has experienced a very low

failure rate.

Because of its size and complexity the installation took almost a year to complete, but the system is meeting all

expectations. Sprocket Systems successfully finished post production of Lucas' most recent film "Tucker." According to Scott, the installed system design was successful in accomplishing its most important criteria: flexibility. "We hope we're set for five years. With each cable run installed, we included extra pairs. We also installed extra patch bays and Ultra Patch panels. The whole idea of incorporating the cross-connect system is to be able to conveniently make changes

and add new equipment. In this industry, nothing stays the same for more than a year. New recording and mixing equipment seems to be introduced every



This diagram illustrates the "star" system of cross-connection.

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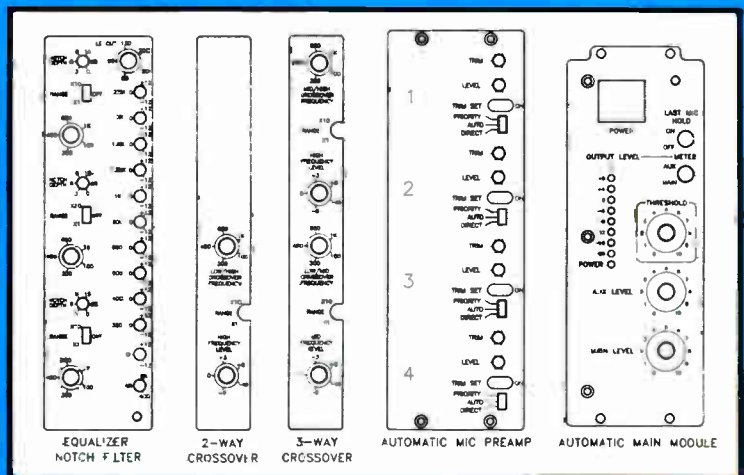
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# THE IMPORTANCE OF GOOD CABLES

BY GARY D. DAVIS & RALPH JONES

**A** given cable probably costs less than any other component in a sound system (unless it is a multi channel snake, which is pretty costly). Still, there may be hundreds of cables in a single system, so the cost can add up to a sizable figure. Hum, crackles, lost signal due to open circuits, or failed outputs due to shorted circuits can all be caused by a cable. If you think about it, regardless of how high the quality may be of your mics, mixing console, amplifiers and loudspeakers, the entire system can be degraded or silenced by a bad cable. You should never try to save money by cutting corners with cable. A system's worth of good cable is expensive.

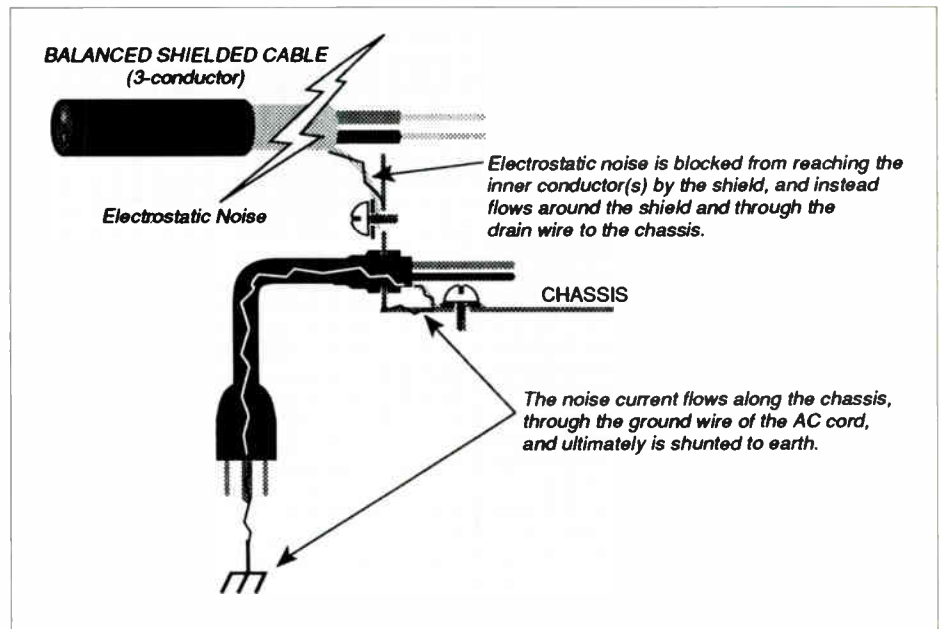
High price alone does not guarantee a good product. There are major differences between similar looking cables. All wire is not the same, nor are all look alike connectors made the same way. Even if the overall diameter, wire gauge, and general construction are similar, two cables may have significantly different electrical and physical properties such as resistance, capacitance between conductors, inductance between conductors, overall flexibility, shielding density, durability, ability to withstand crushing or sharp bends, tensile strength, jacket friction (or lack thereof for use in conduits), and so forth. Almost all audio cables in a sound reinforcement system should utilize stranded conductors, yet many same-gauge wires use a different number of strands. More strands usually yield better flexibility and less chance of metal fatigue failure or failure after an inadvertent nick in the cable. Even the wire itself makes a difference. Pure copper is an excellent conductor, but lacks tensile strength. Copper/bronze inner conduc-

tors are strong yet adequately flexible. Aluminum is strong and lightweight, but has too much resistance for practical use in audio circuits. Connectors may be well made, with low contact resistance (and low tendency to develop resistance over time), or perhaps not. They may be well secured to the cable, with thoroughly soldered shields and inner conductors and good strain relief, or they may be carelessly put together.

The following paragraphs shed some light on the function and construction of various cables and connectors.

## SHIELDING

Shielding for mic and line level cables is essential in most applications. Mic and line signals are relatively low in level, and will be amplified. Any noise entering the cable will be amplified along with the desired signal. The purpose of shielding



*This drawing illustrates how shielding shunts electrostatic noise.*

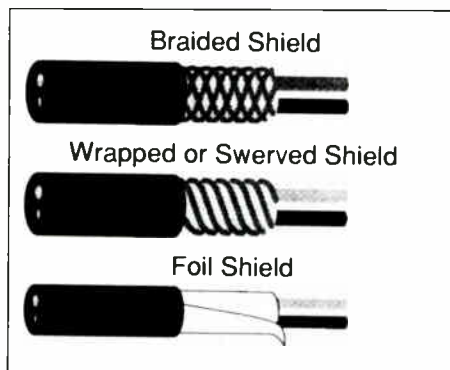
There is also the question of which type of cable to use: single or dual conductor shielded type? Cable with braided, wrapped or foil shields-or cable with no shield at all? Separate, loosely bundled cables for each channel, or a multi-core snake with many channels sharing the same outer jacket?

is to exclude electrostatic fields-to intercept these spurious charges and drain them to ground so they do not get into the inner, signal carrying conductor(s) of the cable. In the case of an unbalanced cable with a single center conductor, the shield also acts as a return path for the signal.



Higher frequency noise, including the very steep wave-fronts generated by sparking, has shorter wavelengths and is therefore more of a problem for loosely braided or wrapped cable shields. (The shorter the wavelength, the easier it is for the noise to penetrate even minute spaces in the shielding.) The best shielding you can use in fixed (permanent) installations or within a rack or piece of equipment is a foil shield. Metal foil provides nearly 100% shielding effectiveness (known as shielding density), but such cables (i.e., Belden 8451 or Canare LP2B2AT) are not particularly strong or flexible, and the shielding will deteriorate if they are flexed very much. This is why cable with braided or wrapped wire shielding is more commonly used for mic and instrument connections to the sound system. Cables with wrapped (or served) shields may offer greater flexibility than similar braided shield cables, but the wrap will tend to open up with flexing, which not only degrades shielding density, but can also cause microphonic noise, as described below. Electrostatic charges may be caused by sparks at the armatures of motors or generators, by gas discharge lighting (neon or fluorescent), and other sources. These charges can capacitively couple into a cable. If the inter-conductor capacitance changes within a section of the cable itself, noise will also be induced. When you flex a cable and you hear it, there are two possible causes: either some wire strands are broken and are intermittently touching, or the capacitance between inner conductors (or shield and inner conductors) is changing. If the capacitance changes, the cable is said to be microphonic. This is a major problem with phantom power in mic cables, although it can happen in any cable, and you definitely don't want this internally

generated noise to occur in any sound system. The best way to avoid electrostatic noise and microphonic noise is to use cables with stable dielectric (insulating) material that won't let the center conductors migrate relative to the shield, and with a tightly braided shield that is well-trapped by the outer jacket so the shield itself does not open up as the cable is flexed. A rubber outer jacket is often favored for mic and instrument cables because it has a good feel and is flexible



*The different types of cable shielding.*

over a wide temperature range, but good quality vinyl has become popular, too. Vinyl pulls through a conduit better than rubber. In fact, there are special plenum cables that don't necessarily need conduit. These are jacketed with tough, slippery fluoropolymer resin compounds such as Pennwalt KYNAR, Allied HALAR, or DuPont TEFLON — which can withstand temperatures of 125, 150, and 200 degrees centigrade, respectively. Jackets optimized for plenum or conduit installation tend to have inadequate flexibility for most other uses.

We stated that cable shielding is primarily for electrostatic noise, and this is true. But there is another type of noise. Electromagnetic noise may be generated by the coils in electric motors,

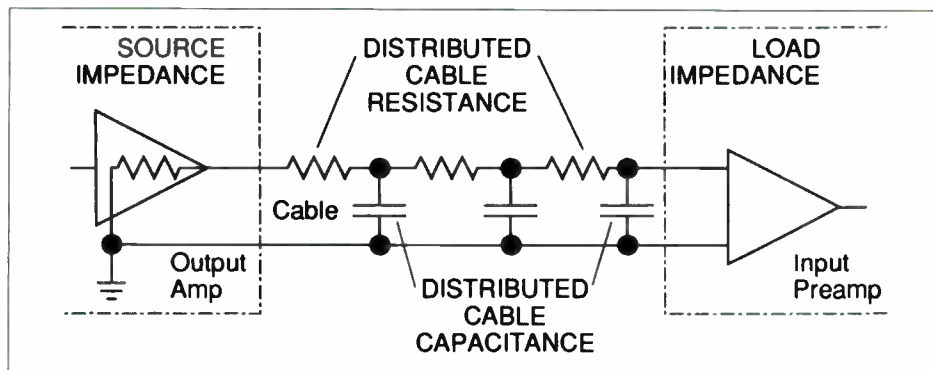
ballast in fluorescent lighting, the coils in large rheostat type lighting dimmers, or the chopping of AC current by SCR (silicon controlled rectifier) dimmers. Such noise enters cable by means of inductive coupling. Normal cable shielding does not exclude electromagnetic fields (unless the shield is heavy iron or steel conduit). Magnetic fields are cancelled only by a balanced line, with twisted center conductors, and by sheer physical distance from the source.

Ground Loops are also a contributing factor in cable noise, but in this case the noise is being induced by currents flowing through the shield, and it matters not how dense the shield is or how tightly the center conductors are twisted. Only proper grounding will cure the problem.

### SELF-CAPACITANCE

While shielding is beneficial to the extent it excludes electrostatic noise, it can have a negative impact on a cable. It increases the overall distributed capacitance between signal-carrying conductors. Because a cable has finite resistance as well, the combination of capacitance plus resistance constitute a low pass filter. For a given wire gauge, the longer the cable and/or the greater the capacitance per foot, the lower the cutoff frequency of the filter. In practical terms, if you're using more than 100 feet of mic cable, you need to use cable with the lowest practical capacitance per foot. Be aware that on dual conductor shielded cables, there are two capacitance specs to examine: capacitance between center conductors, and capacitance between a center conductor and the shield. Cables with larger diameters inside the shield (we don't care about jacket thickness) tend to have lower capacitance due to greater spacing between conductors. There are, however, major variations in

similar looking cables due to the tightness of the twist between center conductors, the dielectric constant of the insulation, and other factors. You can go through complex calculations to figure out what effect a given cable might have on the high end frequency response of the system, but the bottom line is that the wrong cable may indeed affect the transient or overall high frequency response of the system. Output source impedance and input termination impedance must be considered when figuring out the actual high frequency losses. With older equipment, changing from a low impedance (600 ohm) termination to a high impedance (15 kohm) termination could cut



*How cable resistance and capacitance create a low pass filter.*

in half the filter cutoff frequency, resulting in considerably more signal loss. Today, this is not as likely to occur. The equation for filter cutoff frequency is as follows:

$$f_o = \frac{1}{(2 \pi RC)}$$

*(continued on page 68)*

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## Contracting Close-up

### Reports from Audio Services; Long Communications

#### Audio Services

Audio Services of Tempe, Arizona, installed a \$30,000 audio, lighting and video system for The Cibola nightclub in the Sheraton San Marcos in Chandler, AZ. The installation was part of a late-1988-renovation for the Sheraton San Marcos, formerly the San Marcos Hotel. The hotel built in 1912 is a national historical site and in its "heyday" was visited by movie stars during the early movie years.

"The club is not a big high-energy warehouse," explained Jim Spindler, chief engineer for Audio Services. "They wanted a place to cater to business clientele that stay at the hotel and resort guests, there for golf and sun. They wanted an easy laid-back at-

mosphere that can make a transition into stimulating high energy."

The sound system in the club includes: Technics 1200 turntables; Biamp 4001 DJ-type mixer; Audio Control phase-coupled activator for low-bass reconstruction; AEI Music Network taped music system, for when there's no DJ; Renkus-Heinz dynamo system; Renkus-Heinz P1500 amps; Renkus-Heinz speakers and subwoofers for the dance floor and main room; and an Audio Services rack enclosure. Two clusters are aligned for optimal results allowing for extreme high pressure levels on the dance floor. The system also allows for a "quiet area" in one of the corners of the room.

#### Long Communications Puts Sound Into Koger Center

Long Communications in Winston Salem, NC, has installed the sound system in the Koger Center for the Performing Arts in Columbia, SC. The system was designed by Jaffe Acoustics of Norwalk, CT. A series of setbacks, including pieces of equipment being stolen from the center, has postponed the completion date until mid-April from mid-March. "It was a pretty straight-forward installation," said Frank Martin, project manager at Long Communications. The sound system included 32 input SPA console and 16 input monitor console from DDA; 17 QSC 3200 power amplifiers; six QSC 3500 power amplifiers; speakers with JBL components; IRP equalizers; and Audio Digital signal delays.

Another installation Long Communications has become involved in is the sound system for Thalian Hall in Wilmington, NC. Thalian Hall consists of two separate parts of the building, one part is a theater built in 1850 and the other part is the house chamber for city hall. Long plans on installing systems for both parts of the building some time in May, with a completion date some time this summer. The systems have been designed by Peter George. The theater's sound system will include Crown power amps; Meyer speaker cluster; Soundcraft 500 mixing consoles; and ClearCom Intercom System. The house chamber will have a Shure AMS system.

The Riveroak Church of God located in Danville, Virginia, has installed a sound system for both live sound reproduction and for sends to video recording. Long Communications supplied the equipment and Freeman Bornreger, director of media ministries





at Riveroak, designed and installed the system with the help of other staffers.

"The heart of the system is the DDA 24-channel SP-A control board," said Bill Payne, assistant designer at Long Communications. "We did a lot of looking around," said Borntreger. "We needed a standard sound mixing board with capabilities of 24-track recording for a later date and at least 12 monitor sends — for each musician to get a different mix. We accomplished all that [with the DDA S-PA control board]." Other equipment in the sound system include a central cluster of seven Electro-Voice FR200 cabinets, a pair of EV 18-inch subwoofers on the floor and QSC power amplifiers.

Riveroak hopes its sound system will be a positive example for other churches. Borntreger conducts seminars on sound equipment to help other Churches with their sound problems. "If they don't know how to use sound equipment, we train them as to what all the different buttons do," said Borntreger. "If they want, we check out their systems and help out as much as we can — as a gratis thing. We'll even help them buy the right equipment."

### Colosseum Ltd. Gives Sound to British TV Theater

Colosseum Ltd. is currently installing a sound system for the United Kingdom's "largest independent television theatre" in The Colosseum Production Center in Leeds. The colosseum, that will be finished in July 1989 after refurbishing the 100 year-old theatre, will include a TV studio and a theater for live shows and live broadcasts. The main studio is 6,500 square feet and the three other studios in the Colosseum are 1000 square feet each.

Don Larking Audio Sales have sold the sound equipment to Colosseum Ltd., who are installing the system themselves, according to John Tilley, sound supervisor for Colosseum Ltd.

The Colosseum will use a Soundtracs IL48 for live on air feeds and for program recording. The IL48 is hooked up to a Tascam 24-track machine, which is the ATRAT, and allows a live feed for broadcasting and for multitracking at the same time. Also included will be Dolby SR noise reduction for the system.

The house PA system is a Sound-

tracs 40-input MC with Soundtracs 40-input MCX monitor console feeding a JBL PA system of five kilowatts. The transmission suite is a Soundtracs 16 input version FMB console. The four editing suites will include Soundtracs FMX 842 mixers and a Soundtracs IL4832 console will "probably" be used for sweetening purposes, according to Tilley. ■

## People

### Berger moves to Community Light & Sound; Altec names Hollis District Manager

#### Community Appoints Berger

Community Light & Sound has named Christopher R. Berger as national field sales manager. In his newly created position, Berger will be responsible for communicating with dealers and rep organizations in a problem solving and educational capacity, and will lend support in establishing and meeting sales quotas. He will also oversee various marketing concerns such as advertising placement and effectiveness, and will serve as liaison between Community and its public relations firm, Gregory A. DeTogne Public Relations. Berger was sales manager/systems designer with Pennsylvania-based McManus Enterprises prior to signing on with Community.



Christopher R. Berger

#### Solid State Logic Appoints Collie

Solid State Logic (SSL) has appointed Dave Collie as product development manager. He will be based at SSL's Oxford, England headquarters. Collie, formerly western region sales

manager at SSL's Los Angeles office, will help co-ordinate the development of new analog and digital audio products, and will oversee the evolution and enhancement of the company's console automation systems. Collie has been with SSL since 1984 when he joined the company as a sales engineer.

#### Altec Lansing District Manager Named

Altec Lansing has named Jack Hollis as district sales manager for territory #4, a ten-state area ranging from West Virginia to Florida. Hollis will provide liaison between the factory for Altec's sound contractors and represent Altec Lansing to acoustical consultants, architects, and engineers. Before joining Altec Lansing, Hollis served as marketing vice president for a large sound contracting firm in the Chicago area. He also gained experience as a sales manager on both the regional and national level while employed at Dukane Corporation.



Jack Hollis

**QSC Appoints Sales Administrator**

QSC Audio Products has appointed Patricia Daniels to the position of sales administrator. Daniels will be responsible for working with QSC reps and dealers to coordinate and facilitate order processing. Daniels has over seven years experience in sales and management.

**University Sound Names Sandell Prez**

University Sound, Inc., a Mark IV Industries, Inc., company, has appointed



Robert W. Sandell as company president. Sandell will be responsible for all of the operations of University's business and for implementing University's strategic plan as one of the Mark IV companies. Sandell

left his position as vice president of marketing and sales and officer of Kurzweil Music Systems, Inc., to join University Sound. Prior to his position with Kurzweil, he held positions with several companies including CBS/Fender and Yamaha.

**Joiner-Rose Adds Staff**

Joiner-Rose Group, Inc., has increased its overall staff to 43 with 29 in Dallas and 14 in New York. New staff additions in Dallas include: Barbara O'Toole, theatre systems designer; Richard Zwiebel, architectural acoustics designer; and Sam Berkow, architectural acoustics designer. The New York office staff additions include: Michael Leiboff, audio/visual systems programmer/designer; Lyn Canfield, audio/visual systems programmer; Chuck McGregor, sound system designer; Robin Alleyne, audio/visual systems designer; and Guy LaFontant,

audio/visual systems designer. Joiner-Rose provides interrelated acoustics, audio-visual and television communications, and media production/presentation facilities design services.

**Vaughn Comm Appoints Deyo**

Vaughn Communications Group has appointed Tom Deyo as general manager of its AVC Systems and Video Midwest divisions. Deyo will manage audio and video equipment sales, systems design, installation and equipment service/repair. Before coming to Vaughn, Deyo worked five years as a service sales engineer for Sony Broadcast.

**General Instrument Appoints Five VPs**

General Instrument Corporation has appointed five new corporate vice presidents. At their regularly scheduled meeting on February 27, the Board of Directors elected the new vice presidents who include: Anthony J. Aukstikalnis, general manager of the Jerrold Subscriber Systems division; Ronald A. Ostertag, general manager of the Computer Products division; Richard C. Smith, director of taxes; Lemuel A. Tarshis, general manager of the Jerrold Distribution Systems division; Eugene A. Weisberger, president of the Defense Systems Group.

**Aiphone Names Two Regional Sales Managers**

Aiphone Corp. has named Fred Koffer and Curtis O'Kelley as regional sales managers. Koffer, who has 15 years' experience in the industry, will work out of Aiphone's Randolph, NJ office. He will cover the company's north-east sales region, which consists of New York, New Jersey, Maine, Rhode Island, New Hampshire, Vermont, eastern Pennsylvania, Maryland, Massachusetts, Connecticut, Delaware, and

the District of Columbia.

O'Kelley, formerly operations manager at Osborn Sound & Communications in Atlanta, will cover Aiphone's southeast region covering Florida, Georgia, Alabama, Mississippi, Tennessee and North and South Carolina. He will be based near the Atlanta area.

**Centro Appoints Montgomery**

Centro Corporation has appointed Gary L. Montgomery as national dealer



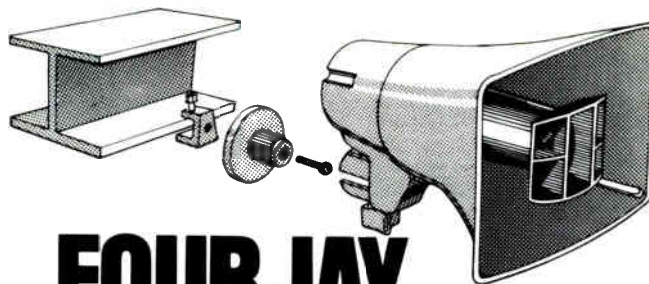
sales manager. In his new position in Salt Lake City, Montgomery will devote his full-time efforts to establishing and maintaining a worldwide dealer and representative organization. Montgomery

comes to Centro from Quanta Corporation where he served as regional sales manager on the west coast.

**Anixter Names VP**

Anixter Bros., Inc. has appointed Larry Walsh to the newly created position of vice president-inventory management. Walsh will be responsible for setting and implementing company inventory management policies and procedures, including national purchasing, inventory modeling and placement, and excess inventory reduction. He will work closely with the Product Management Group and regional inventory managers to coordinate the introduction of new product programs.

Walsh has been with Anixter for 20 years and has held several sales and management positions. Most recently, he was the regional vice president of the company's midwest region. This position has been filled by Carl Putnam, formerly southeast regional vice president.



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### Digital Sound Signs Account Rep

Digital Sound Corporation has signed Steven Loving as an account representative. Loving will be responsible for sales and support of Digital Sound's distribution channels in his five state region of Kentucky, Tennessee, North Carolina, South Carolina, and Georgia. Digital Sound's distributors in these states include Centel Communications Systems, BellSouth Advanced Systems, and others.

### Perma Power Appoints New Officers

Perma Power Electronics, Inc., has named Leonard Abrahamson as president. Abrahamson had been serving recently as a consultant to Perma Power, where he earlier had been executive vice president and general manager from 1967 to 1970. He then joined Dynascan Corporation, where he served until early 1988 as vice president of operations/planning and vice president, human resources.



Norman A. Ackerman, former president of the company, has become chairman and remains chief executive officer. Ackerman plans to concentrate on long-term planning, with particular emphasis on engineering and marketing.

Louis Schornack has been promoted to vice president of engineering. Schornack has served as director of engineering at Perma Power since November, 1984, and will now be responsible for all product research and development activities for the company's lines of computer power protection products and portable public address systems. Before joining Perma Power, Schornack worked as director of engineering for Dynascan. ■

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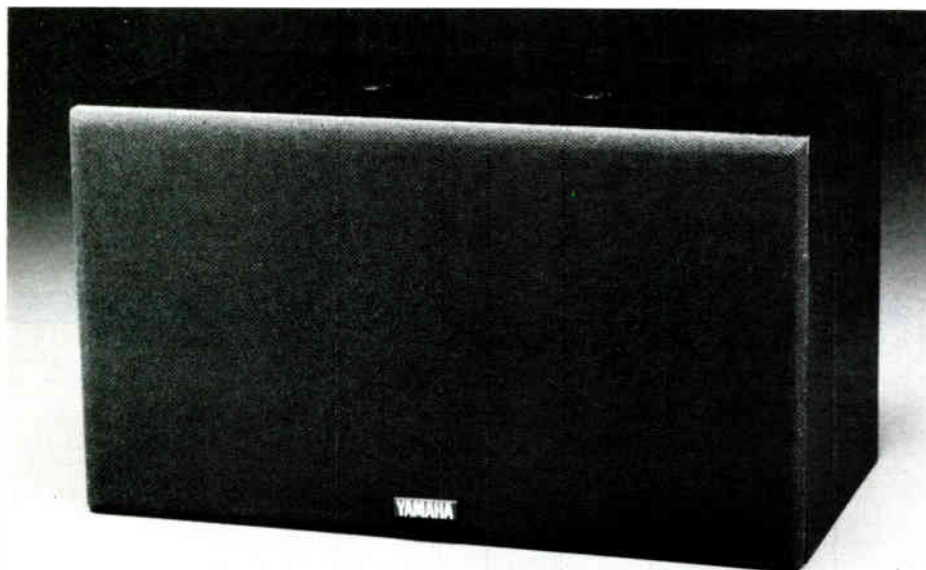
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## Products

### New monitor system from Yamaha; AMX introduces line of A/V controls



#### Yamaha Monitor Loudspeaker and More

Yamaha Corporation of America's NS10MC commercial monitor loudspeaker system is designed for the demands of commercial sound applications, according to the company. The NS10MC is a full two-way system incorporating a Yamaha seven-inch cone woofer and a 1 $\frac{3}{8}$ -inch soft-dome tweeter. It has a suggested retail price of \$265.

Yamaha's SPX900 and SPX50D are digital multi-effect processors. The SPX900 is a high performance processor that uses a second-generation Yamaha proprietary LSI processing IC, the DSP11, for full bandwidth on all effects and for multiple programs that can provide up to five effects at once. The SPX50D is a cost-effective one

rack-unit high digital multi-effect signal processor with 16-bit linear quantization, a sampling frequency of 31.25 kHz and 50 factory preset programs.

*Circle 1 on Reader Response Card*

#### AMX Intros New Products

AMX has introduced the SX-8+ relay controller. The SX-8+ is a trim line version of the AMX standard SX-16+. It has eight relays instead of 16 and communicates with other AMX peripherals via the AMX communications buss, like the SX-16+. It offers eight programmable relays, front panel controls and is rack mountable. The compact SX-8+ will fit into the standard AMX AC-RK rack mount kit, which will accommodate three AMX peripherals.

The AMX SX-232 serial data controller can control up to three individual

pieces of equipment via the RS-232 control, according to the company. Each of the three RS-232 ports on the SX-232 can be independently ad-



dressed and can have individual baud rates selectable from 300 to 9600. It also features full handshaking capability with both transmit and receive data LED's for each RS-232 port that indicate data status.

AMX's SX-DI-8 direct interface between a simple switch closure and the AMX SX system communications buss structure accepts up to eight different inputs from outside sources and causes the SX system to respond with pre-programmed functions.

AMX's SX-VRG voltage ramp generator provides control for equipment requiring variable voltages to adjust status. Lighting systems, volume controls and some video tape search functions are common variable voltage applications. The SX-VRG has eight outputs which are independently adjustable from 0-10 volts DC.

AMX's DX-8 is an eight bay expander for the SX-DCU data control unit from AMX. The DX-8 is connected to one of the three available output ports on the SX-DCU and will execute up to eight simultaneous functions to individual machines, according to the company. Multiple DX-8's can be used by routing the last output of the DX-8 into the input of the next DX-8. It has a suggested retail price of \$259.

*Circle 2 on Reader Response Card*



**Tannoy Primary Mixing Reference Monitors**

Tannoy, Inc.'s SGM-15B primary mixing reference monitor is a 15-inch K-3809 dual concentric housed in a constructed cabinet measuring 26½-inches high, 19¾-inches wide and 18½-inches deep. Frequency response is from 20 kHz down to 40 Hz ± 4 dB.

*Circle 3 on Reader Response Card*

**Ivie Spectrum Analysis System & Sound Level Meter**

Ivie, a Mark IV company, has introduced the PC-40 computer-controlled spectrum analysis system and precision sound level meter. It is capable of making a variety of measurements (in dBm, dBv, and AC Volts). It features 20

nonvolatile memories, parallel and serial outputs, and is user programmable in BASIC. The PC-40 is completely portable with dimensions 13.25-inches by 8.5-inches by 3.25-inches. The industrial net price is \$5,196.

*Circle 4 on Reader Response Card*

**Drama Phone Portable Communication System**

Drama Phone's portable communication system is for both general theatre and on location use. The communication system features a control panel console that can be permanently installed or used as a portable unit in the field. It can operate with as few as two headsets or as many as six, eight, ten or more.

*Circle 5 on Reader Response Card*

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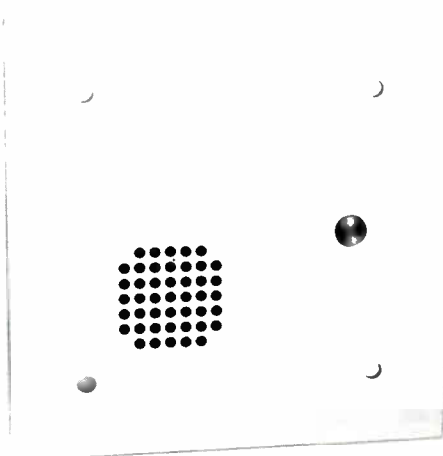
**TELEX**  
TELEX COMMUNICATIONS, INC.

*Circle 223 on Reader Response Card*

while maintaining a basic in-wall signal distribution system. The terminals provide an "audio pathway" from the in-wall speaker cabling to the external speaker system and can handle up to six pairs of speakers, the company says. They mount in conventional electrical boxes or plaster rings.

Sonance has replaced its Sonance I surface mount speaker system with an in-wall design incorporating sonic improvements. The new Sonance IA features a polypropylene woofer which provides fuller and more accurate reproduction, the company says. It has a suggested retail price of \$195 per pair, including Sonance's patented installation brackets.

Sonance's in-wall passive subwoofer, the PSW2, is designed to work in conjunction with full-range speaker systems and to augment the bass delivered to the room. The speaker requires no high level crossover or dedicated amplifier, the company says.



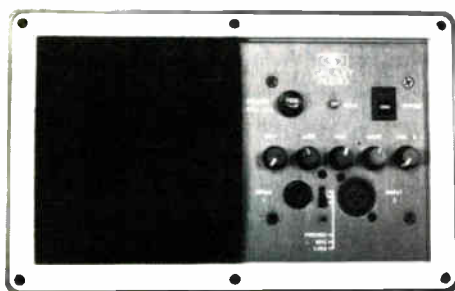
cessed mounting assemblies are designed for application in hands-free intercom, electronic signalling or voice paging systems where potential exposure to deliberate equipment damage, or demanding ambient indoor or outdoor environments, require special protective considerations.

Circle 12 on Reader Response Card

### Bogen Presents New Systems

Bogen Communications, Inc. has introduced model FG-10, a compact speaker system designed for high fidelity performance in foreground music systems for restaurants, night clubs, offices and stores. The FG-10 features a separate woofer and tweeter and wide frequency response.

Bogen's control centers are de-



### Galaxy Audio Hot Spot

Galaxy Audio's Hot Spot P.A. II is a revised edition of the Hot Spot P.A., which has been used as a monitor, self-contained public address system or practice amp. The Hot Spot II includes these new features: 15 volt phantom power, balanced inputs and a redesigned faceplate.

Circle 11 on Reader Response Card

### Atlas/Soundolier Vandal Proof Loudspeakers

Atlas/Soundolier has introduced Series VPCS and VPVT remote loudspeakers/signalling stations. The re-

signed for school, institutional and industrial sound systems, including models for small, medium and large facilities. All the control centers feature capability for two-way intercommunication with classrooms or other loudspeaker-equipped locations, as well as distribution of public address, program material, or emergency announcements.

Circle 13 on Reader Response Card

### Speaker Design Toolbox

Carvin is now shipping version 1.0 of AudioCAD, a loudspeaker design application for the Macintosh computer. AudioCAD calculates and displays the frequency response of any loudspeaker driver/box combination.

Circle 14 on Reader Response Card



### Belden Multi-Pair Snake cable

Belden Wire and Cable has introduced a line of multi-pair audio "Snake" Cable featuring individually jacketed and shielded pairs for protection against signal loss. These cables interconnect audio components such as console board equipment for the broadcast industry including recording studios and radio and television stations.

Available from stock in 100, 250, 500 and 1000-foot put-ups, the line has a suggested retail price starting at \$640 for 1000 feet of four-pair cable. ■

Circle 15 on Reader Response Card



## Literature

### Fiber Optic reprint from Corning Glass; University issues new catalog

#### Printed From Corning

A reprint from *Communications Technology*, available from Corning Glass Works, describes the performance characteristics of fiber made from the outside-vapor deposition (OVD) and inside-vapor deposition (IVD) processes. The article titled "Single-Mode Fiber-Optic Technology," by Douglas J. Eccleston, manager of North American applications engineering for Corning's

telecommunications products division, explains the OVD and IVD manufacturing processes and discusses their effects on such fiber characteristics as bend performance.

Another reprint available from Corning, printed in *Installer/Technician*, "Producing Optical Fiber," by Scott A. Esty, market development supervisor for Corning's telecommunications products division, explains the various

manufacturing methods, including the currently used outside-vapor deposition process developed by Corning.

A set of booklets from Corning discuss the factors that affect the strength of optical fibers. Included in the Optical Fiber Strength and Fatigue series are a tutorial, a glossary of terms and a bibliography.

#### Brochure and Catalog From AMP

AMP Incorporated's 26-page brochure provides general product information and catalog cross-reference for a variety of surface-mount and surface-mount compatible products, from pre-

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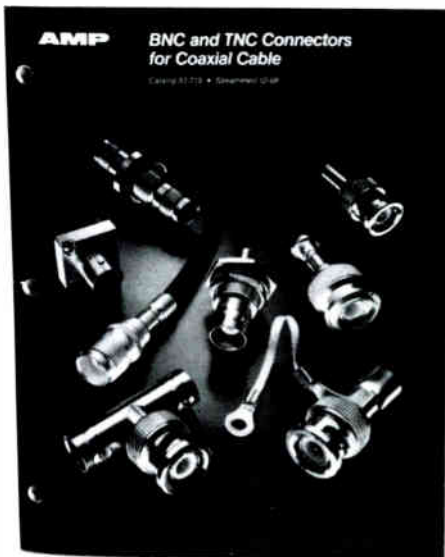
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molded plastic chip carriers to high-density PCB connectors.

AMP's 56-page catalog provides information on an expanded line of bayonet-style and threaded-style coaxial connectors in 50- and 75-ohm versions. The catalog offers product facts, specifications and applicable accessories for BNC and TNC connectors, as well as information on application tooling and technical documents.

Circle 16 on Reader Response Card

#### University Sound Catalog

University Sound has issued a catalog detailing its full line of products. The catalog is available to sound installers, consultants and users of commercial sound products.

The catalog's large, clear product photos, with features separate from product text, is what University contractors and dealers asked for in surveys and personal interviews conducted by the company, according to Jeffrey Pallin, marketing manager for University Sound.

Circle 17 on Reader Response Card

#### EAO Switch 1989-90 Catalog

EAO Switch Corporation has released a 100-page, 1989-90 catalog. Switches are listed by applications and the catalog includes product photos, features, mounting dimensions, technical information and complete product listings and specifications.

Circle 18 on Reader Response Card

*New from MacKenzie Laboratories, the leader in digital message repeaters*

# Random Access Digital Audio

MacKenzie's Random Access Digital Audio (RADA) is an audio message repeater system with multiple-message capability. It is designed to serve as the voice playback section of alarm systems in applications such as:

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Messages are digitized, stored in removable EPROM memory chips and controlled by the system's built-in microprocessors. The voice is entirely natural, just like a tape recording.

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RADA is furnished in standard 19-inch equipment rack configuration. The basic unit provides up to 80 messages. Building-block expansion via sub-chassis



RADA unit shown with front cover removed.

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Circle 19 on Reader Response Card

**New Product Supplement**

### Crest Product Supplement

Crest Electronics, a manufacturer and supplier of equipment repair and replacement parts for hospitals, nursing homes and medical clinics, has published its New Product Supplement for spring '89. The 36-page catalog illustrates and describes a wide selection of products.

Circle 19 on Reader Response Card

### Master Bond Substrate Bonding Chart

Master Bond Inc. has published a substrate bonding chart for Master Bond adhesive systems. The table lists specific epoxy resin grades recommended for bonding specific substrates.

Circle 20 on Reader Response Card

### Master Bond Offers Application Selector Guide

Master Bond is offering a four-page application selector guide on its high temperature resistant adhesives/sealants and coatings. Viscosities, gel times, cure schedules, tensile shear strength, service operating temperature ranges and application recommendations for different Master Bond grades are listed.

Circle 21 on Reader Response Card

### Short Form Catalog From FSR

FSR, Inc. has a 21-page specification catalog available. Over 150 products are listed in quick-reference form with both specifications and applications.

Circle 22 on Reader Response Card

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## CALENDAR

### MAY

**Electronic Distribution Show (EDS):** Las Vegas, NV. Contact: 312-648-1140. May 9-11.

**National Fire Protection Conference:** Washington, DC. Contact: 617-770-3000. May 15-16.

**National Council of Acoustical Consultants (NCAC):** Toronto, Canada. Contact: 201-379-1100. May 20-22.

**National Sound and Communications Association Expo and Conference '89:** Nashville, TN. Contact: 312-593-8360. May 25-27.

### JUNE

**National Presentation Expo:** New York City. Contact: Barbara Stockwell, Ass. V.P., Knowledge Industry Publications, 800-328-5474. June 6-8.

**National Association of Music Merchants (NAMM):** Chicago, IL. Contact: 619-438-8001. June 17-20.

**American Society of Mechanical Engineers (ASME):** Pittsburgh, PA. Contact: 212-705-7732. June 18-22.

**International Security Conference/Central (ISC):** Chicago, IL. Contact: 312-299-9311. June 27-29.

### JULY

**Electronics Technician Association (ETA):** Boise, ID. July 20-22.

**International Association of Auditorium Managers (IAAM):** Reno, NV. Contact: 914-683-1000. July 29.

### AUGUST

**National Heat Transfer Conference and Exposition:** Philadelphia, PA. Contact: 212-705-7793. August 6-9.

**International Society of Certified Electronic Technicians (ISCET):** Tuscon, AZ. Contact: 817-921-9101.

**International Security Conference/East (ISC):** New York, NY. Contact: 312-299-9311. August 29-31. ■

## REVERBERATION

*(continued from page 31)*

Other terms such as intimacy, warmth and brilliance have also been introduced to divide the sound field not only in time windows, but also by frequency bands as well.

Contributing to the creation of reverberant sound, in addition to delayed reflections reaching the listener, are standing waves. As mentioned earlier, all rooms have characteristic resonant frequencies, and as we know, sound will decay slowly after excitation if these frequencies are present in the original sound. The actual resonant frequencies of a room depend on its dimensions, much like an organ pipe. And just like organ pipes, overtone frequencies are also present in multiples of the fundamental. As the frequency rises, the resonant peaks from various modes tend to blend together and give a somewhat flat room response (giving each enclosure a unique

frequency response).

The modes set up at low frequencies can be separated by gaps where room response is poor, regardless of initial intensity, and true reverberation cannot be obtained in those gaps. Obviously for small rooms, a low-frequency reverberant-field may not be developed at all, and large rooms will have bands of lower frequencies where response is poor. And the relative loudness of the standing waves will differ as one moves around the room, an effect Sabine noted many years ago.

The question is whether the human ear can detect these narrow bands of good and poor response, or do they get muddled together in the overall image. These gross differences in room response can make reverberation time measurements misleading. Measuring the RT60 from a single frequency source or receiver only shows the room response to a certain frequency, and not the whole audible band. The method of using pink-noise tends to provide smoother (and hopefully

more accurate) reverberation curves, with fewer modal dips and peaks. Some researchers have even constructed passages of music to test room response with, since the human voice and music are transient in nature and not steady state.

Many may ask what the relation is between these modes of vibration and reverberation: they are one and the same. Those modes that develop standing waves are continuing the sound vibration process. When there aren't any modes present, the sound is damped, and RT is low. In between mode frequencies, some have measured the beating phenomena as energy is transferred from one mode to another, attempting to resonate at a more natural frequency.

The above statements suggest some problems. For instance, small rooms are subject to naturally poor low frequency response. The longest dimension will determine the largest wavelength that can develop a standing wave. Small rooms (offices, for example) with sig-

# AD INDEX

Company	Page	RS #
Allen & Heath (203) 795-3594	27	216
Applied Research & Technology Inc. (716) 436-2720	8	214
Architectural Acoustics (601) 483-5365	7	210
Atlas/Soundolier (314) 349-3110	31	217
Ashly Audio (716) 544-5191	29	220
Audio Digital Inc. (800) 423-1082	47	223
Audio-Technica (216) 686-2600	13	206
BGW Systems (213) 973-8090	11	204
Cal-Switch (800) CAL-SWCH	59	235
Crown International (219) 294-8000	45	211
Delta Communications (206) 582-2201	59	236
Electro-Voice (616) 695-6831	CII	201
Fourjay Industries Inc. (513) 890-6444	57	231
FSR Inc. (201) 239-0988	63	221
GNWC (800) 468-2121	35	225
Industrial Research Products (312) 439-3600	CIII, 17	202
Innovative Electronic Design Inc. (502) 267-7436	57	232
IVIE (801) 224-1800	30	230
JBL Professional (818) 893-8411	CIV	203
Lectrosonics Inc. (800) 821-1121	48	207
Mackenzie Laboratories Inc. (800) 423-4147	65	227
McKenzie Loudspeakers (312) 585-1212	23	209
Nel-Tech Labs (603) 434-8234	22	219
Panasonic/Ramsa (714) 895-7278	37	205
Quam-Nichols Co. (312) 488-5800	3	212
Samson Technologies Corp. (516) 932-3810	5	213
Sonic Systems Inc. (203) 356-1136	24	222
Speco Inc. (800) 645-5516	46	226
Tektone Sound & Signal (407) 844-2383	61	228
Telex Communications (800) 328-3771	6, 59	233
TOA Electronics Inc. (800) 843-4753	25	208
Vibration Technology (416) 438-9320	51	224
West Penn Wire (800) 245-4964	15	229

nificant absorption such as ceiling tiles and rugs, will be subject to low RTs. But it seems we would not want our workspace to be more reverberant than necessary to enhance speech.

Nothing would please me more than closing by saying which formula designers should use for each situation. Unfortunately, the reality is discouraging at best. Proper design includes steady state excitation along with transient sources that need clarity. Actually, many concert halls built have lower than predicted RTs when tested. This is not to say that the consultant is unqualified, but is just a reminder that nothing is carved in granite where acoustics are involved. ■

## BOSE MODELER

(continued from page 36)

Modeler licensees. Users with different opinions will appreciate that user-defined parameters can usually be substituted for the default values. Mechanical design is now supported through SpeakerCAD, the second software program release from Bose. A third program, RackMaker, has also been released for electronic equipment rack layout (both SpeakerCAD and RackMaker will be reviewed next month). Modeler Version 3.0 is scheduled for release in July, and enhanced modeling tools, intelligibility prediction, and gain-before-feedback modules are tentatively planned for inclusion. (Current plans call for a review of this new version in the fall.)

If you looked over and rejected earlier releases of Modeler, or other sound system design programs, you should take another look. Even though some important functions are still missing, many of these functions are in the works for future inclusion. Bose has demonstrated their high level of commitment to refining and maturing this program in a timely fashion.

If you are currently using a sound system CAD program, I would appreciate your comments. If you have tried one of these programs and decided that it was not for you, I would also like to hear from you. Comments on these reviews would be helpful, too, as consultants, contractors, and manufacturers all have somewhat different perspectives. You can write or call me directly at Menlo Scientific, 39 Menlo Place, Berkeley CA 94707 (415-528-1277). I am also available (for an astronomical fee) to walk you

through the simplest of sound system designs. ■

*Next Month: Bose's SpeakerCAD cluster mechanical design program and Rackmaker, a rack layout program (which imports from Modeler and SpeakerCAD, and exports to MacWrite, MacDraw, and Excel) will be reviewed. And if you have been reading these reviews and are undecided on what program to buy, you should definitely plan on attending the NSCA: a number of sessions and hands-on events featuring sound system CAD are scheduled.*

## SKYWALKER

(continued from page 47)

month or so."

Although they haven't ruled out digital consoles and fiber optic communications for the future, right now Scott is happy with the flexibility of the analog equipment and the wire system installed. "We can make changes," said Scott, "add equipment, and reorganize the signal flow easily without having to stop work and shut everything down." ■

## CABLING

(continued from page 51)

where  $f_0$  is the -3 dB point of the filter,  $\pi$  is 3.1416, R is the resistance of the cable (in Ohms) and C is the capacitance of the cable (in Farads). As you can see, higher capacitance or resistance causes the cutoff frequency of this 6 dB per octave low pass filter to slide lower and lower.

Cables used within equipment are generally shorter, and may have smaller diameters. The small diameter allows the cable to bend around short radii inside a chassis. Wire gauge of No.24 and No.26 AWG are OK in these applications because over these relatively short distances, overall resistance remains low. The larger insulation diameters required to reduce the capacitance per foot of cable are also less of a factor when relatively few feet of cable are involved. When such cables are misused to cover long cable runs, their extra capacitance and higher resistance will cause very noticeable degradation of system performance. ■

*The editors would like to thank Gary Davis and Ralph Jones for permission to use material from the Yamaha Sound Reinforcement Handbook.*



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Circle 240 on Reader Response Card

## Technically Speaking:

### Swan Song in C-Major (With Feeling)

**F**our years ago a fellow traveler, Chris Foreman, asked me to write an article for *Sound & Communications* magazine. That first article was the beginning of many contributions and the beginning of my tenure as Technical Editor. The past three years have seen the exploration of many ideas—most of which were highly successful. The quality of the technical content of *Sound & Communications* has led consultants, contractors, operators, and manufacturers to recognize the magazine as the leading industry publication.

The authorial caliber is no less than academic level, with many articles on cutting-edge technology appearing for the first time in these pages. We at *Sound & Communications* have pioneered technical coverage of many contracting introductions, including DSP, MIDI, and micro-processing. During the past three years the amount of editorial coverage has doubled, and the magazine's flagship, the *Blue Book*, is clearly our industry's Bible.

Recently I was asked to consider a

new post, with the Audio Engineering Society. Your Technical Editor had never considered leaving *Sound & Communications*. However, the AES position was an unusual opportunity, an offer that could simply not be refused. I leave *Sound & Communications* in the most capable hands of Bill Intemann, with whom I have had the great pleasure of working and growing during the past year.

Some of you know the magazine's Publisher, whom we endearingly call "Vinny." Vincent P. Testa is a man with great vision and dedication to this industry. When his friends and business associates learned that he purchased *Sound & Communications* some three and a half years ago, he was considered a little crazy. Or, perhaps, revolutionary in his vision to make the bold move, and then enlist the services of Chris Foreman and myself. Vinny continued his deep commitment to the industry in the face of what many called a losing battle, a battle now clearly won.

During the past three years Vinny supported and nurtured the growth of

*Sound & Communications*. It was Vinny who quietly in the background cultivated and established NSCA-TV, and the AES CrossTalk Symposia—both of which are widely acclaimed. I am proud to have been part of the team that has supported special projects like the Heyser Scholarship Fund, the publishing of the Volkmann Library Series, and I feel privileged to have worked with Vinny, and graduated from the *Testa School of Communications*.

During these three years I have spoken to some of you, and communicated to a large cross-section of our industry. I will sadly miss the short stories, the Dr. Wokka Letters, and the opportunity to freely speak my mind to my colleagues in the sound and communications business. The magazine has matured and is now in full force. Calls and letters are received daily: "how to be published in your journal?" Keep those calls and letters coming, and I will see you at the next AES convention.

Jesse Klapholz  
Technical Editor

### Coming Next Month . . .

Our NSCA Preview: a look at what to expect at the upcoming contractor's convention and exhibition. Hot products, seminars, "extra-curricular" activities, and more. We also present the next installment in our ongoing review of software for sound system design: *SpeakerCAD* and *Rackmaker* from the Bose family of software programs.

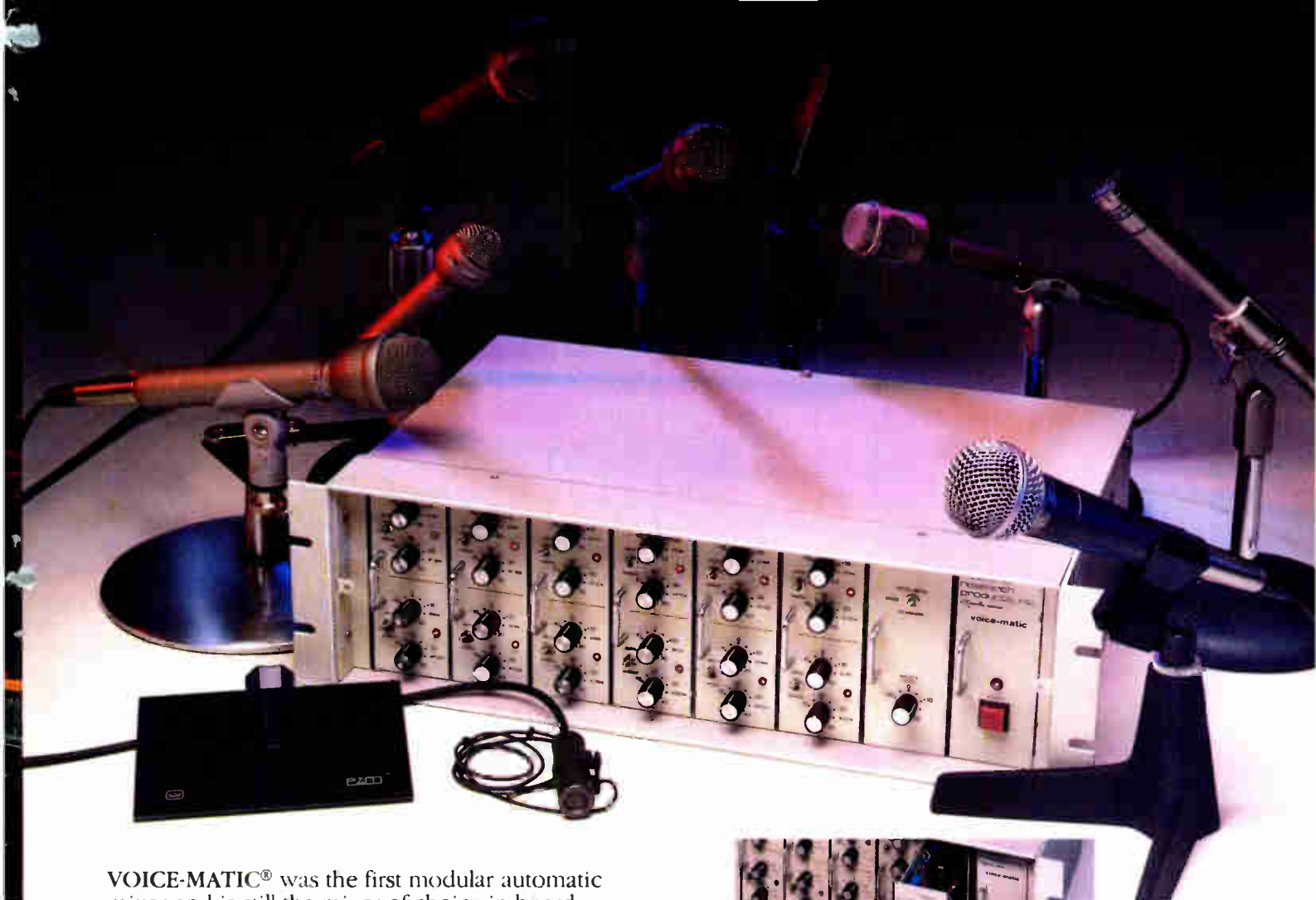
And look for articles on these topics:

- Sound Reinforcement
- Power Amplification
- Recording/Playback Systems

Don't miss the May issue!

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Regardless of the size of the hall, signal delay is inevitably required. And, every array needs to be tightened up to some extent. The 7922 gives you both long delays for large halls and the highest resolution of any professional delay for precise cluster driver alignment.

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reproduction of the sonic picture, we've built in a 4 times digital oversampling filter and D/A converter system. This results in flat frequency and  $\pm 5^\circ$  linear phase response from 20 Hz to 20 kHz.

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