

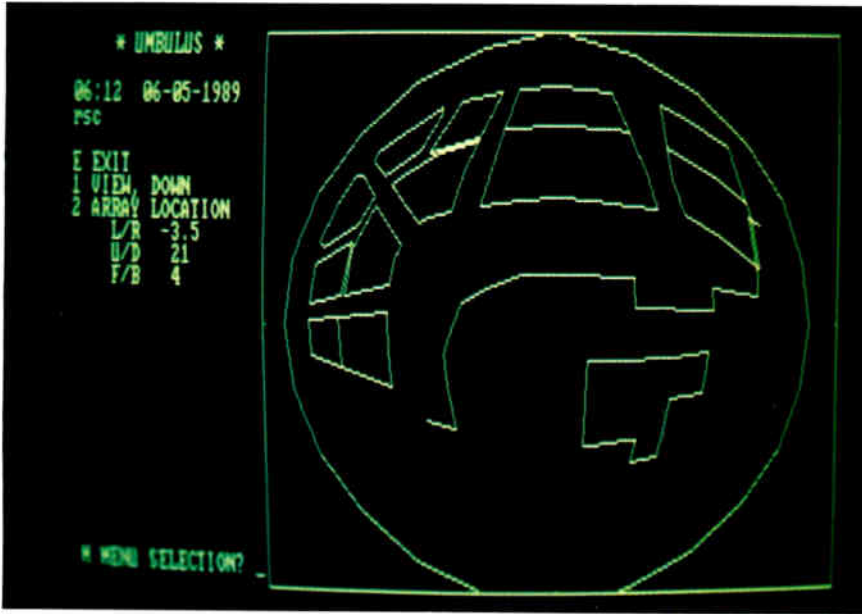
SOUND



COMMUNICATIONS

Volume 35 Number 6

June 24, 1989



UMBULUS

In this month's software review, we examine the Umbulus Array Design Program from North Star Sound. Umbulus (consisting of two separate programs, Room Mapper and Array Builder) is a powerful engineering tool that will guide both the experienced engineer and the junior technician in creating designs that are at least the equal of, and typically superior to, those produced on more graphically sophisticated program. We explore the pros and cons of this unique program.

40

INTERPRETING SPECIFICATIONS: NOISE

Some types of noise are useful as test signals for calibration of electronic equipment or frequency response alignment of speaker systems. Other types are unwanted, and of no value for any practical purpose, they can be annoying and can damage equipment. We explore various types of noise, interpretation of output noise specifications, and more.

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EQUALIZATION AT THE GRAMMY AWARDS

The Grammy Awards show presented some unusual challenges for Burns Audio of Sunnyvale, California: it required producing a well-mixed live air feed for over 70 million home viewers, at the same time producing a live house mix for an audience that includes some the most talented performers and engineers in the industry. And because it was a TV broadcast, loudspeakers and mics had to be placed with great care and sensitivity, so as not to block camera angles, lighting equipment, or set pieces. While the situation is far from ideal for the live sound engineer, no excuses will be accepted for poor sound quality. With teamwork, and a little help from



l equalization

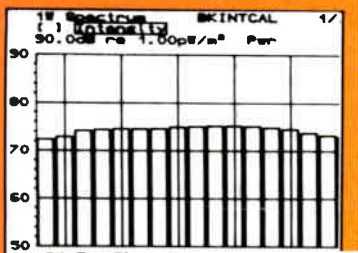
069C ns Audio met

R2 s with great

28

ACOUSTIC MEASUREMENTS

The limits of recording have been based, in simplified terms, on noise floor, dynamic range, frequency response, speed accuracy, phase response, and portability of the recorder. But newer recording technology is becoming available: we evaluate the (DAT) recorder in acoustic



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DeltaMax is brought to you by the same company that invented a variety of better mousetraps for the audio world, including constant-directivity horns and the world's first neodymium compression driver, the N/DYM® 1.

Give us a call today for more information and engineering data sheets.

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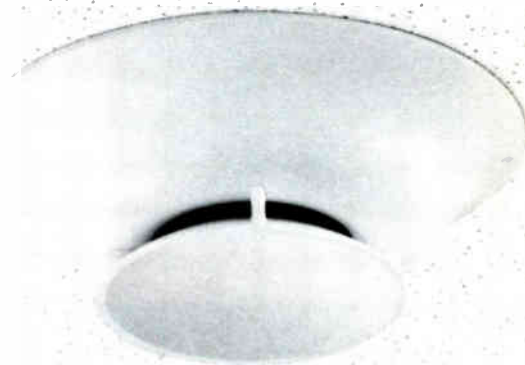


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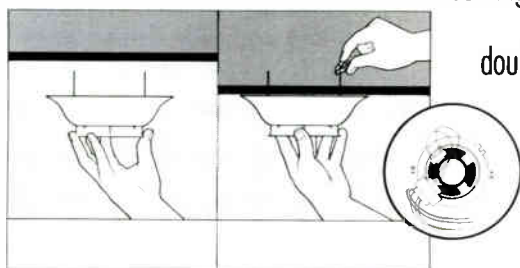
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The QM-300 Speaker Has An Unholey Advantage.



While conventional speakers require that you cut a hole in the ceiling, GEMCO's new QM-300 speaker puts a ceiling on your installation time and costs.

Here's how it works: The two steel mounting posts simply insert through most popular lift-out ceiling tiles, then secure the QM-300 in place with the Push-n-Lok mounting system. The mounting posts double as speaker leads, and the clips provide sure, positive contact.



The QM-300 is lightweight, too. So you won't have to worry about panels sagging. And, if the system ever has to be taken out or moved, there are no tiles to replace. For a complete listing of available sizes and features, call or write GEMCO today.

**MADE IN THE
USA**

To install, simply puncture ceiling tiles with the mounting posts. Then secure in place and connect speaker leads with our Push-n-Lok retaining clips. To remove, reverse procedure.



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FEATURES

22 How To Read And Interpret Specifications, Part Two: Noise

By Gary D. Davis and Ralph Jones

Some types of noise are intentionally created for use as test signals. The other types of noise are basically unwanted, can be annoying to the listener, and may actually be damaging to your equipment. We examine the uses of noise, and the interpretation of output noise specifications.

28 Equalization At The Grammy Awards

By Mike Klasco

Burns Audio, Sunnyvale CA, was faced with some unusual challenges at this year's Grammy Awards Show. Using advanced equalization techniques, these challenges were met with great success.



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34 DAT Recording Of Acoustic Measurements

By Steven J. Orfield

The limits on the recording of acoustic measurements have been based in part on the limitation of the recording instruments used. But newer recording technology is becoming available: we evaluate the use of the Digital Audio Tape (DAT) recorder in acoustical measurement recording.



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40 Software Review: Umbulus

By Mike Klasco

The Umbulus Array Design Program from North Star Sound consists of two programs: Room Mapper and Array Designer. In part one of this review, we examine Room Mapper, a powerful tool unmatched in stimulating an instinctive feel for good sound system engineering.

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By Dr. Wilhelm Wokka

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Coming in July. . .

The second part of our review of North Star Sound's Umbulus Array Design Program. With articles on sound intensity measurements, production intercoms, our NSCA wrap-up. . . and much more. Don't miss it!



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Prepare to expand your horizons. With the Yamaha DEQ7, the completely digital equalizer. With not one but 30 different EQ and filter configurations, in stereo.

To be specific, it has 11 graphic EQs, four parametric, three tone configurations, five band pass/band reject filters, six dynamic filters and one multi-notch filter configuration, plus up to 738 ms of delay per channel.

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Like memory. The DEQ7 has sixty user-programmable memory locations, so you can store and title your favorite curves, and recall them any time manually or via MIDI. There are digital I/Os for direct connection to other digital components, as well as analog inputs and outputs.

Since we're on the subject of output, it's equally important to mention that, in the opinion of many critical users, the DEQ7 produces an open, natural-sounding EQ. Which means that you can create extreme EQ settings without creating extreme anxiety.

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Maybe we should give away our products. And sell our service.

The thought has occurred to us more than once. Not that Quam products aren't worth the money. They are. We build some of the best-made, most innovatively-designed loudspeakers, baffles, backboxes and accessories in the industry. But we know you can buy adequate product elsewhere.

What you can't buy elsewhere is our service. Beginning with a factory inventory of 70,000 catalog items, with same-day factory assembly of 3450 different loudspeaker, baffle and transformer combinations. And shipment of your order within 24 hours—without exception and without backorders—so you can have the Quam products you need, when you need them.

We manufacture and stock not only a dozen different 8" models, but the hard-to-find loudspeakers as well. With Quam, you have a wide choice of speaker sizes and configurations—from 2" and 5" intercom speakers to 3" outdoor

speakers to 12" coaxial foreground speakers—that are standard items ready to ship, not specials that make you wait.

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And, wherever you are, there's a Quam representative close by, knowledgeable and helpful. This national capability is worth something, too.

It's hard to put a price on this kind of complete service, so we'll continue to give it away to the sound contractors who buy our products. They know what a bargain they're getting!

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NEWSLETTER

RING BROADENS ITS SERVICES

Ring Communications, Ronkonkoma, NY, well-known as a supplier of intercommunications products, recently announced it would begin distributing the Clarity line of amplifiers, loudspeakers, transformers, and mics.

The new strategy is a result of Ring's change in ownership last October. Peter McLean, company president, has been planning an expansion of the company's product offerings for some time. While the main thrust of Ring's marketing efforts will remain the RingMaster intercom, the company plans to build a complete new product line over the next 18 months.

RAULAND-BORG'S NEW HOME

The Rauland-Borg Corporation has relocated its manufacturing facilities and corporate offices from Chicago to Skokie, a suburb north of the city. The 140,000-square-foot facility allows the company to consolidate manufacturing, engineering, research and development, marketing, and administrative offices in one place.

TECHTRONICS FORMED

A new sound, light and video contracting company, Techtronics, recently took over Ethereal Concepts (Dayton, OH). Techtronics will continue to support all of Ethereal Concepts' products. Techtronics mainly provides sound reinforcement services, including consulting, sales and contracting. The company's address is 754 46th Ave., San Francisco, CA 94121; phone (415) 750-0431.

MCS' NEW BASE

Mircom Communication & Security Inc. moved its facilities recently. The new address is 429 Alness St., Downsview, Toronto, Ontario, Canada, M3J 2H4; phone (416) 665-4301, Fax (416) 665-2825.

QUEBEC COMPANIES REGROUP

Multi-Vox Ltd. and Telesysteme National LTEE (Televox Division) recently regrouped and are operating under the name Maxivox Inc. The intercommunication company has its head office in Quebec.

IN QUEST OF PRO AUDIO AND LIGHTING

Quest Marketing was recently formed to market and distribute pro audio and lighting products in the U.S. and Europe. Marketing director Scott Berdell is located in the Boston area, and is responsible for managing all sales and marketing activities, as well as contacts with manufacturers. Financial director John Kafer is located in Atlanta and will handle finance and operations.

TWETEN ELECTED

Carver Corporation (Lynnwood, WA) has announced the election of Len Tweten of Magnolia Hi-Fi & Video to its board of directors. Tweten began the business that was to become Magnolia in 1954. Last year, sales for the company were approximately \$50 million.

VME BOARD HAS PRO SOUND APPLICATIONS

SPECTRUM Signal Processing Inc. (Waltham, MA) has just made a board available for the VME Bus based on Motorola's 56001 Digital Signal Processor. The board provides access to the 56001 digital signal processor in a self-contained "system on a board"—which includes data acquisition and the choice of either VME Bus Master or Slave. Richard Doucette, product marketing technologist, says that the board has pro digital audio and graphic equalizer applications.

NEWSLETTER

ERA ELECTS OFFICERS FOR 1989-91

New officers who will direct the activities of the Electronics Representatives Association (ERA) were elected to two-year terms recently. ERA's new chairman of the board is Russell Diethert, co-owner of LTD Technologies (Itasca, IL); the new president is Joel H. Schwartz, president of L-C-A Sales Company (Tuckahoe, NY). The four ERA members elected to the association's four senior vice presidencies are: senior vice president/fiscal and legal—Robert J. Groh, owner of Groh Associates (Irvine, CA); senior vice president/industry, principal and government relations—Glenn R. Alverson, president of Hilltronics, Inc. (Royal Oak, MI); senior vice president/education—Timothy H. Eyerman, vice president of Cetech Electronics Corp. (Potomac, MD); and senior vice president/membership—David W. McCoy, president of Cartwright & Bean, Inc. (Norcross, GA).

RUPERT NEVE JOINS AMEK

Rupert Neve has joined AMEK Systems & Controls Ltd. (Salford, UK) to develop a new and advanced range of equipment. He will also make some circuit enhancements in the existing AMEK line.

EDGE DISTRIBUTION RELOCATES

Edge Distribution Corporation has moved from New York City to larger facilities in Millbrook, New York. The move is an interim step in the consolidation of the administrative and service functions of Edge Distribution Corporation and its Boston-based parent company, Edge Technology Group Inc.

MFS WITHDRAWS FROM ASSOCIATION FOR LOCAL TELECOM SERVICES

Metropolitan Fiber Systems, Inc. (MFS, Oakbrook Terrace, IL) recently withdrew from the Association for Local Telecom Services. Company spokespeople cited differences in business philosophy, interests, and goals as the reason for the action.

REP NEWS

Tony Vespoli of Vespoli Entertainment Services in Ashtabula, Ohio, has been named Midwest representative for Celco's Elektralite Division. Also, Elektralite has been appointed the exclusive U.S. distributor for Lynx Lighting, U.K., manufacturer of the Tube, Synchro-Scan, and Synchro-Spin lighting products. Lynx also manufactures elevator and swing platforms.

Peirce-Phelps, Inc., Audio/Video Systems Division (Gaithersburg, MD) has been appointed representative for Sony Broadcast Products for Maryland, Washington, D.C., and northern Virginia.

North Shore Marketing (Seattle, WA) was recently honored by Audio-Technica's "Order of the Samurai" award, an annual distinction that recognizes excellence in the sales and marketing of Audio-Technica products. The award was presented by Audio-Technica president Jon R. Kelly to North Shore's Lew Barrett and Ferd Boyce. North Shore Marketing covers the Pacific Northwest territory for sales of Audio-Technica's pro products in broadcasting, MI, recording, and sound contracting markets.

Bolt Beranek and Newman Inc.'s (BBN) architectural acoustics and environmental technologies group has recently become Acentech Incorporated, a subsidiary of BBN Systems and Technologies Corporation. Acentech has been selected to provide noise and vibration consulting services for the Argonne National Laboratory's photon source particle accelerator research facility.

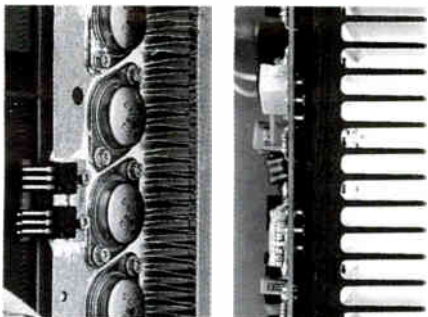
Warning: To Avoid Risk Of Shock,



Ignore This Amp-To-Amp Confrontation.

Let'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.



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

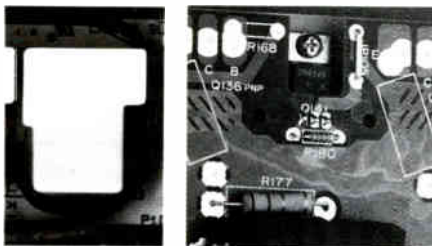
If the MacroTech heat exchanger reminds you of an air conditioner, you've grasped its design. This approach works, at least until dust and dirt clog the fins. But as soon as the air flow slows or stops, temperature rises. Soon after that, the Crown shuts off — it could even fail.

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

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.

REAL SPEAKER PROTECTION

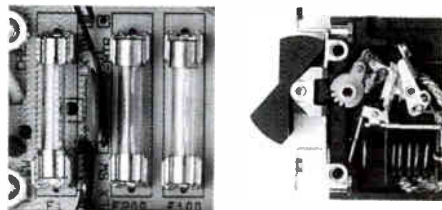
Most amps today are direct coupled, so a blown output transistor (the most common failure) connects the power supply directly to the speakers. Earlier MacroTechs had no protection against DC. Now Crown has learned their lesson — or have they? The sensing circuit and relay they now use shuts off the power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



Left: 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.

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.



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.

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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BENEFITTING FROM TRADE ASSOCIATION MEMBERSHIP

by William G. Little

From time to time you are no doubt exposed to a membership pitch from a trade association, chamber of commerce, or some other business-oriented group that seeks to convince you of your duty and obligation to support the organization's noble work by putting up some of your hard-earned dollars. If this appeal to your better nature is adequate to get you to whip out your checkbook, I honor your generosity of spirit, but you are entitled to get more for your money than the warm glow of knowing you are doing a good thing.

Over the years, I have been active in numerous trade associations, and the more I involve myself in these endeavors, the firmer I grow in the conviction that trade association membership is a bottom-line decision. And I believe that membership in a good association will almost always be cost effective for those who participate actively.

But what about those who only pay their dues? They may find it harder to measure the bottom-line result, but good trade associations do deliver ROI for their passive members as well as their active ones.

Obviously your greatest ROI comes

Little, president of Quam-Nichols Company, was recently elected chairman of the 1200-member Electronic Industries Association, the pre-eminent organization for electronic manufacturers.

from attending meetings, programs and conventions, and reading the materials the association publishes. Statistics, market data, trend analyses, and case histories are the meat and potatoes of most trade gatherings and association house organs. Active involvement, however, also lets you reap the yields of networking, getting the benefits of idea exchange,

'Membership will almost always be cost-effective for those who participate actively.'

gaining insights on how to solve your problems by learning how other people solved theirs and developing close personal contacts with potential customers, suppliers, consultants and colleagues.

Trade associations provide small businesses with economies of scale, so they can carry out projects as part of a group that would be financially im-

possible individually. Whether it's a special seminar or such other economic advantages as group insurance programs or mass purchasing plans, you have a payoff. Even when you don't buy through the plan, your association has helped you with comparison price shopping, and has given you a negotiating lever with your local suppliers. Sound contractors gain many such opportunities through their membership in NSCA.

What about the indirect benefits—those that help the person who can't find the time to participate? First of all, your association helps focus and define the marketplace. Again, NSCA is a case in point. Ten years ago, commercial sound vendors and installers alike "enjoyed" stepchild status on the margins of other peoples' trade shows. Neither group had a forum for resolution of common-core internal or external problems. Then NSCA was organized by a small group of contractors with vision, with the encouragement and support of association-oriented manufacturers who were active in EIA, representatives who were active in ERA, and with a launching pad provided by EDS and the Electronic Industry Show Corporation.

This teamwork not only created a foundation for a dynamic new trade association and for your show and conference, but created daily benefits for you from the definition and identification that NSCA has provided to the

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could have a curve to match!

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

UniPoint Technology at Work

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



response so vital to natural sound reinforcement.

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Less Noise Two Ways

By using a very low-mass diaphragm and a case heavier than the others, we sharply reduced sensitivity to mechan-

ical noise. The electronics are audibly quieter as well – a tremendous advantage in typical boundary microphone applications. We also include a low-cut switch to help control acoustic room noise. The AT871 can be powered by an internal battery or from 9-52VDC phantom power.

Effective Problem Solver

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



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contracting function. Vendors, representatives, distributors, and customers today have a better idea of who you are, what you do, and the importance of your activities. This helps directly in your purchasing, your planning, your recruiting, and your marketing. Your association has helped you interpret yourself to the people with whom you interact.

One of the most important aspects of an association's work is representing an industry's interest in the halls of government—whether in Washington, in your state capitol, or in city hall. With the growing complexity of doing business in global markets, your association's capability to provide a voice for the industry and a vehicle for concerted action becomes a significant contributor to your ability to compete

and to accumulate capital.

Working in an association provides you with an opportunity for personal growth, as you meet the challenges of

'Your association helps focus and define the marketplace.'

interaction with peers, suppliers, legislators and bureaucrats. Moreover, you heighten your own visibility and that of your company. . . another hard-

to-measure benefit that nonetheless reflects on the bottom line.

So I return to the point with which I started—trade association membership is a bottom line decision. Your association must show you that it is operating effectively on your behalf. The electronics industries, including the commercial sound segment, have been fortunate to have such associations—the Electronic Industries Association, National Sound and Communications Association, Electronics Representatives Association, to name but three. Or perhaps we have been fortunate to have bottom-line oriented entrepreneurs and corporate leaders, who have recognized the benefit of effective associations, and have demanded that their associations be effective! ■

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CONSIDERATE.

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THOUGHTFUL.

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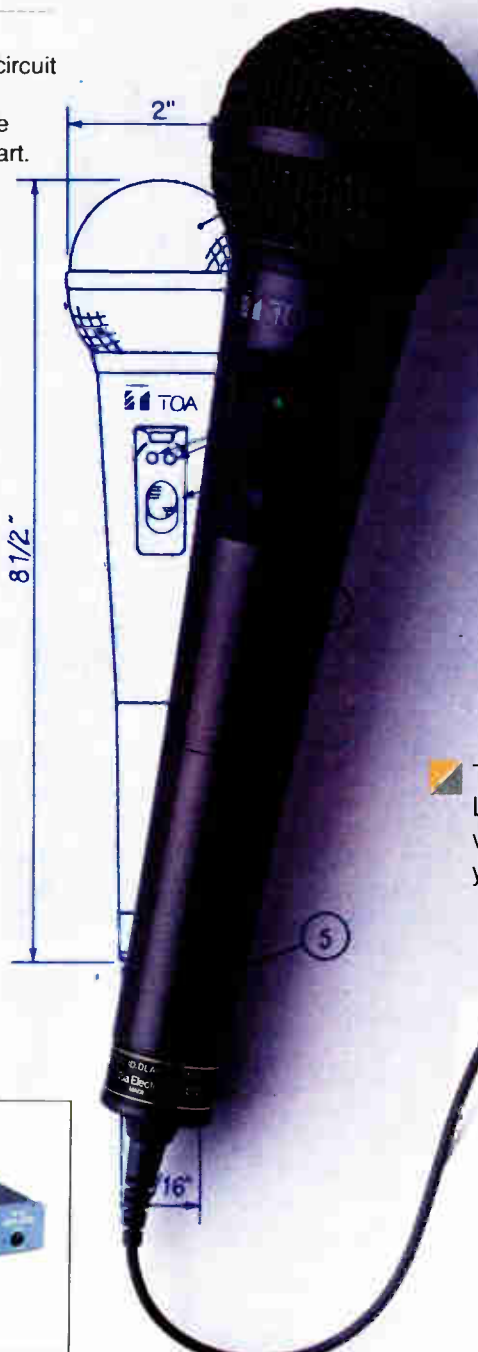
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Ask Dr. Wokka

by Dr. Wilhelm Wokka

Editor's Note: Each month we look forward to receiving Dr. Wokka's column, typically written in black marking pen on the inside of an unfolded and carefully dried half-gallon chocolate-milk container. This month, instead of the usual manuscript, we received a disturbing package: an envelope from the Tydee Nytee Motel in Akron, Ohio, containing only a single C-90 Rite Aid cassette tape. As you will see from the following transcript of that tape, it would appear that Dr. Wokka is in some kind of danger. There is a possibility that we here at Sound & Communications will share that danger by printing this, but we refuse to be silenced by intimidation.—B.I.

Dr. Wokka: "This is Dr. Wilhelm Wokka of the Philadelphia Medical College Of Musical Knowledge. The cassette tape you are listening to is of national importance. Please forward this immediately to Bill Intemann, care of *Sound & Communications*, Port Washington, New York. Do not listen any further or you may find yourself involved with a ruthless international organization of murderers and criminals. Just stop here and send the tape.

[Pause.]

"Well, Bill, I'm here all alone in some motel room in the middle of nowhere. I know I am being followed—I can feel it. And I know that the information I was going to reveal in this column is the cause of it all, so the best I can do now is recite the information into this cassette recorder, little Willie's *My First Sony*, and hope that you receive this

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

tape. I'm scared to death of what might happen to Blanche and the kids back in Philadelphia, not to mention what might happen to me. My family should be pretty safe, though; they're staying with Aunt Norma, and she owns more guns than the Camden National Guard Armory. I only hope this doesn't get you involved to the point where they come after you. Well, I guess I'd better tell you what's going on here.

"When I announced the topic of my upcoming column 'Analog Versus Digital; God Versus Satan,' I had no idea how devastating the consequences would be. First, a compact disc soaked in the blood of some poor wretched animal was nailed to our front porch. Then Blanche began receiving threatening phone calls, warning her to leave me if she wanted to avoid 'guilt by association.' And, as if that wasn't enough, a cross was burned outside the Medical College, a cross made from hundreds of 3.5-inch 720 KB floppy discs. Attached to the cross was the packing carton from a Mitsubishi 32-track digital recorder, with the words 'Stay Away' scrawled on it.

"I began putting two and two together when I started up the old Citroen 4CV one morning and a cassette tape in the Wollensak started playing automatically: 'THE GODS OF DIGITAL HAVE FOUND YOU GUILTY OF BLASPHEMY AND YOU MUST DIE!' That's when I got on the old JAWA motorcycle and left town, after telling Blanche to grab the kids and head for Aunt Norma's.

"So sharpen your pencil, Bill; I am entrusting to you the task of getting this message to my dear readers. Here goes:

"Brothers and Sisters, the *Big Choice* is coming and you'd better be prepared. Digital Audio threatens to take over our lives: research for the past thirty years at the Philadelphia Medical College of Musical Knowledge has shown conclusively that the compact disc and the DAT is the work of the Devil and his accomplices. Reactionary drivel, you say? Not so.

"Digital coding of music involves turning it on, recording a level, turning it off, and so on. Have you ever listened to music at a party and had an inconsiderate guest mute the system, say his piece, then unmute it and let the music continue? This is literally what happens in the production of a digital recording. Making a digital recording involves turning the music on and off continuously as data streams out of the storage medium. Now picture your obnoxious guest turning your music on and off more and more rapidly. What was once a singular annoyance now becomes a continuous one. Moreover, the repetition makes each interruption even more annoying. However, as the rate the music is turned on and off becomes increasingly more rapid, Audiosonical Scientists will tell you that you 'don't notice it any more.'

"A lot of you have swallowed this hook, line, and sinker, judging from the proliferation of CD's and CD players in our society today. What actually happens is that you are so continuously annoyed by all this that you get numb to it, sort of like when a prize fighter gets hit in the face too much. But you love the music and continue to listen to it in the numbed stupor caused by getting annoyed at the rate of 44,100 times a second!

Once upon a time

This was a movie
soundtrack.

And this was
an amplifier ↑

In their day, they were the state-of-the-art. The theater organ (or piano) provided all of the sonic textures required to completely involve an audience with the film on screen. The megaphone was reliable, but its limitations quickly became obvious. Its frequency response was rather limited, and its direct dependence on input level made it usable only by oral athletes. With man's undying need to expand his ears' horizons, the film soundtrack came to replace live accompaniment. Sound reinforcement came to span everything from audio in the home, to rock and roll in the arena. As the quality of these mediums grew, the need to surpass the limitations of existing amplification became apparent.

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DR. WOKKA

"The second part of it is even more hideous. Do you know what happens in the 'off' periods in between the adjacent 'on' periods? In each of these pauses, there are cleverly coded messages that you receive at the rate of 44,100 times a second.

"Shocked? So were we, but not as shocked as when we actually deciphered some of these messages on our *Audiophonical Spectrovarial Context Analyzer*. Here are just a few examples:

"Love is digital...Tap your speaker cones...Bad sound is good enough...This music is not annoying...Dr. Wokka is a fool.

"Well, it goes on and on and gets much worse, with messages imploring us to buy all sorts of consumer products. That's right, these messages are responsible for the intense craving that Americans have for sweets, beer, and cigarettes. Not only does digital sound rapidly annoy the listener into a stupor, but it is the medium for a powerful, international, and illegal Satanic advertising ring which is covering the earth with its sinister plan.

"And does this process take God out of music? You bet it does. Of course, every PMCMK student, professor, and graduate has had extensive training in musical theology at the Philadelphia Church of the Living Sound, and knows that music should not be interrupted. Digitizing interrupts all music on a continuously annoying basis. God's musical spirit is interrupted 44,100 times every second by Satan and his accomplices, and you get a digitally-encoded Satanic advertisement in every pause.

"Well, the other side must have found out we were planning to expose all this. Our offices were broken into and all our records destroyed. My two collaborators have mysteriously disappeared. I know that the data can be duplicated, but only three people in the world know about this. Who knows what our pursuers have in mind for us? But this heinous plot must be exposed. Digital recordings have to be made safe for good people; the technology has to be controlled and...wait, I think room service is here with my dinner...hold on."

[A door opens, then several voices are heard shouting at once, followed by what sounds like a fierce struggle, the door closing, and silence. After a short time, we hear another voice on the tape, apparently the real room service waiter.]

Waiter: "Room service. Hello? Anyone there? *[Door opens]* Hello? Funny, he musta split. Well, I'll just leave his Twinkies and Tuna Jello over here by the...hey, he left his tape player on. I wonder what..."

[The tape stops here. Apparently, the waiter must have listened to the tape and passed it along to us per Dr. Wokka's instructions. —B.I.] ■

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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.

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*IEQ Video Monitor Features

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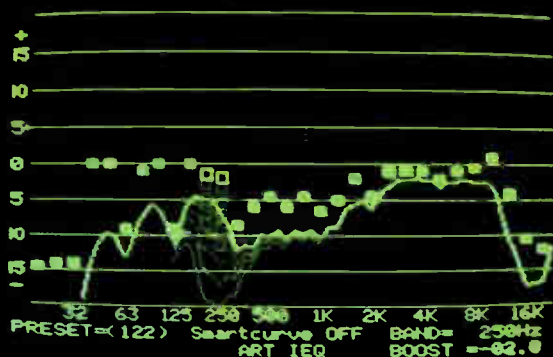
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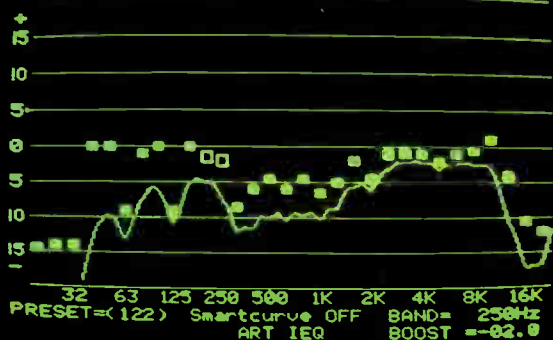
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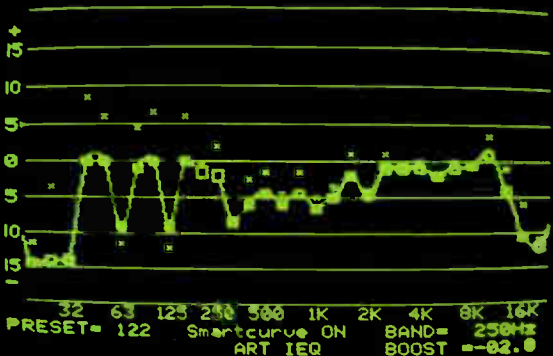
1 See the Sound

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

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HOW TO READ AND INTERPRET SPECIFICATIONS, PART TWO: NOISE

BY GARY D. DAVIS & RALPH JONES

Assuming one is listening to relatively good headphones or loudspeakers, the noise that one hears when a high quality amplifier's gain (or level, or volume) control is turned all the way up, with no input signal present, is known as white noise. White noise is unfiltered, unaltered thermal noise.

When the energy content of a white noise signal is averaged (integrated over time), it will be found to contain equal energy per Hz. What does this mean?

If one measures a 100 Hz wide "window" between 100 Hz and 200 Hz, and then again between 1,500 Hz and 1,600 Hz, or 10,000 Hz and 10,100 Hz, the amount of energy will be exactly the same in each case. Plotting the power of white noise, with respect to frequency, will

result in a 3 dB per octave buildup in level as the frequency rises, as shown in Figure 1. Why is this so? When we say the energy rises 3 dB per octave, we have to consider what an octave is. It is a doubling of the frequency. From 20 Hz to 40 Hz is one octave. From 100 Hz to 200 Hz is one octave. From 4,000 Hz to 8,000 Hz is one octave. Notice that as the frequency rises, there are more actual Hz in each octave: 20 Hz in the octave between 20 Hz and 40 Hz, compared to 4,000 Hz in the octave between 4,000 Hz and 8,000 Hz. We have stated that white noise has equal energy per Hz. That means that if there are more Hz in a given octave, there will be more energy in that octave. That's why white noise shows a 3 dB per octave increase.

There are noise generators that will produce white noise. Lacking one, you can get a pretty good facsimile of it by adjusting an FM radio so it is not tuned to any station, and turning off its muting circuit; the resulting hiss is basically white noise.

White noise can be used to calibrate electronic equipment. It provides a signal with which to measure levels, and it drives the circuitry at all frequencies simultaneously. However, it is almost never used for testing loud speakers, as explained in the following text.

Pink noise is white noise which has been modified with a pinking filter (really). Such a filter is nothing more than a 3 dB per octave roll-off that commences at a sub-audio frequency and continues to reduce the level as the frequency goes higher and higher. In essence, it nullifies the 3 dB per octave rise in energy of the white noise signal to create noise which has equal energy per octave.

Since pink noise has equal energy per octave, it is more useful as a loudspeaker test and calibration signal. For one thing, it makes it easier to get a "flat" plot on a 1/3-octave real time analyzer, since the level will be uniform with respect to the octave scaling. However, there is a more important reason to use pink noise.

Musical programs typically have much more energy at low frequencies than at higher frequencies. The very highest octave in a sound system is driven primarily by harmonics of musical notes, and most of these are at a considerably reduced level relative to the fundamental. Were white noise to be used as the test signal, it would

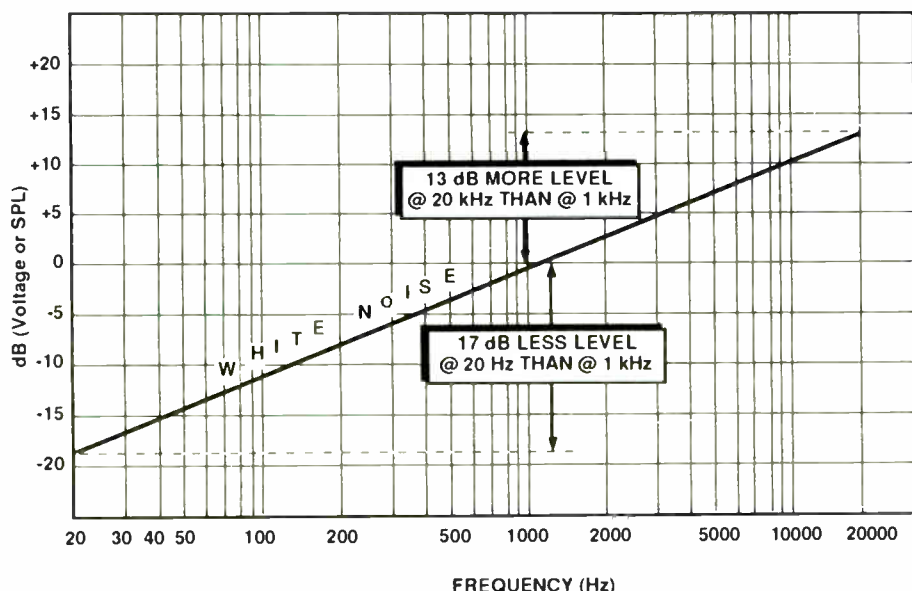


Figure 1: White Noise Energy vs. Frequency

be delivering far more energy to the high frequency drivers than to the midrange or low frequency drivers. This would be a very unrealistic test and would tend to burn up a lot of tweeters without making the woofers work very hard at all. Pink noise is balanced to more closely simulate the kind of signals the sound system will actually be required to reproduce.

This series of articles is about specifications, which means it's also about testing. If you read a loudspeaker power specification and it states that noise was used as a sound source, that noise has probably been "shaped"—that is, it has been filtered in some way.

Pink noise itself is a "shaped" signal, shaped by the pinking filter. However, true pink noise (or white noise) will have unrestricted bandwidth, and it really doesn't make sense to feed a given driver frequencies that are beyond its intended range of operation. That only causes excess heat (at higher frequencies) and excess diaphragm excursion (at lower frequencies).

To create an appropriate signal, then, the noise is subjected to further bandpass filtering. If a woofer is being tested for power handling or sensitivity and is intended for use in the 40 Hz to 500 Hz range, then the noise source should be shaped with a 40 Hz high pass and a 500 Hz low pass filter. It is important to note not only the frequencies, but also the slope rates of such filters, since this all affects the specified performance.

Some manufacturers use specially created filters to shape the noise, often with reasonable justification. It is important, when comparing specs, to examine

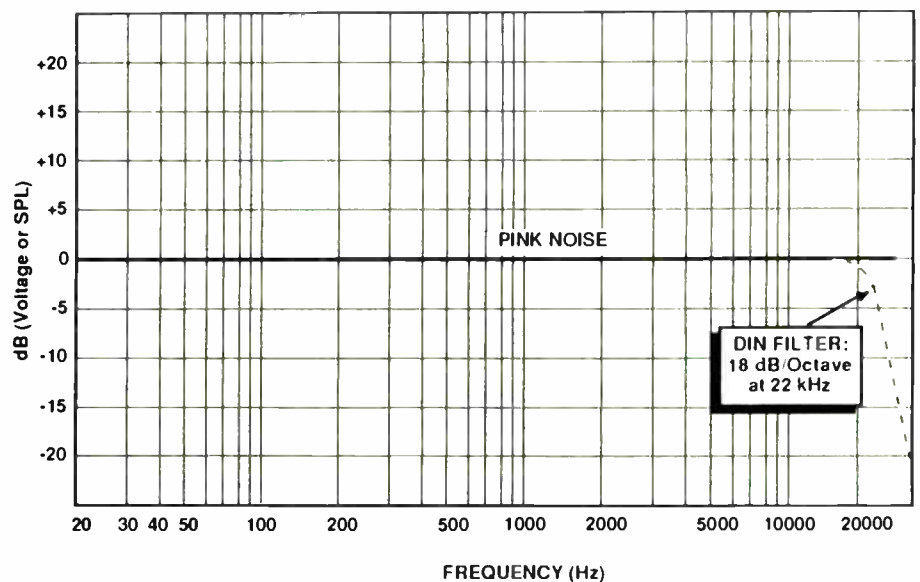


Figure 2: Pink Noise Energy vs. Frequency

the filters that were used on the noise. (Unfortunately, some manufacturers measure woofer sensitivity in the 1 kHz to 2 kHz range, which makes the numbers look better, but is worthless since the units are "beamy" at those frequencies and are used at much lower frequencies.)

Using noise as a test signal is one thing. Finding it at the output of a mixing console, a signal processor or a power amplifier that is supposed to be *quiet* is quite another matter.

In circuits that have microphone inputs, one common specification is the Equivalent Input Noise, abbreviated EIN. This is a measure of how quiet the mic preamp really is—except it's measured at the device's output: typically at the output of a mixing console. To determine the EIN,

one actually measures the noise at the output then subtracts the amount of amplifier gain. However, the math is a bit more complex than simply measuring so many dBm at the output and then subtracting so many dB for the gain. Typically, the measurement is done with a resistor connected across the input (usually 150 ohms) to represent the microphone and to keep out spurious signals. Calculations must account for the actual impedance of the input termination, as well as the temperature (remember, noise is thermally generated, so heat will affect it). The bandwidth of the circuit is also important, since the wider the bandwidth, the more overall noise energy will be present (as can be seen in Figures 1 and 2).

What is a good EIN spec for a mic pre-amp? Here we're in luck; there is a the-

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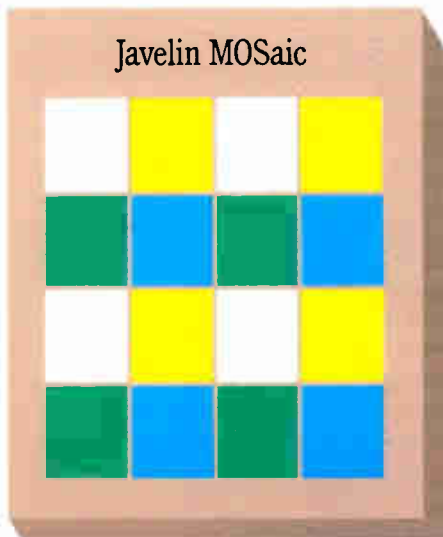
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oretically calculable minimum noise (the thermal noise of the resistor) below which no mic preamp will ever go. Given a 20 Hz to 20 kHz bandwidth and a 150 ohm input resistor, at 59 degrees fahrenheit, that resistor's theoretical minimum is -131.9 dBm. Notice that EIN should always be specified in dBm, since it represents the noise power.

If you see an EIN specified with the input shorted, beware. Such a specification makes no sense. For one thing, what good is a mic preamp if its input has a dead short circuit across it? Wire, which has very little resistance, will generate much less thermal noise than a 150 ohm resistor, so the EIN will probably look a lot better than it should. The chances are such a spec was either measured by someone who didn't know any better (not a good omen in terms of the circuit design), or was measured by someone who felt the EIN spec was necessary for shopping comparisons, but who felt it necessary to improve the numbers that describe a noisy input.

(Note: Some differential amplifiers are specified with regard to "equivalent input wideband noise voltage." In this measurement, the input of the amp is shorted, and the output voltage is then divided by the DC gain of the amplifier. This type of measurement is not particularly applicable to audio equipment, however.)

Output noise is a useful specification for any electronic device. It accounts for all the sources of noise within the device: preamplifiers, filters, summing amplifiers, buffer amplifiers, solid state switches, power supply leakage and so forth. Particularly in mixing consoles, it is one of the most easily manipulated specifications, because so many things affect the output noise.

Here are four typical output noise specifications:

- a) **Output Noise:** Better than 90 dB below maximum output.
- b) **Hum and Noise:** Less than -70 dBm.
- c) **Hum and Noise:** Less than -85

dBm (20 Hz to 20 kHz).

- d) **Hum and Noise:** Less than -70 dBm (20 Hz to 20 kHz, one input level and one master level control at nominal position, all other level controls at minimum, input pad bypassed, 600 ohm input and output terminations).

Did you guess that these four specifications are all describing the same mixing console?

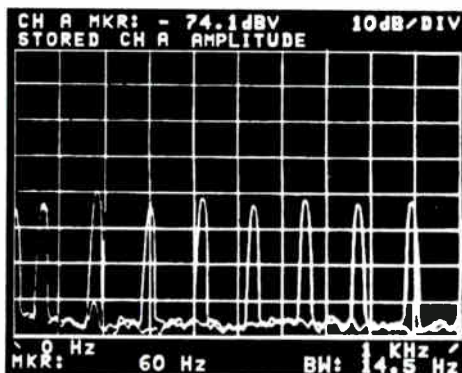


Figure 3: Frequency spectrum of noise induced by an SCR dimmer on a 60 Hz AC power line.

In (a), only output noise is cited, and we don't know if power supply hum was a component of that noise. A skeptical reader might assume there was considerable hum and that a notch filter was used to remove that hum so the noise figure would look better. This might hold up in court, but it is not exactly ethical (if intentional), and it certainly doesn't tell us much about real-world performance. So let's assume that it really is a hum and noise spec; if so, why is the figure 90 dB? Well, it's spec'd at 90 dB (or more) below the maximum output level. If the maximum output level is $+24$ dBm, this spec could be interpreted to be "Better than -66 dBm," which is really not as good as spec (b).

We really don't like spec (b) either, because it lacks essential information—like the bandwidth of the noise. If a 100 Hz to 10 kHz "shaping" filter were used ahead of the noise meter, a lot of hum

and/or high frequency hiss present in the actual output would go unrevealed by this specification. Once again, let's assume the manufacturer is not hiding something, and a reasonable bandwidth of 20 Hz to 20 kHz were used. There's still some important information missing, as illustrated by specs (c) and (d).

Remember, these specs all describe the same console. Why, then, does spec (c) claim to be 15 dB quieter than spec (b)? Here the bandwidth is given, and it is reasonably wide. Was it that spec (b) had a miniscule bandwidth? Not likely. No, a look at spec (c) suggests the answer; it has to do with where the console's level controls are set. You know that when you turn up the level, the noise generally increases—and usually the more channels you add to a mix, the more noise. Well, in spec (c), all the level controls were set at minimum, so the output was very quiet. But what good is a console with all the level controls shut down? In spec (d) we see one input and one master circuit contributing to the output noise, and we get a reasonable indication of true performance. We also are told that the input and output are terminated by (connected to) 600 ohms; we already know the termination can have a significant effect on the noise level from the EIN discussion.

Incidentally, the mere specification of a 20 Hz to 20 kHz noise bandwidth does not tell us how such a bandwidth was obtained. If very gradual filters are used, significant noise can be present above 20 kHz. For example, a 6 dB per octave roll-off would mean that at 40 kHz, a white noise source would have been attenuated only about 3 dB, since it rises at 3 dB per octave. Clearly, either a much steeper filter, or one that begins at a lower frequency, is called for.

Around 1974, Yamaha began measuring noise with a special filter because, at the time, there was no standard noise filter for testing mixing consoles and other electronics. By selecting a -6 dB per octave low pass filter with its knee (-3 dB point) at 12.47 kHz, they obtained the equivalent high frequency noise energy to an infinite

SPECIFICATIONS

dB per octave "brick wall" filter set at 20 kHz. The resulting noise measurement, then, was intended to give more meaningful results relative to the range of human hearing.

You may recall we briefly cited hum, buzz, static and popcorn noise at the beginning of this

article. These are all types of noise and are seldom specified. Hum is generally the result of leakage of AC power line energy into the audio circuit. It may be caused by a poorly isolated power transformer, a power supply problem, or indirectly by electro-magnetic coupling of AC magnetic fields into cables or other components. It can be caused by excess harmonic distur-

tion on the AC line itself. While AC power lines are normally 60 Hz in the U.S.A. (or 50 Hz in some other parts of the world), hum is comprised primarily of sine wave components at 120 Hz, 180 Hz and other harmonics of 60 Hz (or 100 Hz, 150 Hz, etc. for 50 Hz power lines).

Buzz is similar to hum, but contains harmonically related noise energy across the audio spectrum, including high frequency energy. It is often caused by SCR dimmers (silicon controlled rectifiers) that "chop" the 60 Hz AC power line sine wave; the resulting steep wave form is the cause of harmonic distortion which readily couples into nearby audio circuitry (especially if the shielding and/or grounding in the system is not correct). An analyzer screen photo of SCR induced buzz is shown in Figure 3.

Static can be caused by distant lightning, by intermittent sparking of power lines, generators or electric motors or by radio frequency energy that enters the sound equipment and is rectified. The latter is also known as RFI, which is an abbreviation for "radio frequency interference."

Proper grounding and shielding, both within a given piece of equipment and for the overall sound system, go a long way toward minimizing problems with hum, buzz and static.

"Popcorn noise" is not obtained by placing a mic near a heated pan of popping corn, although it may sound similar. It is instead a sporadic, crackling sound that can be caused by internal breakdown within transistors, or by dirty patch-points or other connections. It should never be present in properly designed sound equipment that uses high quality components and is in good operating condition. ■

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

There are many ways to split a mic, but only one way is best

Jensen MB-series Mic Splitter Transformers

When you need to split a mic, you should use a transformer because it provides a balanced, isolated signal to the input of each mixer; none of the mixers' grounds need be connected to each other (via the mic cable) so ground-loop induced noise is easily avoided. There must be a Faraday shield on each winding so that the transformer will not provide a path for capacitive coupling of common mode noise.

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R-431 Graphic Equalizer (top) R-830 Graphic Equalizer (bottom)

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EQUALIZATION AT THE GRAMMY AWARDS

BY MIKE KLASCO

The television broadcast of the Grammy Awards offers some unusual challenges that are generally not present in most live performance situations. The first requirement is producing a well-mixed live air feed for over 70 million home viewers. And, because that audience of home viewers is a primary consideration to the producers of almost any television show, it is imperative that loudspeakers are located in such a way that

they do not block camera angles, lighting equipment, or set pieces. Podium microphones are generally placed in unusually low positions so as to be out of camera view. Unlike other shows of more general interest, the Grammy Awards feature the challenge of producing a live house mix for an audience that includes the most talented performers and engineers in the industry. While the situation is far from ideal for the live sound engineer, no excuses will

be accepted for poor sound quality. Any problems (such as feedback) that are heard over the air usually mean that the engineer or sound rental company will not be invited back the following year.

This year the Grammy Awards were held in the Shrine Auditorium in Los Angeles, California. The interior of this 6500-seat venue features a steeply raked balcony and large parallel, hard surfaces. The 100-foot wide stage is very popular



The Grammy Awards, 1989: 70 million home viewers, and a live audience of the industry's most demanding professionals.

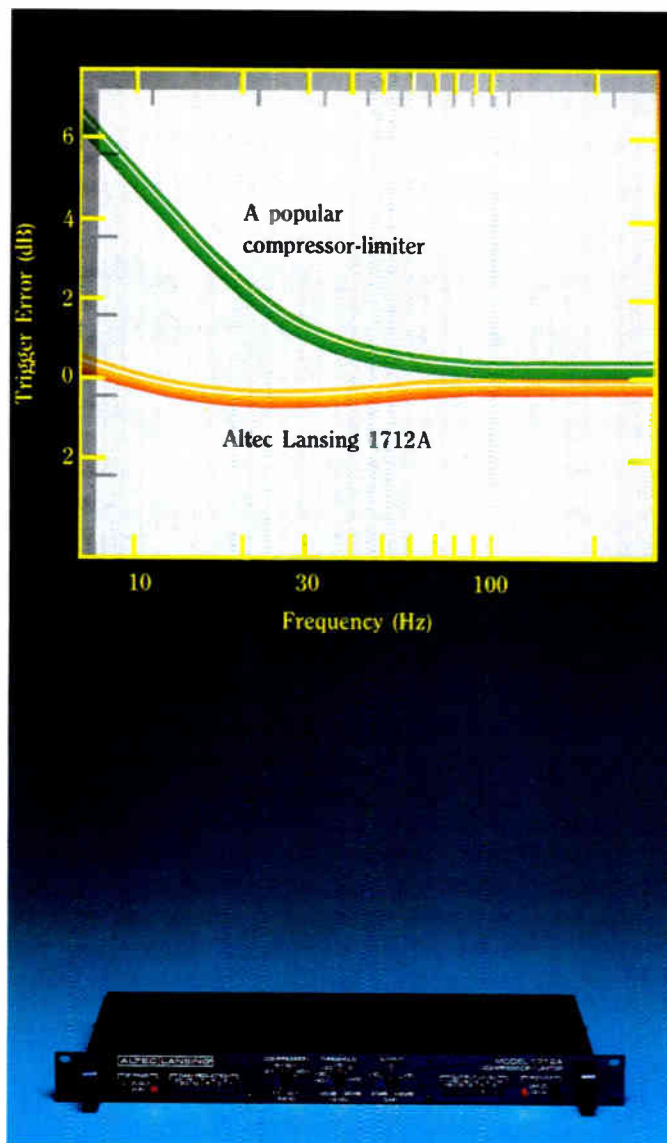
In compressor-limiters, peak reversion equals audible pumping. One major reason for dissatisfaction with limiters in sound systems is the way many of them initiate limiting action at inappropriate times: they change the sound level unexpectedly, when the signal dynamics don't require it. This false triggering is called pumping, and is very audible.

The problem of audible pumping is a complex one, and its cause is often not apparent on the test bench. It is sometimes impossible to duplicate the triggering heard in dynamic sound system use, with tones or with pink noise. And yet the pumping goes on.

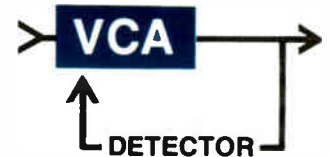
Altec Lansing research has discovered the cause of pumping in many contemporary limiters, and prevented it in the new model 1712A.

Compressor-limiters use detector circuits that monitor the envelope of the audio signal passing through. Limiting action is controlled by this detector. Not only must the frequency response of the audio circuit in the limiter be flat, but the detector itself must have a flat frequency response. Otherwise, it would trigger limiting action at different levels for different frequencies. If the unit is excessively sensitive at some frequencies, signals at levels that the limiter should ignore cause unwanted action.

The popular limiter shown in the graph has an excellent frequency



response for the audio signal passing through it. However, its triggering is more sensitive at all frequencies below 100 Hz, and 5 dB more sensitive at 10 Hz. It has reverted from r.m.s. to peak detection: peak reversion. Who cares about 10 Hz? You will, if subsonic junk is making your limiter attenuate all frequencies at unexpected and unwanted times.



When envelope detection comes after limiting action, tracking accuracy suffers.

Altec Lansing engineers also decided to control the limiter by detecting the incoming signal. Many limiters detect the signal after their own limiting action. These limiters must detect tenths of decibels to control tens of decibels. The new Altec Lansing 1712A compressor-limiter uses the much more robust feedforward system.

In compressor-limiters, the benefit of peak reversion correction is reduced false triggering and audible pumping. The benefit of feedforward control design is greater tracking accuracy.

Fact.

In Compressor-Limiters Peak reversion = audible pumping



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World Radio History

with television producers, but combined with the relatively low weight-bearing capacity of the ceiling (after the large amount of television lighting has been installed) loudspeaker placement can be difficult. The sound system for this year's show was designed and installed by Burns Audio, Sun Valley, California. Burns Audio was very familiar with the Shrine, having handled dozens of shows in the auditorium in the past: it was due in part to their excellent handling of the American Music Awards that they were selected for the Grammy Awards project.

For the house system, Burns chose to hang three Apogee 3x3 speakers and two Apogee AE-12 dual 18-inch subwoofers on risers at either side of the stage. Along the front of the stage were four compact AE-3 speaker systems. A supplementary cluster was hung for the balcony. The Apogee speaker systems, powered by Crest 8001 and 4001 amplifiers, are electronically coupled to processors that provide frequency and phase equalization, electronic crossover, and driver protection circuits.

The house consoles featured the Yamaha PM 3000 and Ramsa 800 series boards. The rack contained a Lexicon PCM 70, a Yamaha REV 7, a couple of REV 5's, an SPX 90, and 14 limiters, mostly the dbx 160 series (along with a dbx de-esser).

The monitors were mixed on two Ramsa SR840 consoles whose outputs were fed to a Yamaha PM406 mixer that summed the outputs and fed the power amplifiers. The monitor rack included the dbx compressor limiters along with Klark Teknik 1/3-octave equalizers.

In an effort to obtain maximum sound pressure levels in the house and minimize the chance of feedback that would interfere with the on air mix, Burns Audio selected the CORREQT equalization system from Apogee Sound. "It was a key element for us to include an advanced equalization technique that would provide maximum gain at the podium and improve the overall sound in the house," said Burns Audio's Bruce Burns.

The CORREQT system utilizes a dual



The low weight-bearing capacity of the ceiling made placement of the Apogee loudspeakers a challenge.

channel FFT analyzer, over 60 channels of parametric equalization, and several measurement microphones placed in selected positions around the room. Ken Deloria, president of Apogee, explained: "We utilize a high resolution analyzer and use an arbitrary source such as the program output of the console as a reference source. Then we look at the signal we are getting from the various mics that we place around the room. The spectrum analyzer compares the two signals and derives the transfer function which is the frequency response of the system."

Narrowband modes appear on the response characteristic and can be cancelled out with a parametric equalizer. The room may be equalized when empty, and once the audience fills the room (or if the house temperature changes) the room can be readjusted. Since the test signal is the program, the process can be subtle enough not to disturb the performance. According to Deloria, Apogee is "working on automation and semi-automation of the process (following initial set-up) to enable long-running shows to take advantage of the system on an ongoing basis."

Murray Allen is president of United

Recording of Chicago, Illinois, has been affiliated with the Grammy Awards since 1973, and for the last decade has been the show's sound designer. Allen was enthusiastic about the sound at this year's show: "It was by far the best sound ever heard at the Grammy Awards and the best sound ever heard at the Shrine." And there had been more demands than ever on the systems this year: Allen had introduced a number of innovations, including surround-sound for the home viewing audience.

The podium mixer for the house was Steve Kibbons, vocals were handled by Rich Breen, and instrumentals by Pat Baltzell. The foldback was by Michael Abbott and Kevin Wapner. The CORREQT tuning was controlled by Ken Deloria.

Kibbons has been involved with the Grammy Awards in various positions with different companies for 13 of the last 15 years. The podium mixer has a very specific role at the show, handling the presenters and any special material (such as tape playback and scripts). According to Kibbons, the spoken word accounts for more than half of the show's content, and there are always problems with audibility

and intelligibility, particularly in cases where the presenter may not have a strong voice: "The audience always had to fight to hear, it's always a problem. This is the first year that [the system] didn't have to be pushed so the audience could hear. Even though speech is 60 percent of the show's content, the sound system used to be equalized only for music (using conventional equalization)."

Kibbons explained that last year's show was the first time a new type of tuning system was attempted, using the music rather than pink noise to flatten the response and filter out peaks. "The system worked," he added, "but there were conflicts over control of the sound between the mixing engineers and the tuning system operator. Sometimes the sound quality would shift. This year the rapport on the crew was excellent. Ken [Deloria]



Equalizing the system.

took the time to explain, and asked for opinions and participation." Working side by side with the crew, Deloria acknowledged real-world problems and pragmatic solutions and did not just go "by the book." The first few days of rehearsal were spent getting rid of the last vestiges of feedback, the last two days were spent tweaking the podium setup to obtain the best possible sound.

Pat Baltzell was the mixer for bands and orchestra. Baltzell is on the staff of Burns audio, and is an experienced sound system engineer as well as an accomplished mixing engineer. His primary concern was intelligibility in the room: "The first goal was not flat response, just no feedback. Podiums under clusters are always tough, and 60 percent of this show originated from the podium position, sometimes with the speaker two feet off-axis from the

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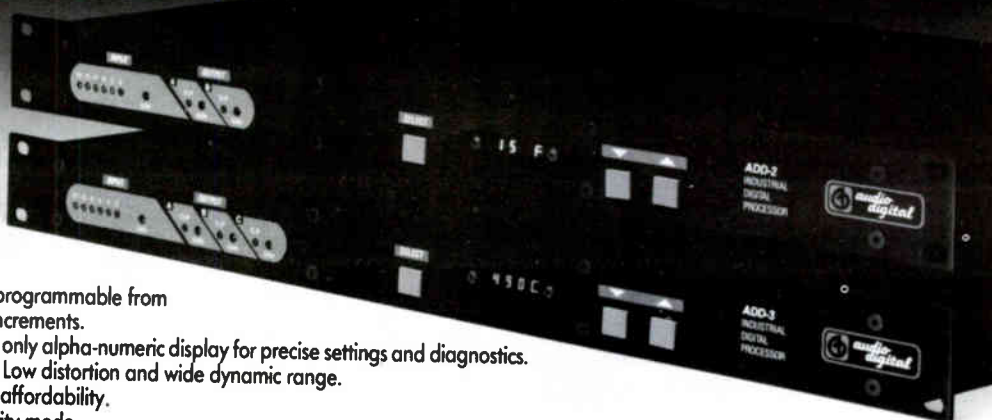
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mic.” According to Baltzell, the room had enormously long decay time below 200 Hz, and as the system neared feedback, the reverb time got even longer. “The CORREQT system let us control the cluster EQ first, cutting the generation time of the room/sound system interaction. This cut back on the EQ needed to reduce the feedback on each mic channel. Once the podium sounds great, everything else holds up.”

Rich Breen, who covered the house vocal mix, has worked in various positions on the last four Grammy Awards. Breen commented: “The entire house was never covered this well. And we never had the feedback problem under this much control. The sound was very satisfactory, with good bass and fine tonal quality.”

‘It was by far the best sound ever heard at the Grammy Awards, and the best sound ever heard at the Shrine.’

Producing a quality live sound reinforcement system in an architecturally difficult space is always a challenge. That challenge becomes even more complex when you add in the very particular requirements of a televised broadcast of a music awards show. With the help of innovative solutions and teamwork, the challenge was successfully met.

Editor's Note: This article is meant only to inform our readers of available technology. No endorsement of products mentioned in this article is given or implied by Sound & Communications.

Klasco is president of Menlo Scientific, Berkeley, CA.



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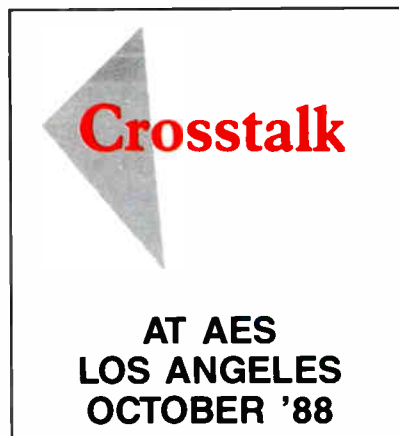
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DAT RECORDING OF ACOUSTIC MEASUREMENTS

BY STEVEN J. ORFIELD

Ten years ago, the audio engineer with testing equipment was an anomaly; today, the proliferation of test devices in the hands of the audio community is staggering. The technician who used to "walk the room" and listen to sound levels from a pink noise generator is now carrying around a real time analyzer, an FFT, or a TDS analyzer and is attempting to not only measure constant signals but also to measure and evaluate "impulse response" and "phase response" of the sound system. Additionally, those measurements traditionally made by acoustic consultants, such as reverberation time and background noise levels, are now the province of the audio engineer or technician.

Acoustical consultants have traditionally been interested in the ability to record data



The B&K 2133 dual-channel real-time analyzer, and TEAC's RD 100T DAT recorder.

for later analysis, and recordings have long been made of acoustical phenomenon well known to the audio field, such as reverberation and background noise level. Intelligibility evaluation has often been recorded for later analysis via the use of such test methods as PB Word Score and Modified

Rhyme Test. Specific advantages of recording data for later use include time savings, testing by more company personnel than test equipment inventory allows, and the ability to leave large, cumbersome test equipment back at the shop. Another use of data recording is the ability to later demonstrate performance to the user, engineer, architect, or jury.

The limits of recording have been based, in simplified terms, on the noise floor, dynamic range, frequency response, speed accuracy, phase response (two channel measurements), and portability of the recorder.

A newer measurement procedure, sound intensity measurement, has provided the most severe limit on data recording, in that this type of measurement requires close phase-matching of both the

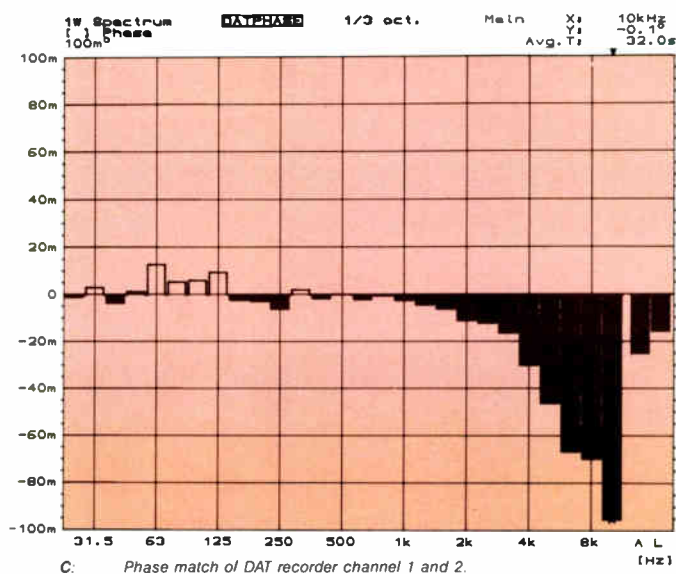
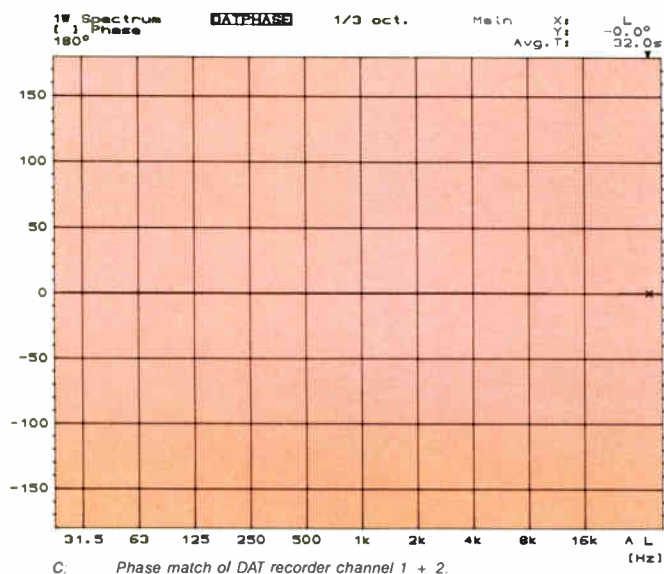


Figure 1: 1/3-Octave Phase Mismatch, 360 degree range.

Figure 2: 1/3-Octave Phase Mismatch, 0.2 degree range.

analyzer and the intensity probe (at about .05 degrees of match).

Newer recording technology is now coming on-stream, and with this in mind, we have begun to evaluate the use of the DAT (Digital Audio Tape) recorder for acoustical measurement recording. We invited TEAC, along with the acoustical test equipment manufacturer Bruel & Kjaer (B&K), to join in a meeting at Orfield Associates to discuss and work out the interface between the TEAC RD 100T DAT recorder and the B&K 2133 Dual-Channel Real-Time Analyzer. (While these two devices are oriented to the serious acoustical consultant and are unlikely to be in the inventory of most audio contractors, the concept and issues of using DAT recording may be easily applied to less expensive equipment.)



Tests were undertaken to determine the compatibility of the TEAC recorder and the B&K 1057 power supply.

Our first meeting to consider the interface of these devices occurred in Minneapolis, and present at this meeting were Ryo Sugahara and Keizo Ihara of TEAC, Roger Upton of B&K Denmark, and Richard Craig of B&K US.

A number of problems in system match-

ing were quickly apparent:

1. The TEAC RD-100T recorder is a 1:1 recording device with no attenuation and no gain available at its inputs or outputs.

2. The full range of the B&K 2133, via different range settings and sensitivities, was far greater than the DAT recorder. For low level measurements and less sensitive microphones, additional gain was needed.

3. Normal measurement microphones used in acoustical testing are 200 Volt Powered mics, and no phantom powering was part of the standard TEAC RD 100T recorder.

4. Since we were also interested in channel phase matching for dual-channel intensity measurements, the phase match rating of the RD-100 was not high enough, based on TEAC's rated tolerance.

The issue of compatibility was discussed

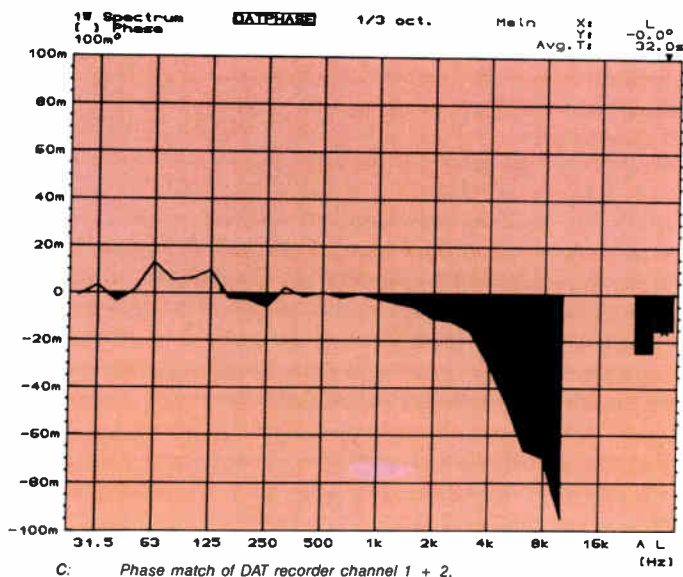


Figure 3: 1/3-Octave Curve Phase Mismatch, 0.2 degree range.

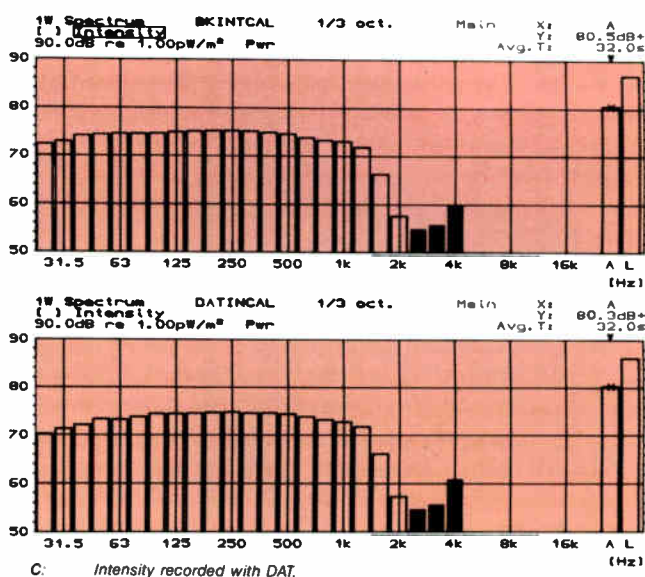


Figure 4: B&K 2133 and TEAC RD 100T Intensity Calibration.

with TEAC and B&K, and it was soon determined that a special engineering product of B&K might solve this problem, and that was the WB 1057, a microphone power supply with 20 and 40 dB of gain, both "A" and "Linear" weighting and 200 (and 2B) Volt microphone power. (A simpler power supply, the B&K 2804, could be used for higher level measurements on the RD 100T). The maximum input range on the RD-100T is +2V or +20V, and the output range of the typical B&K high sensitivity preamp (2639) is 1.7mV-22V (4.6-150 dB using a typical 50 mV/Pa microphone.)

The B&K 1057 power supply was received shortly thereafter, and a set of tests were undertaken to verify the compatibility of the two devices. Involved in these tests were Chris Struck of B&K Denmark and Rick Craig of B&K Minneapolis.

The following tests of the DAT recorder were performed:

1. Frequency response
 2. Two Channel Phase Response
 3. Dynamic range
 4. Intensity calibration and taped testing.
- While the limit of sound pressure meas-

urements is generally that of the minimum levels, recorder noise floor, and dynamic range, intensity measurement adds the problem of phase correction. Both the intensity analyzer, itself a dual channel analyzer, and the intensity probe with its two microphones, are phase-matched for a minimal phase error. (.05 percent from 20-250 Hz in the case of the B&K 2133 with the 3545 probe noted here.) The success of phase matching on the analyzer limits the frequency range of measurement, with the lower frequency limit being most effected. The use of conventional data recorders has been a constant problem in this area.

Since phase-match was the measurement of greatest concern, this was undertaken first, and this measurement process involved most of one day. The intent of the process was to calibrate the B&K 2133 with its intensity calibrator (B&K 3541), calibrate the TEAC RD 100T with the same calibrator, then store a memory of each measurement (and compare the differences).

The TEAC is rated at a 5 degree phase

match, although the TEAC engineers suggested that the actual result would be far better. The first measurement of phase match on the 2133 analyzer indicated that it was within its specifications; the first test of the TEAC indicated that it was far out of spec with regard to intensity measurement. After much check-out, it was discovered that there was a ground loop between the two devices. The B&K analyzer must be set on a "floating ground" for this test, and immediately, the results changed dramatically. Using a 360 degree measurement range, the phase mis-match could not even be detected, as shown in Figure 1.

Moving to a much finer scale of 0.1 degrees maximum, phase mismatch became clear, and throughout most of the measurement range, it averaged less than 0.01, increasing to under 0.1 at 10 KHz. (This upper limit is not problematic in the intensity field, as the normal measurement range is far below this frequency limit.)

Figures 2 and 3 illustrate 1/3 octave phase mismatch and 1/3 octave curve phase mismatch, respectively.

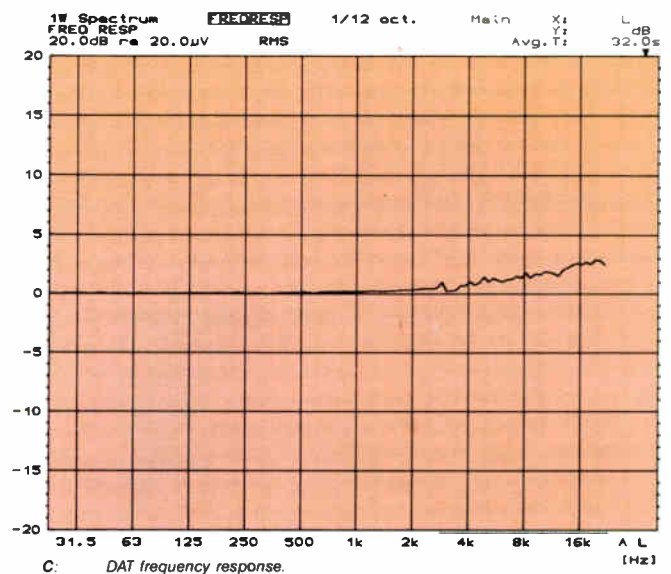
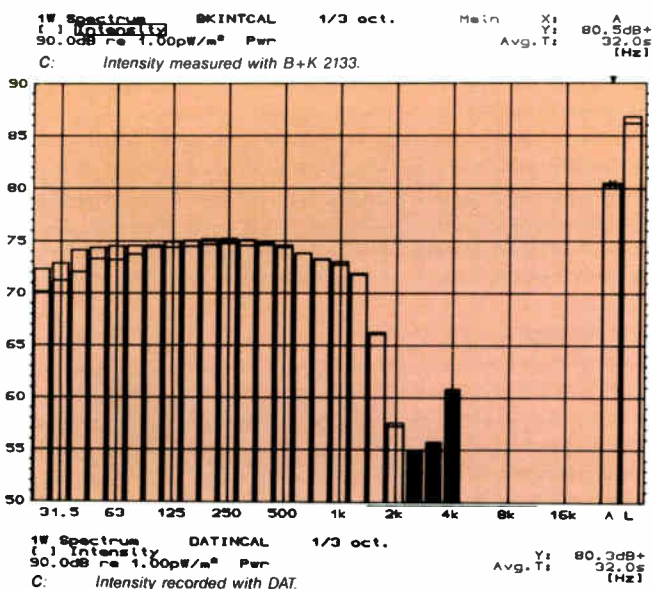


Figure 5: Overlay/B&K 2133 and TEAC RD 100T Intensity Calibration.

Figure 6: TEAC RD 100T Frequency Response, +/- 20 dB Scale.

A plot of an intensity measurement obtained with the intensity calibrator and the two devices is shown in Figures 4 and 5, with an overlay plot of the two results.

Sound Pressure Level

For most users of DAT recorders, the sound pressure measurement will be the more relevant use of the device; with this in mind, measurements were taken of the dynamic range of the RD 100T and of the frequency response of the recorder. Again, the reference device was the B&K 2133. Using pink noise from the analyzer as an input to the recorder, a tape was made of the pink noise signal, and this was then input to the analyzer for display. Based on a 20 dB limit scale and a 20-20 KHz measurement, the RD 100 was shown to be quite flat, with its maximum variation at the high end of the frequency range with a plus 3 dB value, as illustrated by Figures 6 and 7.

Next, a dynamic range measurement was taken of the RD 100 T to determine its ability to deal with greatly varying signals; the results of this measurement

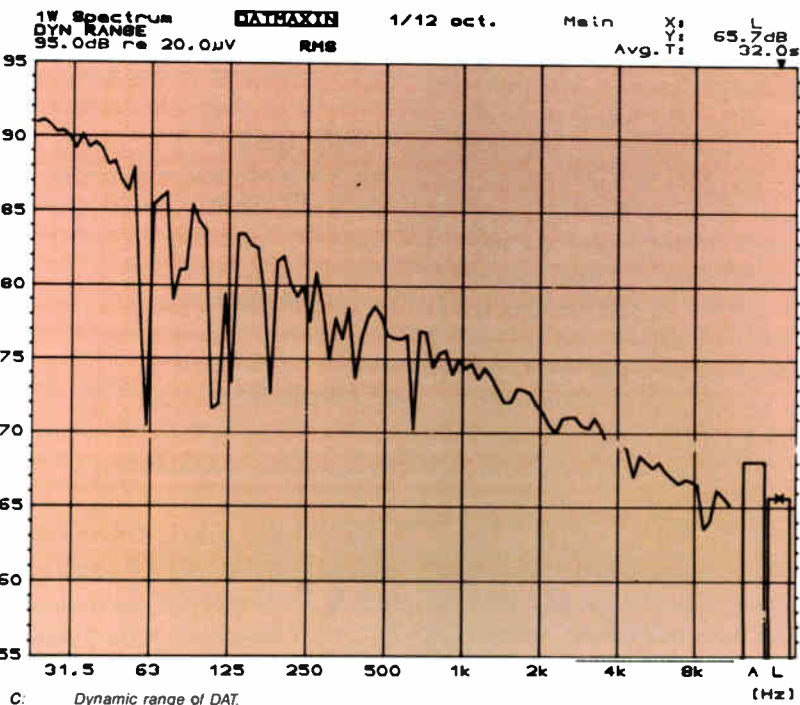


Figure 9: TEAC RD 100T Dynamic Range, 1/12 Octave Curve Fit.

suggest a reducing range from low to high frequencies with about a 65 dB limit at its low point; at the low end of the spectrum,

it ranged as high as 91 dB. This range is illustrated via the chart shown in Figure 8, with data displayed in 1/3 octave bands.

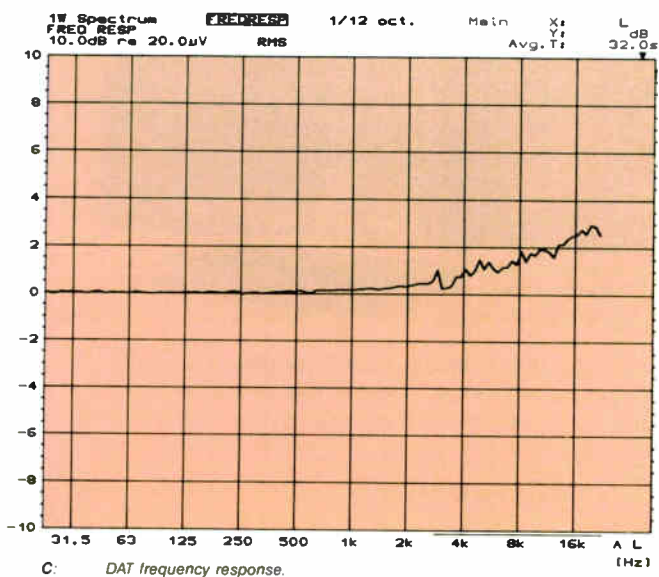


Figure 7: TEAC RD 100T Frequency Response, +/- 10 dB Scale.

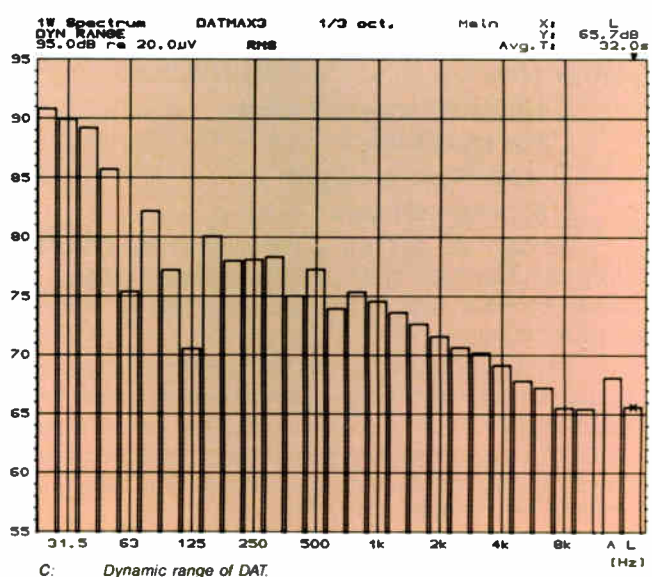


Figure 8: TEAC RD 100T Dynamic Range, 1/3 Octave.

In order to look at a higher frequency resolution, the same data was plotted in 1/12 octave bands, as shown in Figure 9. Since this testing was not extensive in terms of product samples, it is representative of the product which we evaluated only.

The result of the sound pressure level calibrations suggests that this system is very capable in that regard. Finally, the range relationship between the DAT recorder and the microphone and power supply were calculated, and a chart of these ranges is shown in Figure 10.

Having considered the use of DAT recording for precision acoustical measurement of sound pressure level and intensity, there was some clear skepticism of the potential results. Without tight procedures and measurement calibration, this method (like all precision methods) should not be used. With those procedures in place, the measurement is valid and high in quality.

FIGURE 10

RD 100T Recording Range w/WB 1057 Power Supply

WB 1057		Microphone Sensitivity (mV/Pa)		
		12.5	50	100
0 dB Gain	Min	138	126	120
	Max	73	61	55
20 dB Gain	Min	118	106	100
	Max	53	41	35
40 dB Gain	Min	98	86	80
	Max	33	21	15

I would like to extend my thanks to the engineering staffs of B&K and TEAC, and to Rick Pierson of my own staff in this effort; their assistance was invaluable during this evaluation. I would also like to

thank TEAC for partially funding this research effort. ■

Orfield is president of Orfield Associates, Minneapolis, MN.

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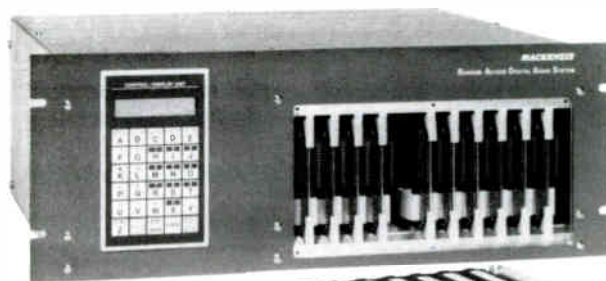
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The AES Heyser Scholarship Fund



The Richard C. Heyser Scholarship Loan Fund has been set up to honor Dick Heyser, a highly gifted, loved and respected engineer, with a lasting memorial. The scholarship loan will financially assist promising graduate engineering students in the field who, otherwise, could not continue with their studies.

In March of 1987 Dick died, just a few months before he would have assumed the office of AES President. He not only was active in AES but he contributed greatly to the audio field through his Time Delay Spectrometry discoveries. He gave of himself on a personal level as well. Carolyn Davis, Co-Founder of Synergetic Audio Concepts, said of the fund, "Dick, himself, gave so much to all those with whom he came in contact, especially those just starting out; we feel Dick would have been pleased to know he is being remembered in this way."

In conjunction with this memorial, a major update of The PHD Program[†] will be dedicated to Dick Heyser and all the proceeds will go to the Richard C. Heyser Scholarship Loan Fund.

You may obtain a program for a donation of \$300.00 or more; prior owners may upgrade for a donation of \$50.00 or more. Make your check payable to the Richard C. Heyser Scholarship Loan Fund. Send to the Richard C. Heyser Scholarship Loan Fund, c/o *Sound and Communications*, 25 Willowdale Avenue, Port Washington, NY 11050.

[†] Trademark of Ambassador College.

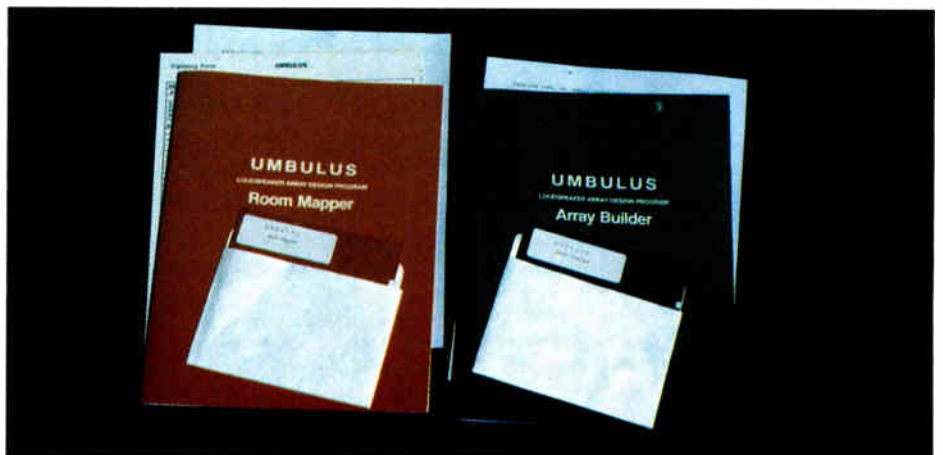
UMBULUS: NORTH STAR'S LOUDSPEAKER ARRAY DESIGN PROGRAM

BY MIKE KLASCO

In the early 1960s, Tom McCarthy of the sound contracting firm North Star Sound began a research project. Its purpose was to determine the Q of large arrays and the coverage patterns of horns angled steeply downward into seating areas. This research resulted in the practical application of architectural field mapping, and McCarthy gave a paper at the fall 1978 AES. While Ed Seeley is acknowledged as the first to apply coverage overlays and architectural mapping techniques to audio, McCarthy was the first to transpose overlays into isobars.

The use of mapping with isobars and spherical projections was discussed in McCarthy's paper, and although no specific mention was made in that paper of computer-aided design techniques, an HP table-top computer was used. The program, in conjunction with overlays and plots, served North Star as a practical internal tool for determining sound system cluster coverage. The company continued to develop and refine their techniques, but did not aggressively attempt to market the program to sound contractors. Some effort was spent in trying to license the program to speaker manufacturers to remarket to sound contractors, but these distribution arrangements never quite worked out.

McCarthy's program apparently was used as a reference for at least two of the more popular first generation sound system programs. Given credit for his early work in *Sound System Engineering*, McCarthy has otherwise gained little fame or fortune for his efforts. The program was



Umbulus: Room Mapper and Array Builder program kits.

released in 1984 for MS-DOS IBM compatibles, and two articles on its development and application appeared that year in *Sound and Communications*. In May 1988, an AES paper was presented on version 3.0 of Umbulus: this latest release is the subject of our review.

Umbulus consists of two programs: Room Mapper, which maps rooms and aids in the design of loudspeaker arrays, and Array Designer, which aids the construction of arrays by helping the builder work out the smallest possible coherent array and draw it as projected on any plane. Each of these programs can be used as a stand alone, or they can be used together. Since the designer progresses from Room Mapper to Array Designer, that is how we will review the programs.

Hardware Requirements

Umbulus will run on IBM (MS-DOS)

compatibles with 256K memory using dual 360K 5.25-inch floppy drives, medium resolution (CGA) graphics board, and either monochrome or color monitor. An Epson compatible printer should be used for the graphic dumps, but any printer can be used for printing out tabular data. All of this can be bought for about \$1000, although this configuration is not optimum. Alternatively, a higher resolution video system with EGA or VGA graphics board/monitor (that is, backwards-compatible with CGA) would be a better investment and would add about \$500 to the tab. The very popular Hercules high resolution monochrome graphics standard will not normally work with Umbulus. There are emulator programs that allow CGA software to work with the Hercules graphics standard, but there are MS-DOS computer compatibility problems with many combinations of hardware and software.

A hard disk drive would save time by eliminating floppy disk swapping and searching for which disk had the files you were looking for. The current release (3.0) of Umbulus does not support hard disk drive operation, but the program can be specially configured for hard disk operation or for higher capacity floppy disk drives (for a nominal charge) by North Star Sound. One of the benefits of these other configurations is the increased capacity of the driver and horn library.

The present version of Umbulus does not support use of the math coprocessor option. Math coprocessors cost between \$150 and \$250 depending on the speed and type of microprocessor used in your computer. The coprocessor plugs into a socket on the computer's motherboard and would be an appealing addition, as software that takes advantage of this option can run from two to ten times faster. As Umbulus is not graphics- or computation-intensive, this is not a significant factor for this program.

Umbulus will screen-dump for hardcopy printout (that is, dump whatever you see on the screen to an Epson-compatible printer). Epson-compatible printers cost from \$200 on up. A bare bones system with EGA high resolution monitor subsystem would still be only about \$1500, and the other peripherals can all be added later.

Umbulus was originally designed to require only the simplest hardware, but now even the most basic personal computer systems typically have hard disks and high resolution graphics. The program would benefit from configuration set-up options

to take advantage of the present level of hardware sophistication rather than aiming for the lowest common denominator.

Unlike the programs we have reviewed to date, Umbulus does not provide all of the drafting capabilities from within the program. [North Star states that limited screen size, sweep non-linearities, and the inability to depict path gain demand exter-

nal plotting—Ed.] The operation manual states that a drafting table, scales, triangles, and the like are required. In addition to some sort of drafting system, isobar overlays will be required for the speakers to be evaluated for the project. Although the program lets you sketch out the room from within the program, the speaker isobars still must be physically overlaid over the drawing.

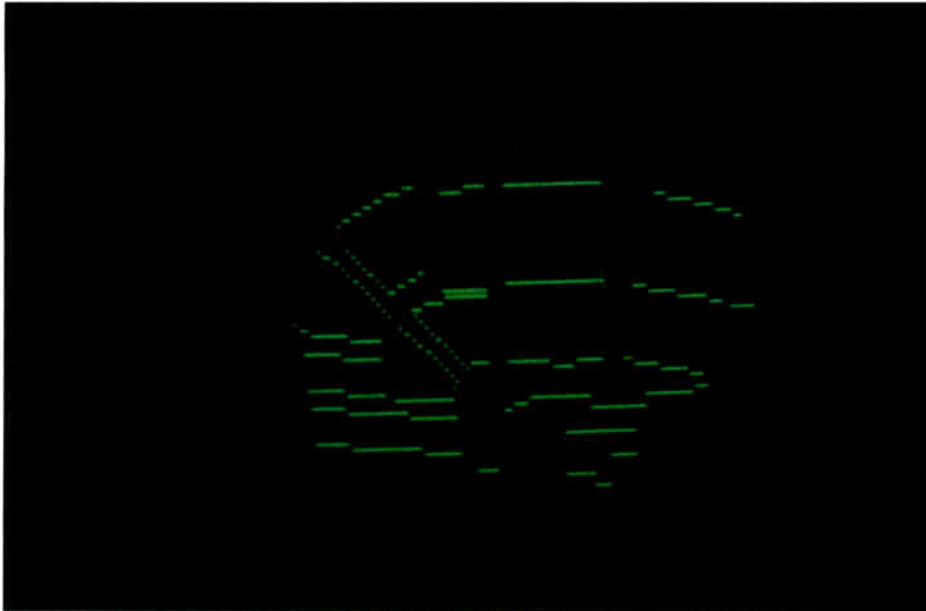
The use of mechanical drafting equipment and transparent overlays (isobars) was commonly used in first and early second generation release sound system design programs, such as Altec's Central Array Design, EV's VAMP and John Prohs' PHD (release 3.2 and later have since eliminated the use of external drafting equipment). Not all sound engineers have welcomed the phasing out of physical overlays, as this approach provides a powerful intuitive guide to selection of horn coverage patterns. Although the newer, graphically intensive programs are more convenient to use, with less physical clutter, some visual insight into horn selection (and how well they will work) has been lost. For this reason, Umbulus has maintained the use of transparent overlays and other drafting paraphernalia.

Software Requirements

Umbulus is licensed to anyone who is willing to follow the licensing agreement and is not restricted to dealers of any particular brand of speakers. The one-time licensing fee is \$365 for Room Mapper and \$385 for Array Builder. Typically, the two programs are bought together, making the



Isobars for various horns are selected and positioned for optimum coverage. Horn aiming angles are determined by the positions of the isobars on the map.



The room is modeled into Umbulus and sketched in plan view on the screen. (The ear planes are visible, as is the altar platform.) The two vertical lines are beams between which the array will be located.

total package price \$730. The program includes a data library for JBL and EV components, although isobars or data to create isobars are available from just about all manufacturers and can be entered without undue effort into the program data library.

Umbulus is very much an “a la carte” program, not only in the mapping and array design programs, but in the peripheral programs also required. If you have a non-Epson compatible or IBM compatible printer you will need a printer utility disk, such as *Pizazz*. This will let you exploit special features of some printers (such as color printing, wide carriage, high resolution 24-pin dot matrix or laser printing). Even if you have an Epson or IBM compatible printer you should consider this type of print utility.

Umbulus does not include modules for calculation of reverberation time or intelligibility, and the on-screen mechanical drawing functions are not adequate for working drawings or client presentations, so drafting facilities or a computer-aided drafting program such as *AutoCAD* or

GenericCAD will be useful. Some modules require the use of a calculator, so a “pop up” memory resident program such as *Sidekick* (which contains a calculator) would also be handy. [For extensive calculations not done by Umbulus, such as calculating articulation indexes, North Star uses a *Visicalc* program with the Puetz formula; copies of the overlay are available from the company on request—Ed.] As with the other sound system design programs, Umbulus does not contain a system flow charting (block diagram) module, so you might want to consider a program like *Flowcharting II+*.

User Interface

Umbulus is menu-driven, and the main menu for Room Mapper toggles into the main menu for Array Builder. While the program does summarize the function of each module, and specifies the relevant section of the manual to look for further information, no contextual help system is provided. Some programs have a designated “help” function key to press when

you don’t understand what is going on, and information on the aspect of the program you are using appears on the screen. The actual operation of the program is straightforward, and the user rarely finds himself needing to refer to the manual, as screen prompts and other screen messages are usually self-explanatory.

Umbulus is not an easy program for me to review. In some ways, it is the most practical and sensible sound system design aid I have yet encountered, yet as a sound system design software program its graphics, user interface, utility programs, convenience functions, and various other aspects are dated and far more limited than most of its present competition. For example, no intelligibility or reverberation time calculation utility program is provided, nor are any isobar overlays, and the mechanical drawing module is reminiscent of “Etch-A-Sketch.” Umbulus’ DIRECT SPL module requires each data point to be manually processed, while other programs will calculate this function automatically.

Error trapping is only fair: when you screw up, the program usually dumps you into the operating system (and some of your data into never-never land) instead of telling you that your response is invalid. The lack of hard disk configurability without special complications, the inability to transfer speaker driver and horn data files easily, and numerous other aspects indicate that the program offers less sophistication in operational amenities compared to the third generation of sound system software.

On the other hand, the program is a powerful and intuitive design aid, from the initial selection and aiming of horns, to the prediction of acoustic feedback, all the way through to cutting the links between elements of the array (it even allows you to expand the array or make it more compact, trading off packing density versus component serviceability).

Documentation And Support

The manual directs both experienced and inexperienced designers through the

program (and job) efficiently, provides excellent insight and advice, specific tutorial examples, and workbook exercises. Support from North Star Sound is very good: my phone calls were generally returned the same day.

Program Flow Overview

In Umbulus Room Mapper, measurements are taken from blueprints, sketches, or from the actual room, and these coordinates are entered onto the supplied "digitizing form." The ENTER ROOM DATA module is run, and the data is entered through the keyboard. The room model is then stored on the data disk. A trial array location is selected and the VIDEO SKETCH ROOM module is run; the computer calculates values for mapping the room and displays them on screen. The scale of the mapping values is adjustable to match the scale of the isobar overlays. The plotting data can be printed out on a form using the PRINT ROOM DATA module, and the room map can be sketched on the monitor (and printed out) in several different views and

as seen from any number of points you select.

Once the room is mapped, other modules (such as CALCULATE DIRECT SPL) and the isobar overlays can be used to determine the best combination of horns to use, and their orientation, to cover the room. The HORN ANGLES module is then run. Having defined the array, you will be able to build it. You will then go to the Array Builder program.

Umbulus Array Builder contains various modules that can be used to further determine design parameters and other factors that may be useful in predicting how well the sound system will function. These will be examined next month.

Getting Started

The floor plan and elevation drawings are marked with a scale on the borders of the prints. Dimensions are in feet and tenths of feet (not inches) and metric is not supported. A t-square or a drafting table will be helpful. Alternatively, a sketch can be created on grid paper. A benchmark location is selected and marked on

the prints. Typical benchmarks would be the centerline of a stage, some corner, or the center of the room. The supplied digitizing form header is filled out. The listening plane (ear level) is located. Measurements are made off the prints and entered into the form. From the plan view the front/back, right/left, and up/down cartesian coordinates corner points of the audience ear plane(s) are taken.

For the more meticulous, Umbulus suggests that you plot a grid rather than just the corners of the ear plane(s) and digitize the nodes. This is especially useful for the CALCULATE DIRECT SPL function. Other points the manual suggests you may need to digitize are balcony rails, obstructions, room boundaries and openings, microphone locations, array locations, and features that make the room recognizable to the client when they look at the sketch. These coordinates are then entered into the program using the ENTER ROOM DATA module. By entering the microphone locations you get a feel for potential acoustic feedback problems when you overlay the speaker isobars. Most rooms will not require more than 70 location points.

This data is saved as a room file. It is important to make a note of the room file name on the digitizing form as Umbulus does not have any way to access the directory listing of room file names (which is rather inconvenient). Although the modeling is basically manual, obstructions, mic locations, very large indoor and outdoor areas can all be accommodated.

Room mapping becomes much quicker as familiarity with the program increases. Plan on looking over the floor plan and elevation prints for half an hour, then add another half-hour to add scales to the border and sketch the simplified room model. (Without interruptions, this should taken even less time.)

As with other currently released programs, Umbulus cannot generate curved surfaces. Curved walls must be approximated with a number of straight lines that fall outside of the curved boundaries. The



Here the room as seen from the array location. Umbulus offers users the ability to "fly" around the room, searching for a vantage point that gives an unobstructed view of all ear planes (as well as meeting other array location criteria).

program developer suggests that a maximum of eight points are needed to approximate a full circle. I like to hand draw in the curve on the printout so I don't try to improve room coverage for an area outside the real boundaries of the job.

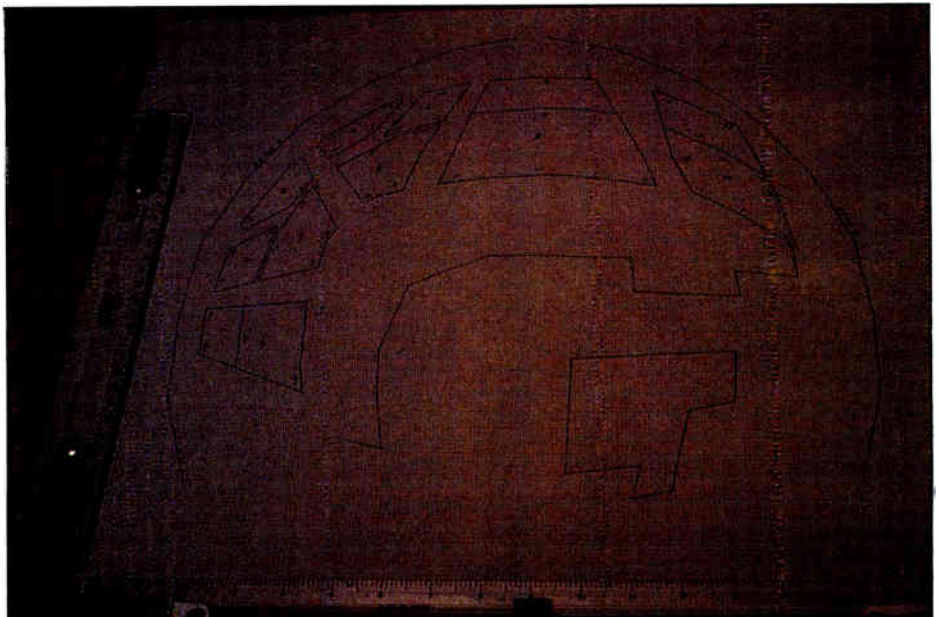
Reverberation Time

Umbulus does not provide a module for calculation of reverberation time, but various programs for MS-DOS/IBM compatible computers are available (and will be reviewed in an upcoming issue). *Acoustics II*, from Headware, takes care of room volume, surface area, average absorption coefficient, RT60 versus frequency, and even the preferred equation for the specific size and character of the room. (*Acoustics II* is available only for the Apple II.) TPM Software offers OPTORT60. This program is generally very helpful and easy to use, but is awkward in dealing with materials not included in its data files. New materials can be used for a specific calculation, but not saved. Altec also provides a simple RT 60 utility (free) that runs on IBM compatibles.

Rough determination of RT60 will require less than 30 minutes with any of these programs, but at least another half an hour should be allowed for checking with architects and interior decorators on surface materials and the like, and for looking up absorption coefficients. You should have a reference book handy that provides absorption coefficients as the file libraries supplied with these programs are not comprehensive. (The RT60 program is used before starting with Umbulus.)

System Diagram

Umbulus does not provide any utilities for generating system flow charts. Various flow charting programs are available, one of the most complete and efficient MS-DOS (IBM compatible) programs I have come across is *Flow Charting II+* by Patton and Patton. Cost is \$200. Mac/Modeler users will be interested to know that Bose will be introducing a sound system flow chart program this year.



The room is mapped in a scale that allows detailed engineering work. Ear planes and beams are identified and path losses written in.

Video Sketch Module

From comments made in the manual, the program developers apparently do not see "slick" client presentations as a legitimate function of sound system design programs, and Umbulus provides a relatively crude 3-D mechanical design program. This program is useful for the initial planning and preliminary evaluation of array locations, serving some of the same functions as the Bose *SpeakerCAD* room modeling module (although for graphic sophistication, Umbulus does not begin to compare with *SpeakerCAD*). Essentially a straight line sketch program, the user instructs the computer to connect the points, line by line. Mirroring is provided, to save time in sketching symmetrical rooms, and the view can be changed without having to re-enter coordinates. Hard copy printout is by a low resolution screen dump (whatever is on the screen is dumped to the printer).

One of the limitations of this module is that only one job can be stored, so the previous video sketch file is lost when a

new file is entered! There are ways around this (by using a separate floppy disk for each job), but they seem unnecessarily awkward.

Users may find that *AutoCAD*, *GenericCAD*, or other full scale mechanical design programs should be used instead of the internal sketch module when creating room layouts.

Print Room Mapping

This module creates the printout of the points that are used for plotting the map required for the transparent isobar overlays. The room file name is entered, an array location is specified, and a plotting method is selected. Which of the plotting methods should be used is discussed in detail in the manual, as there are trade-offs in mapping distortion that should be considered. Altec's room mapping technique suffered from serious inaccuracies, and Umbulus avoids this problem by providing a choice of plotting techniques. EV's VAMP program minimized mapping distortion in their overlay technique, although

VAMP was rather cumbersome to use.

Array Location

In selecting an array location the manual suggests that you first have an idea of the purpose of the array, an idea of what the client wants, and some knowledge of the acoustical characteristics of the room. The manual provides additional guidelines and some rather astute advice on locating the array.

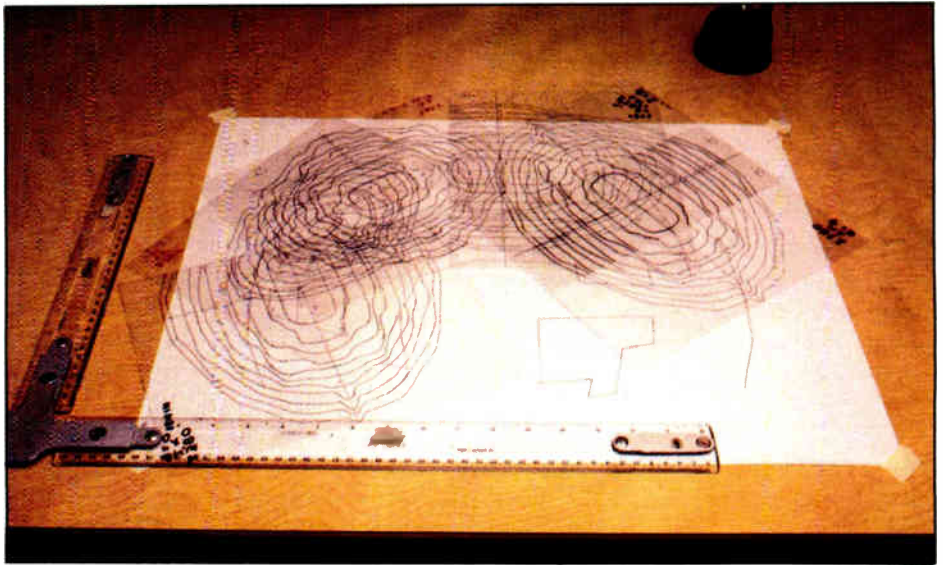
One of the guidelines: place the array beyond the critical distance of any microphone. When calculating the critical distance, using your calculator (or a "pop up" memory resident calculator utility program) you should use the Q of the array at the mic in question, not the speaker's rated on-axis Q. Any Q at any point can be determined by using the CALCULATE DIRECT SPL module. Remember that cluster interactions make this only an estimate. Eventually speaker manufacturers will provide data on how their speakers (horns) work in clusters, but until this data is available, estimated values will have to suffice.

Polar Plotting

Polar plotting is prepared manually and is required for creating the room maps needed for the isobar overlays. Plots can be made by the angles/distance method (which is efficient but requires a drafting machine), or by horizontal/vertical measurements (which only requires a drawing board, T-square, and other manual geometric hardware). As described, both procedures are completely manual, although Umbulus outputs data that allows any computer-aided drafting program to be used.

Aside from polar plotting, Umbulus provides special functions such as cylinder plotting and intermittent point plotting.

Cylinder plotting is a special case sometimes used when the horns face straight out toward the audience. Cylinder plotting is similar to some of the mapping techniques that were evolved at Altec in the early 1980's from Tom McCarthy's original work. Cylinder plotting becomes highly



The room map, with isobars in place. Initially, coverage is attempted with as few horns as possible; horns are added only as necessary. Path Loss is played against isobar contours to produce the most even coverage. Horn aiming angles are determined by the positions of the isobars on the map.

distorted at angles that are not an 0 elevation and Umbulus will automatically delete these points in what the program developer calls the "forbidden zone."

Intermittent plotting is a technique to more accurately map the path of long interconnecting lines. If a highly accurate room map is desired then this module is used. Interconnecting the points on the maps are not accurately represented by straight lines, but actually by slightly curved lines. For expediency, straight lines are used, but if a precision map is desired, the actual intermittent points can be located using this module. (Typically, the sound pressure variation is less than 1 dB and this procedure is not necessary.)

Calculate Direct Sound Pressure Level

This module requires extensive data entry and manual manipulation, and while it is accurate, it is also significantly more inefficient than most of the other sound system design programs.

Using the transparent isobar overlays, and knowing the sensitivity and DI (directivity index) or the Q of the loudspeakers,

the designer can determine the direct sound pressure level at key locations. Normally, this procedure will be taken at the 2 KHz band, which is most critical for intelligibility.

After you have entered the DI or Q and sensitivity of the horns (at the frequency range of interest), the room map that you have prepared is overlaid with the isobars for the horns you propose to use. Looking at your room map, a point is selected for which you want to determine direct sound pressure level. This point is entered into the program, along with the range to this point and the dB value of the isobar contour. This procedure is done for each point of interest.

This procedure is repeated for other frequency bands of interest. The overlays for the new frequency band will be needed as the new values (if different) of DI or Q and sensitivity will also need to be entered. Effects of refraction and diffraction such as caused by temperature gradients is not accounted for, nor is super attenuation of high frequencies. Each horn that is used can have its power level adjusted independently.

The information provided by CALCULATE DIRECT SPL, along with reverberation time and room volume, can be used to calculate articulation characteristics at room points.

The program developers have not included a module for articulation because procedures for prediction of intelligibility are so questionable. Actually, a module for this function had previously been incorporated, but was removed for this release because of the marginal accuracy of these techniques.

An articulation index utility is available from TPM software called AI, which runs on IBM compatibles.

Conclusion

Umbulus Room Mapper is a mixed blessing. It is a powerful engineering tool

that will guide both the experienced engineer and the junior technician in the design of arrays that are at least the equal of, and typically superior to, those designed on more graphically sophisticated programs. Key elements such as obstructions, microphone feedback, intelligibility, uniformity of coverage can all be handled by Umbulus.

Umbulus does not exploit the calculating and graphics capabilities of the personal computer, and requires extensive manual data entry, comprehensive drafting and plotting, and tedious calculations. The bulk of this effort could be shifted over to the computer rather than the operator, if the program was further developed. Job filing facilities and graphics quality (both the screen image and printouts) are low resolution.

With increased use, operator efficiency

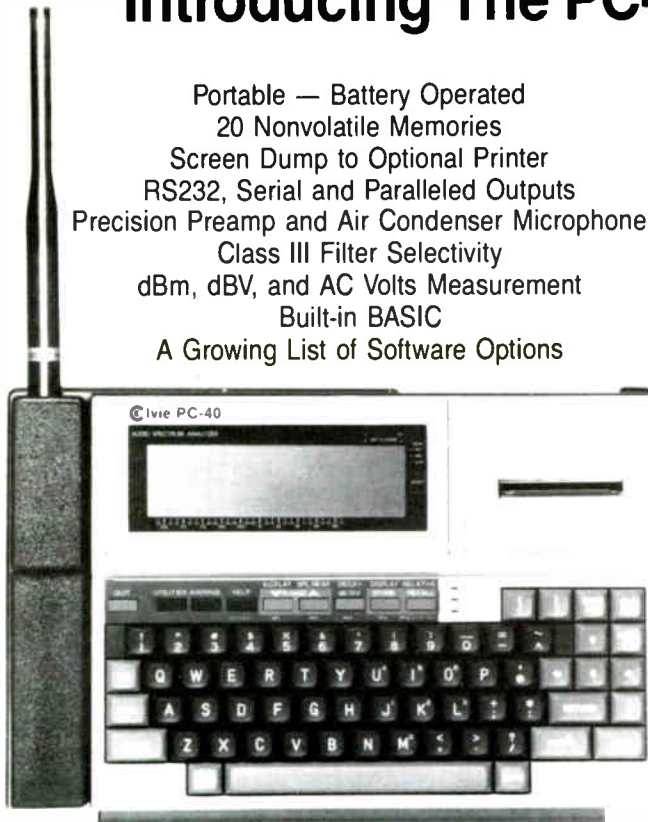
would improve to the point where the time and effort required to use the program would be worthwhile, especially when the benefits to the quality of the final system performance are considered. As a sales presentation tool the program is inadequate; as an engineering design tool it is powerful, if somewhat unwieldy; as a tool for instilling an instinctive feel for good sound system engineering it is unmatched.

Next month we will explore Umbulus Array Builder, which offers such unique features as automatic design of tight packed coherent arrays and automatic creation of link cutting lists for array component hanging hardware. ■

Klasco is president of Menlo Scientific, Berkeley, CA.

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Contracting Close-up

Shanahan Electronics Wires 7-Showroom Auto Mall

Auto Audio

On a 30-acre site in Tewksbury, Massachusetts, a multimillion dollar facility has introduced a new concept in automobile retailing: the Hallissy Auto Mall brings seven car dealerships and their respective service departments together under one roof. This consolidation of sales and service is expected to provide more convenience to customers (and higher profits to the dealers). But the size and complexity of the 200,000 square foot, multipurpose facility presented some challenges in paging and music system design and installation.

Shanahan Electronics, Inc. of Lowell, MA, a sound system contractor and designer with nearly forty years experience, was asked to meet those challenges.

Hallissy required a paging and music system that would be flexible and easy to use, while providing clear, uniform, vibrant music and voice transmission at the same time. The system had to be reliable and intelligible, not only in each of the showrooms, but in the noisy 71-bay service department as well. Hallissy knew its customers would appreciate paging that was undistorted and unobtrusive, and background music that didn't sound "canned."

In addition, Hallissy wanted a system which was simple, aesthetically pleasing and (of course) as inexpensive as possible. Both client and contractor agreed that the economy of a good system can easily be lost when service

and maintainance are difficult. With this in mind, Shanahan was to design a system for Hallissy that would emphasize ease of repair and service. Adding to the challenge was the fact that construction plans called for the Auto Mall to be built and occupied in multiple stages. As each dealership's showroom was completed and ready for business, its section of the overall sound system had to be up and running.

Shanahan's goal was to produce a smaller and smarter system for the car dealership. The system they designed met that goal with a total of two power

amplifiers (a TOA A-912 and an EMS/Music 7800-8) and 74 loudspeakers (14 Soundsphere PA110s and 60 Bogen S810SGBWs).

Each of the seven showrooms was provided with its own Soundsphere PA110 loudspeaker. The parts department, a three-tiered open steel grid design covering 18,000 square feet, was equipped with three Soundsphere PA110 loudspeakers. The service department employs 71 technicians and mechanics, each with a fully-equipped service bay (including a computer and all necessary hydraulic machines). Four of the PA110s (tapped at 8 watts each) cover this 32,000 square foot area. The service write-up area, some 15,000 square feet, is adequately covered by a single PA110.

An integral part of the Shanahan installation is a modular current drive amplifier: the EMS/Music 7800 and



The Hallissy Auto Mall, Tewksbury, Massachusetts.



788 controller panel. It accommodates up to 8 A-10 modules, each a separate integrated amplifier system with full music and microphone capabilities. The 7800 is a highly flexible design allowing multiple A-10 modules to be wired together in numerous configurations.

The 7800 accommodated Hallissy's requirements: zone control, individual volume control, and progressive stages of operation through the construction phases. The 7800 also provides the specified system flexibility: The amplifier drives associated speakers with current amplification without the use of transformers, and circuiting was accomplished with parallel wiring.

When Shanahan demonstrated the first part of its installation, Joe Doucett, comptroller for Hallissy and this project's communications coordinator, indicated his approval: "Great sound! And no one will be able to say they didn't understand the page."

Southbound Community

Based in Little Rock, Arkansas, Arkansas Sound is a full-service contracting firm with a strong background in church and auditorium installations.

In West Memphis, The West Memphis 15th Street Church of God & Christ became the recipient of one such system, which utilizes a Community CSV52 loudspeaker to deliver sound throughout its main sanctuary, which is approximately 85 feet deep and capable of seating more than 300 people. Services held in the church are dynamic and highly emotional, with a heavy emphasis placed upon music, which is provided not only by the choir, but by a band that plays a Hammond organ, bass, and drums.

A brand new structure marked by an interior complemented with extensive use of natural wood, Arkansas Sound was enlisted when the church realized that the PA they had on hand wouldn't be sufficient to handle the levels re-

quired for both voice reinforcement and the band.

"The preacher gave us a strict set of guidelines pertaining to budget, aesthetics, and sound quality," Aikman recalls. "As far as sound was concerned, he simply told us that even if he screamed into the mic, he didn't want to hear any distortion. On the aesthetic side of things, he wanted something that would match the natural decor, and didn't have a giant logo going across the grille."

With these factors in mind, Aikman and crew selected Community's CSV52 which has a Finnish oak Formica finish. The cabinet, with its own T-nuts, Aikman said, "...let us suspend the cabinet with aircraft cable which we crimped with a special tool to avoid the use of unsightly clamps. The result was a clean-looking installation that appeared as if the cables were actually part of the cabinet's structure."

"When you're trying to achieve proper EQ in a room that large, it's easy to overextend a 2-way cabinet," he said. "With the 3-way CSV52, you gain the benefits of wider coverage, better response, and added intelligibility in the midrange, plus you maintain the lightweight and compact design of a 2-way cabinet."

When complete, The West Memphis 15th Street Church of God & Christ installation easily came in according to budget, and was received favorably by the clergy and the congregation on a cosmetic and performance level.

At the West Baptist Church in Batesville, another Community-based system was recently installed by Arkansas Sound which used a single wedge-shaped RM325i 3-way loudspeaker to handle sound reinforcement chores in a sanctuary slightly larger than the 15th Street Church of God & Christ's. Housing a 15-inch low-end transducer, a pair of piezo-electric drivers coupled to a pattern control horn for frequencies above 3.5 kHz, and Community's M200

midrange compression driver matched to an exponential pattern control horn to cover the crucial range lying between 450 Hz and 3.5 kHz, the RM325i incorporates a one-piece fiberglass faceplate that serves as the backbone for the unit's coherent wavefront design.

The Hub Club

The Hub Club, a three-story dance club in Boston, opened this past New Year's Eve in a century-old landmark. Formerly known as the "Adams House," the structure has a vaudvillian past that Gary Louks of E.U. Wurlitzer, also located in Boston, had to help bring up to date.

The club has three active levels, each with a different atmosphere: a food and cocktail area on the first, a dance area on the second, and a bar on the balcony. The DJ booth is an isolated room on the latter floor.

The hardware installed included three JBL 6230 power amps, one JBL 6290 power amp, four JBL 6260 power amps, 12 JBL Control monitors, 12 JBL 4410 monitors, four JBL 4425 monitors, two JBL 4647 15-inch enclosures, two JBL G718 sub woofers loaded with 2240H speakers, two Rane GE27 graphic equalizers, one DBX 1531P graphic equalizer, a DBX 166 compressor, two DBX 160X compressor, a dbx 150 noise reduction, a JBL 5234 crossover, a Numark DM1900 DJ mixer, two Technics SL-1200MK2 turntables, a Tascam 32 2-track open-reel tape deck, a Tascam 112 2-track cassette deck, a Numark DM650 mixer, and a Numark DM500 mixer.

Originally, rumbling in the DJ booth caused by a post coming up from the dance floor caused the turntables to skip. The Wurlitzer installation staff got rid of the turntable disturbance by placing them first on top of a wooden panel, then the panel in a box filled with sand, so the turntables "floated." ■



People

Hollis Joins Altec Lansing; Armstrong Moves To Renkus-Heinz

Jim Lee Moves Up

Jim Lee has been appointed vice president, general manager, at Velodyne Acoustics, Inc. (San Jose, CA). He now oversees all marketing, sales, and advertising, as well as the manufacturing of all Velodyne products. Lee joined the company in 1987 as vice president of operations.



Jim Lee

consulting community and major customers.

HME Promotion, Appointment

Eunice Davis was recently promoted by HM Electronics, Inc. (San Diego, CA) from regional sales manager to pro audio general sales manager. Davis had been the company's western regional sales manager since 1987. Randy Opela was appointed marketing product manager after serving in

HME's sales management for two years.

The Up-And-Coming At Rauland-Borg

Kenneth T. James has been elected executive vice president and chief operating officer for Roland-Borg (Elk Grove Village, IL). He joined the company in 1972. William N. Krucks has been named vice president, assistant general counsel for the company.

Rick Blunt has been named vice president of sales and marketing for the corporation, after serving with the corporation since 1976. Rick L. Stalkfleet has been promoted to vice president/controller. John Gutknecht is now vice president/manufacturing. Carl Cox has been named vice president and director of engineering.

Brady Is CBCI's New VP

Coast Business Communications, Inc. (Livermore, CA) has named Robert M. Brady, PE, vice president-sales. Brady was previously an area sales manager with General Electric Co. and the director of operations for Eclat Intelligent Systems.

Hollis Named Altec District Manager

Jack Hollis has been named Altec Lansing's district sales manager for Territory #4, a ten-state area ranging from West Virginia to Florida. In the new position, Hollis will provide liaison to the factory for Altec's sound contractors and represent the company to acoustical consultants, architects and engineers. Hollis was previously marketing vice president for a Chicago-area sound contracting firm.

Patric Flannery has been named to the position of district sales manager for the midwestern Territory #3. Flannery will be responsible for contractor relations and general liaison with the



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In conjunction with the firm's recent move, the following personnel changes have taken place: Harry Hahn has been promoted to national sales manager; Lawrence A. Ball is now product group manager, Telecenter products; Thomas Balle has been made marketing manager for the correctional market; Anthony Stochmal has become manager of the customer service department; and Cathy Groves is now manager of order entry.

Peirce-Phelps Promotions

R. Richard Dyer has been elected chairman of the board of directors of Peirce-Phelps, Inc. (Philadelphia, PA). He joined the company in 1959 as a sales rep, and served as branch manager of the Harrisburg office from 1962 to 1964. In 1980, Dyer was named executive vice president and chief operating officer of the company.

Brian Peirce, grandson of the late W. G. Peirce, one of the company's founders, has been named vice president of planning and development. He joined Peirce-Phelps in 1985 as general manager of the parts division.

Armstrong Now With Renkus-Heinz

Steve Armstrong, formerly western regional manager for JBL, has been



Steve Armstrong

hired as national sales and marketing manager for Renkus-Heinz of Irvine, California. In this capacity, Armstrong will manage the combined functions of the sales force, provide for the advertising direction, and the overall marketing thrust of Renkus-Heinz product groups into the sound contracting, tour sound and musical instrument marketplaces.

Kleiman Joins EV Team

Electro-Voice (Buchanan, MI) has appointed Claude Kleiman as market development manager of wireless microphones. Working with market development managers at EV, Kleiman will be responsible for the marketing and sales of high-performance wireless mic systems under both Vega and Electro-Voice brand names to all pro audio markets. Kleiman was formerly sales manager for audiocom/headset products at Telex Communications.

Fichera Comes On Board At Klark-Teknik

Chris Fichera has joined Klark-Teknik as DDA product sales representative. He will be headquartered in Los Angeles and will be initially responsible for DDA studio consoles.

Crown Adds Division Leader, Regional Sales Managers

Gil Nichols was appointed division leader for Crown International's North American amplifier and microphone marketing and sales operations. The position is part of a newly instituted organizational plan.

Joe Wisler was recently appointed regional sales manager for Crown International's (Elkhart, IN) western U.S. operations. Wisler was formerly a freelance audio producer as well as a coordinator of audio for the PTL network. Chuck Gring recently joined the company as regional sales manager for the central U.S.



Chuck Gring

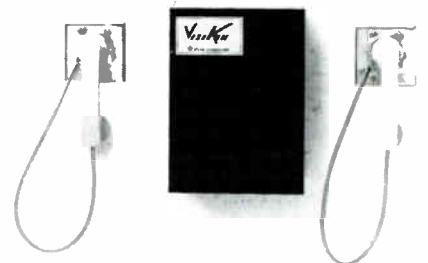
Products

New Series Of Wireless Mics From Shure; Atlas/Soundolier Debuts Prison Phone System

Shure Wireless Mics

The L Series of wireless mics from Shure is now available. The LS13, for guitars and instruments, includes the L1 body-pack transmitter and the WA300 instrument adapter cable. The LS13/839 wireless lavalier system consists of the L1 body-pack transmitter, the L3 receiver and the 839W omnidirectional lavalier microphone.

Circle 1 on Reader Response Card



Phone System For Detention Facilities

The modular Atlas/Soundolier telephone station system is designed for visitation areas of detention, correctional and penitentiary facilities where

protective physical separation between intercommunicating individuals must be maintained. It provides multiple paired conversation paths between handset stations and, says the manufacturer, can assure privacy and free-

dom from cross talk for each communication channel.

The Series VI enclosure system applications have been expanded to include security, communications, studio and electronic control equipment by supplying standard components in complete factory-assembled housings, or as individual factory-assembled modules. Series VI matching accessories include writing shelves, swivel casters, wedge modules for multi-bay enclosures, etc.

Circle 2 on Reader Response Card



For Performers

Sennheiser's MD 518 Handheld Dynamic Microphone was designed for sound reinforcement of high sound pressure signals, including vocal and percussion. The unit offers roadable construction combined with acoustic features often required by musical acts, says the company.

Circle 3 on Reader Response Card

Line Voltage Regulator

The AR-117 AC line voltage regulator is new from Furman. It uses a toroidal multiple-tap (10 taps) autoformer, with the proper tap switched electronically at the voltage zero-crossing to minimize line disturbances. Housed in a single space rack-mounted chassis, it has eight regulated outlets on the rear panel and one on the front. The unit

shuts down when it senses overvoltage or low-input voltage.

Circle 4 on Reader Response Card

The Firewatch II

Faraday's Firewatch II two- and four-zone control panels provide capacity

for operating manual and automatic initiating devices like manual station, two- and four-wire smoke detectors, heat detectors, water flow and supervisory switches. Signalling capability for both audible and visual signals is provided.

Circle 5 on Reader Response Card

Meet the New Community



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While you were out doing tours and installations, Community's engineers were developing the next generation of trapezoidal Wavefront Coherent™ flying array speaker systems. These systems incorporate the latest in dynamically controlled, feedback-loop sensing circuitry in a single rack space.

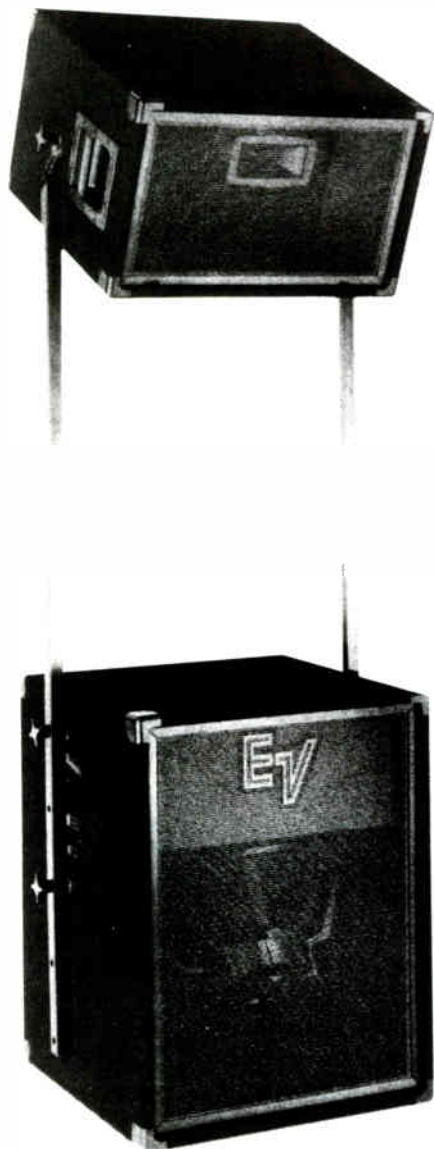
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range main speaker system; the SH-1810V-ER, an 18-inch subwoofer system; and the SH-1810H-ER, a high-output, mid/high enclosure. The optional 1810P mounting system can assemble the modular system. The SH-1810-ER is also available as a modular system.

Circle 6 on Reader Response Card

Audio Distribution Cards

Innovative Electronic Designs is introducing a series of microphone level audio distribution cards. The 5014RE, 5114R, and 5124R, all feature low noise, balanced input and output, low distortion, and greater than 75 dB isolation between individual outputs, says the company.

Circle 7 on Reader Response Card

Bogen Amps

Bogen Communication's new series of public address amps features five mic inputs, a built-in graphic equalizer, and automatic level control. The series is comprised of 35-watt, 60-watt, and 100-watt models.

Circle 8 on Reader Response Card

DJ Cartridges

The Stanton Magnetics 890 AL DJ Pro Cartridge was designed for use in high-quality professional DJ applications. It features a super-high-polished diamond for reduced record wear, and its newly designed suspension system is tuned for applications such as back cueing, scratch mixing, and rough handling.

Stanton's 500AL-MP matched pair of 500AL cartridges is selected to maintain matched performance for professional DJs.

Circle 9 on Reader Response Card



Convert Your Speaker System

The 6210 and 6211 amplifiers from JBL are designed to convert any 8-Ohm speaker system into a complete self-contained sound system. Both units feature two input connectors wired in parallel and active balanced inputs which will accept balanced or unbalanced line level sources. The 6210 has three pin XLR and .25-inch phone jack connectors and the 6211 has both male and female XLRs. Additionally, the 6211 features a switch-activated preamp.

Circle 10 on Reader Response Card



Same Space, Twice The Capabilities

Aiphone has produced a new master station for its LAF loudspeaker intercom system. The LAF-20 has the same number of call buttons (ten) as the LAF-10 master station, but an "ex-

EV News

The Electro-Voice neodymium N/DYM 1/2MT is an 18.6-pound dual-driven high-frequency acoustic summation system that provides high acoustic power output over a wide frequency range, claims the company. The components are available separately as well: the N/DYM MT-16 compression driver and the MTA-22 high-frequency summation device.

The SH-1810-ER speaker systems include the SH-1810-ER, a 3-way, full-

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more in upcoming issues of
Sound & Communications.***



answering feature with internal switching from audio to message and back to audio again and an anti-feedback message.

Circle 14 on Reader Response Card



Projection, Dispersion

The TXD Series of enclosures from Turbosound were designed for sound reinforcement, especially where near to medium projection and wide dispersion are required. The TXD-520 has applications in filling areas that cannot be directly reached by the main loud-speaker system. The TXD-530 is made for under-balcony theatrical applications. The TXD-580 is a 3-way system designed for bands and small touring applications.

Circle 15 on Reader Response Card

Help For The Hearing Disabled

The Easy Listener from Phonic Ear, Inc. is an FM amplification system designed to improve hearing and speech recognition. A mic worn by the teacher transmits sound to student-worn receivers.

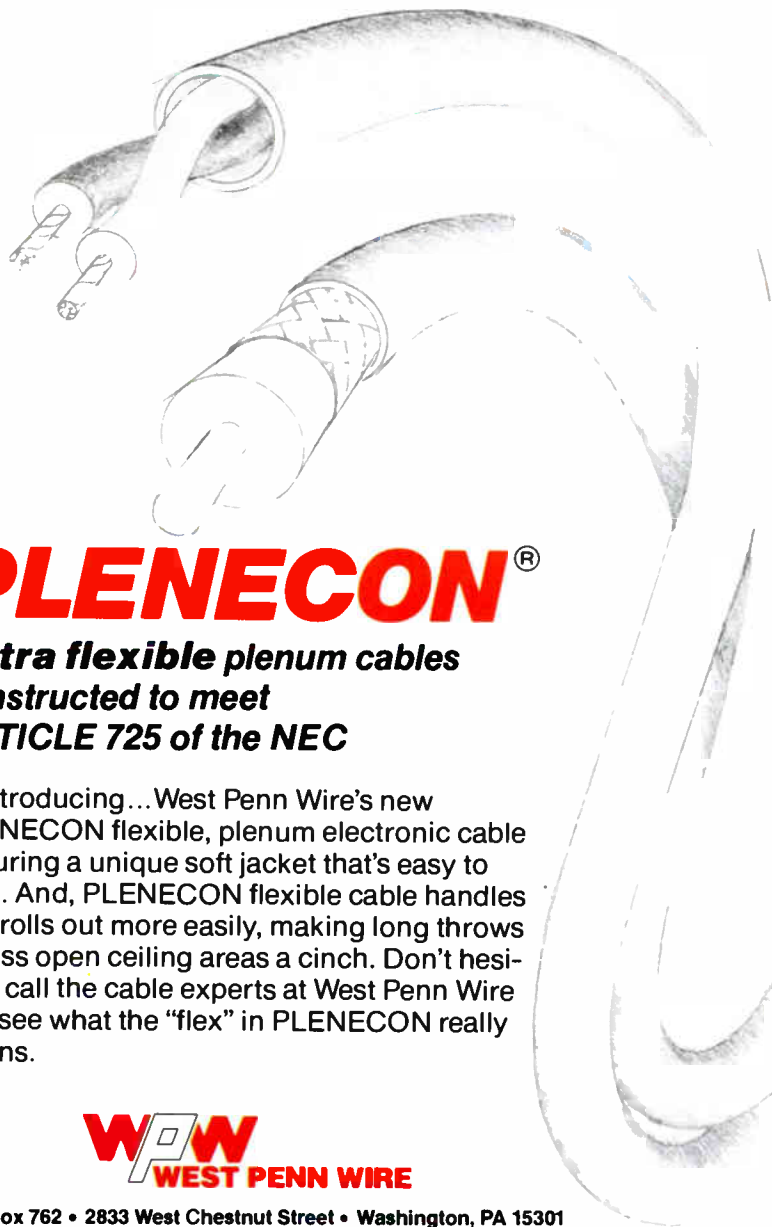
Circle 16 on Reader Response Card

Battery-Powered BAM

The BAM One is Anchor Audio's battery-powered amplifier mixer. The unit has two compact rechargeable batteries that can sustain three to five hours of continuous service per charge.

Circle 17 on Reader Response Card

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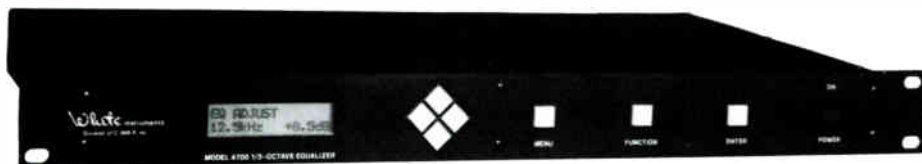
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Circle 230 on Reader Response Card



The 4700 Digitally Controlled One-Third Octave Equalizer

White "Noise"

The 4700 Digitally Controlled One-Third Octave Equalizer is an analog unit based on white instrument's implementation of R-C active filters. The company says, "This marriage of the analog and digital worlds maintains a high degree of audio performance while taking advantage of the convenience, flexibility and security of digital control."

Circle 18 on Reader Response Card

J.W. Davis New Prods

J.W. Davis & Company NED-100 is a high performance P.A. amplifier designed for telephone systems applications. It provides 100 watts R.M.S. 70 volts power output with built in short circuit protection. Special input circuitry permits interfacing with most types of PABX or key telephone systems without the need for external paging access units, according to the company.

J.W. Davis' five-inch ceiling assemblies, the CA5 series, include Davis TR-705 and TR-255 transformers maintaining the frequency response of the DS-505 speakers.

The J.W. Davis QM-1 mount allows wall plate installations to be made when an electrical box is not required. The QM-1 can be installed at any location on a wall, according to the company.

Circle 22 on Reader Response Card



Command An Equipment Combo

The TD-72, from York Controls, is a 72-channel wireless control with 16-character LCD display. It can control up to 72 functions of a York Controline System, commanding combinations of media or environmental equipment—such as VCEs, slide projectors, screens, drapes, lighting, etc.

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Circle 252 on Reader Response Card

University Offerings

The MA/MA A series of 5-input mixer amplifiers from University offers

features designed for paging and reinforcement. The series includes 35-, 60-, 100-, and 150-watt units, as well as a 35-watt piece with a built-in receiver.

The ZP-4 Zone Page Controller supersedes the ZP-3A, says University. Among the improvements are full dual-tone multifrequency key-pad compatibility, and four zones instead of three. It expands a 600-Ohm paging output port from a phone system to four zones and all zones, as selected by means of the tones from the touch pad on the phone used as a paging source.

Circle 20 on Reader Response Card

Speakers And More From Altec Lansing

Altec Lansing has debuted new speaker systems, including the 938-8AD and 938-8AE, which use the 604 coaxial Duplex in a "compact, rugged, multiangle enclosure to provide a wide response for use as a fold-back monitor or as the main element in smaller portable sound systems," says the company.

The A700 system offers high output, wide bandwidth, and precise directivity control in a single enclosure, says the company. The system is intended as a building block for clusters in churches, auditoriums, hotels, and civic centers. The trapezoidal, slope-front cabinet houses a 515-8G driving a vented bass horn and a 909-8A compression driver on a MR994A Mantaray horn. The A700XLF low frequency loudspeaker system has been designed to complement the performance of the A700 by extending the bandwidth of the combined system to 43 Hertz, says Altec. The A700SK suspension kit is an accessory hanging system.

The 1632A Electronic Crossover is a 2-channel crossover that provides more precise control and protection of speaker systems, says the company.

Circle 21 on Reader Response Card



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June 1989 59

Literature

Contact East's New Supplement: Catalogs Available From Master Bond, Zero Corp.

Free Supplement

A new 1989 supplement to the Contact East General catalog is available at no charge. The catalog features products for testing, repairing and assembling electronic equipment. The 48-page *Tools of the Trade* contains things of interest for engineers, managers and technicians. All items are described with specifications, color photos and prices.

Cable Video

The Dekoron division of Fluorocar-

bon has produced a video, "Latest News on Cable," that explains changes in the NEC Code requirements under Articles 725, 760, and 800. The tape discusses application areas for electronic cable and the correct wire to use. The video demonstrates a vertical flame test and covers other topics as well. The tape is a VHS format, 12 minutes long, and costs \$49.95.

Wire Tacking Adhesive Guide

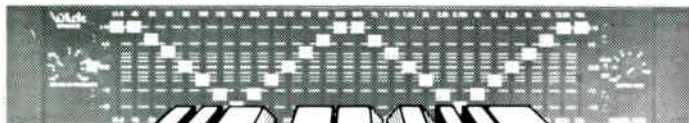
Master Bond Inc. has developed a new application selector guide for its

line of adhesive compounds for tacking wires and attaching components to printed wiring boards. One- and 2-component epoxies, UV curable epoxies, reactive acrylics, hot melt and cyanoacrylate adhesives are illustrated. Application conditions and performance profiles are provided for each type of product.

Deep Drawn Product Catalog

Zero Corporation has released a new 52-page catalog detailing more than 40,000 standard deep drawn aluminum enclosures in square, round, and rectangular configurations. In addition, it itemizes enclosures that are available in a variety of materials. The catalog also lists a range of options and accessories, as well as outlines a range of custom capabilities. ■

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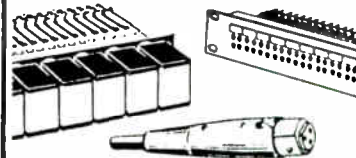


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Calendar

Upcoming Events

JUNE

Georgia Tech Education Extension Courses: Atlanta, GA. Contact: 404-894-2547. June 6-7, 12-13.

National Presentation Expo: New York, NY. Contact: Barbara Stockwell, Asst. VP, Knowledge Industry Publications, 800-328-5474, in New York State, 914-328-9157. 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: 212-705-7057. June 18-22.

Sound Engineering Seminar: Norman, IN. Contact: 812-995-8212. June 22-24.

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

JULY

Georgia Tech Education Extension Courses: San Francisco, CA. Contact: 404-894-2547. July 11-12, 13-14.

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

Sound Engineering Seminar: Norman, IN. Contact: 812-995-8212. July 21-23.

International Association of Auditorium Managers (IAAM): Reno, NV. Contact: 914-683-1000. July 29-August 1.

AUGUST

Georgia Tech Education Extension Course: Atlanta, GA. Contact: 404-894-2547. August 1-3.

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. August 6-12.

DASH Format Seminar: Fort Lauderdale, FL. Contact: 305-491-0825, ext. 186. August 10-11.

Sound Engineering Seminar: Norman, IN. Contact: 812-995-8212. August 24-26.

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

SEPTEMBER

Georgia Tech Education Extension Courses: Nashville, TN. Contact: 404-894-2547. September 12-13; Dallas, TX, 18-20, 26-27, 28-29.

NAB Radio '89: New Orleans, LA. Contact: 202-429-5300. September 13-16.

IEEE Broadcast Symposium: Washington, D.C. Contact: 212-705-7900. September 21-22.

Sound Engineering Seminar: Norman, IN. Contact: 812-995-8212. September 22-24.

OCTOBER

National Electrical Contractor Association (NECA): Chicago, IL. Contact: 301-657-3110. October 1-3.

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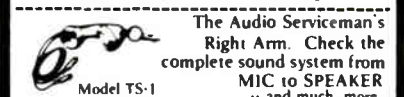


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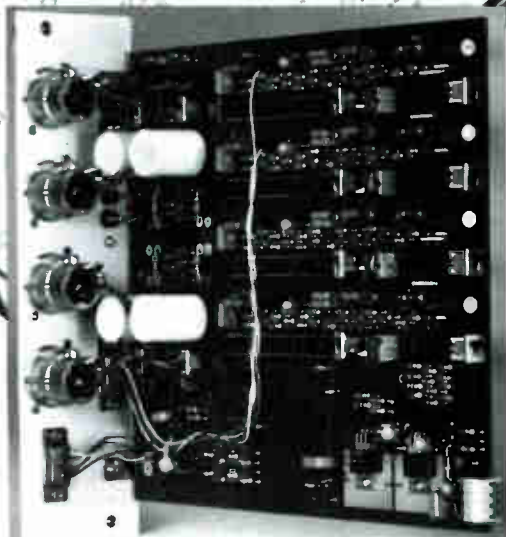
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Modules

Two new Voice-Matic microphone mixer modules add automatic flexibility and operating performance to System 41 installations. The DJ-4114 Voice-Matic Microphone Mixer Module and DJ-4115 Voice-matic Master Module offer noise-free interconnection and total compatibility with all other System 41 components.



Model DJ-4114 Voice-matic Microphone Mixer Module

The DJ-4114 Input Mixing Module features buffered pre-amp outputs, pre or post gates, status LED and logic outputs and 18 volt phantom power supply. Optional features include remote level and input controls and 48 volt phantom power.

All IRP Products are made in the U. S. A.



Model DJ-4115 Voice-matic Master Module

The DJ-4115 Voice-matic Master Module mixes the microphone signals from all DJ-4114 Modules in the system along with any auxiliary input signals. Various remote controls are optional.

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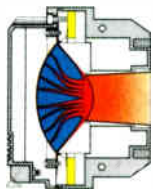
World Radio History

It Takes More Than A Little Neodymium To Change The Face Of Driver Technology.



Hailed as the catalyst for a new generation of high performance compression drivers, the rare earth compound neodymium showed up in our R&D lab shortly after it was first formulated. But its extremely high cost and sensitivity to heat had to be overcome before neodymium could live up to its full potential.

The availability of this highly magnetic, extremely lightweight material coincided perfectly with our development of the Coherent Wave™ phasing plug.



JBL's 2450J Neodymium Compression Driver with Coherent Wave™ phasing plug provides in-phase combining of sound waves for extended high frequency performance. JBL's patented diamond surround titanium diaphragm with new embossed dome greatly reduces distortion and damage at high SPL.

This new design, a phasing plug with annular apertures of constant path length, uniformly directs sound through to the throat providing in-phase combining of sound waves for extended high frequency performance. This new technology is combined with our patented diamond surround titanium diaphragm, incorporating a new embossed dome, to reduce the possibility of distortion or damage at high SPL.

2450J

The 2450's smaller size translates to tighter spacing of horn arc arrays, more even and precise coverage and greatly reduced requirements for delay. Plus, the 2450 nets out at a mere 4.8 kg (10.5 lb). The benefits of this dramatic weight reduction include lower shipping costs to the site or on the road and significantly less load bearing requirements for both structures and rigging. With built-in mounting points, the 2450 will take much less time to install.

Yes, it took more than a little neodymium to change the face of driver technology. But we're confident you will find the breakthrough results were certainly well worth the wait and the effort.



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