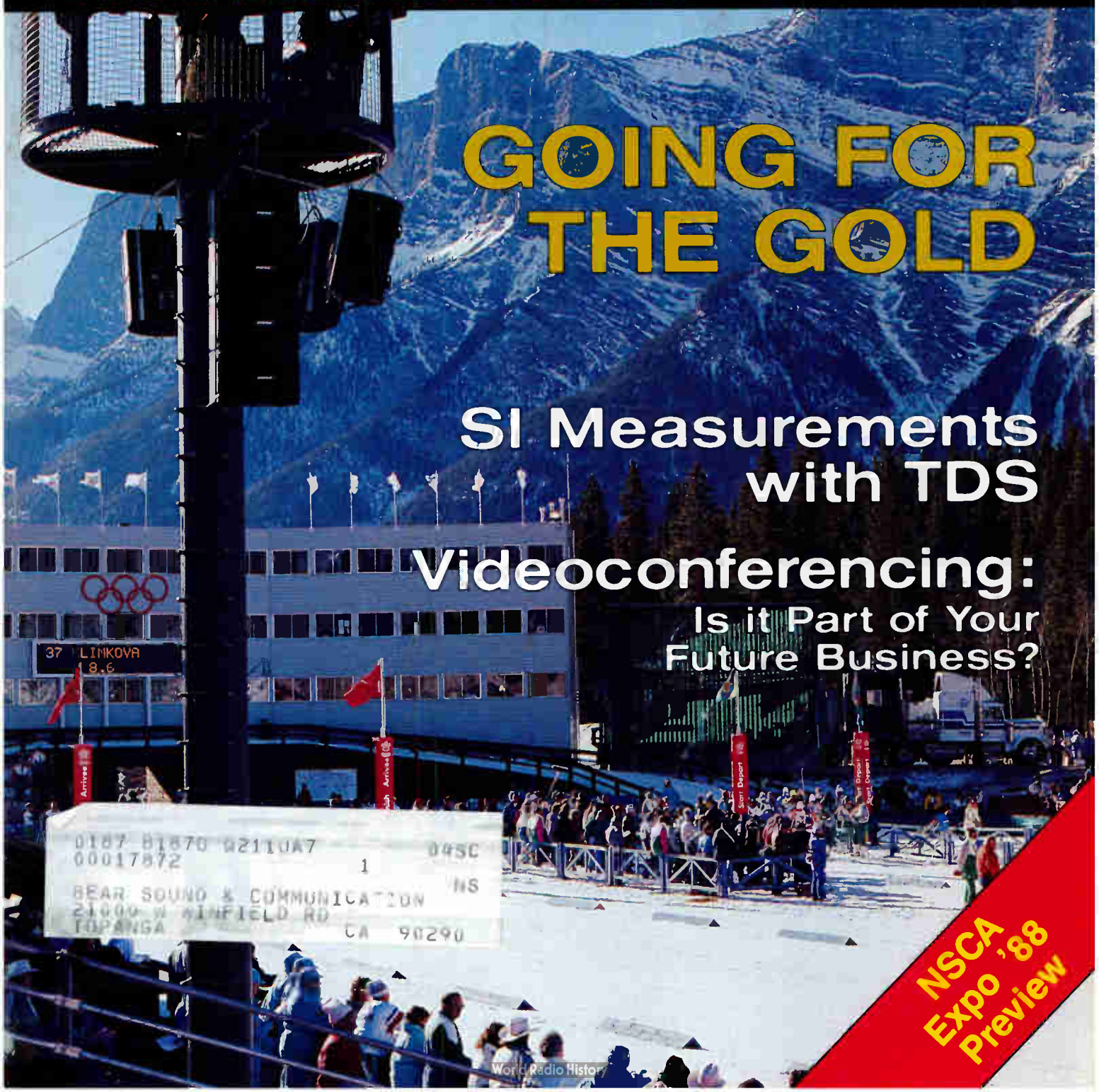
Field Test: Power Solutions PS-2000 Amp

SOUND & COMMUNICATIONS

FOR CONTRACTORS, SYSTEM MANAGERS AND SPECIFIERS

APRIL 1988



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Masahiko (Hiko) Shihoda
President

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SOUND & COMMUNICATIONS

Volume 34 #4
April 1988

COLUMNS

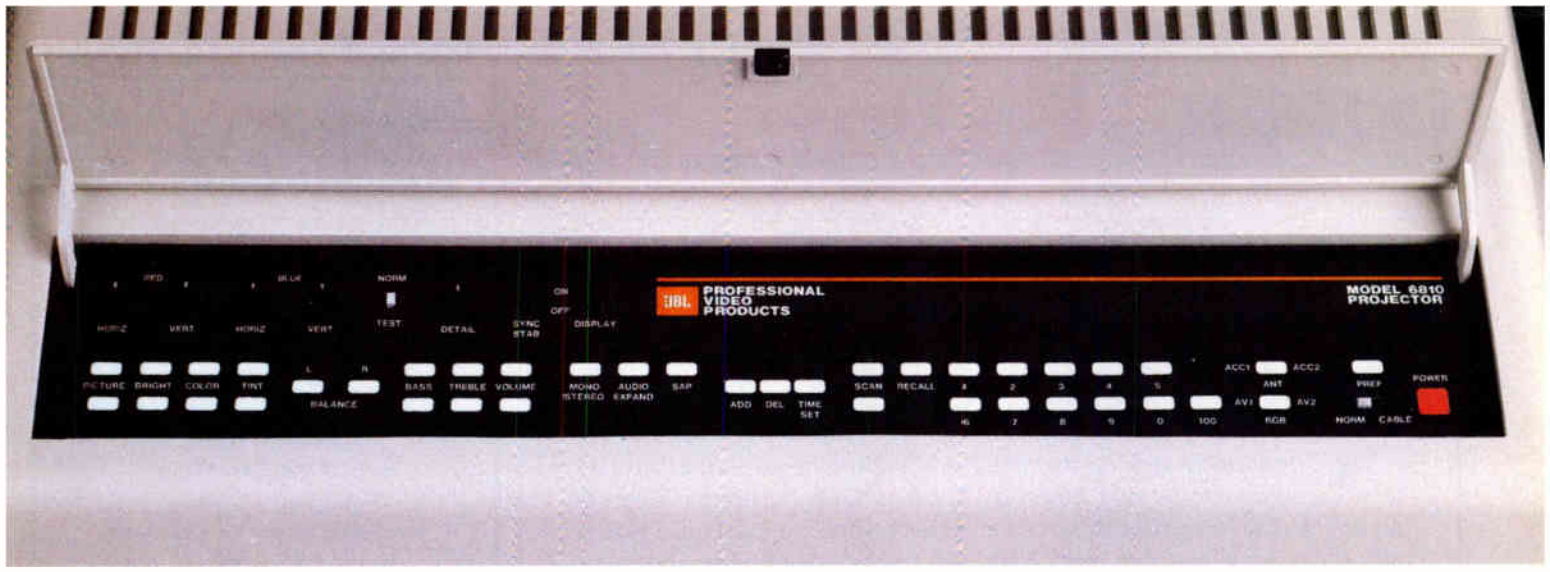
DEPARTMENTS

ON THE COVER

At the site of the cross-country skiing events, a grandstand was set up along side the finishing line area. Pictured is the main pole-hung cluster of stacked Bose 802s.

Photo by Jesse Klapholz

FEATURES



IF YOUR PROJECTOR ISN'T THIS FLEXIBLE NOW, IT NEVER WILL BE.

JBL's new Model 6810 Video Projector offers off-the-shelf flexibility the others can't touch.

The Model 6810's 40-function remote control puts sophisticated command in the palm of your hand.

An input panel that's worthy of a blue ribbon panel.

It's just one of the many reasons why JBL's new Model 6810 Video Projector is your most complete choice for a wide range of professional applications.

Unlike most other projectors, the Model 6810 is *born* brilliant. We knew you needed plenty of inputs, so we gave you six: enough RF inputs to accommodate antenna, cable, and satellite dish simultaneously. Plus plenty of inputs to handle your VCR, videodisc player, or computer. (Many competitive models give you just one or two inputs.)

Because your professional needs can change quickly, the Model 6810 offers impressive off-the-shelf flexibility. You can choose from floor or ceiling mounting, front or rear projection. And the picture size goes from five to fifteen feet diagonally on virtually any type of screen surface, flat or curved.

But flexibility wouldn't mean much without a sharp, superior picture. The Model 6810 gives you an extra crisp picture because it has the widest video amplifier bandwidth of any projector on the market.

JBL's Model 6810 fits right into your environment, offering a choice of front or rear projection (5 to 15 feet diagonally) on all types of screens.

And just take a look at some of these Model 6810 exclusives:

...the only video projector with a built-in 178-channel tuner and stereo decoder for Zenith/dbx* stereo and Second Audio Program broadcast signals.

...the only video projector with a wireless 40-function remote control.

*Zenith is a registered trademark of Zenith Electronics Corporation
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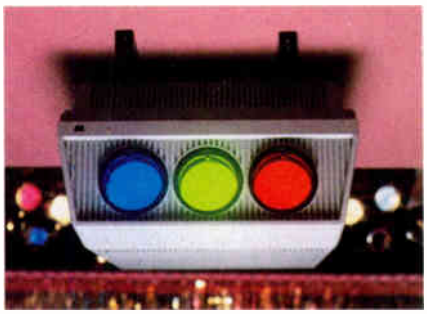

If floor space is at a premium, the Model 6810 can be ceiling mounted quickly and easily.

...the only video projector that supports onscreen graphics and lets you superimpose text.

...the only video projector that accommodates a variety of personal computers with just a flick of a switch (from analog to TTL). Many competitive models don't allow for TTL input, something that's absolutely necessary to connect an IBM PC.

JBL Professional, an audio legend for more than four decades, now offers a remarkably complete vision of what video projection is all about. To learn more about the Model 6810's professional performance and flexibility, contact your authorized JBL Dealer today.

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See us at NSCA booth 210

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Another Smash Show? Let's Hope So!

There's excitment stirring over this year's 1988 National Sound Contractors' Conference to be held from May 18-20 at the Bally's Reno. There is no doubt that last year's show had the best turnout to date...and NSCA officials promise that this year's Expo will be bigger and better than ever. So far, it looks that way, with over 270 exhibitors registered to show their wares. New and exciting products are supposed to be unveiled. Manufacturers, contractors, consultants, and reps in attendance should find this a very important three days. Many of last year's attendees are looking forward to the seminars (a track has been added this year, CAD/Instrumentation) and extended exhibit hours. The highlights of the show will be discussed in a subsequent issue.

Sound & Communications will be there with a camera crew filming NSCA-TV News. The show is written and edited by the editorial staff and produced by the publishers of *Sound & Communications*. Manufacturers will have the opportunity to have their products seen "on-the-air"in hotel rooms—Bally's Reno, The Peppermill, The Nugget, and The Airport Plaza—and on large screen televisions on the exhibit floor every hour of the day. So if you have important news you want the sound and communications industry to know, send it to us. *Sound & Communications* stays on top of this industry.

In fact, this issue of *Sound & Communications* includes articles on venues at the 1988 XV Winter Olympics in Calgery. You'll also find an in-depth article on Speech Intelligibility with Time Delay Spectrometry, and a never-before published paper on A Dual Radial Horn Loudspeaker System With Congruent Cylindrical Wave Front Radiation by A.J. May and the late Dr. John Volkman, former head of the Camden, New Jersey, RCA acoustical laboratories. In addition, the April issue also includes an article on the latest technology in videoconferencing and its glorbal ramifications to the sound and communications industry.

In May, we will bring you our third annual In-Depth Market Report on the Contracting Business. This indispensable report is a reliable source of statistical data that helps everyone in the sound and communications industry make better marketing plans and more accurate sales forecasts. This year's survey of a random sampling of 1,700 professional sound contractors promises to be the most complete and comprehensive study to date of the sound contracting industry.

See you at NSCA Expo '88!

Debra A. Pagan

Debra A. Pagan
Managing Editor

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THE BACK TO THE FUTURE

Introducing the Bogen "D" Series Modular Amplifier

The new Bogen "D" Series of modular amplifiers, mixers and power amplifiers represents the latest technology in sound system planning. Providing unsurpassed performance, the "D" Series is the latest in a long line of innovative systems designed by Bogen for engineered sound applications.

The "D" Series is a dream to install. It's reliable, cost-effective and specially designed to be flexible for meeting today's and future requirements.

The Bogen "D" Series of modular amplifiers, mixers/pre-amps, and power amplifiers, when combined with our state-of-the-art program modules will perform virtually every function a sound system might require. Mosfet circuitry guarantees performance and reliability, with less than 0.3% distortion.

You can begin to install the future in sound reinforcement today. The "D"Series will includes 20, 40, 80, and 160 watt modular amplifiers; 80, 160 and 320 watt power amplifiers; 80 and 160 watt in-wall amplifiers; and, a mixer/pre-amp. Designed by Bogen, this new Series of engineered sound systems is unsurpassed in its catagory for quality, value and reliability.

The Bogen "D" Series of modular amplifiers is today's answer to tomorrow's commercial sound needs.

The DMA 20 Modular Amplifier

Output Power:	20 watts RMS Continuous
Outputs:	4 and 8 ohm plus 25 and 70 volt
Frequency Response:	± 1 db from 20 Hz to 20 kHz
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HENRICKSEN AND HOCKMAN JOIN U.S. SOUND

In response to rumors heard at the last two AES conventions, *Sound & Communications* has learned that U.S.Sound Inc., a New Jersey concert sound company, has two new employees: Clifford A. Henricksen has been named director of engineering and Gregory M. Hockman has been named director of sales and marketing. According to John Lemon, president "The addition of Cliff and Greg to our team puts U.S. Sound in a very unique position for a touring sound company because it gives us strong engineering, product development and marketing experience and expertise." They will be responsible for further development of our COHERENT ZONE™ (patent pending) Concert System and other products.

Clifford Henricksen comes to U.S. Sound from the Engineering Department at Electro-Voice, Inc., where he was manager of the Loudspeaker Components Group. He previously held positions at Altec Lansing and Community Light and Sound.

Greg Hockman comes to U.S. Sound from QSC Audio Products where he was director of sales and marketing. Prior to QSC, Hockman held positions at Electro-Voice and Soundcraft mixing consoles and established Soundcraft Electronics in the U.S. Market.

EDGETECH FORMS NEW U.S. FIRMS

Edge Technology Group, Ltd., the U.K.-based mother company of Turbosound Inc., has created a new U.S. company, Edge Technology Group, Inc. in order to increase distribution of EdgeTech products and begin distributing products for other manufacturers.

Headed by a new president, Lance Korthals, the new U.S. Edge Technology Group, Inc. will oversee Turbosound Inc. (U.S.) Previously, Turbosound Inc. (U.S.) had been under the wing of its U.K. parent, Turbosound Ltd. "Besides my other responsibilities, I'll be seeking suitable companies interested in a professional association with Edge Technology Group, Inc. (U.S.)," Korthals said. Turbosound had traditionally distributed its own top-end speaker enclosures, Korthals said. He would not say, however, what new companies Turbosound will distribute. "We hope to associate with other external companies in exchanges of technology," Korthals indicated. "Acquisitions are a possibility, and we'll be looking to European and Far Eastern manufacturers that are looking to the U.S. and who need a strong distributor."

A 16-year veteran of the pro audio industry, the 36-year-old Korthals has served as director of marketing for Lexicon Inc. and before that, director of marketing and sales for Professional Products Division of dbx. "We believe that the EdgeTech companies can experience tremendous growth in the U.S.," said Alan Wick, managing director for Edge Technology, Ltd. in England. "Thus we have established Edge Technology Group, Inc., (U.S.) to strengthen and expand our current U.S. operations." EdgeTech U.K. is also the parent company of BSS, manufacturers of high-end signal processing equipment such as crossovers and dynamic processors, and Precision Devices, makers of raw speaker drives.

ZIMET, WELL-KNOWN AUDIO MENTOR, DIES

Sidney Zimet, who's Long Island audio store was one of the first to embrace new technology in sound recording and mixing in the 1970's, died with his wife, Nancy, in a plane crash on March 4.

He was remembered by friends and associates in the pro audio business as a pragmatic man with a sharp intuition for technology and strong opinions about the products he sold, rented and repaired. He cared deeply about his business, family and friends. "I learned a lot from him, from his visions and his insight," said Michael Tapes, who started working with Zimet in 1973 and is now President of Digital Creations. Zimet and his wife, who often accompanied him on business, were travelling to Nashville, Tennesee, for Zimet's rental business, Audio Force, when the small plane they were traveling in went down. The Zimets, who lived in Northport, left behind a son Glenn and a daughter Barbara.

In the 1960's, Zimet founded Audio By Zimet in Roslyn, New York, and began selling, repairing and installing high-fidelity products. Those who worked with him said Zimet only sold American-made products that could be easily serviced, a trait they said was losing its vogue in the new world of imported transistor radios and stereos. In the mid 1970's, Zimet and Tapes founded Sound Workshop, which became known for its 242 stereo reverb, 882 mixer and 1280 recording console.

MICROAUDIO ANNOUNCES ISSUE OF PATENT

The U.S. Patent Office recently issued (date of issue February 16, 1988) a patent to MicroAudio on programmable, tamper-proof equalization. The patent covers all types of remotely programmable, tamper-proof, fixed and variable frequency equalizers, according to president Eugene Rimkeit. Rights to the use of the patent will be given to Altec Lansing Corp. in conjunction with MicroAudio, Inc.

The patent includes the EQ POD 2.1 and 2.2, Dual 1/3 octave tamper-proof programmable equalizer in a one rack high case. The EQ POD 2.1 digitally remembers a single equalization curve, while the EQ POD 2.2 will remember 8, recallable only by a three digit access code for total security. The EQ POD 2.1 is programmed, as with all MicroAudio equalizers, via the IBM PC, the 2800 RTA/EQ or by the low cost model 28 handheld programmer. This patent also includes all previous models of MicroAudio equalizers.

KLARK TEKNIK PURCHASES MIDAS AUDIO SYSTEMS, LTD.

Klark Teknik recently announced its purchase of certain assets of Midas Audio Systems, Ltd., British manufacturer of live mixing consoles. Midas products will now be sold and serviced by Klark Teknik from its U.S. offices. "The purchase of Midas Audio Systems demonstrates Klark Teknik's commitment to servicng its clients' needs," said president Jack Kelly. "Midas consoles have an excellent reputation in the sound reinforcement industry. Thus, Klark Teknik can now concentrate on gearing its DDA consoles specifically for the post-production/recording studio market." The production facilities of Midas Audio Systems, Ltd. have been relocated to Klark Teknik headquarters in Kidderminister, U.K.

HOTEL CHANGE AT AES SIXTH INTERNATIONAL CONFERENCE

The Audio Engineering Society's sixth annual international conference location has been changed from the Opryland Hotel to Stouffer's Hotel in Nashville, Tennessee. The conference will be held from May 5 through the 7. It will consist of papers and demonstrations representing the state of today's art in sound reinforcement systems. Conference chairman is Ted Uzzle, director, market development at Altec Lansing in Oklahoma City, Okla., and *Sound & Communictions* contributing editor and book reviewer. The opening event at the conference will cover the history of sound reinforcement, and willl be presented by *Sound & Communications* technical editor Jesse Klapholz. Papers will include Computer Control & Sound by Norbert Sobol, product manager of AKG Acoustics Parent Company in Vienna, Austria.

How an Aiphone made this little girl

intercom system feel more at home.

Meet Rebecca, one of the most doted upon girls in her class.

Like many families both of Rebecca's parents work. Which means, on a rare occasion, she's left in charge of the household.

As you can guess, this dilemma didn't sit too well with Rebecca's parents. So, to combat both fear and guilt, they bought an Aiphone intercom system.

With an audio/video system installed inside and out, she can safely regulate who comes and goes.

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

SPECTRUM LEVELS

Past articles have discussed the area under the curve concept. for octave and 1/3 octave bands, the band sound pressure level is related to the total area under the curve. This article relates the concept to a power spectrum as measured by FFT systems, i.e. Fourier analysis of a time signal.

Consider a power spectral density plot for a limited frequency range as shown in Figure 1. This is the 'true' energy per Hz which might vary substantially as in Curve A or very slowly as with Curve B. Only a segment of the power spectrum is shown for the frequency limits of Fl and Fu, e.g. 1010 Hz to 1120 Hz. The total sound energy is found by integrating between these limits and the resulting power will vary with power spectrum height and the frequency interval which is the difference between Fl and Fu.

Assume that the power spectrum is broadband noise, e.g. white. noise which is used as the input to a speaker. The output will *not* be white because of the response of the speaker system. The average level for this noise is given by the lines of constant level for both curves as shown in Figure 1.

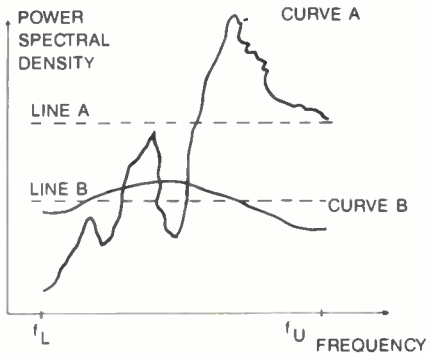

FIGURE 1

The spectrum level will vary with the frequency interval which is the width between Fl and Fu and the height of the line which represents the average energy. For this discussion, assume that the noise is true white noise and that the power spectral density curve is essentially flat which means that the average line is identical to it. For this case, the total energy will vary directly with the passband as given by Equation 1.

(1) SPL(band) = SPL(density) + 10 Log(del F)

where:

SPL(band) = sound pressure level for the band,
SPL(density) = sound pressure level per unit Hz,
del F = filter bandwidth in Hz.

An inspection of Equation 1 shows that the SPL(band) will increase by 3 dB each time the bandwidth is doubled. If it is increased tenfold, the level will increase by 10 dB.

With narrow band analyzers, e.g. FFT systems, the lines of resolution determine the value of SPL(band). For example, if a frequency analysis is done from 0 to 4000 Hz with a 400 line analyzer, then the del F will be 10 Hz. If 800 lines are used, then del F becomes 5 Hz. This has an obvious impact on the SPL(band) where it decreases by 3 dB because the passband was halved. This discussion has

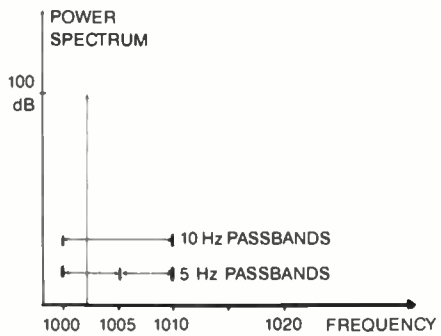

FIGURE 2

THIS GENERATION WILL BE WIRELESS.

What are *you* waiting for? With the introduction of our Stage II system, a limited budget won't hold you back. Samson world-class wireless technology means you can finally get the highest standard of audio quality and professional performance at truly affordable prices.

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the underlying assumption that the spectral density is a continuous spectrum such as broadband noise.

What happens with a line spectrum where pure tones occur at discrete frequencies? Consider a line spectrum with pure tones at a level of 100 dB, e.g. the line spectrum in Figure 2 where the spacing between tones is 100 Hz. For the first case, assume that the filter width is 10 Hz with Fl at 1000 Hz and the tone at 1002 Hz. The level in the band will be 100 dB. If the del F is changed to 5 Hz, then the level between 1000 and 1005 remains at 100 dB but the band between 1005 and 1010 drops to the noise floor of the instrument which might be as much as 70 or 80 dB down, e.g. an SPL(band) of 20 dB. This is shown in Figure 2.

Consider a second case where the tones are at intervals of 5 Hz where each has a level of 100 dB as shown in Figure 3. For an Fl of 1000 Hz and del F of 10 Hz, the passband has a total energy level of 103 dB, the sum of these two tones on a mean square pressure basis. If the del F is changed to 5 Hz, then each tone is detected by the passband and each band has an energy level of 100 dB (Figure 3).

This discussion demonstrates the implications of the power spectral density and the lines of resolution which determine SPL(band) with Fourier Analysis. It is easy to envision combinations which could yield different results which might not be interpreted properly by the user unless this spectrum level concept is understood.

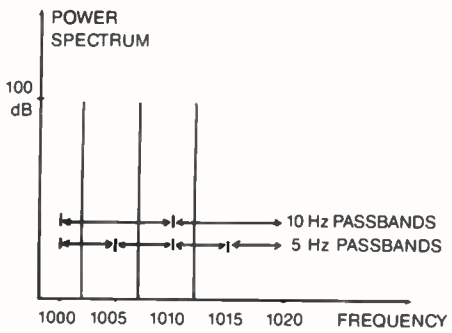

FIGURE 3

MAY

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

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

Until Now!

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

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

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

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

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

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

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

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

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by Ron Rosen

Send Me A Salesman! Part I

As a district manager for a major manufacturer of sound and communications equipment, it was part of my job to insure that we were receiving our fair market share in a given area. Our only sales outlet being our duly appointed distributor/sound contractor, we had little hope of receiving this market share if the distributor did not maintain an adequate sales force for the assigned territory. When factory orders fell below par, and the problem was obviously insufficient sales staff for the assigned territory, in most instances the sound contractor was not slow in recognizing the problem; chances are he has already been looking without success, or has been through the painful process of hiring salespeople untrained in our business, and upon finding that they cannot be turned into instant profit centers, discharged them within 60 to 90 days.

Which explains why, when I and my contemporaries pointed out the need for salespeople, we were met with an exasperated look and the cry of: "Send Me A Salesman!"[1]

[1] Let me make it clear that the title of this article is in no way intended to exclude the many excellent *female* salespersons in our industry. I am using the term *salesman* in its strictest generic sense. The word is used to avoid the jumbled syntax of "he or she," etc., for the convenience of both the writer and reader.

Ron Rosen is a freelance writer and has been both a contractor and district manager in the sound and communications industry.

No one is saying it is easy. Chances of finding a highly qualified, experienced salesman seeking employment in a cottage industry such as ours are about as good as winning the State Lottery and not having to worry about such things anymore. Most of us will agree that if such a person decided to relocate, he could step off the plane in any city, go to the nearest airport phone booth, call any major sound contractor listed in the local Yellow Pages, and chances are he would be eagerly invited down for an immediate interview. This is one of the advantages of being a specialist in a specialized industry, it just wouldn't work with life insurance or vacuum cleaner sales.

Modern psychiatry teaches us a four-part answer to problems:

1. Is there indeed a problem?
2. Identify the problem.
3. Find a solution.
4. Implement the solution.

So far this article has dealt with items one and two. If three and four seem like the hard part, it is probably because they are. Let us examine the options.

The salesman should obviously be able to sell. He also has to be technically competent in sound and communications systems. In order to produce such a person, we could:

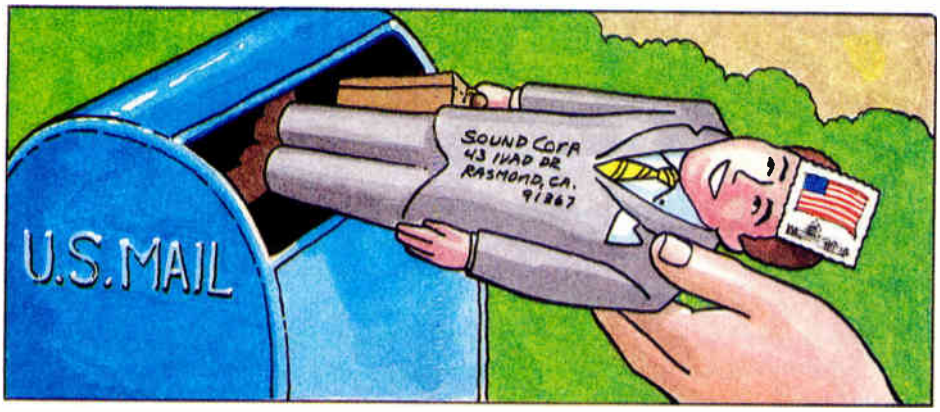
A. Hire him away from our competitor,
B. Take a technical person and teach him to sell,
C. Find an experienced salesman from another field and teach him the technical part.

Solution A is difficult. Your competitor is as aware of the difficulties in finding experienced people as you are, and *if* that salesperson is good, and *if* your competitor is a smart businessman, he is keeping him happy. You will have to arrange a meeting with that person surreptitiously, offer him an exorbitant salary, and if your strategy succeeds you will have to live in constant fear that another competitor will hire him away by the same method.

The exception to this is when you *know* a person is not happy with his company, and is amenable to discussing a change in employment. That person can be disillusioned with his present employer, but that does not mean he cannot be a loyal employee of yours. Chat freely with your manufacturer's reps and others in the industry, let them know you are seeking a qualified salesperson, let the word get around. A Help Wanted advertisement in a trade journal such as *Sound & Communications* will probably reach that person and let them know you are in the market for his talents.

Solution B, taking that personable technician or engineering type and teaching him to sell your wares is, to my way of thinking, the least desirable option. The only person that seems to have made that transition successfully is the owner of the business. I have seen too many technicians become demoralized and beg to be allowed to return to the toolbox. Selling takes more than a bright personality; the better a person is technically, the more he is inclined to talk in esoteric terms in the vicinity of the ceiling over the customer's head.

Solution C, teaching sound and communications systems to a person experienced in selling has a much better chance of succeeding, and is one method that I have personally observed producing some real winners.



COMMAND PERFORMANCE

The AD 13 Complete Digital Alignment System

PAINSTAKING DESIGN ensures the AD 13 has all of the functions and interface options to satisfy an extensive variety of system configurations. Utilizing National Semiconductor's new 16-bit HPC Series Micro-controller, the AD 13 provides up to 650ms delay on each of three outputs, with programmable 1ms or 20us steps.

READY TO WORK. There are no expensive options to order or configuration decisions to make. Use three separate buttons on the rear to select either transformer-coupled or active balanced/unbalanced outputs.

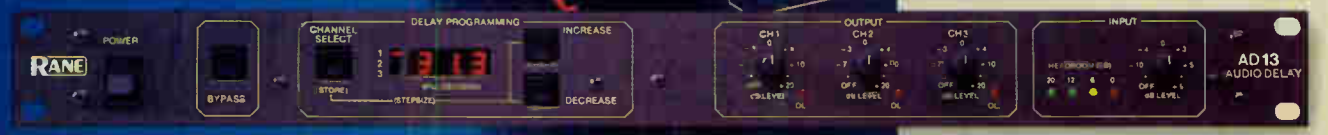
THREE-PIN CONNECTORS AND TERMINAL STRIPS are included for the input and all three outputs.

REAR PANEL LOCKOUT BUTTON and steel security cover protect your system alignment at all times.

EXCLUSIVE FAIL-SAFE BYPASS feature gives you comparison capability and automatic back-up protection from signal loss in case of failure or power loss.

EEPROM MEMORY BACK-UP: no batteries, ever.

Separate input and output level controls, LED metering, linear phase filters. . .the list of features goes on and on. Whatever the installations might require, cover your options with the most comprehensive delay package available: the AD 13.



RANE

Rane Corporation
10802-47th Ave. W. Everett, WA 98204
(206)355-6000

Circle 204 on Reader Response Card

See us at NSCA booth 204

The key here is to not lose sight of this person's role. We are not going to teach him to be an electronic engineer. He is probably never going to match your years of experience in this business. He may never really know how to calculate articulation loss of consonants in Alcons, but he can describe the difference between good and bad sound to the customer in words that make sense.

Not to put down the role of the skilled sound engineer, but the *average* sound installation is not all that complex. Save your talent for the special jobs. How good of a sound engineer do you have to be in order to recommend and install a proper school sound and intercommunication system? Or a hospital nurse call and paging system? A restaurant background music system? Few will deny that the revenue derived from this type of sale can be as much as, and often much greater than, the most complex and carefully designed church or auditorium system.

Lest I incur the wrath of my peers, however, let me hasten to add I am *not* stating that the proper design of a nurse call system does not require knowledge and skill; just that these skills *can be learned* without having an extensive background in electronics. Think about it.

The Search

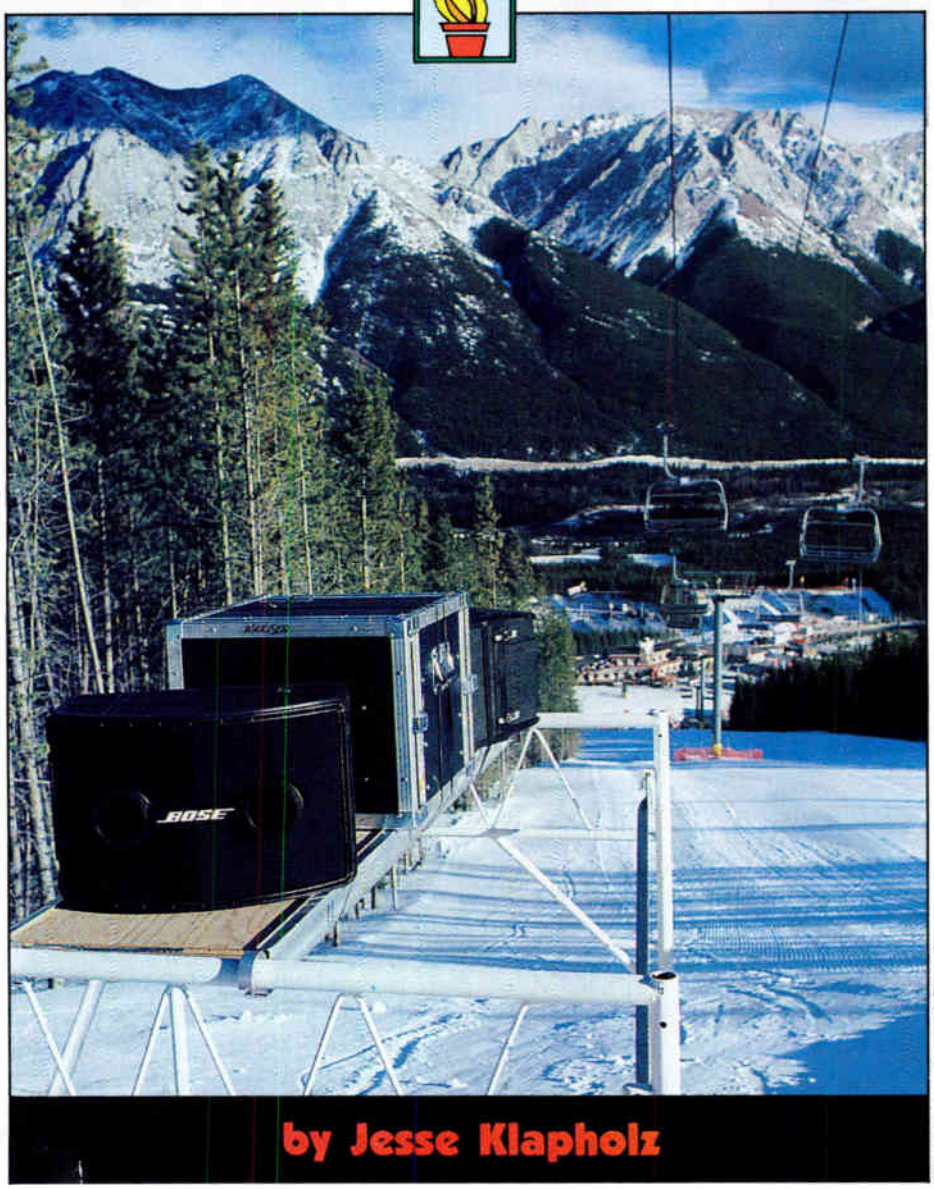
As will anything else, the degree of success in finding and keeping that elusive person and having that person consistently produce profits for your company is in direct proportion to the time and money invested. This is no place to pinch pennies. If you advertise in the newspaper, the one with the highest Classified Advertising rates probably reaches the most readers. Your ad is the first impression of your company that the candidate is going to get; excessive abbreviations, too brief a description of your type of work, etc., hardly promotes an image of the type of company one wishes to pursue a career with. Going for bold typeface or that extra line of copy might make all the difference.

(Need we remind anyone *not* to advertise with a blind box number, or fail to mention what the job is all about? Would *you* answer an ad like that?)

Trade journal and newspaper advertising are good places to begin. The fee charged by most private employment agencies, typically 10 percent of the employee's annual salary, makes this a somewhat unattractive option to a business the size of the average sound contractor. One resource, however, that is often overlooked is your State Employment Office, which can produce a surprising amount of talent. Their services are free to both employer and employee, and there is a trained staff whose sole purpose is to match employer with employee, often with the aid of computers. All it takes is a telephone call.

What are we advertising and looking for? As previously mentioned, an advertisement in the classified section

(continued on page 76)



(Photo courtesy of Bose)

Probably the most difficult venues to cover were the Alpine Skiing events atop Nakiska at Mount Allen, where Bose 802s were used.

Going for the Gold

by Jesse Klapholz

As you know by now Bose Corp. was the official supplier of professional sound equipment to the XV Winter Olympics recently held in Calgary, Canada—"a first ever designation at a Winter Olympics." Back in January Bose Corp. decided to assemble a *review* team to visit the site of this year's Winter Olympics at Calgary. The team consisted of three equal representations of the press, electroacoustical consulting community, and the sound contracting world.

After several weeks of hectic planning by Bose, and its public relations firm, Borman Associates, we all received our final agenda and instructions: warnings of the temperatures ranging down to the arctic freeze-zone, followed by detailed apparel instructions to include as many layers as possible, topped with a reminder not to be vain on the treacherous slope of Mt. Nakiska. Bose was to provide neck warmers. Most of us had a full day of travelling to arrive at the 60 degree-plus city hosting the world-wide television event. We were told it was the Chinook winds blowing in from the West. As some sign from above, the hotel managed to stop the first four arrivees in the elevator, including baggage, between the first and second floors for half an hour.

Nonetheless, being the troopers that we are in this industry, nothing could stop us from the welcome cocktail reception and dinner hosted by Bose, and its Canadian Division, Bose Ltd., of Toronto. Starting the evening's presentation was David Bell, general manager, Professional Products, of Bose—certainly the most colorful and entertaining of Bose's management—setting the stage for the story to unfold.

Sherwin Greenblatt, president of Bose, spoke next. Mr. Greenblatt, a very likeable personable person, has been at Bose since its beginnings in 1964. He painted the set, imparting the essence of Bose's philosophies—basically excellence, do a job worth doing in the most elegant manner.

Dr. Amar Bose, who has been a professor at MIT even before he founded Bose Corp., has always had his eye out for *star* pupils. Among his recruitments is John Carter, chief engineer at Bose. John gave a short talk on some of the technologies that Bose had as a resource pool enabling them to tackle a job of this size. Speech intelligibility seemed to be the buzzword of the day, and all of the technologies discussed stressed intelligibility.

Olympic Stars

Also joining us for dinner were, Robert Safrata, 1988 Olympic Torch Bearer and 1976 Olympian-alpine events, and Nancy Green, Canada's first Olympic skiing Gold Medalist, 1968. Safrata gave an enlightened talk about what the Olympics meant to him and how important the sound at the events are. From his few days prior to the dinner he was quite enthusiastic about Bose's performance.

A short talk by Larry Russell, general manager, Bose Ltd., Toronto, basically told us how Dan Fraser had to convince him that Bose Ltd. could coordinate the sound systems, and maintain their sales and support for existing business at the same time. Dan Fraser is the Canadian national sales manager for professional products in Canada. But during the last two years he became the Olympic project manager—it was his vision and persistence that paid off in the end. Fraser is a quiet, soft spoken guy, that started the ball rolling two years ago when Bose coordinated the sound for the World Cup Downhill in Whistler, B.C. His discussions with David Shank, general manager of Corporate Relations for OCO '88 (XV Olympic Winter Games Organizing Committee) led to Bose's involvement with the spring event "Previews '88," held at Mount Nakiska and Canmore. "The sound Bose provided for the figure skating, skiing, speed skating, and press conferences were a successful "demo," in that they proved to OCO that Bose could do the job," said Fraser. For the last two years Fraser spent an average of one week per month on this project, which escalated to a full-time job since September, '87. Bose's next contact, through Fraser, was with John Way, OCO's "Supervisor-Broadband Services." Way was responsible for all the video and audio coordination with all of the permanent and temporary facilities to be used for the Olympic events.

That means a lot of coordinating with competitive events taking place in some 10 venues in Calgary and the ski areas 50 miles away. Calgary had to upgrade some existing facilities, and build new ones to be competitive with other sites fighting for the Olympics.

Sound was one aspect that needed to work to the satisfaction of OCO, and the operators of existing facilities. According to OCO '88 president Bill Pratt, "Bose has earned an excellent reputation in meeting the acoustical and environmental challenges at many important musical and sporting events including the Preview '88 events in Calgary and Canmore."

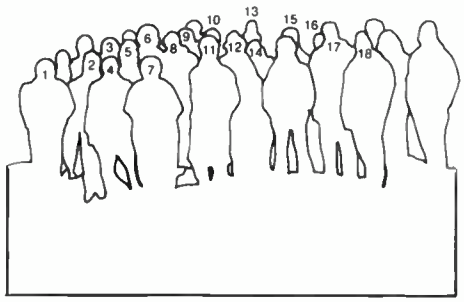
The relationship that developed was both unique and challenging since Bose was responsible for all OCO sound system requirements including the Olympic events, meetings, athletic training sessions, special events, and press conferences. At the schematic design stage, Fraser called in Bruce Meyers and Ken Jacobs of Bose.

Modeler

Working with Way, they used the Bose Modeler Program to evaluate installed systems at established venues, and lay out new systems where necessary. Based on these evaluations, new designs, and Way's requirements, an initial "Christmas List" budget was established. After more number crunching and discussions, a final budget of $1 million was agreed upon to supply turnkey sound systems for all of OCO's requirements. In all, Bose was responsible for 11 venues, five portable systems, and four sponsor events (more on the Federal Express "Festival of Lights" later on) actually totalling 45 different systems.

Where systems were adequate, only minor improvements were called for. In other cases new systems were permanently installed. Other situations, because of the nature of the temporary configurations and crowd sizes, meant systems would be installed for the Olympics only. In all, 85 percent of all venues needed audio upgrading, and 75 percent of the off-venue systems used Bose equipment.

Designing and redesigning sound systems for 11 venues took the three-man team many hours at their Macintosh keyboards. But the design of each system involved athletes in each sport, according to Fraser. While distributed sound systems provide even, non-localizable sound



The Review Team included:

1-Bill Schiefer
2-Jim Brawley
3-Sherwin Greenblatt
4-Ken Pohlmann
5-Laurie Whitley
6-Don Stockfleth
7-Rolly Brook
8-John Carter
9-Ron Baker
10-Randy Savicky
11-Dave Klepper
12-Hans Fantel
13-Daryll Fortune
14-Lisa Borman
15-Richard Feld
16-David Bell
17-Tom Knauss
18-Jesse Klapholz

(Photos by Jesse Klapholz)

At the rodeo, the centrally located scoreboard in the coral had 18 Bose 802s arrayed around its four sides. An additional six 402s were hung at the far end of the arena.

reproduction, the Bose design team learned that they won't necessarily work for figure skaters, for example. "Skaters actually need to be able to pinpoint loudspeakers as they do their rapid double and triple spins," Fraser said, "it helps them keep count!"

However, designing the systems was only the beginning. Coordinating the necessary power amplifiers, which were Bose MOS-FET types from Europe, and the various other electronics, cable, hardware, and generators was the next step, followed by arranging for the installation of more than 500 loudspeakers, 200,000 watts of power, 34 mixers, 16 FM receivers, and 20,000 feet of cable. Frigid weather conditions, and extremely isolated locations, presented some unusual conditions as well.

Coordination

Staging as many as 25 different events a day for 16 days became an important factor for staffing and scheduling. Bose was responsible to OCO that every system would both be physically working, and operated by a capable technician. Fraser and Russell used another Macintosh program, called Time Line, to schedule personnel at the appropriate venues, special events, and sponsor events.

Besides Bose Ltd.'s own staff, local independent contractors, and Bose crews from other countries were enlisted for the cause. Tom Clelland, of the Watt Shop, a non-Bose sound contractor of Regina, Saskatchewan, was hired as manager of the Olympic venue installations for Bose. Speaking to Clelland at the dinner over drinks, he commented on how impressed he was with the ease in which the Bose systems were installed, as compared to the larger horn-type clusters one might usually use. Clelland was also impressed by their performance, enough to seek a Bose Dealership.

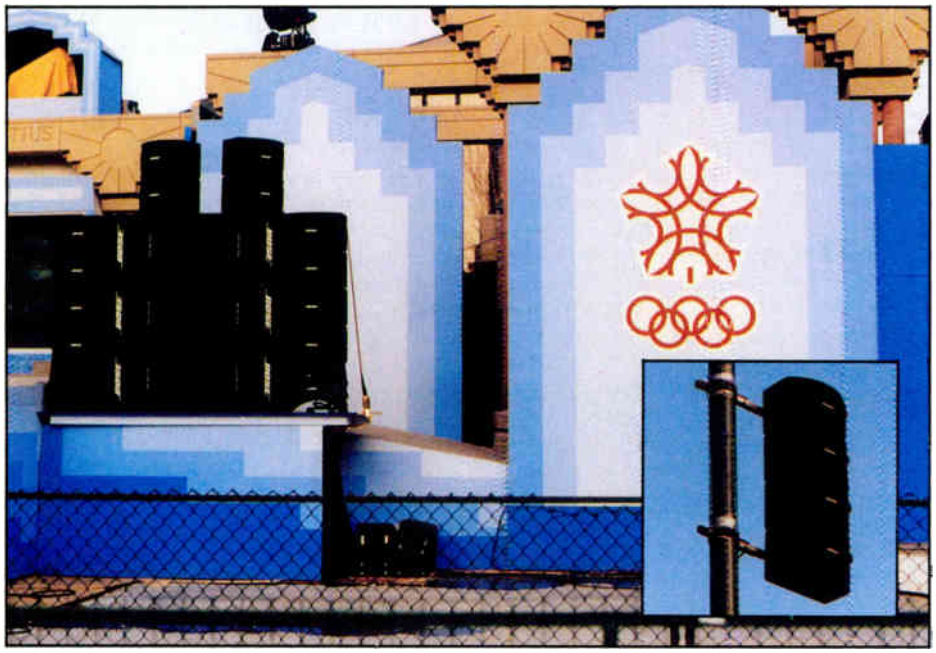
Perhaps the most difficult venues to cover were the Alpine skiing events atop Nakiska at Mount Allen. Over 30,000 spectators needed sound coverage at 24 different viewing areas across the ski slopes. Because of the distances and terrain, hard wiring these locations would have been "somewhere between difficult to impossible," according to Bruce Meyers of Bose. "Therefore, after several planning meetings and some tests it was decided to use ac generators driving power amplifiers, and FM receivers at these remote locations," said Meyers. "Unfortunately, best plans sometimes don't end up as we expect," he continued, "and the broadcast people kept turning our amplifiers down to keep them out of their crowd pickup microphones—it was a never ending battle."

Observation Day

Observing a variety of venues at the Olympics—ranging from the spread out viewing areas at the cross-country skiing location, to the indoor rodeo at the Stampede Corral—had different effects on the assembled expert viewers. Descriptive factors can be broken down to loudness, even coverage, intelligibility, and fidelity. Environmental acoustics and conditions are implicit in these observations, and the educated observer includes these in his assessments.

Systems were auditioned for both speech transmission and musical reproduction. As far as musical reproduction is concerned, environmental/room acoustics begin to cross over into a more subjective domain, and these characteristics change with music type. Criteria such as intimacy, definition, running liveness, warmth, dynamics, color, envelopment, etc., while they do have effect on speech intelligibility, are more applicable to musical spaces. While the acoustical characteristics of a space pre-destine its performance, it often becomes difficult to separate acoustical performance from electroacoustics.

This huge screen called Star Vision, supplied by Avesco Screen Co. of Surrey England, is a matrix of 1,000 CRTs. It was used at the cross country skiing site.



(Photos by Jesse Klapholz)

Bose 802s and 302s were used on stage for the medal presentations at Olympic Plaza. (inset) Bose 802s were on poles around the perimeter of the plaza.

Anyway, our first stop was at Canmore, the site of cross-country skiing. A grandstand was set up along one side of the finishing line area, and spectators could walk all along the some 3,500 meter long trails. While none of us die-hard audio experts strayed too far away from the comfort of warm benches, toilets, and shops, some did "walk" through the coverage area of the main pole-hung cluster of stacked Bose 802s, and into the treacherous "satellite" 402 speaker coverage locations.

The results of the short survey was high-quality sound, evenly distributed around the facility. However, an even further observation was the fact that walking through the overlapping patterns of the stacked 802s resulted in much smoother transitions than one would expect. In fact, compared to a conventional horn cluster it seemed much smoother. The author's synopsis was that an array of 802s seems to be much more forgiving than horn clusters which *must* be exactly aligned with each other for minimally acceptable overlap performance. This does not even consider the fact that most contemporary cluster designs use medium to high directivity devices for the high frequencies and low directivity devices for the low frequencies.

Another case in point is the fact that whether an experienced sound system designer saw this loudspeaker array on a drawing, or in a computer model, or on the pole, his experience would closely approximate what he would hear once the system was installed and operative.

World's Largest TV Set

During our trek back to the rest of the group, the Philly contingency happened upon the road crew from Surrey, En-

(continued on page 94)

Was this the type of delay you originally specified?

Klark-Teknik reliability means fewer unplanned service calls

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

Klark-Teknik experience means superior performance

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

Klark-Teknik quality stems from unrelenting scrutiny

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

Series 700 Digital Delays have proven their reliability over ten years of use: like all Klark-Teknik products, they undergo 100 hours of testing before being shipped. Our standard procedures include stereo dynascope board inspections, full performance verification and a cycled burn-in followed by a complete re-check. Lower standards of design, construction and testing could make our delays easier to purchase. But it would make them far more difficult to install and operate. There simply are no short cuts to true "set and forget" operation.

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

Each of Klark-Teknik's Series 700 Digital Delay Lines, Series 300 Graphic Equalizers and Series 400 Parametric Equalizers is optimized for specific applications.

KLARK-TEKNIK

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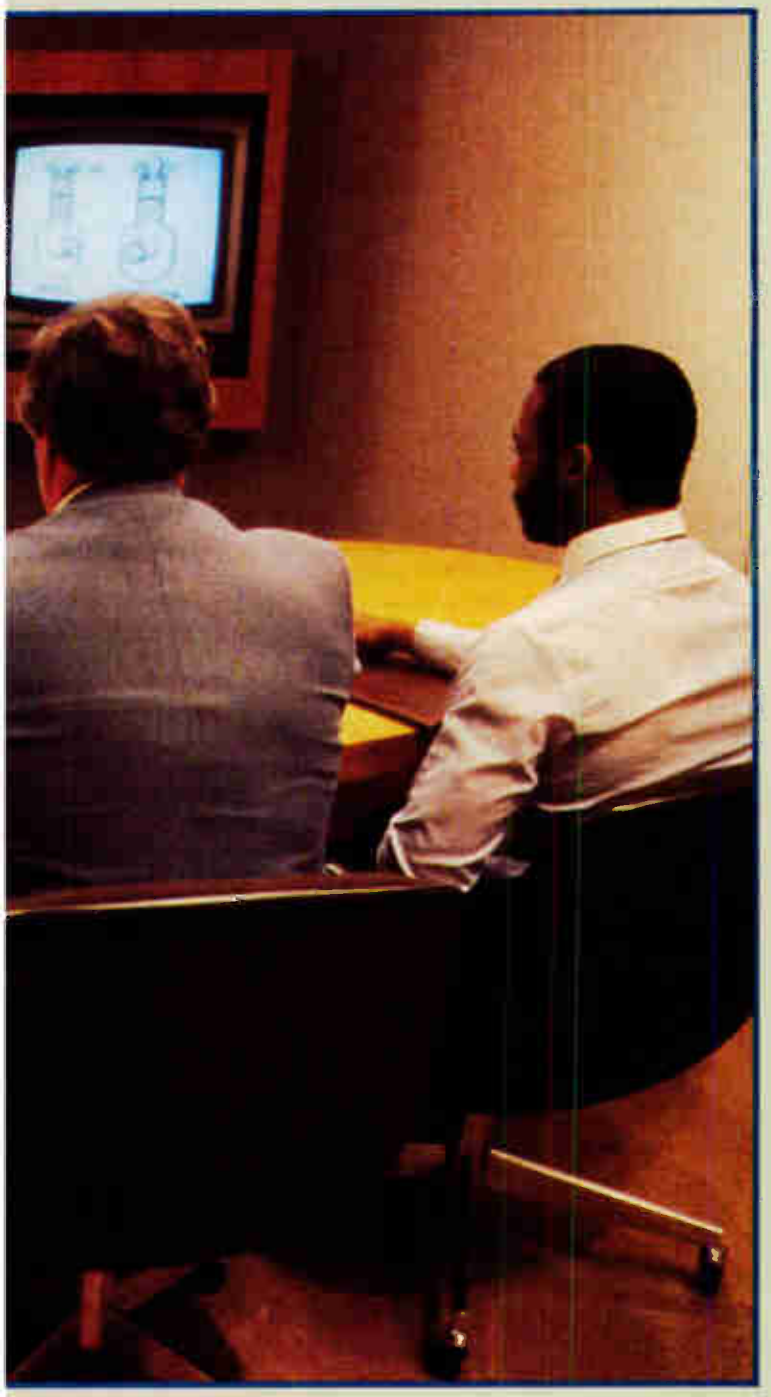
Circle 219 on Reader Response Card

(Photo courtesy of Georgia Power Co.)

V · I · D · E · O · C · O · N ·



Is it part of your future business?

by Robert E. McFarlane and John J. Leay

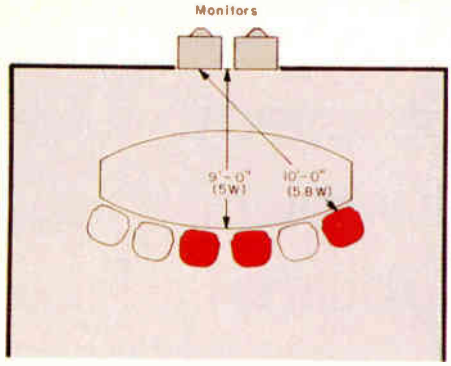
As a sound system contractor, you have probably done some sort of audio-conferencing installation by now. And you may well have had the common customer request to "provide for a future up grade to video-conferencing."

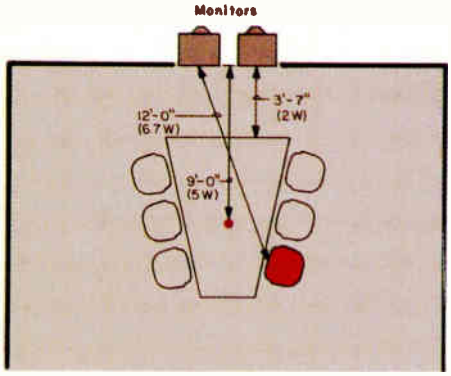
Videoconferencing pushes both audio and video technology to its limits, requiring a fine balance in design and engineering tradeoffs. No individual piece of the system can truly be optimized, but each must operate "close to the edge." It must also be operable by the users virtually without thought or effort, and be transparent to the dynamics of the meeting, and do this between locations that may be thousands of miles apart.

Thankfully, enough com-

F · E · R · E · N · C · I · N · G

A highly sophisticated videoconferencing room at Georgia Power Co. Five primary participant chairs face the monitors.





(Charts by Robert McFarlane)

The optimum viewing distance for TV monitors is five times the width of the monitor screen—the 5W rule; in the examples shown, 5W is taken as 9 feet for a 27-inch screen. At a semicircular table (Figure 1), participants at the outer seats will be a bit beyond the best viewing range if those at the center are optimally located. At a wedge-shaped table (Figure 2), participants at the far end of the table sit at a distant 6.7W, while those nearer the monitors sit almost at 2W.

panies took realistic approaches, and worked with experienced design professionals, to result in some good, working, and heavily used systems. With the viability of the medium demonstrated, a few venture-minded manufacturers saw a future in the medium and invested heavily in R&D to develop new products that have made many things a lot easier.

So today, while you read very little about this subject in the popular press, it's quietly growing and expanding. But there's a new potential trap out there for the inexperienced—the "roll-in" and "desk top" units. They have a lot of applications, but may lure you into thinking that all the problems are solved and that you don't really need to know much to install a system these days.

While full blown rooms may still cost up to a million dollars, the newest "desk top" approaches are sold as "just another board for your PC." The medium has come a long way in a short time, but not so far as to provide a million dollars of performance for a few thousand. Know what you're getting before you buy.

Roll-in units, on the other hand, are enticingly advertised between $60k and $80k. But the roll-ins don't include Codec (another $65k), the circuits (anybody's guess), and the options most people want, like a graphics camera, video and audio player/recorders, or decent speakers for the audio link.

And integrating "desk tops" with "roll-ins" and full-blown rooms is a job for a Master, although its requested by users all the time. All told, it's kind of like buying a car. You'd better plan on paying a lot more than the advertised price if you also want the advertised performance!

You may well want to get into this business if you're not already there, but you should be aware of the challenges that face you before taking on a job. These are *not* just "grown-up" TV surveillance systems. Even people highly experienced in the television industry call for specialized help with many videoconferencing applications. The simple fact is that working in any kind of standard office environment, whether the Executive Suite or a Conference Room, is darn tough for both audio and video, what with windows, architectural lighting, air conditioning noise, and restricted space to deal with.

ADDING VIDEO

Videoconferencing, the ability to illustrate conversation with life-like pictures, is usually the first request from most new users. Every day on the morning shows we see interviews conducted, apparently face-to-face, with people in all parts of the world. Unfortunately, the way it's done on the Networks, and the way it must be done in an office, are completely different, but the viewer at home doesn't recognize that. The Networks employ millions in equipment and hundreds of technicians to achieve that effect, plus on-camera professionals who can look at a monitor out of the corner of an eye and make you think they're seeing the same giant-screen picture you see at home.

VIDEOCONFERENCING THE "OLD NEW MEDIUM"

A thumbnail sketch of the history of technology may be useful to understanding some of the problems, and avoiding their repetition.

Videoconferencing is not really so new. Early links included NASA and Banker's Trust in the 1950s, and the ill-fated development of the AT&T "Picturephone." There was a clear perception that people wanted to both see and hear if that were posssible.

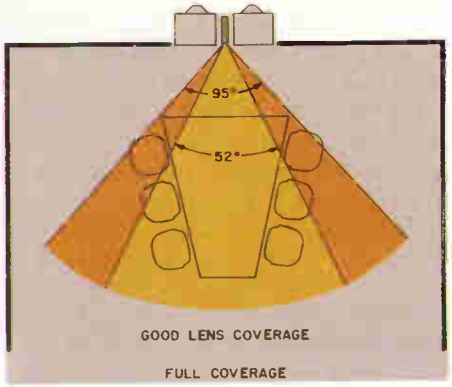
So what delayed major usage so long? Cross-country, or even intra-city analog video circuits are 6-10 Mhz wide—a far cry from a 4 kHz "Voice Loop," or even a 7 kHz "Broadcast Loop." The problem with such service was cost, which grew even higher with the broadcasters' demands for available land lines, far beyond virtually any user's ability to sustain.

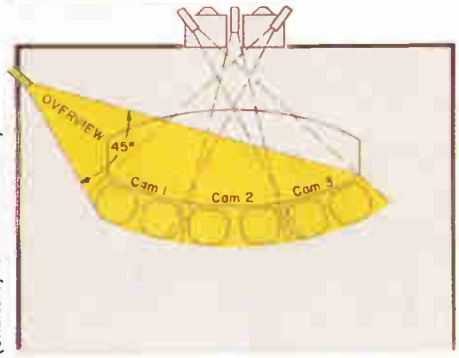
So people made do with Conference Telephones, as most still do today. The infamous Western Electric 4A "Speakerphone" became a familiar fixture, even while drawing negative comments from most users. It is a classic case of engineering compromise. It has to work in almost any acoustic environment, be small and unobtrusive, easily movable, and usable even by executives! It may sound like a rain barrel, and edit words out of your sentences, but for years it has been the way to involve several people in a call.

AUDIOCONFERENCING

Major strides have been made in achieving good quality "open audio" by companies like Darome, AT&T with its stick-like "Quorum" microphone, and Shure Brothers with their "Pyramid" and "Discus" designs. Add the enormous developments in equalizers, voice gating technology, and dynamic echo cancelling, and you've achieved a quantum leap ahead of "speakerphones." However, none of these devices performs up to par without proper attention to the room acoustics (which is optimally different for each approach) and the systems balance. Not enough emphasis can be placed on the importance of quality in the audio link, for without it, the conference stops.

In fact, audioconferencing is still the biggest part of the industry, either as a stand-alone installation, or "enhanced" with the addition of facsimile, electronic writing boards, or computer graphics communications. These forms of teleconferencing are generally known as "Enhanced Audio," "Audiographics," or "Augmented Audio." If you're just thinking about entering this business, you'd be well advised to get a good grounding in audioconferencing and audiographics before diving head-long into the videoconferencing arena.





(Charts by Robert McFarlane)

Wedge tables (Figure 3) require wide-angle lenses for overview shots. The shaded triangles show that the optically best lens choices (center areas) cannot cover a sufficiently wide field and lens angles wider than 52 degrees are likely to result in unacceptable perspective distortions. At a semicircular table, designers typically use three cameras and sometimes add an overview camera at one side (Figure 4).

There's no way you'd want to try the same approach in a conference room, even if you could. It's just not conducive to carrying on a natural conversation or to creating a "normal" meeting environment.

For many users, the first step into videoconferencing is "Freeze Frame" Video. Although it rates its own category in the teleconferencing hierarchy, it can really be thought of as a much more sophisticated form of "audio enhancement." Television cameras are used to record still-frame images of participants and/or graphics material using television "freeze frame" techniques. These images are then read out slowly by a device called a "Codec" (Coder/Decoder), line-by-line, in much the same way a facsimile image is formed. This makes it possible to transmit a complete television picture over anything from conventional dial-up telephone lines to high speed computer data circuits. The variable is transmission time, which may run as long as 90 seconds over dail-up phone lines, and as little as a few seconds over high speed data links. Again, the difference is circuit cost. The audio is handled on a separate circuit, and is still as critical as ever.

The advantage of "video" over the other forms of enhancement is the ability to show 3-dimensional materials and other non-standard graphics that do not lend themselves to facsimile transmission. Users can "zoom-in" on key areas, either to focus attention or to improve readability. It is also possible to show people, either for purposes of introduction, or to maintain awareness of who is in the room. Color is another option, along with the opportunity to show slides, or extract still-frame images from videotape. But the introduction of television brings with it other considerations, which make the jump from audiographics to videoconferencing such a major step. These are the problems of television resolution, and the need to achieve adequate lighting.

"Resolution" is fundamentally limited by the standards adopted years ago for broadcast television. Our 525-line system (of which only about 330 lines of resolution are perceptible), coupled with the 6 MHz bandwidth allocated for broadcast transmission, pretty well dictates how the vast majority of television equipment is manufactured. Even though computer graphics have created a push for higher resolution video monitors, the fact remains that 330 lines vertical by 350 lines horizontal is about the best resolution you should generally plan on from commercial television equipment. This is significantly less than is achievable with most facsimile machines, and is totally inade-

quate for showing a full-page, typewritten letter. It is one of the biggest surprises users have with television systems, and is why videoconferencing rooms are often supplemented with facsimile machines for quick transmission of detailed computer printouts, typewritten letters, or the like. But the resolution of basic television equipment is not achievable without adequate lighting. The problem of getting good television lighting in what otherwise appears to be a standard conference room is the primary reason that the best videoconferencing facilities are custom designed and built.

Ansett Technologies' L-400 Lectrum wireless digital infra-red transmission system.

THE CONFERENCE "EYE"

Selecting the right camera for a videoconferencing installation is not easy. It's the camera that serves as the distant viewers eye into the room, and it has a demanding job to perform.

In cameras, you get what you pay for. All the gadgets and adjustments of full studio cameras are not necessary, but "cheap" cameras just won't work. They lack resolution, don't "white balance" well, and are noisy. We'll deal with the importance of the noise problem shortly.

Videoconferening today generally relies on the CCD (Charge Coupled Device) camera, because of its stability and low light level performance. But this camera introduces problems of its own, particularly where lens selection is concerned.

Camera manufacturers are selling cameras, not lenses, so the lens that comes

Barco's Retrovision 67-inch rear screen projector system.

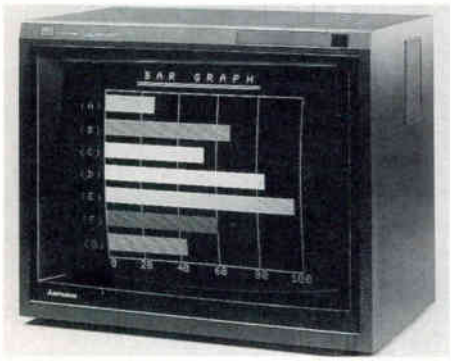
with the camera may best be used as a paper weight. Even if the stock lens is pretty good, videoconferencing usually must be done in limited space, with the monitors close enough to read from, and the cameras right along with them. This dictates the need for wide angle lenses—often wider angle than good practice would recommend since they introduce "perspective distortion," with the extreme result typified by the well-known "fisheye" lens. About 52-degrees is the maximum recommended width, but videoconferening settings often require angles up to 95-degrees for full coverage. Even the best lens can't change the laws of physics, so foreground and background subjects will appear vastly different in size when lenses this wide are used.

NEC's DP1200A data projector with video controller and remotes.

Another lens problem occurs because of the non-standardization of CCD cameras. These cameras lack the ability to adjust out chromatic aberrations, which are present in all lenses. Very high quality, chromatically neutral lenses must be purchased, selected for the specific *camera*, not just for speed, focal length, and type of mount. If the wrong lens is used, there may be serious focus and setup problems.

JBL's 6810 video projector with remote.

Just avoiding this problem may justify paying for "roll-in" type equipment if you're inexperienced, even if the installation is to be permanent.



Mitsubishi's AM-3501R 35-inch autoscan color video monitor with remote.

SIGNAL COMPRESSION

Once the lighting and camera problems have been solved, there is little fundamental difference between the room requirements for a system using "freeze frame" video or "full motion" video. The major difference is in the transmission system. "Motion" codecs employ highly complex and proprietary mathematical "algorithms" that enable "compression" of the video image to a degree not imagined possible only a few years ago.

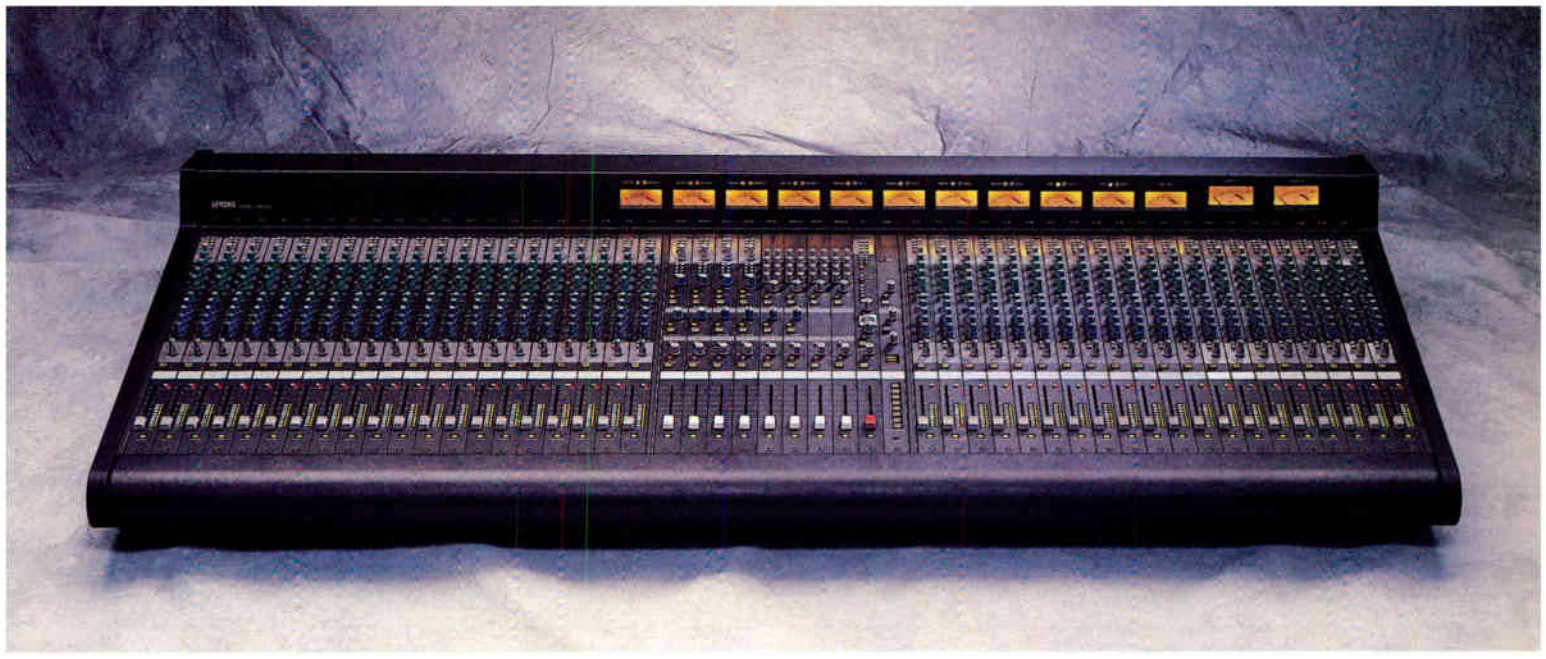
The analog signal that comes out of a TV camera is not suitable for transmission via other than those very expensive full-bandwidth circuits that stopped progress of the medium years ago. What has changed all that is the advent of video digitization and compression via "motion codecs." A full video image, digitaized as the broadcasters do, requires 45 Megabit per second (Mbs) circuits for transmission. Most videoconferencing today runs on circuits of 1.5 Mbs (known as "T1"), "Half T1" (768 kbs or kilobits per second), "Quarter T1" 384 kbs , and even 56 kilobits per second (kbs). Since we know there is no free lunch, how come?

Since teleconferencing is, in large part, "talking heads" and stationery graphics, the teleconferencing system is able to send a basic image only once, and thereafter send only changes in the image. For example, if a person is speaking in a fixed position, the Codec sends only the movement of the mouth, which is then overlaid on the image of the face that was

(continued on page 98)

Panasonic's PT-101Y Pro Series S-VHS projection system.

Sony's VPH-1040Q video/RGB projector.



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The PHD Program† For

Proceeds Donated to the Heyser Scholarship Loan Fund

The upcoming new version of The PHD Program†, version 3.02, is a complete sound system design program which runs in color on an IBM or compatible computer. It takes you all the way from the acoustical analysis to the performance analysis of a sound system. This CAD program is known for its ability to quickly and accurately allow the input of architecture and loudspeaker positions. The capabilities of the program include the following:

VARIETY OF CHOICES

- English or Metric units
- Sabine, Norris-Eyring, or Fitzroy calculations
- Outdoors or Indoors (with air absorption factor)
- True Satistical or Semi-Reverberant Field
- Direct Sound or the Patronis Method for Power Analysis
- One monitor to Multiple Loudspeaker Clusters

EASE OF USE

- Tutor mode available
- Menu driven (No commands to laboriously learn)

FLEXIBILITY AND SIMPLICITY

- Visualize the room from an array's perspective with the array in a variety of locations
- Check for shadowing from obstructions in the sound path
- Reposition cluster and see results quickly
- Large library of horn isobar patterns
- Automatically or manually plot map points

ACCURACY

- 100 percent Horn isobar accuracy at any mapped location
- Field tested intelligibility Prediction

OUTSTANDING FEATURES

- Acoustical, Coverage, Power and Performance Analysis
- Generates patterns, inputs existing patterns, calculates Q and Energy Distribution with Q-PLUS†
- View the design situation in *all* directions
- Reverse plot From Angle to Architecture
- Rapid determination of Horn Orientation
- Quick repositioning of any horns
- Acoustical Gain Examinable At Any Location
- Peutz and RASTI Intelligibility Prediction

EXPANDABILITY

- Add new horns and drivers as *soon* as manufacturers publish their specs (and delete obsolete ones at will)
- Add new material to the list of absorption coefficients

PRESENTATION DOCUMENTATION

- Computer Generated Copies
- Client Presentable Format
- Color printable view of room and loudspeaker coverage from an array perspective

AVAILABLE SOON

- Runs on IBM PC, XT, AT and True IBM Compatibles with CGA based graphics

See page 98 on how to obtain a program for a donation to the Richard C. Heyser Scholarship Loan Fund.

†Trademark of Ambassador College.

The sound system design engineering program, now released by Ambassador College, is based on a time proven, highly accurate, spherical mapping method.

The program, by John Prohs and David Harris, has many handy features to make a designers' job easier. Loudspeaker isobar patterns are quickly drawn in color on the polar graph and can be re-aimed, or even changed and very rapidly redrawn right there. Rotation effects on coverage are easy to try and view. The rotation needed is evident for cluster installation. Several major cluster changes can be tried in only a matter of minutes.

Designers can add to, edit, or even delete isobar patterns if desired. No accessory hardware is needed. The mapping is done entirely on computer which shortens design time considerably. After room data is entered, the designer can proceed right to a Polar Graph view where he can have the room swiftly plotted on the screen and try out different loudspeakers.

Another new feature is a Screen Aspect Radio adjustment added so the graphics will display true on portables or other computer monitors requiring a correction factor.

Horn information saved in the Polar Graph Section is automatically transferred forward to the Power Analysis Section. After the drivers desired are entered, the power needs are ready to be calculated for you. New isobar horn patterns from manufacturer's polar plots are easily added.

The room map, or the horns, or the entire design can be printed out in color if you have an IBM compatible color printer with graphics capability and the right printer drivers.

Two disk drives, each with at least 360K capacity, are needed but a hard drive is strongly recommended.

The capabilities of the program include the following:

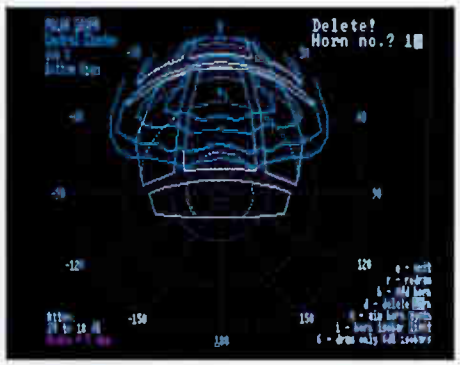
†Trademark of Ambassador College.

Sound System Design

Edit Mode Section Menu
Choose to edit 1) Architectural Acoustics, 2) Architectural Mapping, 3) Power Analysis. View and change Polar Graph and run a Performance Analysis.

Architectural Acoustic data shown in Edit Mode.

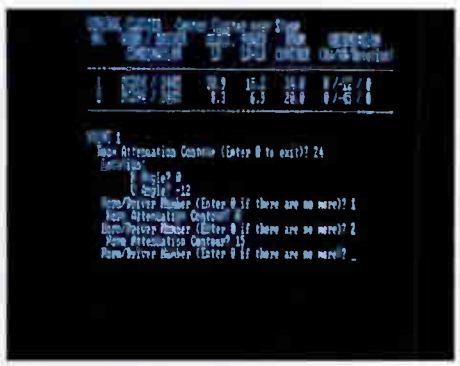
Automatic-Plot Data for one seating bank shown in Review Mode. This can be edited under Edit Mode.



Deleting Horn #1.

Horns can be realmed by choosing (A) "Aim Horn Again", choosing which horn you want to move and inputting it's new coordinates.

Polar Graph Menu allows choice of a different view, move cluster, disable/enable certain items on Polar Graph or (V) - save changes and analyze power.



Performance Analysis
Examination of Point 1. The designer inputs data he is prompted for. Choose the location desired to be examined, enter room contour, location, horn/driver number and it's horn attenuation contour affecting Point #1.

A few of the calculations PHD makes are 1) Total Direct SPL, 2) Variance from Desired SPL, 3) Articulation Loss and 4) RASTI.

Total System Performance.

(Graphs by John Wise)

BASIC PRINCIPLES

for Suspending Loudspeaker Systems

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

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

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

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

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

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

Slings

A sling is a looped line used to hoist, lower or carry something. Slings in sound system rigging are generally made from

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Rope Diameter (inches)	Single Vertical Hitch	Single Choker Hitch	Single Basket Hitch	2-Leg Bridle Hitch and Single Basket Hitch with Inclined Legs		
				60 Degrees	45 Degrees	30 Degrees
3/16	650	480	1,300	1,100	900	650
1/4	1,150	860	2,300	2,000	1,600	1,150
5/16	1,750	1,300	3,500	3,000	2,500	1,750
3/8	2,550	1,900	5,100	4,400	3,600	2,550
7/16	3,450	2,600	6,900	6,000	4,900	3,450
1/2	4,700	3,500	9,400	8,150	6,650	4,700
9/16	5,700	4,200	11,400	9,900	8,050	5,700
5/8	7,100	5,300	14,200	12,300	10,000	7,100
3/4	10,200	7,650	20,400	17,700	14,400	10,200

Table 2. Wire Rope Sling Data

wire rope or polyester fiber, and are used to hitch loads to various parts in the chain of rigging components. Table 2 shows several variations of wire rope slings and tabulates rated capacities for each configuration of hitch based upon 6 x 19 classification, Improved Plow Steel, IWRC at an assumed design factor of 5.

Polyester or synthetic fiber slings enjoy considerable popularity for the rigging of portable sound and stage equipment. They offer advantages in that they are light in weight, easy to handle, will not damage delicate and unusually-shaped materials and, depending upon the individual sling, are stronger than wire rope. They also are better than wire rope for working tight radius bends. SpanSet™ products are typical of the range of synthetic fiber slings available for this purpose—refer to the manufacturer's data for capacity rating information, as it can vary from product to product. A note of caution regarding synthetic slings: polyester fabric is relatively poor in its fire ratings—consult local building code authorities before installing.

Load Angle Efficiency

Load angle is the angle between the load (horizontal surface) and the sling.

Figure 6 illustrates the effects of load angle efficiency using a two-leg sling to hang *[*for example*]* one JBL 4846 low frequency system. The load angle affects the sling tension inversely. As the load angle is reduced from 90 degrees to 0 degrees, the sling tension increases from the sling's share of the load to an infinite value.

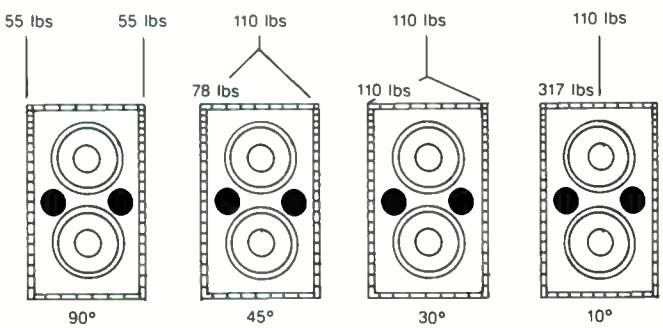

Figure 6. Load Angle Efficiency

The sine of the load angle is numerically the Load Angle Efficiency, e.g., a 30 degree sling angle will have a Load Angle Efficiency of 50% (Sine 30 = 0.5). A Load Angle Efficiency of 50% means that the sling tension will be twice that of the sling's share of the actual load. The JBL 4846 weighs approximately 110 pounds. Using two independent slings, each will be tensioned to 55 pounds. If we were to bridle the two sling legs such that each leg were to form a 30 degree angle with the horizontal surface of the cabinet, each leg would be tensioned to 110 pounds. As the angle between the sling and the horizontal surface is diminished, the sling tension will increase in inverse proportion to the sine of the load angle.

It is important to recognize that the sling tension affects all of the hardware that comprises the sling assembly, including the attachment points. This may result in excessive loading of hardware, especially at the point of attachment to the loudspeaker cabinets. All of the components that attach to the sling will be subjected to a tensile loading equal to that of each sling leg and must be sized accordingly.

Sling tensions may be directly calculated from physical measurements (Figure 7).

A loudspeaker cluster to be lifted weighs 1250 pounds. Using a two-leg sling, the distance (A) from the lift point to each anchor point is 48 inches. The distance (B) from the lift point to the horizontal surface is 24 inches. The tension on each leg of the sling will be A-*[*48*"]* divided by B-*[*24*"]* times 1/2 the load (2 legs) = 1250 pounds. This represents a Load Angle Efficiency of 50%. These calculations should be performed for each load to be lifted in order to prevent overloading of hardware or a reduction of design factors.

Since the loudspeaker cluster is being lifted from a single point, guidelines will be required to stabilize the assembly from rotating.

Hardware

There are as many different sources and quality levels of hardware as there are potential vendors for sound systems, perhaps even more. It should be noted, however, that the consequences of exercising poor judgement in selecting

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Material Size (inches)	Pin Diameter (inches)	Rated Capacity (lbs.)
1/2	5/8	2,800
5/8	3/4	4,400
3/4	7/8	6,400
7/8	1	8,600
1	1-1/8	11,200
1-1/8	1-1/4	13,400
1-1/4	1-3/8	16,400

Table 3. Screw Pin Shackle Data

hardware for rigging are not qualitative. In spite of this fact, purchase decisions with respect to hardware are often last-minute items left to installers and technicians having little or no knowledge of safe rigging practices.

To the uninitiated, many similar hardware items appear identical, yet may be orders of magnitude different in terms of their load capacities. The highly competitive nature of the retail hardware and building-supply business in the United States has generated a nearly endless supply of fasteners of unknown (and suspect) quality and consistency. Just as a chain is no stronger than its weakest link, it is a matter of the utmost priority that all hardware used in a rigging chain be of known quality and strength. This is less a matter of expense than one of good planning, as the use of load-rated hardware will make an insignificant difference in the total cost of an installation.

Almost without exception, load ratings for hardware are for axial loading only—a straight pull along the axis of the fitting. Failure to use a device in the manner in which it is intended to be used can seriously weaken the part and render an installation unsafe. It is the responsibility of designers and installers to make proper use of hardware and hardware systems.

Shackles

Different types of shackles are available for a variety of applications. The type most commonly used in sound system rigging is the Screw Pin Anchor Shackle (Figure 8). These parts are most often used to join SpanSets or slings to eye bolts or additional slings. Table 3 lists rated capacity information for Screw-Pin Anchor Shackles.

Only load-rated forged carbon-steel shackles should be used for rigging. The load rating will be stamped on the body of the shackle.

Screw Pin Shackles should be snugly finger tightened only. If tools are required to seat the shackle pin it means that the threads are damaged, and the part should be discarded.

Shackles should always be loaded pin-to-end—never on their sides.

The pin end of the shackle should not be allowed to straddle a moving rope, as friction could loosen the pin.

Do not substitute bolts for shackle pins, as the pins are forged and considerably stronger than machine bolts.

Always use packing washers to center narrow loads on the pin. This will prevent the shackle from being pulled at an angle which will weaken and possibly damage the fitting.

Bolts

steel: *commercial iron that contains carbon in any amount up to about 1.7 percent as an essential alloying constituent , is malleable when under suitable conditions, and is distinguished from cast iron by its malleability and lower carbon content. . .resembling steel.*

—Webster's Third New International Dictionary

Given this rather broad definition of "steel," there is a wide latitude for specific alloys and the consequential tensile strength and hardness that may be encountered in a steel bolt. When ungraded bolts are used in rigging applications, unknown alloys can result in a fastener that may be unreliable under stress.

Fortunately, graded bolts are easily identified. Figure 9 shows the identifying marks for SAE grade 5 and SAE grade 8 bolts. Table 4 lists rated capacities for SAE grades 5 and 8 bolts using an assumed design factor of 7 on the area at the root of thread.

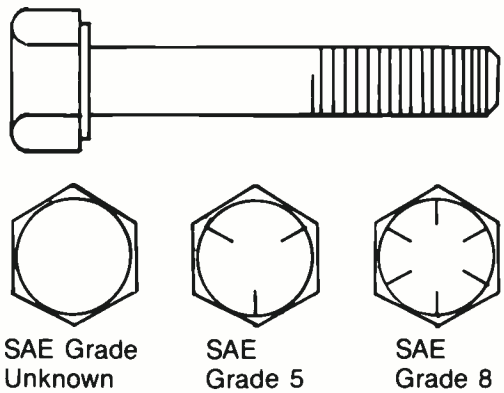

Figure 9. Bolt Grading

Diameter (inches)	Area at Thread Root (sq. inches)	Grade 5 Rated Capacity (lbs.)	Grade 8 Rated Capacity (lbs.)
1/2	.126	2,160	2,700
5/8	.202	3,460	4,300
3/4	.302	5,170	6,470
7/8	.419	6,880	8,970
1	.551	9,050	11,800

Table 4. SAE Grade 5 and Grade 8 Bolts

Eye Bolts

Eye-bolt fasteners come in several varieties:

Lag-Screw Eyes cut threads into wood and rely upon the strength of the wooden threads to carry the load. The ultimate strength of the bond depends upon the strength of the material and total surface area threaded into it. Wood or wood fiber makes untrustworthy threads and should *never* be used to support overhead loads.

Formed Eye Bolts consist of steel rod bent into an eye with a machine-screw threaded shank. These products are widely available at hardware counters and do-it-yourself building material outlets. These products come from a wide variety of domestic and offshore sources, are unmarked, and may be soft or brittle. The eyes have a nasty habit of pulling straight

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Size (inches)	Vertical Pull (lbs.)	75 Degree Load Angle	60 Degree Load Angle	45 Degree Load Angle
1/4	500	275	175	125
5/16	800	440	280	200
3/8	1,200	660	420	300
1/2	2,200	1,200	770	550
5/8	3,500	1,900	1,200	875
3/4	5,200	2,850	1,800	1,300
1	10,000	5,500	3,500	2,500
1-1/4	15,200	8,350	5,300	3,800

Table 5. Forged Shoulder Eye Bolt Data

or snapping where the curvature of the formed eye meets the shank under modest loads. Formed eye bolts must be considered *untrustworthy* and should not be used for rigging purposes.

Note: *Often eye bolts are welded closed to prevent opening under load. This practice can damage the metallurgical structure of an already suspect fitting, causing the bolt to lose resistance to breakage under stress and result in an even more untrustworthy part.*

Plain Pattern Forged Eye Bolts are designed for straight pulls only, and are trustworthy to support vertical loads. Note that plain pattern eye bolts should never be used for angle pulls. The rated capacities for plain pattern eye bolts will be the same as for shoulder bolts under vertical load.

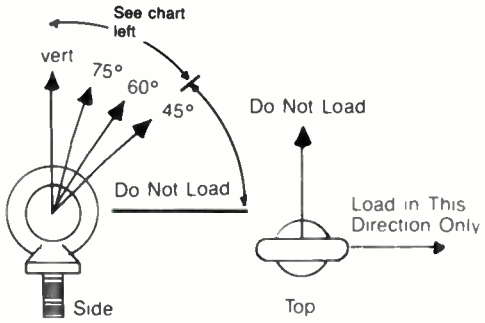

Figure 10 Shoulder Eye Orientation

Forged Shoulder Eye Bolts are preferred for all applications, especially those in which angle pulls are likely to be encountered. Note that the rated capacity for shoulder eye bolts is reduced substantially for angle pulls. Note also the correct orientation of the bolt for angle pulls (Figure 10). Loading at angles greater than 45 degrees from the vertical axis is not recommended. Table 5 lists rated capacity information for forged shoulder eye bolts.

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NSCA Contractors' Expo '88

Manufacturers, contractors, consultants, reps, etc. will be putting on their cowboy hats and heading out to Reno, Neveda, from May 18-20 for the eighth annual NSCA convention. Over 4,000 sound and communications industry people, including over 270 exhibitors, are expected to attend this year's show to exchange information and introduce new products and technology at the Bally's Reno.

According to Bud Rebedeau, NSCA executive director, this year's show will be bigger and better than ever. "Because last year's show was such a huge success, we've increased exhibit hours and enhanced the seminar program by adding a track. We expect traffic to be heavy." On Wednesday, May 18, and Thursday, May 19, the floor will be open from noon to 5 p.m. On Friday, exhibitors will display their products from 9 a.m. to noon. This year's tracks will be Audio, CAD/Instrumentation, CCTV/Teleconferencing, and Marketing (see sidebar for details). There will be a limited number of tickets for each track and tickets will be checked at the door. This will prevent overcrowding of seminars.

Two days prior to the NSCA Contractors' Expo, NSCA will offer two courses for contractor salespeople—the Basic, and the Intermediate Sound Design and Estimating Course. On Monday, May 16, at 8 a.m. Tim Vear of Shure will discuss Microphones, Types and Usage; at 10 a.m. Carl Dorwaldt of Bogen will conduct a course on Mixers, Amplifiers and Combination Units; at 1 p.m. Ted Uzzle of Altec Lansing and *Sound & Communications* book reviewer will discuss Loudspeakers, Horns, and Other Radiating Devices; and beginning at 3 p.m. Louis Valente

of West Penn Wire & Cable will conduct a course on Wire—and What We Need to Know About It.

On Tuesday, May 17, at 8 a.m. Jim Morrison of Aiphone will discuss Intercoms—Direct Wire, Duplex, and Nurse Call; at 10 a.m. Vic Hall, contractor, will conduct a session on Data Gathering and Communications Tools; at 1 p.m. Emory Straus of White Instruments will discuss Layout and Estimating; and beginning at 3 p.m. Mike Bradley, contractor, of Chambers Electronic Communications; Tony Monfort, rep, for Monfort Electronics; and Ken James, manufacturer, of Rauland Borg will discuss Identification of New Markets and Expanding Into New Ones. Expo '88 will officially kick off with a cocktail party at 7 p.m. to welcome all attendees, exhibitors and reps. This annual event is sponsored by participating sales reps. There will also be a post NSCA Expo Tour in Lake Tahoe from Saturday to Sunday.

Sound and Communications will again sponsor four seminars this year. Vincent P. Testa, publisher and president of Testa Communications, will host a panel discussion on Developing New Business From Marketing Awareness on Wednesday, May 18, from 10 to 11 a.m. On Thursday, May 19, Managing Editor Debra Pagan will present a panel discussion on Establishing Better Communication Between Manufacturer and Contractor and Consultant from 8 to 9 a.m. Also, *Sound & Communications* Consultant's Comments columnist Marc Benningson will discuss Project Management Organization from 9 to 10 a.m. Technical Editor Jesse Klapholz will present a paper on How to Cut Days Off of Your Projects also on May 19 from 10 to 11 a.m.

In addition, for the third year NSCA-TV News will be on the air, produced by the publishers of *Sound & Communications* Magazine and written and edited by the editorial staff of *Sound & Communications* Magazine. The news program will give convention attendees up-to-the-minute, immediate coverage of the three-day expo. The news show will be on-the-air in hotel rooms at Bally's Reno, The Peppermill, The Nugget, and The Airport Plaza, and on large screen televisions on the exhibit floor every hour of the day.

Have a good show! In subsequent issues, *Sound & Communications* will give a thorough rundown of the product, technology and marketing innovations exhibited at this year's NSCA Contractors' Expo.

MAY 18

8:00 - 9:00AM	Keynote Speaker Danny Cox, noted accelerationist. What's an accelerationist? One who causes faster movement, higher efficiency, and increased productivity. Mr. Cox's experience ranges from supersonic test pilot and air show pilot to turning a failing organization into a record breaking industry leader. Open to all attendees at the NSCA Contractor's Conference and Expo '88.			
9:00 - 10:00AM	Annual NSCA Business Meeting			
	Audio Track	**CCTV/ Teleconferencing Track**	**CAD/ Instrumentation Track**	**Management Track**
10:00 - 11:00AM	Telephone Teleconferencing and Room Acoustics	CCTV-an Interesting and Challenging Addition	Test and Measurement System Performance and Analysis (10:00-12:00)	Developing New Business From Marketing Awareness
11:00 - 12:00AM	The importance of Architectural Acoustics in Sound Reinforcement	Long Haul Transmission by Fiber Optics		How to Make A Proposal
12:00 - 5:00PM	NSCA Exhibit Floor Open - *See 284 of Our Industry's Leading Manufacturers*			

MAY 19

8:00 - 9:00AM	Rigging Clusters	CCTV - High Speed Scan/Pan/Tilt	Measuring Speech Intelligibility Using RASTI	Establishing Better Communications Between Manufacturers, Contractors, and Consultants
9:00 - 10:00AM	Upjohn's TC-80 Computerized Paging System	CCTV - An Interesting and Challenging Addition	What Consultants Look for in System Check Out	Project Management Organization
10:00 - 11:00AM	Loudspeaker & Amplifier Design Forum (10:00-12:00)	Long Haul Transmission by Fiber Optic	How To Cut Days Off of Your Projects	Budget - Do or Die
11:00 - 12:00PM		Teleconferencing Tutorial	Conduit and Wire Systems Via CAD	Managing Your Money
12:00 - 5:00PM	NSCA Exhibit Floor Open - *See 284 of Our Industry's Leading Manufacturers*			

MAY 20

9:00 - 12:00PM	NSCA Exhibit Floor Open - *See 284 of Our Industry's Leading Manufacturers*
1:00 - 3:00PM	Tour the World's Largest Working Stage - *With the Contractor that installed the Job*

THE IEQ WITH Smartcurve™

Not Just Another Programmable Equalizer With MIDI™

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

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

IEQ Model Specifications:
Controller & Satellite
- 128 battery backed presets
- MIDI
- Frequency Response 20Hz-20kHz ± 0.5dB
- THD - ≤ .009% @ 1kHz, 0dBM typical
- Dynamic Range - ≥ 100dB typical
- Balanced inputs and outputs

***IEQ Video Monitor Features**
- 19" rack mountable
- NTSC compatible monochrome monitor
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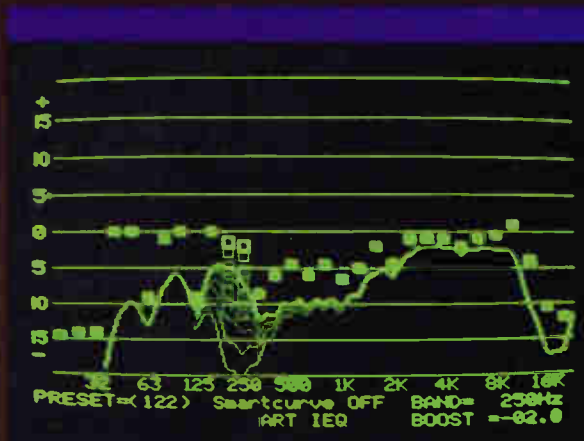
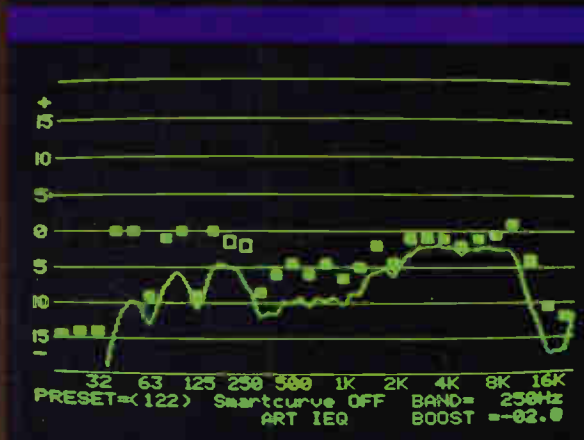


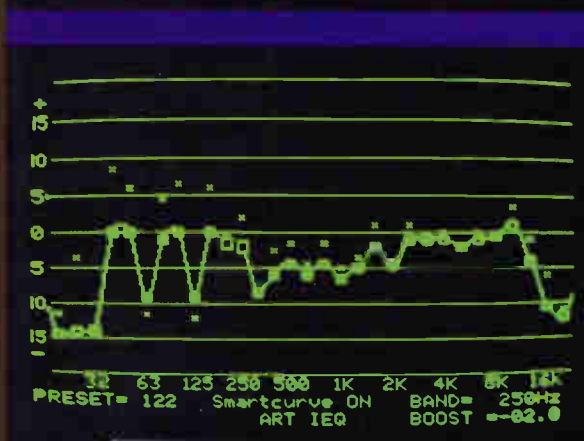
1 See the Sound

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



2 Hear the Sound

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



3 Perfect Sound

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

The McMahon Stadium Sound System

by John Parris Frantz

FLYING SPEAKER CLUSTERS IN STADIUMS HAS BECOME COMMONPLACE IN THE 1980s, BUT THE FLOWN SYSTEM at McMahon Stadium, the site of the opening/closing ceremonies at the 1988 Winter Olympics last February in Calgary, Alberta, Canada, had unique design problems.

The major problem was the absence of a roof or dome at the 38,000-seat open-air stadium, with which to fly a system.

Because a single sound source application was ideal, stadium owners chose a speaker cluster system suspended 100 feet over the middle of the playing field.

"The absolute most desirable design for a speaker sound system is a single point source, and nothing fits it better than a central main cluster," claimed Dan Moran R.E.T., of Morgan Dowhan Engineering Ltd., Edmonton, Alberta, the sound consultant on the job. "Logistics usually make it impossible in an open stadium and you usually settle for endzone clusters that blast the people close by and don't cover the people far away."

But logistics posed a problem only in cost, which was no factor since the Canadians were concerned with showing the world that all their Olympic facilities were world class.

Suspending 60 speakers divided in five rows and weighing over 2.5 tons requires expertise. Therefore, structural engineers Lamb-McManus, of Calgary, became an integral member of the audio design team. In fact, nearly two-thirds of the $1.1 million sound system went towards structural steel and its installation.

For many of the contractors involved in the $16 million facelift of the 20-year-old stadium, it was a job of a lifetime. Even veterans of communication specalist, Alberta Government Telephone—Special Products Division, the sound installer, had never experienced such an unusual project. "This is one job we won't forget for a long, long time," assured AGT technical sales representative, Jim Molle.

Supporting the speaker cluster are four 160-foot-high steel towers at equidistant points outside the stadium walls using 1 1/4-inch-thick bridge strand cable strung to the cluster.

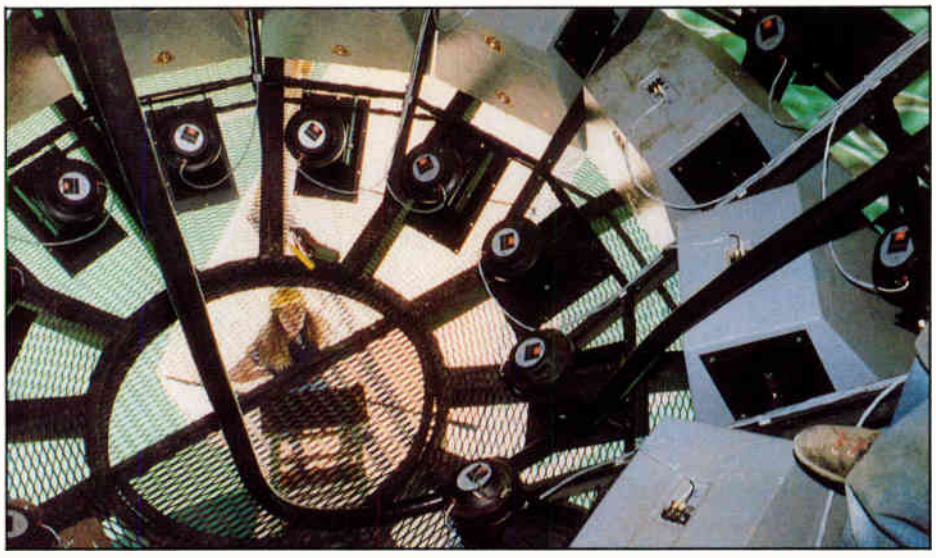
Inside the cluster are (24) JBL 2385-A horns; and (12) 2386-A horns all with 2445-J compression drivers. In addition, the cluster has (24) 4847 Cabaret series 15-inch, low frequency compression drivers in bass cabinets, which include 15-degree angled corners allowing a tighter fit in the limited space of the cluster.

Protecting the cluster is a black fiberglass dome outfitted with heat tape to prevent snow accumulations. The steel structure encasing the speakers includes a black steel mesh to discourage bird nesting.

The 18-foot diameter, 12-foot high speaker cluster was assembled at ground level then hoisted into place with two motor-driven winch stations borrowing from the block-and-tackle theory. The winch stations are permanent and will become important for lowering the cluster in the event of servicing.

One person who least enjoyed the project was the worker delegated to ride a small one-man cable cart over 100 feet off the ground to secure a 1,100-pound plastic coated/flexible steel armor outdoor conduit with 3/4-inch wide stainless steel banding to one of the bridge strands. Inside the conduit are 14

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



(L.) The 2.5-ton cluster in its lowered position. (R.) Inside the cluster.

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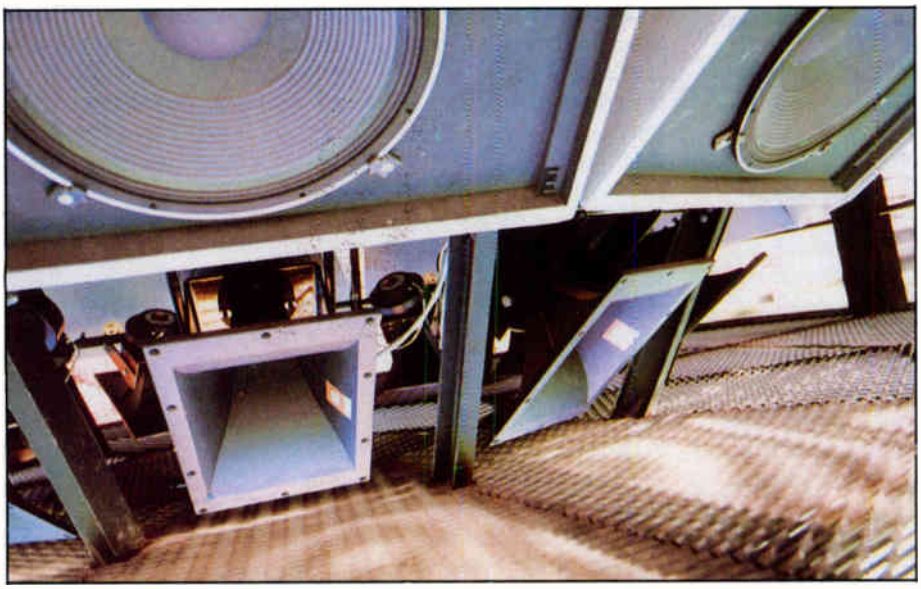
runs of 10-gauge/2-wire speaker cable and 20 runs of 12-gauge/2-wire speaker cable.

The speaker cable runs from the cluster to a 200 square-foot equipment room under the bleachers. Inside are eight off-the-shelf equipment racks supplied by Hammond Manufacturing, Guelph, Ontario. Six racks hold (13) JBL 6290 1200-watt and (30) 6260 600-watt power amplifiers along with a 6230 monitor amp.

Moran recommended JBL power amplifiers as one of four optional brands because of its specified 1200-watt power output in the 8 ohm bridge mode. Weight considerations of the cluster were important in the system design. Ideally, Moran preferred to use 200 V transformers, however 30 transformers weighing some 40 pounds each would have added nearly another ton. Therefore, the system was run at 8 ohms. Running 8 ohms at such long distances, however results in a fairly high line loss. Moran compensated with more power and bigger cable.

"Wherever possible, I don't like mixing different manufacturers' components for compatibility reasons, plus it makes



(L.) The lowest ring: JBL 2385 horns rotated 90°. (R.) The P.A. Announcers Booth.

it nicer on the service end," Moran said. "This is one reason JBL was chosen for both power amplifier and speaker applications."

Other components used in two remaining racks include a Modular Audio model 7821 distribution amplifier; a JBL/UREI LA-4 limiter/compressor; a JBL/UREI 539 one-third octave, cut-only equalizers; a JBL/UREI feedback suppressor; a BGW Systems Model 10 electronic crossover; a JBL/UREI 950 ambient noise control amplifier; and three Klark-Teknik Electronics DN 716 delays.

Besides the equipment room components, additional processing equipment was installed in the press box such as: a Yamaha MC-1604 mixing console, two Tascam 122-B audio cassette decks; a Yamaha CD-2000M compact disk player; and a Bode frequency shifter for feedback that has yet to used. The project also supplied microphones such as: two Samson FM wireless PR-50 wireless receivers; two Samson HT-20 hand-held mics and TH-1 belt packs; Crown PZM clip-on mics; and a variety of hard-wired on-field mics.

Besides weight, stadium owners raised concerns about any construction on the artificial turf. As a result, the cluster had to be built on a wood/plastic platform with wooden walkways leading workers on and off of the field.

The short time period allotted for construction added an extra challenge, too. What Molle estimated as a six to eight-month job had to be completed in less than four months. The job was bid in November 1986 and work was completed from Feb. 1 through May 20 of 1987 in time for the Canadian Football League season opener in June.

Three Other Systems in Operation

It's not known, but Moran suspects there are three such systems in North America—two in Canada and one in Mexico. Ironically, Clay Johnson, also a communications designer with Morgan Dowhan Engineering, designed the first North American installation in 1978 at Edmonton's Commonwealth Stadium. The Edmonton system, made up mostly of Altec components, cost considerably less because existing light trusses were structurally capable of bearing the flown cluster load.

The difference of 10 years lent Morgan Dowhan Engineering many advancements in technology between the two jobs. Today's constant directivity horns have tighter pattern control, for example. Also, phase alignment through electronic signal delays allowed the cluster to be calibrated with the same acoustical center. "In Calgary we got rid of a whole lot of cancellations (in comparison to Edmonton's older system) and have actually been able to increase the output of the cluster by about 5 dB just through phase alignment and not with any additional amps," said Moran.

Moran's firm spent two weeks compiling a feasibility study outlining the different methods of audio distribution. While government, University of Calgary, and Olympic officials were offered choices of 1) an end-zone cluster system (approx. $650,000); 2) a series of vision-impairing cluster stations on poles throughout the seating area; or 3) the more costly, but best-suited center-field cluster system; the latter was chosen for several reasons.

Even in 1986, plans had been laid for the grandiose opening and closing Olympic ceremonies where athletes covering the entire playing field would march to music. Officials were concerned with athletes hearing the music simultaneously and staying in step regardless of field position.

Besides a desire for world class audio, another factor is the

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current rivalry between Calgary, Edmonton and their football teams. The bottom line for Calgary officials was a better stadium and sound to bring the Calgary Stampeders' home field up to other CFL stadium standards—and keep one step ahead of Edmonton technologically. To get a better sound system, they hired the same design team of Commonwealth stadium's audio.

"In Calgary we got rid of a whole lot of cancellations and have actually been able to increase the output of the cluster by about 5 dB just through phase alignment and not with any additional amps."

Weather Elements Affect Design

Designing outdoor systems is difficult in Calgary, according to Moran, because of the environment. Outdoor audio is subject to the infamous Chinook Winds, which reach 50 m.p.h. coming down the Rocky Mountains and temperatures vary as much as 40 degrees within a few hours. When the Chinook winds blow along the length of McMahon Stadium, sound is carried away from people. The winds, temperature changes and vast humidity differences all effect the sound distribution, according to Moran. "We spent several weeks just researching these effects on the propagation of sound," Moran said.

The fact that the final installation was set exactly as planned from initial drafts is a credit to Moran and his research. Moran attributes aids such as JBL's CADP computer software program, Techron's TEF analysis equipment, and published articles on designing outdoor audio for his successful design.

Moran used JBL's Central Array Design Program (CADP). Although the CADP's memory wasn't powerful enough to accommodate the McMahon's 60 speakers simultaneously, it helped indicate direct sound pressure levels and effects of overlapping speaker coverages.

In addition, TEF analysis reduced calculations and alignment work from an estimated three days to only six hours of testing. With tests of up to 300 feet, TEF analysis veteran, George Uhrich, president of sub-contractor Wavelength Systems, Edmonton, recalls the McMahon project as the most different he had tackled to date.

In determining the effects of the elements, Moran found great help from Don and Carolyn Davis of Synergetic Audio Concepts, Bedford, Indiana, an organization that has an archive of audio articles dating back to the 1950s on subjects such as weather effects on audio.

Speaker Alignment Critical

Although Moran had the advantage of state-of-the-art design equipment and tools, the human factor of physically aligning the speakers to blueprint specifications were performed with flying colors. "We knew all the angles and aiming points from using virtually every architectural drawing we could get, it was impressive that AGT installed it just the way we designed it," Moran said.

Each speaker's alignment in a row has a common angle with the exception of the corner and end speakers. Each of the five rows, however has varied angles of direction.

Several speakers have an unusual direction of some 15 degrees over the top of the stadium's wall. This overlapping into space above the stadium allows for temperature changes, specifically those that decrease and bend the sound toward the ground, Moran found in his research. "This way we don't lose coverage at the top of the bleachers," Moran noted.

Although the Olympics necessitated the over designing of the system, Moran made it possible for stadium users to transform the audio to a multitude of applications. During a football game—the stadium's most popular activity—speakers and

"The amps and horns are also connected in such a way that if one horn might fail, horns on each side would produce some coverage through overlapping with minor cancellation."

corresponding amp racks can be switched off. For example, speakers with on-field coverage aren't needed nor are those with end-zone coverages since Calgary football fans don't sit in the end-zones. "The amps and horns are also connected in such a way that if one horn might fail, horns on each side would produce some coverage through overlapping with minor cancellation," Moran said.

It'll be a long time before the system again is used to its full capacity, because football games don't require as sophisticated or as powerful a system. In the Olympic closing ceremony, however all the stops were let out as production company, Best Audio, Los Angeles, pumped out music and effects to nearly full power. Asked of his personal impression when attending the opening ceremony, Molle quipped, "I thought they were for sure going to blow it up. They were driving it to where the sound level reading on the field was 104 dB."

While JBL was the main choice for cluster speaker, B.E.S. model B82s, model C70Ds, and C12BTs were used in the concourse, concourse entrances, and rest-rooms respectively. The concourse, which circles the field under the seating area, is a narrow concrete-walled walkway subject to much sound reflection, therefore Moran chose to use some 64 of the omni-directional B82s. AGT had to build custom boxes of 3/4-inch nine-ply birch to house the omni-directional C70Ds in each concourse walkway.

"We used the B.E.S. speakers there because we were concerned with all the reflections we would be getting," Moran said. "The 180-degree /in an enclosure/ coverage of those speakers put the sound everywhere rather than pinpointing directly across from the concrete wall."

There's no comparison of the present system to the stadium's previous audio system. "They had four horns for the entire seating area, a few horns facing down from the press box floor, and two amps," said Richard Ingstrup, AGT sales and service technician.

ABC-TV spokesman, Jim McKay, who has broadcasted from stadiums around the world, said the sound at McMahon was the best stadium sound he had ever heard.

FIELD TEST REPORT

Power Solutions PS-2000 Digital Bass Amplifier

by Jesse Klapholz and Richard Feld

While the manufacturer describes the unit as a *bass* amplifier, we choose to refer to the application of amplifying *low-frequencies*—in order to differentiate from musical instrument amplifiers. As the dramatic impact of systems become more important, the need for dramatic low-frequency re/production increases. Higher power handling capabilities, more acoustic output, and lower distortion devices entering the marketplace in larger numbers recently have created a bigger demand for more power. With amplifiers demands nearing the two-kilowatt range, high voltage and current quickly become factors.

The ability of an amplifier to produce these large swings in voltage/current, with reliability and control is no easy task, as evidenced by the handful of currently available models. Besides the audio requirements, reliability and power consumption become factors. Conventional power amplifier designs simply do not convert 100 percent of the input ac power to an audio signal. In fact, they can dissipate up to 50 percent in heat. This heat means increased cooling and reliability considerations, as well as extra operating expense. With a trend in saving space, weight and expense, a smaller more efficient high performance/quality power amplifier is the goal in the PS-2000.

The unit takes up two rack spaces, weighs 26 pounds, is 90 percent efficient, and produces up to two kilowatts in the low-frequency bandpass. Some of the comments in observing the available products include *stiff*, *mushy*, *wimpy*, *tight*, etc. These all relate to the musicality of accurate production of transient low-frequency events with increasingly large dynamic ranges. The power supplies must be capable of swinging large amounts of current—instantaneously—in order to produce these high-power/high-dynamic voltages.

Power Solutions' solution, is to directly rectify the 120 volt ac power line. In doing so, they maintain a power supply voltage on the output rails of ±170 volts—a very stiff source of current indeed. The unit becomes a power amplifier in a perhaps more literal sense of the word—*power* amplifier. With the benefits of having this large amount of current available, a clear understanding of how to hook up the unit in a low-frequency production system is necessary.

"The unit becomes a power amplifier in a perhaps more literal sense of the word— power *amplifier... the PS-2000 can literally drive an average sized window air conditioner."*

Hookup Considerations

In order to produce two kilowatts of power, a considerable amount of current will flow through the system—over 110 volts ac and 22 amperes RMS. The peak current consumption is rated at 35 amps @ 120 volts. Because the supply is a switch-mode type, the ac frequency may deviate from 47 to 440 Hz, and the line voltage may range from 100 to 140 volts. An optional model is available for 200-280 voltage operation. The PS-2000 can literally drive an average sized window air-conditioner.

When considering the amount of power, from an ac-current point of view, the cabling and wire size considerations should be similar to wiring up that little box you put in the window. One would never use 1/4-inch phone or banana plugs for an ac extension cord, so don't be surprised by the heavy duty 20 amp connector used for the speaker connections.

For safety, it is recommended to use a three-wire system, with the third wire used as a *safety* ground.

Because the loudspeaker neutral is the ac neutral, all ac connections must be verified for proper connection and

(Photo by Jesse Klapholtz)

polarity. A ground fault LED is located on the rear panel adjacent to the audio output receptacle. Additionally, protection is afforded by, digital muting circuitry to eliminate power surges at the speaker, 33 amp current limiting to provide continuous short circuit protection, and integrated sensors that monitor both temperature and line voltage protect the amplifier from catastrophes.

The Listening Tests

The listening tests were done at a local sound company where a full concert sound system was used, including lighting equipment, as well as computer equipment in the offices on the same ac circuits. No low-frequency hums or buzzes were audible at all. We listened to the amplifier through a double-18 inch, direct radiating enclosure. A number of CDs were used to literally shake the some 10,000 square foot warehouse. Through low levels and insanely loud dynamic synthesizer reproduction, the low-end capability of the system was rather impressive. At no time did the fault or clipping condition LEDs illuminate. Standard SJ/3 wire with 20 amp ac connectors were used for the hookup.

Reliability cannot be measured by an afternoon session in the field, or on the test bench. But this sound company's system uses four of these units, and after a number of events in many venues report zero failures. The name of the amplifier is misleading, leading one to believe it's a musical instrument amplifier. This is the single largest detriment to the unit. We are convinced that the performance and sub/sonic qualities of the PS-2000 is in a new class of high-power/high-current amplifiers appropriate for very-low-frequency production systems. ■

Front Panel: Power On/Off and adjustable Gain Control. LEDs for Power, Signal, True Clipping, and Fault.

Rear Panel: Signal Input: Switched 600 ohms or HI-Z, balanced or unbalanced with XLR or 1/4″ phone connectors. Switched Floating or Grounded.

Signal Output: Straight Blade wall receptacle (20A, 125V). Ground Fault LED and two MDA 15A fuses.

Cooling: Continuous variable speed fan regulated by integrated temperature sensing circuit.

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List Price: $1995.

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in New York, October 12, 1965.

The RCA LC-9A Dual Radial Horn Loudspeaker System.

Editor's note: This article represents the beginning of a series of articles to be published from the wealth of information produced by John Emil Volkmann from his 50 years of experience working at RCA. Mr Volkmann, along with many other pioneers, were members of the large group of "ancients who stole our ideas of today and tomorrow."

There is always a need in the field of sound reproduction for loudspeakers which have a uniform characteristic with respect to directivity as well as frequency.

The improvement in performance obtainable from such loudspeakers has been particularly demonstrated since the advent of stereo in theaters and is similar to the improvement shown by uniformly directional microphones such as the velocity type.

We have developed a loudspeaker for the professional audio field to bridge the gap between the large theater type two-way horn loudspeakers and the small control room monitor size speakers. It is intended for applications such as a large recording studio or a small auditorium where a greater amount of acoustic power is required than can be obtained from simple direct radiator, or combination direct radiator/horn type loudspeakers, yet where the space required by even the smallest professional theater type system is intolerable.

This needed loudspeaker should encompass many of the proven salient features of the two-way radial horn theater loudspeaker systems—namely:

1. Optimum frequency response characteristic, including smoothness of response and frequency range.

2. Controlled directional characteristics, which result in uniformity of response with respect to listening position throughout the entire desired coverage area.

3. High acoustic output capabilities, which of course implies reasonable sensitivity.

In loudspeakers for professional applications it is particularly important that the distribution of sound from the loudspeaker should be such that the direct sound reaching every listener in the desired coverage area is the same. The tonal balance should remain constant throughout the nominal coverage angle.

For example, there should be no humping up of the mid-frequencies for listening positions near the central axis of the system; (0º20° off axis) no hollowing out of the lower mid frequencies at listening positions moderately removed from the central axis area (20º40° off axis); no noticeable falling off or loss of high frequencies toward the sides of the desired coverage area (40º60° off axis).

For a *professional* installation there should be no "*bad* seats in the house." In an ideal situation, a trained listener located in *any* position within the nominal coverage area of the loudspeaker should obtain the same evaluation of a given selection of program material.

by John E. Volkmann & A.J. May

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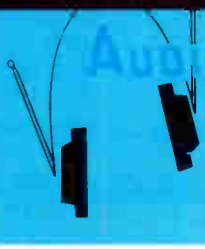

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In the title of this paper the use of the conventional term Two-Way horn loudspeaker was avoided to eliminate the sometimes mistaken interpretation of Two-Way as applied to two directions, i.e. two horns pointing in opposite directions.

In the loudspeaker systems described in this paper the frequency spectrum is divided into two parts by a loudspeaker dividing network (often referred to as a crossover network) in which the high frequencies are reproduced by a high frequency radial horn, and low frequencies are reproduced by a low frequency radial horn. The nominal crossover frequency is 500 Hz. The frequencies in the vicinity of the crossover frequency are reproduced by *both* horns. The H.F. horn almost *solely* determines the H.F. *Directional* characteristic and plays a prominent part in determining the H.F. *response* characteristic. In a like manner, the L.F. horn almost solely determines the *L.F.* directional characteristic and plays a prominent part in the L.F. *response* characteristic.

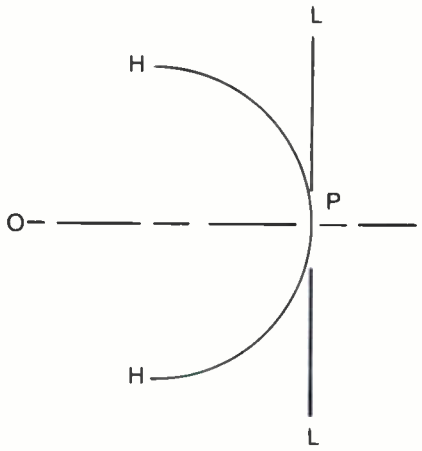

Figure 1

Particularly critical is the crossover frequency region due to the dual source radiation. This will be discussed in more detail later in the paper.

Plane wave horns are designed so that a plane area normal to the axis of the horn and bounded by the walls of the horn expands exponentially with the distance from the throat end. Polar pressure curves show that the horn is practically non-directional at the lower frequencies and becomes more directional as the frequency is increased. A polar plot of the wave front showing the surface contours over which the pressures are in phase gives an almost spherical surface at the low frequencies. The source or point of origin of these frequencies appears to be at the center of the horn mouth. As the frequency increases, the surface within the useful angle of radiation becomes nearly plane.

"Plane wave horns are designed so that a plane area normal to the axis of the horn and bounded by the walls of the horn expands expotentially with the distance fron the throat end."

Radial horns are designed so that a cylindrical area normal to the axis of the horn and bounded by the walls of the horn expands exponentially with the distance from the throat. Such horns produce cylindrical wave fronts which result in a radiation pattern that closely approaches the shape of the wave front as the frequency increases. The directional properties of radial horns was the subject of a paper which we presented at the Philadelphia meeting of the Acoustic Society of America some years ago.

A simple way of presenting the concept of radial horn is to consider two ordinary salad bowls. The first salad bowl is upside down, the second is right side up and is supported co-axially above the lower bowl by an imaginary spacer. If a vertical line joining the two salad bowls and at a radius k from the center line is rotated about the center line at a constant radius, a cylindrical area will be generated. It is seen that as the radius k increases, the area increases. It then becomes obvious that if the salad bowls are properly shaped the cylindrical area can be made to expand exponentially as the radius increases.

Next consider an infinite horn composed of two such curved surfaces. If a cylindrical sound wave front that is vibrating radi-

The method now commonly used to connect and distribute the input and output signals of audio and video equipment is to insert patch cables into a jack board. This patch cable type patch bay is a well established connector and distributor of signal lines, but it poses various inconveniences. Changing the connections is time consuming, and to remember a certain patching system it is necessary to record everything on tables. Furthermore, such problems as dirt or rust of the jacks and plugs resulting in poor contacts and damaged patch cables disconnecting the lines occur frequently. The Akai Digital Matrix Patch Bay System has been developed to eliminate all these problems. For the exchange of input and output signals of professional audio equipment, this system uses balanced type/line level inputs and outputs for the audio signals and 75Ω BNC/composite line inputs and outputs for the video signals.
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ally and is symmetrical with respect to the center line of the curved surfaces is produced near the center of such a horn, a 360° radial radiator will be obtained. From the geometric symmetry of the radiator it is seen that the directional characteristics of such a horn will be absolutely uniform in a horizontal plane.

Two infinite perpendicular planes intersecting along the vertical axis of symmetry of the horn will leave the directional characteristics unaltered except for the minor secondary effects of viscous losses and absorption at the planes. The horn may thus be divided into four equal parts. Since the dividing planes are infinite, three of the four equal parts may be discarded from consideration. Thus we obtain an infinite exponential 90° radial horn that has uniform distribution over a 90° horizontal angle. In a similar manner the 360° horn could have been divided into three equal parts thus obtaining a 120° radial horn. This elementary concept may be extended to finite radial horns.

"Radial horns are designed so that a cylindrical area normal to the axis of the horn and bounded by the walls of the horn expands expotentially with the distance from the throat."

The directional characteristics of finite exponential horns were investigated experimentally. For our investigation three prototype horns were made each with a different angle. Angles of 120°, 90°, and 60° were chosen. Each horn was so constructed that sections could be removed to obtain another horn of the same angle, but smaller mouth dimensions than the parent horn. A series of four horns was made from each parent horn.

It was from information obtained from this study that our original line of two-way radial horn theater speakers was developed. Now with the increasing interest in small speakers, we have extended our line of loudspeakers with further refinements of the established principles to achieve the LC-9A Speaker.

Earlier in this paper I mentioned that

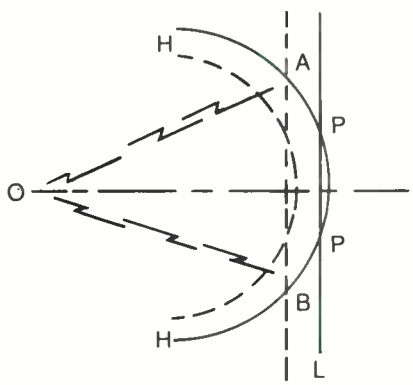

Figure 2

the cross over frequency region is particularly critical due to the dual source radiation. Obviously, the wave fronts from the two sources must remain in phase as they proceed to each listener if partial cancellation is to be avoided. Let us consider a few simple cases.

Figure 1 shows the equi-phase contours at the crossover frequency for the combination of two wave fronts, one of which being a plane wave front (L-L) and the other a curved wave front (H-H). It is seen that for the phasing shown, perfect phasing results only along the line O-P (See Figure 2) and in fact a 180° out of phase condition exists at the points A and B. If the phase is shifted slightly (See Figure 3) (as would be obtained by pushing the H.F. radiator forward as in the case of a two way loudspeaker), perfect phasing could be extended to two points P1 and P2 thus perfect phase along two lines O-P1 and O-P2. This would of course result in some out of phase condition along the axis but would increase the area in which the phase error was not too serious. Yet, however, the 180° out of phase points would still not be shifted sufficiently far off the axis.

However, if similar shape wave fronts are combined (See Figure 4) as was introduced with the *dual* radial horn system perfect phasing can be maintained over the nominal coverage angle. This feature has been used in all our current line of radial-

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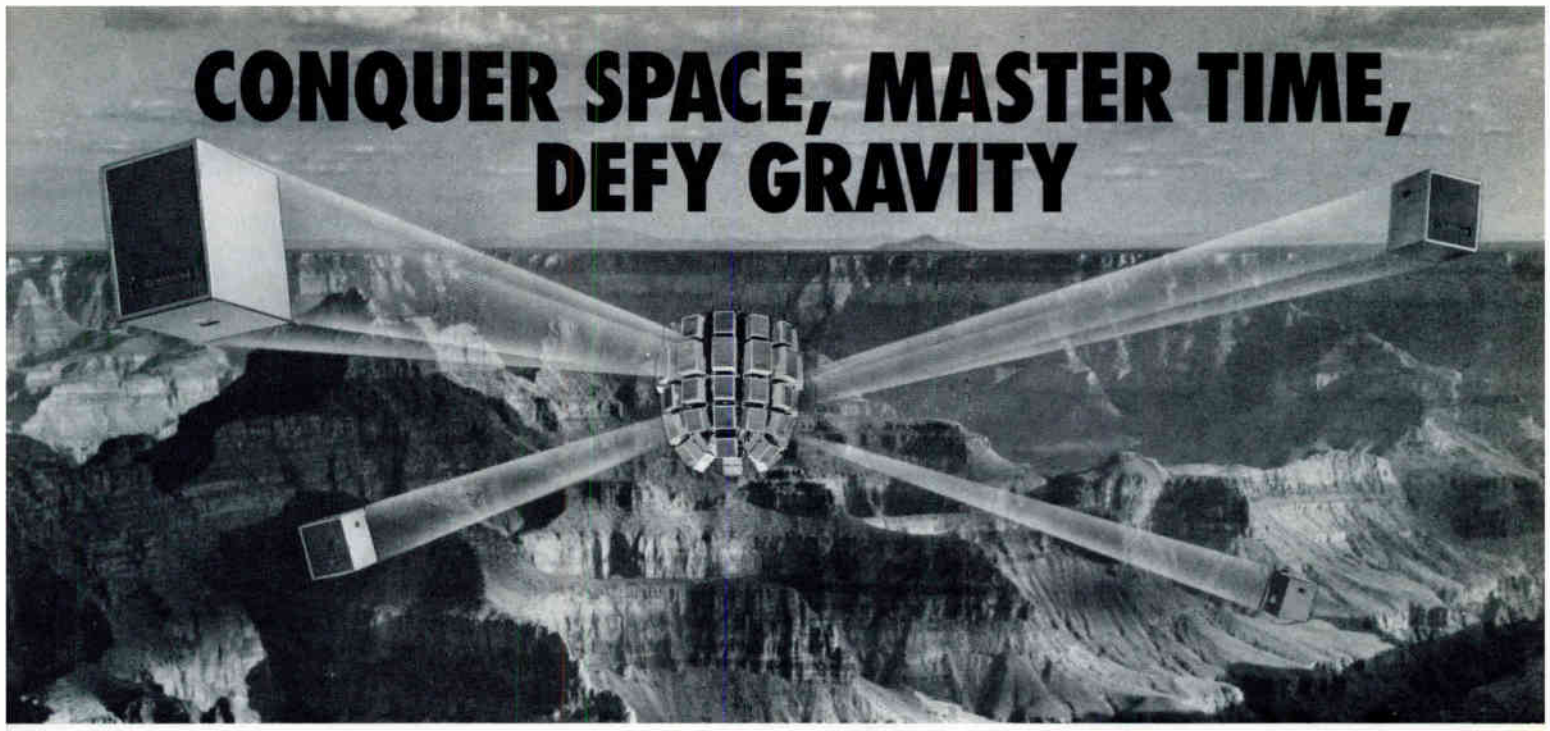

Some speaker systems attempt to conquer acoustic space with brute force—deploying massive cabinets, firing horns at everything that moves. Others resort to electronic trickery, which requires delicate racks of complex gadgetry.

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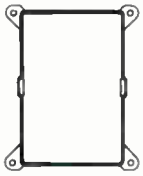
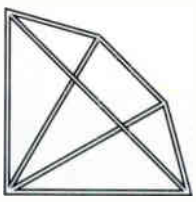
TSE Flying Frames remove load stress from the cabinet. Connected with Quicklinks, frames and cabinets pivot to form a smooth coverage arc. Vertical dispersion is easily adjusted with the TS-6 or TS-10 strap connected to the bottom flying frame and the suspension quadrant.

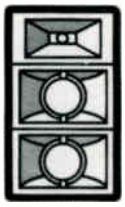


TSE-111—10" TurboMid + HF horn/driver. Fits the FF-111 Flying Frame, with a square frontal cross section to let you change dispersion patterns by rotating the frame.

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

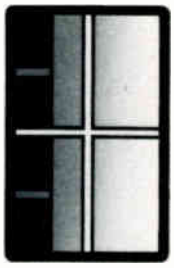


TSE-211—2 x 10" TurboMid + V-2 HF unit. Superior Mid and HF projection. Switchable active bi-amped or passive two-way operation. Dual vertically-coupled TurboMid devices double power handling. The V-2 extends frequency response, enhances intelligibility.



TSE-260—V-2 HF unit. Two HF drivers coupled with Turbo loading techniques, minimizing phase cancellation and distortion.

TSE-215—2 x 15" TurboBass. Balancing TSE frequency response is easy—LF units are separate from mid/high cabinets. With six units to choose from, generating the proper frequency response and coverage pattern for any venue can be as simple as laying dispersion angles over the blueprints.



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

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horn loudspeakers to some extent and now refinements of the larger theater radial two-way horn systems have been made to obtain truly congruent wave front radiation throughout the entire crossover region allowing wider horizontal angle coverage.

This is the new speaker. In this loudspeaker which we are calling the LC-9A speaker, we have two 120° radial horns stacked one above the other with the sides exactly in line and with the mouths of the two horns exactly in line. The high frequency source and the low frequency source are equidistant behind the horn mouth. The design is such that the wave

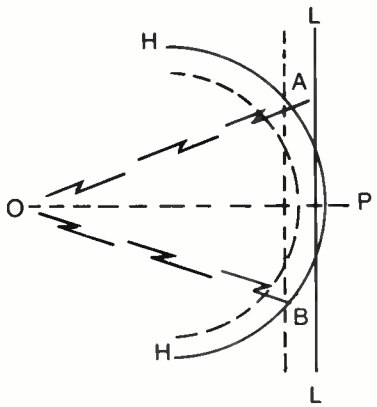


Figure 3

"In regard to sensitivity, the LC-9A approaches within 2 or 3 dB the effective power sensitivity of our largest theater speaker system PL301..."

fronts from the two horn mouths are truly congruent. This has been confirmed with tone burst measurements and with conventional steady state response and directional pattern measurements.

In regard to sensitivity, the LC-9A approaches within 2 or 3 dB the effective power sensitivity of our largest theater speaker system PL 301 and has a power input capability within approximately 5 to 7 dB of our *largest* theater speakers. It has a power input capability of within a 2 dB of our *smallest* full size integrated theater speaker system PL303R.

The speaker has an output capability of approximately 10 acoustic watts. Bearing in mind, the relation (10^{-16} Watts/cm^2 = 0 dB), one acoustic watt spread over an area of 1,000 sq. ft. will produce an acoustic sound pressure level of 100 dB, (re. 0.0002 dynes per sq. cm.). Thus 10 acoustic watts will produce an acoustic pressure level of 100 dB over an area of 10,000 sq. ft.

Using an accepted value of 6.7 sq. ft. of area allowed per seated listener, it follows that 10 acoustic watts can produce an acoustic level of 100 dB in up to a 1,500 seat auditorium.

Comparing this 10 acoustic watt output capability to the few hundred milliwatt acoustic output capability of the usual direct radiator speaker offers a meaningful comparison between speakers.

The LC-9A loudspeaker is unique in that it employs congruent wave front cylindrical radiators for both high and low frequency sections. The degree to which the frequency response remains uniform

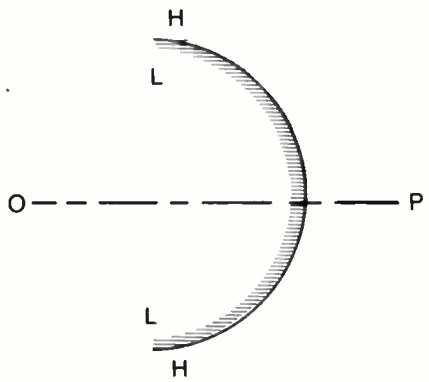


Figure 4

within the desired angle of coverage represents a substantial improvement over earlier systems.

The uniform distribution of sound over the entire nominal coverage area makes the new loud speaker system particularly suitable for *stereophonic* set ups. To obtain the desired spatial effects, good directional and phasing control are absolutely essential.

It has been shown how two radial horns may be stacked without disturbing the directional characteristics in the horizontal plane. In a similar manner two or more full-range dual-radial-horn loudspeakers can be stacked without disturbing the directional characteristics in the horizontal plane. When this is done, the extreme low frequency efficiency is increased and the directional pattern becomes more narrow in the vertical plane. This may be found particularly useful where it is desirable to confine the distribution to a narrow vertical angle as, for example, long throw outdoor arrays.

Sometimes custom designs are required to fit special distribution problems. An example of an array with the RCA PL 303 type loudspeaker combination is at the Shea (Met's) Stadium in New York, which has a stacked array for the 180° coverage. Note how adjustments of horizontal coverage can be obtained by rotation about concurrent vertical axis of arrays. The 1964 World's Fair 360° Fountain of the Planets loudspeaker is another example of the custom application of radial horn loudspeakers. ■

John Emil Volkmann, an acoustical engineer-physicist who studied under Professor Floyd Rowe Watson, early pioneer in architectural acoustics. Volkmann attended the University of Illinois where he received his B.S. (1927), M.S. (1928), and Professional Degrees (1940) in Engineering Physics. Until his retirement in 1978, he worked continuously with RCA in the field of acoustics, and was responsible for the development and application of large-scale auditorium loudspeakers and stereoacoustic sound systems. Outstanding projects to which he contributed include: stereo sound reinforcing systems for Radio City Music Hall, and the Hollywood Bowl; the recording acoustics for Disney's Fantasia; and custom loudspeakers for the 1939 and 1964 New York World's Fairs.

Mr. Volkmann had long time supervisory and managerial responsibilities of the advanced acoustic development and theater equipment engineering activities at RCA in Camden, New Jersey. He was a member of several honorary scientific fraternities, and a Fellow member of SMPTE, and AES. He was also a Fellow Charter member of the Acoustical Society of America. He was highly respected by all of his colleagues in the industry.

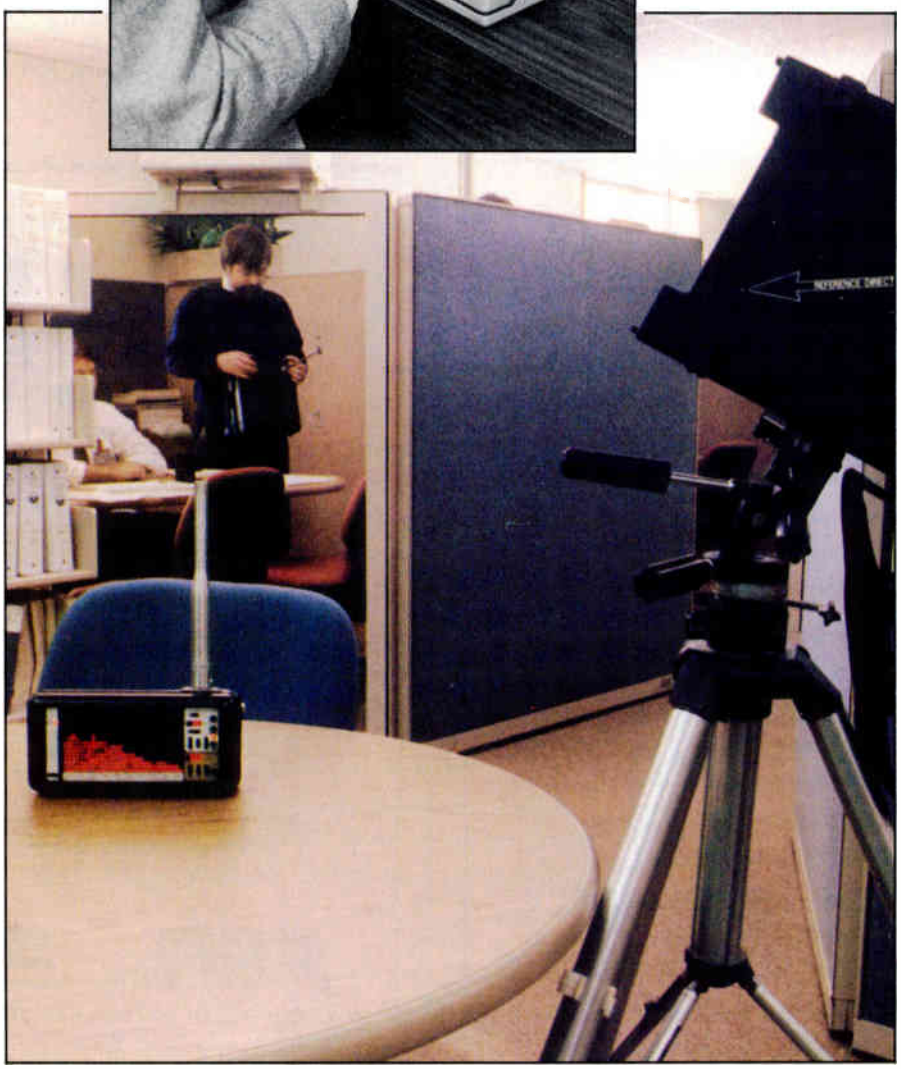
Mr. Volkmann passed away in July, 1980, and was survived by his wife Dorothy Johnson. A former RCA employee, Hans Dietze, managed in his infinite wisdom to arrange with Mrs. Volkmann to archive her late husband's entire professional files. These some 14-plus filing cabinets full of incredibly comprehensive information spanning 50 years of John Volkmann's work in electroacoustics were recently transferred to the Editor's offices. Over the next few issues some of the first new "finds" will be run in Sound & Communications.

A.J. May graduated from Vanderbilt University with a B.E (E.E.), in 1943, and joined the Acoustic Development Section of the Engineering Products Dept. of RCA. He worked on investigations of parameters of new radial type horns radiators, and played a key role in planning and setting up new acoustic facilities in Camden's RCA location. He developed a pulse-type measuring facility for artificial free-field steady-state measurement and transient analysis of loudspeakers. He worked with John Volkmann on many pioneering stereoacoustic projects, and stereo reverberation sound-field reproduction systems, and loudspeaker development. Now retired, he remains active in the field and is a member of AES and the ASA. JK

Speech Intelligibility Measurements With TDS Using MTF & STI Techniques

Fast and accurate speech intelligibility measurements can be made with Time Delay Spectrometry using the techniques of the Modulation Transfer Function and the Speech Transmission Index.

by D. (Don) B. KEELE, JR.
Techron,
Div. Crown International, Inc.



(L.) The Techron TEF System 12 computer based analyser with author Don Keele at the Controls.

(Below) The Bruel & Kjaer Speech Transmission Meter Type 3361 which uses the RASTI technique. The photography shows speech intelligibility measurements being made in an open-plan office area (courtesy of consultant Steven J. Orfield and Unisys Corp.).

Spoken at microphone: testing... testing...one...two..three; heard by listener: τεχτινγ. . .τεχτινγ. . . ονε. . .τψο.ϕΔ.Ϙ ≐ϕΔ.τηρεε. Something wrong? You bet! But how can you objectively quantify or measure how much speech information was lost?

This article briefly describes several methods for evaluating speech intelligibility with emphasis on MTF (Modulation Transfer Function) and STI (Sound Transmission Index) methods, and describes a new software package for the Techron TEF System 12 analyzer that allows quick and easy field measurements of speech intelligibility using the MTF and STI techniques.

Intelligibility Measurements

The most obvious direct method for measuring speech intelligibility would be to invite a large group of people and then run subjective tests based on rhyme or phonetically balanced word lists /1/. After much time and a lot of statistical analysis, you could generate a fairly good rating on how well speech is transmitted in your particular environment. This method, although quite straightforward, is very laborious and time consuming, and requires the involvement of many people.

Several indirect methods exist for predicting speech intelligibility in rooms that are based on making measurements of parameters such as speech signal-to-noise ratios and room acoustics properties. These methods use these acoustics measures to predict speech intelligibility using various algorithms and procedures described in the literature.

Bradley /2/ gives a good overview of the different methods which include the work of Haas /3/, Lochner and Burger /4/, Peutz /5/, Houtgast and Steeneken /6/, and Bradley /7-9/. The Syn Aud Con Tech Topics of Davis are also a rich source of intelligibility measurement information /15 /. Also refer to articles in past issues of *Sound and Communications* Magazine for more information and related topics (See articles by Steven J. Orfield Oct., Nov., 1986).

Portable Measurement Devices

There are currently only two self-contained portable products that allow measurements of speech intelligibility in the field: the Bruel & Kjaer Speech Transmission Meter Type 3361 and the Techron TEF System 12 Analyzer. The B&K unit is dedicated specifically to making intelligibility measurements, while the Techron unit is a general purpose computer-based test device intended for making electrical and acoustic measurements.

The B&K unit uses the technique of the Rapid Speech Transmission Index (RASTI) /10/ based on measuring the reduction of signal modulation in an acoustic transmission path. The Techron unit, which uses the technique of Time Delay Spectrometry (TDS) /11/, currently uses the Articulation Loss of Consonants (AlCons) method of Peutz /5/ to evaluate speech intelligibility.

Note that the B&K system includes an acoustic transmitter (Type 4225) that simulates the level and directional characteristics of speech generated by a typical human speaker. This capability is not provided by the Techron system. Only electronic input and outputs are provided by the Techron unit.

Although the Techron system can make some very sophisticated and detailed intelligibility measurements, it requires a relatively high degree of operator knowledge and skill for proper operation. The B&K product, however is quite easy to operate and doesn't require much operator skill to make effective intelligibility measurements. This is mostly due to the standardized test that the B&K product implements /12/ which minimizes parameter choices that the operator has to make.

This article describes a new easy-to-use software package for the TEF System 12 Analyzer which does speech intelligibility measurements based on Modulation Transfer Function methods (MTF) /6, 13/ and the Speech Transmission Index (STI).

The system can measure both an equivalent of the RASTI intelligibility number and a complete evaluation of the full STI over the range of 125 to 8,000 Hz. The operator has no parameter choices to make except for gain settings and time offset adjustments to yield a valid intelligibility measurement. The software allows quick and easy measurements of speech intelligibility and speech transmission characteristics of sound systems, acoustic spaces, and electronic transmission links.

What is the MTF?

The modulation transfer function is a measure of how well the amplitude modulation (variation of intensity with time) of a signal is preserved when the signal is sent from one point to another in a particular transmission chain. Research has shown that a good portion of the intelligence in human speech is contained in the modulation of the speech waveform /14/ (Fig. 1) (Author's comment: debate has come up recently about this point, see comments by Davis /15/.) Preservation of the speech modulation patterns is important to maintain high intelligibility. Noise, echoes and reverberation are found to decrease the effective modulation of the speech waveform and hence impair intelligibility.

Fig. 2 illustrates the effect of a reverberant room on an amplitude modulated sine wave carrier. Note the clean 100 percent sinusoidal modulation of the transmitted signal (Fig. 2a.) and the distorted reduced modulation of the signal as received at a point out in the room (Fig. 2b.). Note that each modulation and carrier frequency combination is effected differently by the room.

The MTF is usually plotted as a function of modulation frequency with the values ranging from 0 to 1 representing the range of no transmission of modulation to perfect transmission of modulation (Fig. 3). Typical speech modulation frequencies are in the range of 0.5 to 16 Hz. Music modulation frequencies can range up to much higher values /16/.

STI and RASTI

Houtgast and Steeneken /17/ describe a specific method for evaluating speech intelligibility using a direct measurement of the MTF based on sine wave amplitude modulation of a band-limited random noise carrier signal /Fig. 3/. Their method describes a series of modulation transfer measurements with carrier frequencies ranging over 125 Hz to 8 kHz at octave center frequencies. Typical human voice modulation frequencies of 0.5 to 16 Hz, at one-third octave frequency intervals, are used for modulation.

These measurements result in a data set containing 98 modulation reduction indexes which are in turn converted into a single index called the Speech Transmission Index (STI). The STI value is a single number that indicates the effect of a transmission system on speech intelligibility.

A shortened version of this procedure called RASTI (Rapid Speech Transmission Index) is also described which only requires the measurement of 9 modulation reduction factors distributed between the 500 Hz and 2 kHz octaves. Complete information on this technique can be found in B&K's Technical Review /10/, and the June issue of *Sound & Communications*. The B&K Sound Transmission Meter uses the RASTI technique for its measurements.

STI Measurements Using FFT

M. R. Schroeder has shown an alternate method for computing the MTF /13/. This method computes the MTF from the impulse response of a system without having to directly measure the modulation transfer characteristics at each individual modulation frequency. The method derives the MTF by calculating the frequency spectrum of the squared impulse response of the system (see sidebar for more details

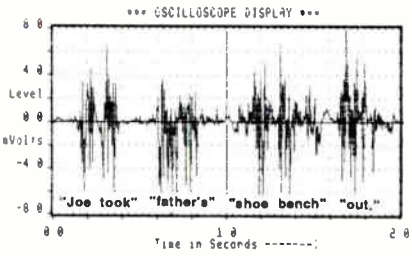


Fig. 1. Oscilloscope display of the speech waveform of the phrase "Joe took father's shoe bench out." Note the modulations or variations of level with time ot the waveform.

Hojberg /18/ indicates how this computation method can be applied to STI intelligibility measurements using a dual-channel FFT spectrum analyzer. The impulse response of a system is first measured using the dual-channel analyzer and then the data is converted to MTF and STI intelligibility data by post processing with a computer. Hojberg discloses that the measurement and computation time for a complete STI determination takes about 15 minutes using his method.

Calculating the MTF from the TDS Measured Response Data

Caution! This sidebar contains math that may be hazardous to your health.

M. R. Schroeder shows that the modulation transfer function (MTF) can be calculated from the impulse response of a linear passive system [13]:

$$\mathbf{m}(\omega) = \frac{\int_0^\infty h^2(t)e^{-i\omega t}dt}{\int_0^\infty h^2(t)\,dt}$$

where $\boldsymbol{m}(w)$ is the complex (having magnitude and phase) modulation transfer function, and $h(t)$ is the impulse response of the system, i is the complex imaginary unit operator (square root of minus one), and w is the frequency in radians per second ($2\,\pi$ times the frequency).

The numerator of the equation is recognized as being the Fourier transform or frequency spectrum of the square of the impulse response and the denominator is just the total energy of the impulse response. The ordinary or traditional MTF is the absolute value of the complex MTF, $|m(w)|$ and ranges over 0 to 1.

The impulse response can be measured with TDS methods using the ETC or Energy-Time Curve data. The MTF and STI can then be evaluated yielding the speech intelligibility prediction.

Because TDS naturally yields the complete complex analytic impulse response $\boldsymbol{h}(t)$[19] which includes the impulse response (real part, $f(t)$) and the doublet response (imaginary part, $g(t)$):

$$\mathbf{h}(t) = f(t) + ig(t)$$

this knowledge can be sued to calculate a more accurate MTF. Note the bold face which denotes a complex quantity.

In this case, a modified version of Schroeder's equation is used with the squared impulse response, ($h^2(t)$), replaced with the square of the absolute value of the analytic impulse response ($|h(t)|^2 = f^2(t) + g^2(t)$):

$$\mathbf{m}(\omega) = \frac{\int_0^\infty |\mathbf{h}(t)|^2 e^{-i\omega t}dt}{\int_0^\infty |\mathbf{h}(t)|^2\,dt}$$

The MTF is calculated from the TDS measured energy time curve (ETC) data in the following manner: First a TDS ETC response measurement is taken over a frequency range centered at the desired octave center frequency. Then the ETC time data is converted to MTF data using the modified version of Schroeder's equation.

STI Measurements Using TDS

TDS can also be used to measure the impulse response of a system /19/. This allows the MTF and STI data to be derived from TDS measurements rather than FFT measurements. The use of TDS to measure the system impulse response has several advantages over the FFT based measurement technique /20/.

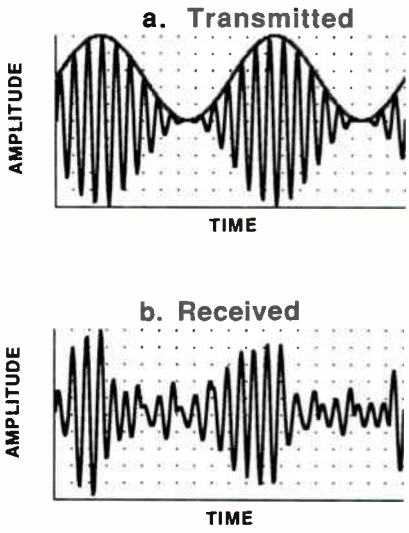


Fig. 2 . The effect of a reverberant room on an amplitude modulated sinewave carrier. a. The acoustic signal transmitted into the room (100 percent sinusoidal modulation of a carrier). b. The signal as received at a point in the room. Note the distortion and reduction of modulation of the received signal due to reverberation and noise in the room.

These including: fast measuring time, superior noise rejection (when required), low crest factor test signal, and more freedom to tailor the frequency content of the test signal to the desired operating range of the system being tested.

A slightly modified version of Schroeder's method of calculating the MTF from the impulse response is used in the TDS data gathering case. Because the TDS process naturally yields the complete analytic signal response (both real and imaginary parts) of the system under test, the complete signal information is used

to calculate the MTF. Rather than using the squared impulse response data alone to calculate the MTF, the squared TDS Energy Time Curve (ETC) data is used to calculate the MTF. The squared ETC data is the energy of the envelope of the system's impulse response with no approximations. As will be shown in a future technical paper, this squared ETC data is found to better represent the actual system energy decay response and hence yield a more accurate MTF calculation. For a more mathematical description of the process, see the side bar.

New TEF Software

A new software package for the TEF System 12 Analyzer has been developed that does speech intelligibility measurements based on the previous concepts. The software can perform a complete STI measurement over the range of 125 Hz to 8 kHz in two minutes. It can also measure a TDS equivalent of the RASTI method by testing only at the 500 Hz and 2 kHz octaves. Limiting the test to two octaves yields a quicker test time of 30 seconds.

The TEF-STI software is integrated into a special version of the measurement program EasyTEF. To initiate a STI test the user needs only to press the 'V' key (stands for Voice) at the main command bar of EasyTEF. The only user adjustments that have to be made prior to a test is to insure that the TEF system gain (both Input and IF gain) is set properly and that system transmission delays have been properly accounted for.

The full STI test is accomplished by measuring seven individual one second time span ETC's at each of the octave center frequencies between 125 Hz and 8 kHz. After each ETC test, the MTF is calculated and the STI in each octave band is computed. Each ETC test is designed to simultaneously measure the background noise in each octave band so that the noise is automatically taken into account in the MTF. The TEF test generator level at each octave band is adjusted to match the average spectral content of speech. At the conclusion of the test, the overall STI value is computed by taking a weighted average of the individual octave band STI values.

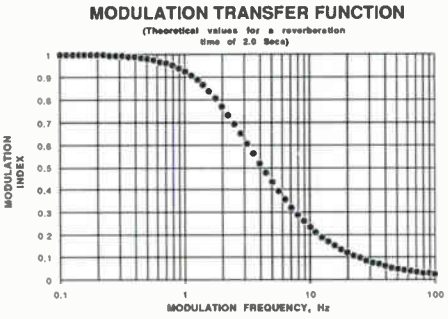


Fig. 3. The modulation transfer function (MTF) between two points in a reverberant room. The graph shows how well modulation is preserved at specific modulation frequencies. Speech modulation frequencies cover roughly 0.5 to 15 Hz, while music covers a wider range of about 0.1 to 100 Hz.

The weights used for the full STI averaging follow the importance of each of the individual octave bands to speech intelligibility. These weights are based on the work of French and Steinberg *[21]* and are found to emphasize the 1 to 4 kHz octave bands. Note that the weights used here *do not* agree with the roughly equal octave weighting of Steeneken and Houtgast *[17]* but agree with the more recent work of Humes et al *[22]* in their hybrid index mSTI (see Fig. 4).

The TEF-RASTI equivalent measurement gives equal weights to the 500 Hz and 2 kHz octave bands which is in agreement with the weighting used in B&K's RASTI technique. The TEF-RASTI measurement method used here also makes use of all the one-third-octave modulation data from 0.5 to 12.5 Hz for both octave bands. This is in contrast with the conventional RASTI technique,

as implemented by the B&K unit, which only uses the modulation data from 4 one-third-octaves bands at 500 Hz and 5 bands at 2 kHz. This sparse spacing of modulation data means that in some situations incorrect intelligibility numbers will be predicted. The software also provides for complete raw data storage and retrieval of all test data. This allows freedom in future post processing of the data to yield new information.

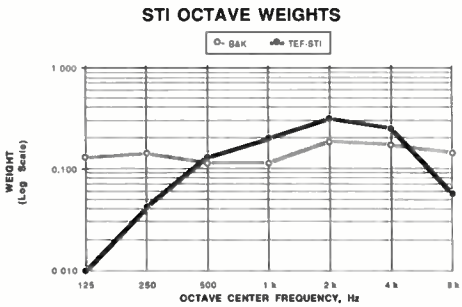


Fig. 4. Comparison between the octave weightings used in the conventional (B&K) STI test and the TEF-STI test. Note that the conventional weighting gives roughly equal weight to each octave while the TEF-STI weights follow the importance of each of the octave bands to speech intelligibility.

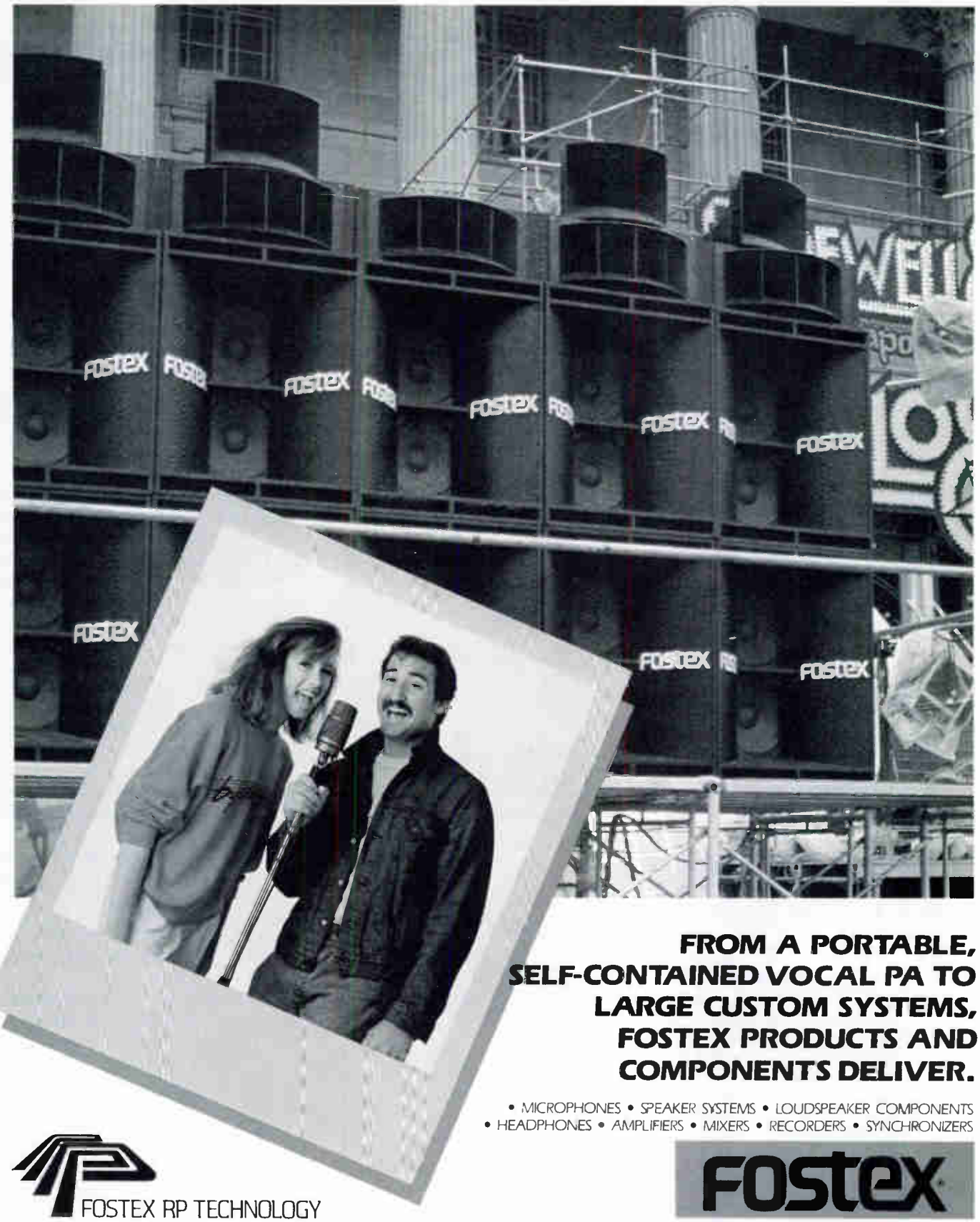
TEF-STI Data and Displays

The TEF-STI software can display several different forms of tabular and graphical data both on the screen and on printouts. All displays show the overall STI value along with the subjective qualification of the speech intelligibility (bad, poor, fair, good, excellent, etc.). The tabular data includes octave specific and overall data for: STI, equivalent early decay time (Early RT_{60}), and equivalent signal-to-noise ratio (S/N Ratio). Refer to *[10]* for explanations of these latter two parameters. The graphical data that can be selected includes plots of the individual octave band ETC's, MTF's, and a display of the STI values, S/N ratios, and early RT_{60} times versus frequency.

Observe that all modulation transfer function data is displayed over the rather wide frequency range of 0 to 155 Hz. This allows assessment of a particular path's transmission characteristics not only for speech modulation frequencies (0.5 to 16 Hz) but for other sources such as music that have much higher modulation frequencies.

Summary

This article has briefly reviewed some of the features of a new TEF System 12 software package that allows rapid and easy objective measurements of speech intelligibility of sound systems, acoustic spaces, and electronic transmission links.



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The software is based on the modulation transfer function and the speech transmission index and is measured using time delay spectrometry techniques. ■

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BIZ FRONT

(continued from page 20)

of the newspaper calling for a salesperson experienced in the art of designing and selling sound and communication systems is hardly likely to overload your mailbox with replies. If you have agreed with my previously mentioned plan to take an experienced salesperson and teach them your product, you have immediately widened your horizons and increased the number of applicants.

By selective, I refer to confining your search to persons used to selling in an allied field. Selling real estate or automobiles usually represents too great of a transition. As previously mentioned it is not necessary to be an electronic engineer, but you will be ahead of the game if your new salesman knows a resistor from a transistor and how to connect two pieces of wire together in order to complete a circuit.

This narrows our possibilities to some extent, but we are still not too limited. We can consider candidates experienced in sales of:

Fire Alarm Systems
Burglar Alarm
CCTV
Two-Way Radio
Computers
Electrical Supplies
Electronic Parts
Home Entertainment

With regard to the last two, many sound and communications system salesmen have been recruited by an astute employer from among the ranks of those *he* buys from. How about that bright salesman behind the counter of the electronic parts store? Surely you can offer him more potential. Were you impressed by the knowledge and the persuasiveness of the store salesman that sold you your last TV set? Tell him about the world of opportunity that awaits him with your company.

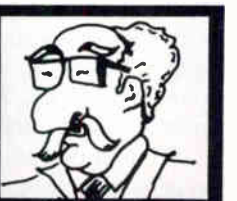
That caveat here is obvious, chances are these persons are not trained in *field* sales. You customers seldom walk in through the door, your salesmen have to go out and find them. The former retail salesman will have to be educated not only in your product but also in the disciplines of field sales; certainly not an insurmountable task for a motivated salesman, but actual field sales experience must be considered a weighting factor in the final selection process.

Part two of this article will discuss training and motivation.

140+

Overpowering the REVERBERANT Field

by Dr. Wilhelm Wokka



Philadelphia Medical College of Musical Knowledge

This is long overdue. Our industry is being slowly taken over by linear-thinking, computer-brained eggheads who sit in a plain white room all day getting multi-color radiation burns from a PC cathode ray rube. It's got to stop. The real world beckons and real systems that work must be made available or nobody will trust us ever again. It's time to stop trusting artifical, intellectualized data and love the Monster Sound. Brothers and sisters, it's time to get down and make some *noise*.

Those of us who are "out there" and doing it every day know that the world is non-linear and the kind of thinking they give you in college engineering and physics just doesn't work. Air is non-linear. The harder you push it, the harder it gets, and the faster sound travels. Actually, they do teach this in college, but they never really explain what this means.

Recently, there is great attention being given to intelligibility maximization in sound systems. However, all published research is done at listening levels at or below 90 dB SPL. Meanwhile, the concert and general high-level sound reinforcement industry has known for years that the key to greatest intelligibility is high levels, i.e., levels exceeding 140 dB SPL. I'll reveal to you what this means. I'll show you that loudspeakers get more directive, things sound better and that nemesis of intelligibility, the reverberant field, can actually be over powered and eliminated by using "140 plus."

Let's get down to the pure physics of it. When sound pressure levels (SPL's) increase, air gets "squirrelly" and distortion begins to make sound quality more and more annoying. This is only to a point. Independent of the kinds of loudspeakers used, when SPL's exceed 130 dB (at a meter) or so at the loudspeaker-air interface, a sort of ionic charge surrounds the cluster or "stack" shown in Figure 1 and something miraculous takes place. Figure 2 shows the exact phenomenological exofact of this.[1] First of all, an iconic cloud or force-field forms, which appears to be steady but is actually in oscillation at above 12 GHz. (See Figure 3). The sound inside this "cloud" is very high distortion, but a sort of A/D and then D/A

transformation occurs at the cloud-air interface. This tremendous discontinuity in "normal" air behavior does two amazing things.

One beneficial effect is that it selectively filters air-added harmonics by a naturally-occurring reverse acoustic mechanism and provides greatly-reduced harmonic and transient distortion. By the time 150 and 200 dB are reached, crystal-clear hi-fi sound is attained. Above 350 dB SPL (peak) is said to be mystical experience. More on this later. This filtering effect and force-field formation seem to be independent of the kind of loudspeakers used, so long as there are enough of them to provide enough "acoustic horsepower" to energize and "fill" the ion-pressure cloud.

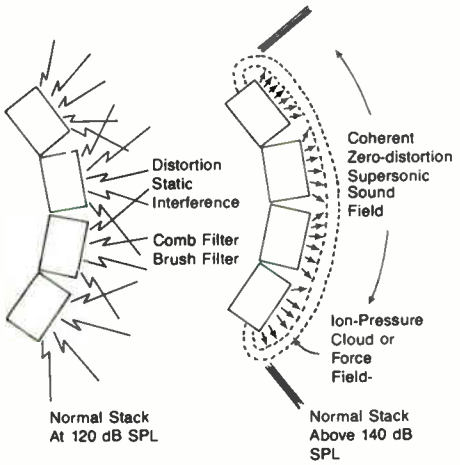


Figure 1: Action of Normal Speaker Stack Above and Below Critical SPL.

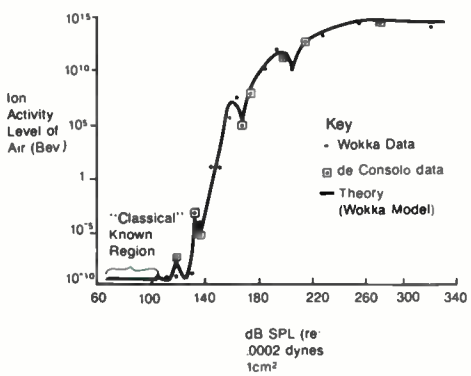


Figure 2: Ion Activity of Air of Various Sound Pressure Levels.

It is, however, a second effect that makes high-SPL sound such a benefit. Most large speaker arrays in high-level reinforcement are dismissed by computer-brained fixed-installation intelligencia as neanderthal, club-wielding idiocy. Au contrair. At 100 dB SPL large speaker arrays have enormous problems of nasty sound and hideous multiple-overlag problems. Above 140 dB, the ion-pressure field surrounds the array and gives clean clear sound, but more importantly, the directivity of the array becomes a function of only the frontal shape of the stack. If we have a wall of speakers we get a plane wave; if we have a curved array, we get a sperical or cylindrical wave. So at high SPL, the speakers merely pump energy into (or energize) the ion-pressure cloud and the cloud itself, aided by the shape of the speaker array, does the work of directivity.

A third effect is enormously helpful to the high-level system. At 140 plus dB SPL, the speed of sound increases dramatically within the high-SPL "beam." This has the powerful effect of separation of the direct-sound beam from the ambient environment. The boundaries between direct sound and the reverberant field become like a true beam of laser light in the darkness. Actual high-shear cavitation occurs and the direct sound actually "slices" through the air at supersonic speed with little or no frictional forces such as occur at normal mundane SPL levels. (See Figure 4). The speakers, via the ion-pressure cloud, shoot supersonic sound directly with, basically, no excitation of the reverberant field. Skeptical? (See figure 5). This is in *print* by a known authority in the field in a major publication. How can you even think of questioning this?!

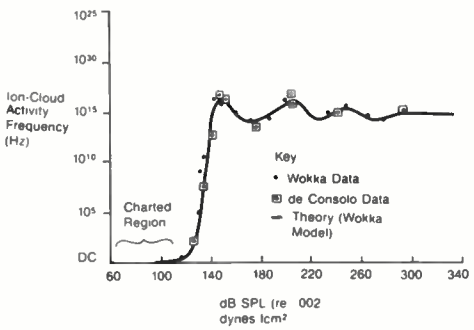


Figure 3: Ion-Cloud Activity Frequency v/s dB SPL.

What happens to the hearing of the listeners? What about OSHA? What about our children? Consider the following scenario: A normal high-level concert starts with "popular" CD's played at 90-100 dB. This gets the usual first wave of hi-fi purist snobs to leave, because it sounds so bad. The opening act is cranked up to 120-130 dB or so, in the ion-pressure "transition" region. This usually weeds out the rest of the faint-hearted weak-kneed lilly-livered 75 dB classical music "buffs."

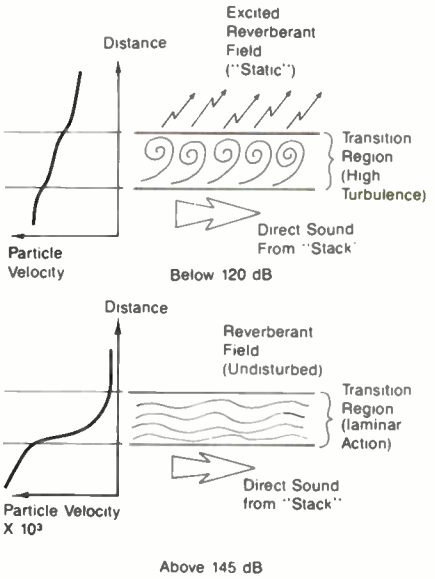


Figure 4: Boundary of Direct and Reverberant Fields Below and Above Critical SPL (approx. 140 dB SPL).

Those In The Know listen attentively with EAR or similar ear plugs while the ion-pressure force-field begins to form around the speaker array. This time-of-formation varies with output. (See Figure 6). Usually, halfway through the opening act's set, the "supersonic halo" is fully-formed and the house engineer puts all the faders on "11", puts his feet on the console and the show goes on. This activity is another one usually disdained and laughed at by the unknowing self-appointed "experts."

Actually, there is no need for mixing at this point because the experience goes beyond "normal." The concert goes into the stage that everyone came for: supersonic sound. As the SPL goes up and the speed of sound in the direct field in-

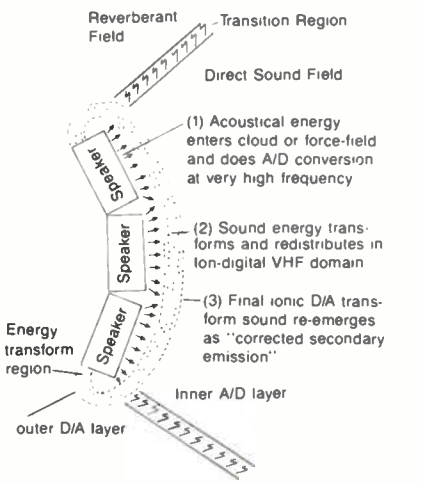


Figure 5: Typical Speaker Array Above 140 dB SPL Showing Full-Formed Ionized-Air Force Field.

[1] *This and Figure 2, from "Experiments in Supersonic Sound," Journal of High-Density Medical Aerobatics," by Fado DeConsolo, M.D.*

creases, (see Figure 7) the effective air density also rises dramatically (see Figure 8) and we have essentially direct-coupled sound through a semi-gas/semi-liquid air medium. A wonderful ear mechanism (previously unkown due to fear of ear damage) called "threshold limit" takes place. The entire ear mechanism solidifies into a solid muscle-and-bone mass and "ear-hearing" as we know it ceases.

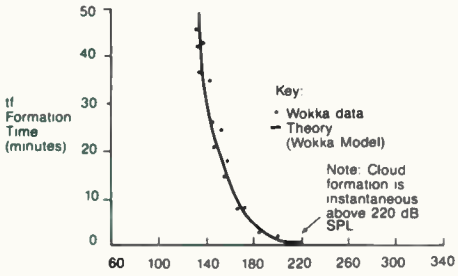


Figure 6: Formation Time of "Ion-Cloud" Force Field Around.

What we end up with is full-body aural data reception, similar to listening under water. It is the purest, most hi-fi metaphysical way of listening to music known to man. No listening damage happens because it's entirely physical listening. Satisfied concert goers leave feeling like they just left an expert masseuse, only better. Modern artists are learning to use

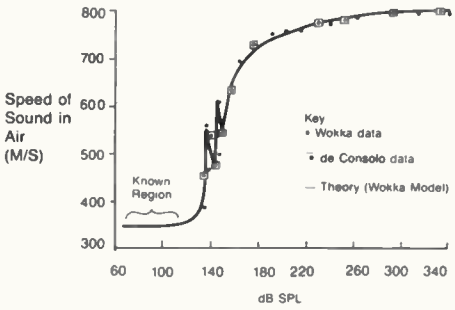


Figure 7: Variation of Speed of Sound with SPL.

this to great advantage. The "let's go to hell" heavy metallers just put this stuff on to scare away indignant moms and dads who don't have well-developed threshold limiting mechanisms, weakened by years of physical inactivity, high-fat overeating and overindulging in alcohol. Today's kids and other highly-physical hip supersonic sound lovers are tuned into the Monster Sound like mom and dad never were. Peak sound pressures exceeding 350 dB are occasionally reported, these being limited merely by power available from the local power grid.

So take note, self-appointed gods of good sound. The next time you see gargoyle-musicians spitting blood, scruffy sound engineers with their feet on the console and "too loud" sound "destroying our youth," remember this article. Stick around for a real treat and prepare to be hip. There's a well-kept secret in the high-level reinforcement industry today. It's never published because the eggheads in control of the major scientific journals keep it out of the public eye, definitely because it's a threat to their way of life. On the other hand, who's making all the money today, Vladaimir Horowitz or VanHalen? Some day, those with the True Knowledge will make these secrets and scientific findings

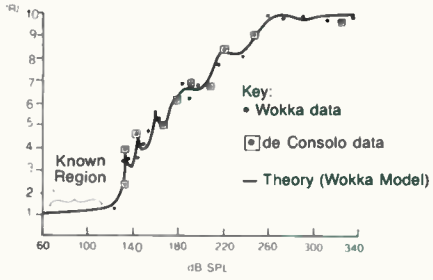


Figure 8: Air Density Ratio (R) Sound Pressure Level.

more available. Until then, high-level sound will merely continue to make money and satisfy a world of growing true hi-fi music and supersonic sound lovers.

Next Month: Why Only Great Men of Science Should Attempt to Design Loudspeakers.

PRODUCTS IN REVIEW

R-DAT Machines Announced by Panasonic

New from Panasonic Audio-Video Systems Group are a pair of full-feature R-DAT Digital Audio Tape machines for the professional audio industry. The Model SV-250 portable recorder features balanced XL-type input connectors and a 2.2 hour record capacity from its rechargeable NiCd battery pack. Model SV-3500 R-DAT machine features balanced XL-type inputs and outputs, remote control and is rackmounted for permanent installation.

The SV-250 portable R-DAT incorporates dual MASH (Multi-Stage Noise Shaping) analog-to-digital converters and 64-times oversampling digital filtering, reducing the signal distortion caused by conventional filters.

The Model SV-3500 Studio R-DAT Recorder features sampling frequencies of 32 kHz and 48 kHz, plus replay sampling frequencies of 32 kHz, 44.1 kHz and 48 kHz. The Model SV-3500 includes IEC Digital Interface inputs and outputs for direct digital-to-digital tranfers of audio material.

The two new R-DAT recorders will begin shipping between late spring and early summer.

Circle 5 on Reader Response Card

AB International's Distribution Amp

AB International Electronics, Inc. introduces its DA2148 Series Distribution Amp. Features include two inputs and eight outputs, active balanced inputs and outputs which have an optional transformer, a front panel routing setting via Dip switch and XLR type in/out connectors. Specifications include a frequency response of plus/minus 0.25 dB 20 Hz to 20 kHz, distortion is THD and IMD less than 0.25 percent, noise is 100 dB below maximum output, input level is +4 dBu and output level is +4 dBm. The suggested retail price is $349.

Circle 6 on Reader Response Card

Bogen Announces Series CM Intercoms

Bogen introduces its new Series CM intercom systems. The intercoms are for two-way communication in offices, stores, warehouses, and small indus-

trial plants. In single/multiple remote systems, remotes reply hands-free and can initiate calls to the master. In all master systems, any station can call any other, and multiple conversations are permitted. Master stations incorporate volume control, station directory and talk-lock button. Remotes have a privacy switch to prevent eavesdropping by the master. All stations can be desk or wall-mounted.

Circle 7 on Reader Response Card

Monster Cable's New Pro-link Series Cables

Monster Cable has announced three new Prolink Series cables with specific applications for the motion picture exhibition industry.

Prolink Series 4HD Audio Interconnect Cable is two-conductor and jacketed with a special friction-free version of Monster's high-density Duraflex.

Monster Cable Pro Speaker Cable employs a special 'helical winding' technique to selectively control the distortion-producing electromagnetic fields.

Circle 8 on Reader Response Card

Atlas/Soundolier's Ceiling Speaker System

Atlas/Soundolier introduces its Model EQ-818 ported bass reflex ceiling loudspeaker rated at 50 watts RMS at 70 Hz to 20 kHz. It is comprised of an 8-inch loudspeaker and 4-inch diameter cone type piezo high-frequency reproducer. Three options of power ratings and line matching transformers are available.

Circle 9 on Reader Response Card

Tannoy Introduces Two New MosFet Amps

Tannoy North America, Inc. has two new high current MosFet amps, the SR-740 and the SR-140.

The SR-740 has a smart power supply, a switchable compressor/limiter, recessed and calibrated level controls, a balanced or unbalanced ¼-inch or XLR plus five terminal barrier strip.

The SR-140 has recessed and calibrated level controls.

Circle 10 on Reader Response Card

a closer look

by gary d. davis

Shure's W15HT/58-87 Hand-Held, Wireless Micorphones

Shure Brothers, Inc. has announced the introduction of the Shure W15HT Wireless Microphone Transmitter, a hand-held unit, the W15HT, designed for use with Shure Wireless Microphone Receivers.

The W15HT is initially available in two versions: The W15HT/58, which is equipped with a Shure SM58 dynamic microphone element, and the W15HT/87, supplied with a Shure SM87 condenser element. Both the SM58 and SM87 heads may be used interchangeably with any W15HT Transmitter. To make sure the W15HT/58 and W15HT/87 deliver the e•act sound of wired SM58's and SM87's, Shure has instituted a quality assurance program that tests each assembled unit for acoustic performance through a wireless link.

The W15HT special dipole antenna system provides users with noise-free signals, minimal dropout, and unobtrusive appearance. The W15HT's performance is enhanced by the "mirror image" compander circuitry incorporated in the other Shure wireless products.

The W15HT transmitter section operates at a single, crystal-controlled frequency in the VHF band between 166 and 216 MHz. A total of 15 frequencies, computer selected for interference-free operation, are readily available; and other frequencies can be ordered from Shure on a special basis. This gives users the ability to operate a number of wireless microphone systems in a single sound installation, simultaneously and without intermodulation problems.

Operating controls on each W15HT unit include Microphone On-Off and Power On-Off with battery condition LED. They are conveniently located in a single area on the microphone's outer surface and are recessed to minimize accidental movement. The W15HT uses a readily-available, easy to install, 9-volt battery.

Comments: There's nothing new about having a Shure SM58 capsule, for example, in a wireless mic. Except that this is the first time Shure themselves have offered such a product. Ditto the SM87. So, what has Shure done to differentiate themselves from the growing number of wireless mic purveyors?

Shure has chosen the VHF high band, which is really a split band beginning at 150 MHz, and ending at 216 MHz. This band is actually shared with commercial VHF television broadcast, so users of such mics must be sure to select frequencies which are not being used by local broadcasters. (This is why the FCC requires the user to obtain a license to use any mic in the 150 MHz to 216 MHz range.) Apparently Shure has made it easier for the user by loading their computer with a database that indicates which frequencies are useable in various localities. This gets tricky, however, if you are touring; Shure claims to have a select group of frequencies that generally are not used by many (or any) commercial broadcasters, but you can count on occasional interference from other wireless mic users who have decided to take advantage of these same few frequencies for touring. Hence, if your system is not going on the road, don't use one of the touring frequencies.

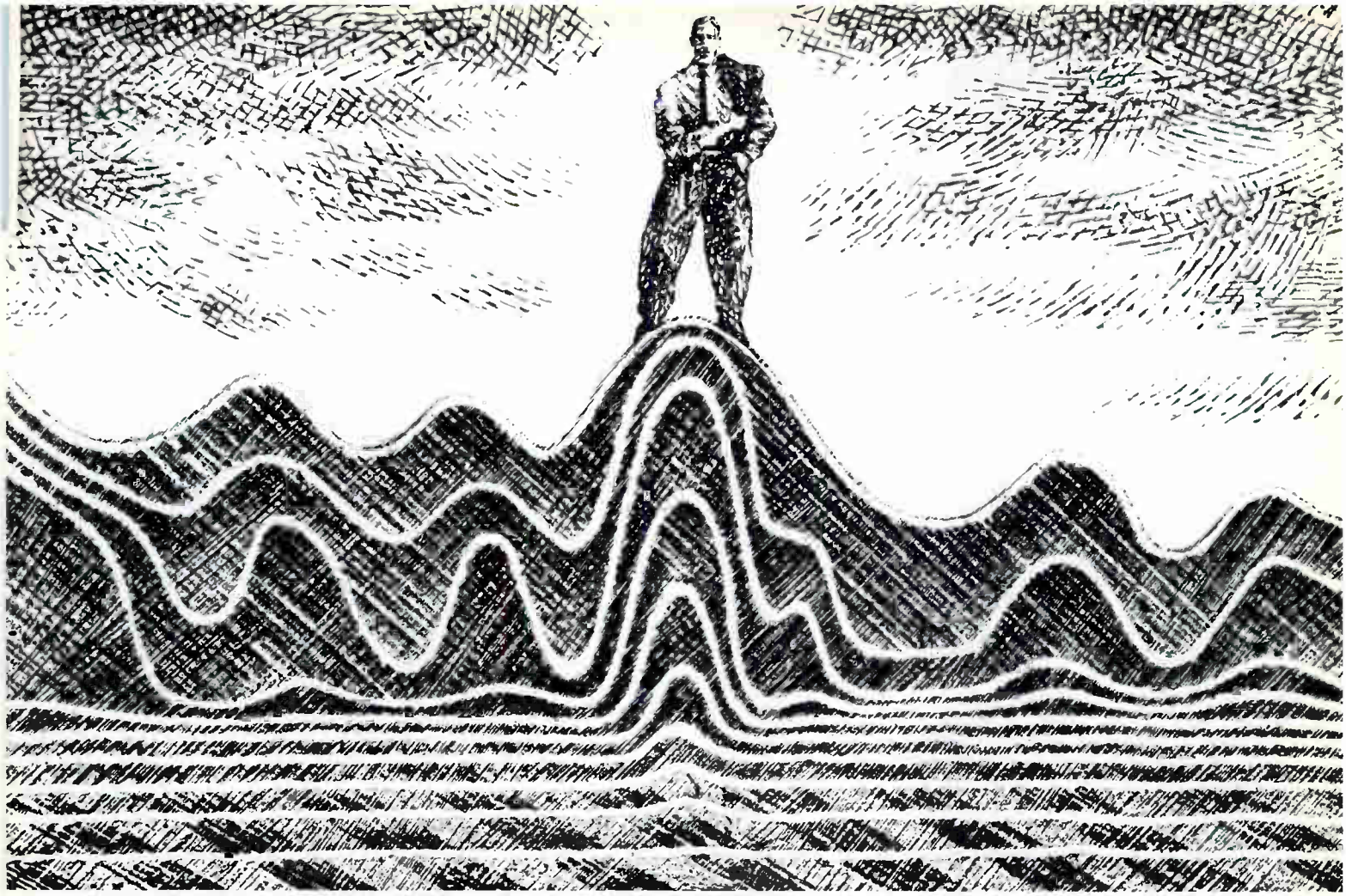
We like VHF in that it avoids the interference from CB, cordless phones, and business radios found in the 49 MHz region, and it is less costly and a bit less touchy (with regard to dropouts) than the UHF band. Dropouts or fades still can be a problem with VHF, which is why Shure offers a diversity receiver. The concept of a diversity system is to use two antennas, each in a different location.

Theoretically, if the signal fades or drops out at one antenna (due to cancellation of multi-path signals that combine in just the wrong way, or due to blockage of the path between the mic transmitter and the antenna), the other antenna will still be receiving a good signal. A moment later, the situation may reverse itself, but generally one of the two antennas will have a good signal. Some manufacturers of diversity receivers merely connect two antennas to a single receiver and hope for the best; unfortunately, this can create as many dropouts as it cures, since out-of-phase but strong signals at both antennas can cancel in the cable before reaching the receiver!

Other methods involve using what amounts to two completely separate receivers, then comparing the audio, and switching the audio output so it is derived from the stronger of the two received signals. That can be a problem in that background noise level, companding, and other characteristics may not match exactly, so the switching can be very noticeable. Besides, one does not gain any advantage from the signal reaching the other antenna if both signals are somewhat weak.

Shure's diversity method, as im-

(continued on page 95)



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Circle 206 on Reader Response Card

by Steven J. Orfield

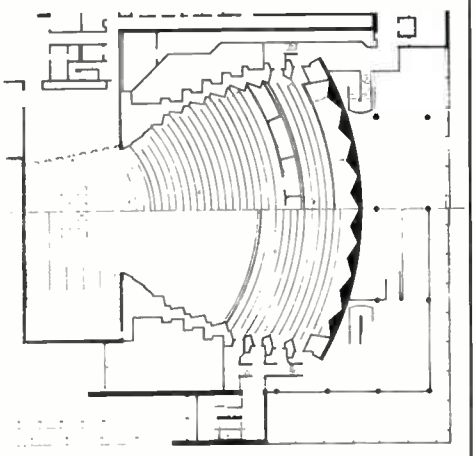
Theater Design and Technology

George C. Izenour, *Theater Design*, McGraw Hill Book Company, 1977, 631 pp, $250, hardcover.

George C. Izenour, *Theater Technology*, McGraw Hill Book Company, 1988, 552 pp., $195, hardcover.

While somewhat far afield of the province of many audio system designers, the practices and problems of working on major projects in the field of theater, concert hall and multi-purpose performance hall design and execution are at once intriguing and unusually complex. This complexity is partially due to the conventions and concerns of this specialized design field; it is generally an insider's game with its own vocabulary and evaluative assumptions. Additionally, the emphasis on multi-purpose halls in the recent past has provided far more technological complexity to this field.

Steven J. Orfield, a Minneapolis consultant, has been involved with architectural technology consulting for 15 years and practices in the fields of acoustics, audio, lighting, daylighting and thermal environment. He is a member of ASA, AES, ANSI, ASTM, IES and IFMA.



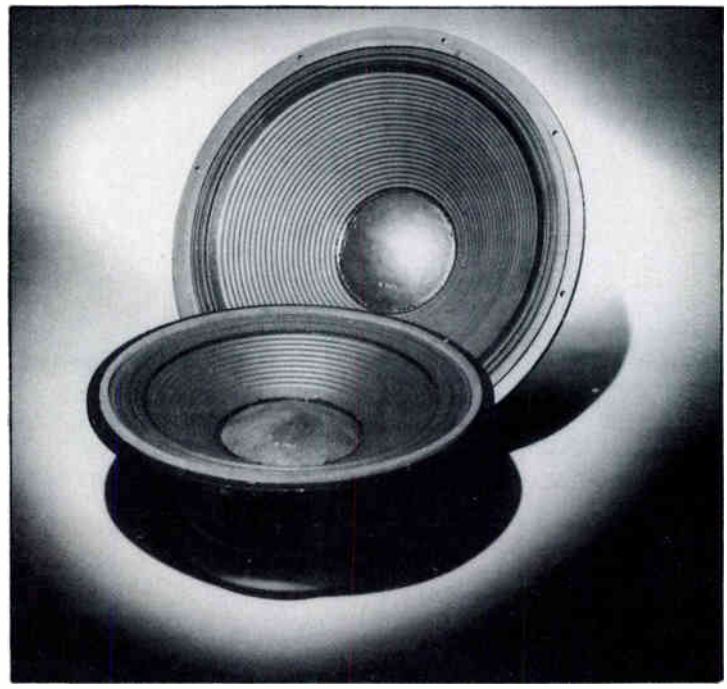
Plan, Koger Performing Arts Hall, University of South Carolina, Columbia.

Like so many specialized building design types, theater design is a field with little patience for the newer design or contracting participant, and thus, one must either be a very quick study or wait many years for useful major project involvement. A serious interest in this field may suggest a quick immersion into both the history and the practice of large performance room design and execution, and this interest could find no better execution than an in-depth reading of a series published over an 11-year span by George C. Izenour, the well-known theater designer, professor and

(continued on page 97)

THE BRITISH ARE COMING!

THE BRITISH ARE COMING!



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Circle 276 on Reader Response Card

CONTRACTING CLOSE-UP

Contractors Go Sporting with Altec Lansing

West Virginia University's Stadium has a new Altec Lansing system.

Contractors are installing Altec Lansing products in sporting facilities across the nation.

The Green Bay Packers Stadium in Greenbay, WI, got a kick in the system when Tech Communications of Appleton, WI, installed a new Altec Lansing system. The 50 yard line system, similar in design to that of the Rose Bowl, consists of 18 Altec Lansing MR42A Mantaray constant directivity horns with 34652 Y-throats, three MR94A Mantaray constant directivity horns with 34656 Y-throats, 42-290-8K compression drivers and six 817A bass horns each loaded with two 515-8GHP bass drivers. The system is powered by 18 Altec Lansing 1590E power amplifiers and four 1270B power amplifiers. The remaining electronic components are eight 1699A mixer/preamplifiers, three 1689A mixer/preamplifiers, two 1612B limiter/amplifiers, two 1631A electronic crossovers and two 1653A equalizers.

Across the country in Morgantown, West Virginia, the West Virginia Uni-

(continued on page 98)

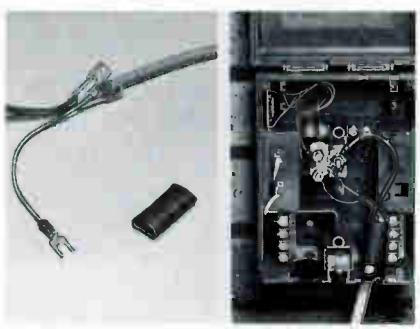
SUPPLIES•SERVICES•SUPPORT

Rack Mount Cabinets From Winsted Corp.

Winsted Corp. has new rack mount cabinets designed to provide increased rack space with greater flexibility of arrangements. The new cabinets feature a 30 degree sloping profile with 21 inch of rack space, and are ideally suited for low silhouette consoles.

The new sloping module can be combined with Winsted's existing System/85 modules to allow a variety of configurations. Corner unit consoles can be arranged with either flat or sloping work shelves.

Circle 1 on Reader Response Card



Panduit's Ground Clip Kit for Wiring

A new Floating Ground Clip Kit for use with Telco wiring is available from Panduit Corp., Electrical Group.

Designed to provide lightning protection at an outdoor network interface box, the kit installs easily with ordinary pliers on any 4- to 5-conductor buried drip wire. The floating design feature maintains ground even during settling of the earth in underground cable runs, according to the company.

Circle 2 on Reader Response Card

Extendable Tip Test Probe by Pomona

A new adjustable test probe capable of extending its tip to a length of three inches beyond the end of the probe barrel has been introduced by Pomona Electronics.

The new probe is designed to reach deep into remotely located test points and make contact without fear of shorting to adjacent components. The extendable probe's stainless steel tip is sharp enough to penetrate contaminants or conformal coatings; an extendable shaft is insulated by a thin Kynar coating. A collet nut locks the probe shaft at any point in its three-inch travel.

Pomona offers its new test accessory as a 48 inch patch cord in seven models offering a choice of other-end connectors consisting of a single stacking banana plug, a single retractable sheath banana plug, an .080 pin tip plug, and four models offered as multimeter replacement test leads. All models are available in red and black.

Circle 3 on Reader Response Card

FACES AND PLACES

LARRY PHILLIPS

Altec Names Phillips Director of Sales

F. Davis Merrey, Jr., president of Altec Lansing Corp. has named Larry Phillips director of sales. In his new post, Phillips will be responsible for management of the company's employed sales force.

As a technical representative with Edwards Co. and as a sales engineer for a sound contractor, he has worked with architects and contractors alike, resulting in an understanding of the industrial/professional audio market. He joined JBL in 1968 where he held a variety of positions, including sales manager and marketing manager during his six year tenure. Later as the director of marketing at TEAC, he helped develop a second generation line of multi-track recorders and consoles. Phillips also worked in the international arena for Harman International for four years.

Wheelock Forms Support Specialist Team

Wheelock has put together an experienced team of marketing/engineering/support specialists for the telephone integrated paging and telephone alerts products lines. Their responsibilities will be in the marketing, product development and technical applications of the lines.

Team members are: Art Arlow, who joined Wheelock in 1986 as market manager, telephone/paging products; Mark Koller, who joined Wheelock as manager, communications products engineering in 1987; and the newest member of the Wheelock telephone/paging products group is Walter Best, who joined Wheelock as a technical support engineer in January 1988.

QSC Appoints Murray Field Sales Engineer

QSC Audio Products has appointed Andrew Murray to the newly created position of field sales engineer. Murray has been with QSC for over eight years, most recently as national sales manager. As field sales engineer, Murray will be responsible for product training, technical liaison and overall product support in the field.

JOHN D. JONES

John D. Johnson Joins IED

John D. Johnson has joined Innovative Electronic Designs, Inc. (IED) as vice president of software engineering. In his six years as a consultant for IED, Johnson developed the original

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Testa Communications' publications hosted three panel discussions during AES: *Music & Sound Output* magazine hosted a symposium on **Engineered Obsolescence?. . .The Future of the Recording Engineer**, *Post* magazine sponsored a discussion on **Audio for Television & Film: I Heard it at the Movies**, and *Sound & Communications* magazine hosted a panel discussion on **Speech Intelligibility. . . What Measure/Whose Ruler?**

The *Sound & Communications* panel was hosted by technical editor Jesse Klapholz. Held before a live audience, well-known guest panelists were Daniel Queen, president of Daniel Queen Associates; David Klepper, co-founder of Klepper Marshall King Associates, Ltd.; Donald Davis, president and co-founder of Synergetic Audio Concepts (Syn-Aud-Con); and Clifford Henrickson, consulting engineer for U.S. Sound Company. A lively discussion was followed by a question and answer segment by the studio audience.

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GOING FOR THE GOLD

(continued from page 24)

land. They were babysitting perhaps the world's largest TV set that sits on a tractor trailer bed. It's called Star Vision, supplied by Avesco Screen Co., and is basically a matrix of 1,000 CRTs, each divided into 64 cells, each cell comprised of three primary-color pixels—for a total of 64,000 by three pixels. A standard RGB video signal is divided up and routed to the appropriate CRT and cell. The whole thing is totally self-contained, and even has an ac generator that has an NC of about 55.

The giant TV takes about a half an hour to set up and was used every day at Canmore and every evening in downtown Calgary for the medal presentations. After Canmore, we took a drive by the Canada Olympic Park, where the ski jumps, and luge took place; and by Nakiska where the alpine skiing site was. Both of these venues had similar conditions of operation, and therefore assumed to have similar performance.

On to the Rodeo

Each Olympic site chooses a sport indigenous to its culture as that year's contribution to the advancement of the state-of-the-art in Olympiadom. Calgary, being the home of the "Calgary Stampede," "The Greatest Show on the Earth," naturally held a rodeo. The 6,000-seat Stampede Corral was the venue to stage the rodeo, whose manager is convinced that, "this room is full of standing waves!" The centrally located scoreboard in the corral, had 18 Bose 802 loudspeakers arrayed around its four sides. An additional six 402s were hung at the far ends of the arena, three per end. Above the center of the room were six Acoustic Wave Cannons. Music through this system was fair—due to the room acoustics. Perhaps the manager was right—too many darn standing waves. Given that there were 20 experts in the peanut gallery at this point scrutinizing the design, an entire article is in the works describing the 20 *perfect* designs conceived that day. As was established later that evening during a rodeo, the system was intelligible.

Medal Ceremonies Mix Biz with Pleasure

Each night, laser lights stab the winter sky, fireworks shimmer, and 60,000 stand around listening to the national anthems of those faraway places with strange sounding names. These are the medal awards ceremonies in Olympic Plaza, which was designed to hold 15,000 but is regularly over-run by overzealous crowds eager to see, something, *anything*, that has to do with the Olympics. Here the staging accommodates two events, the medal ceremonies, and the spectacular extravaganza sponsored by Federal Express. At one end of the plaza is the medals stage, flanked on either side with 12 Bose 302 bass speakers and two stacks of 802s with additional 802s around the perimeter of the plaza atop poles.

After the ceremonies, Science Faction of New York City coordinates a laser light show, fireworks, image projections, special lighting effects, and of course music, on and from 19 downtown buildings surrounding the plaza, and a specially constructed rear-projection wall. The sound system here is based on 12 Acoustic Wave Cannons, and has two stacks of nine 802s on scaffolding above.

As an aside, Theatre Technology,

also of New York, supplied the intercom system to the 24 operators it took to maintain the supervision of this automated montage/presentation. "Basically it consists of a Theatre Technology distribution amplifier driving 22 Shure FP12 headset amplifiers with Koss headphones," according to Peter Erskine partner of Theatre Technology.

The Last Supper

Over drinks with Sherwin Greenblatt later that evening, the author discussed the "bottom line." After all those hours of entering room coordinates, mapping seating areas, and detailing cluster and array configurations the fact remains that these speakers work in overlapping array configurations from a fidelity, as well as even coverage point of view, better than just about any of the assemblage industry experts expected.

The bottom line is, with or without the intelligibility algorithms and room mappings, this group was certainly convinced to at least consider the Bose product line in places they never would have before. To the consultant the systems demonstrated offer viable solutions that require less design by virtue of the simplicity in the devices, and the minimalistic systems design approach.

The fact that all these venues had only five equalizers between all of them is a statement itself. Not one dynamic processor, i.e. limiter/compressor, could be found in any system. To the contractor that means less inventory items—there are seven different loudspeaker components in the line. Everyone enjoyed the hospitality and sincerity of the management and personable engineering staff at Bose. ■

CLOSER LOOK

(continued from page 82)

plemented in the W25DR, is very nice; they process signals from both antennas and, using linear phase filters, combine the two signals in-phase so that both contribute to the ultimate audio output without creating cancellation, and without switching problems. Still, diversity does cost more, and if you are dealing with less critical sound reinforcement or recording, and budget is tight, you can select a non-diversity W20R receiver for use

with either of the Shure mics listed in the press release.

For many years, one of the major drawbacks to wireless mics was limited dynamic range. If the performer shouted loudly, the mic/transmitter could be overdriven. If the operator reduced the gain at the transmitter, then too much noise might be experienced during quieter moments in the program; noise due to the extra circuitry and signal processing involved in broadcasting and receiving a signal rather than sending it down a mic cable.

Enter companding. Very similar to the noise reduction used for tape recording (such as those systems offered by Dolby and dbx). Companding, for those few of you who may not be familiar with it, is a process whereby the signal from the mic is compressed by a specific ratio on the way into the transmitter, and then the received signal is expanded by the same ratio to produce, hopefully, the same dynamics as the original mic produced. This keeps the quiet portions of the program above the noise floor of the transmit/receive link, and it prevents louder passages from overmodulating or clipping the transmit/receive link.

The only pitfall to companding is that the circuitry must be very linear and very well matched, or dynamic range errors will occur. Shure claims to offer an improvement in this area by carefully matching each mic/transmitter to the intended receiver. Since we have not tested or evaluated the equipment directly, we cannot comment on the true merit of their approach, except to say that, in theory, it is certainly a good idea.

The audio frequency response of the receivers and transmitters are specified, but not the response of the overall transmit/receive system. However, the individual component specs are comparable with better units from competitive manufacturers, with receiver specs like 50 Hz-15 kHz frequency response (²1 dB), sensitivity of less than .55V for 12 dB SINAD, at least 75 dB image rejection and 80 dB spurious rejection, and less than 0.5% THD from 100 Hz to 15 kHz. The balanced XLR-type audio output is -20 dBu across 600 ohms, which is suitable, with some padding, to drive a mic input, or without padding for a low-level line input.

The integral mic/transmitters use

9-volt alkaline transistor radio type batteries for a 6 to 8 hour life (or 1.5 to 2 hours use with an 8.4V rechargeable ni-cad). Generally, professionals plan to use a fresh battery for each performance, so battery life is reasonable. The 50 mW maximum RF output is about the most you'll find on such units (there are FCC restrictions), and while the range may be 500 feet or more, once again good practice involves placing the receiver as close as possible to the transmitter, and using long cables (if necessary) from the receiver to the recorder or mixing board. Common concerns with handheld wireless mics involve size, weight, balance, appearance, and durability. The black cases chosen by Shure should be unobtrusive. The weight, with battery, is 10 ounces for the W15HT/87, and a pound for the W15HT/58. A thermoplastic case is used to minimize weight, and to permit a dipole antenna to be built into the mic itself.

Shure is certainly a pre-eminent manufacturer of microphones. They have now entered the realm of wireless mics. We think they deserve your *Closer Look.* ■

Circle 4 on Reader Response Card

BOOK REVIEW

(continued from page 84)

originator of the Yale University Electro-Mechanical Laboratory.

In 1977, Izenour published the first of these works, *Theater Design*, and in this now famous work he covered the gamut of issues related to the execution of large multi-purpose hall projects. In addition, he provided a history of theater design, and in-depth discussion of acoustical issues by two eminent acoustical consultants, Vern O. Knutsen and Robert B. Newman.

With the publication of Izenour's second half of this series, *Theater Technology*, his discussion becomes far more specific as he explains the execution of large hall design in specific construction and operation. This discussion demonstrates the variable control of room size and shape, and it discusses the technical problems of rigging and controlling a multi-purpose hall. It clearly demonstrates the design transparency of the shell construction along with the immense variation possible via the use of adjustable elements.

In his explanation of the design complexity of the modern theater, Izenour's two references will provide both an understanding of the design rationale for many of these projects and can familiarize the reader with knowledge of the specific solutions which have proven so successful to many of the theater design field's most eminent practitioners. This classic exposition should be considered the first reference of choice for the professional who is involved or hopes to be involved with large performance hall projects, and it is one of the most extensive technical introductions to the field as a whole. ■

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.

CONTRACTING CLOSEUP

(continued from page 86)

versity Stadium also received a new Altec Lansing system. Electronic Speciality Co. of Dunbar, West Virginia installed the system that consists of 15 Mantaray horns and 28—290-8K compression drivers powered by seven Altec Lansing 2280A Incremental Power mainframes.

Altec Lansing reached the summit that is the Summit Arena in Houston, TX, when S.M. Hodges Co., of College Station, TX, installed Altec Lansing equipment in the arena. The system replaced the original JBL, Frazier, Grommes-Precision system. The new system includes 25 Mantaray constant directivity horns and 299-16A compression drivers, eight 817A bass horns, and six 816A bass horns loaded with 22 515-8GHP bass drivers, 96—409-T loudspeakers and 15—9444A power amplifiers. The Summit Arena is the home of the NBA Houston Rockets.

VIDEOCONFERENCING

(continued from page 32)

previously sent. If the person moves an arm, that new information is also sent. The most sophisticated systems go even further by mathematically "predicting" the path of motion so as to avoid even more information transmission. Compression is further achieved by avoiding even the initial transmission of duplicate picture information by saying, for example, "the next three inches of the picture are the same solid blue I have just sent." Codecs are really a combination of highly sophisticaed video digitizers, frame stores, and computers. They are complex, rather expensive, but very stable once installed. They are also not generally compatible from one manufacturer to another, since they use different encoding techniques.

Looking back at the previous example discloses another major concern in videoconferencing design. If the person moving an arm discloses details in the background behind the arm, those details must also be re-transmitted, contending for space on the transmission circuit. "Busy" backgrounds are another videoconferencing no-no. Similarly, "noise" generated by a poor quality camera looks like millions of image changes to the digital Codec, so it re-transmits every part of the picture where the "noise blips" occur. To

get to the bottom line, a noisy camera can actually block transmission circuits, confounding the system entirely.

In short, while there have been major improvements in the videoconferencing arena, it is still not "childs play." The challenges are great, and the feeling of accomplishment that accompanies that first "working link" can't be explained in words. But one should not forget that a quality audio link is more important than the pizzazz of doing television. It's also just about as difficult.

Neither can the price of entering the television arena be overlooked. There is a quantum leap in dealing with compressed video, large screen monitors, high quality cameras, computer-based control systems, and wide-band data circuits. When trouble-shooting installations across thousands of miles apart, profits can quickly be spent on the airlines. ■

Robert E. McFarlane is a Senior Engineer for Interport Financial Inc., a consulting firm headquartered in Burlington, Vermont. McFarlane heads the New York Office of Interport, and is a former Principal of The Wilke Orgainzation where he was Director of Technology development and started that firm's videoconferencing design practice. He has published and lectured exensively on the design of video conferencing rooms.

John H. Leay is an Emmy award-winning Independent Television Engineer Consultant whose credits include that of Television Lighting Consultant to the Metropolitan Opera. He is the designer of numerous interactive video networks, has designed television display for NASA Launch Control and Manned Spaceflight Centers, and designed videoconferencing rooms for Bell Laboratories.

CORRECTION

In the January issue on page 44 of the pullout section under Wheelock we inadvertently wrote 110 instead of 122 under the category Axial Sens. and $115 instead of $73.15 under list price.

AD INDEX

CALENDAR OF EVENTS

DATEBOOK

DATE	EVENT/COMMENT	LOCATION	CONTACT
April 18-20	**National Relay Conference.**	Stillwater, OK	Oklahoma State University (404) 624-5168
April 22-23	**"Sound System Engineering."** Seminar sponsored by Syn-Aud-Con	New York City Area	Syn-Aud-Con (812) 275-3853
April 26-28	**EDS '88.** Electronic Distribution Show and Conference.	Las Vegas, NV	Electronic Industry Show Corp. (312) 648-1140
May 15-20	**International Communications Association Conference.**	Anaheim, CA	ICA (214) 233-3889
May 16-17	**"Computers and Communications in the Health Care Industry: Strategic Implications."** Conference sponsored by Frost & Sullivan.	Chicago, IL	Frost & Sullivan (212) 233-1080
May 18-19	**Contractor's Expo and Conference.** NSCA's annual expo.	Reno, NV	NSCA (312) 593-8360
June 25-28	**NAMM.**	Atlanta, GA	NAMM (619) 438-8001
August 16-18	**"Fourth Annual Physical and Electronic Security Symposium and Technical Display."** Sponsored by the Philadelphia Chapter of the Armed Forces Communications and Electronics Assoc.	Philadelphia, PA	Brad Hoelscher (215) 354-2802
October 19-21	**"Network 90's."** Telecommunications conference and expo sponsored by USTA and USTSA.	San Francisco, CA	Paul Rogoski, USTA (202) 835-3158
November 28-30	**Unicom '88.** Expo and conference sponsored by NATA.	Dallas, TX	NATA (202) 296-9800

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is *Sound & Communications'* 1988 In-Depth Market Report on the Contracting Industry. This indispensable report is a reliable source of statistical data that helps everyone in the sound and communications industry make better marketing plans and more accurate sales forecasts. This year's third annual survey promises to be the most complete and comprehensive study to date of the sound contracting business.

Also look for articles on these topics in May:

Test Equipment

University at Buffalo's Alumni Arena Sound System

Basic Principles for Suspending Loudspeaker Systems, Part III

Don't Miss one of the most important issues of the year!

The May 1988 Contracting Industry Report issue of *Sound & Communications*

Who Dictates Technology?

Is the dog wagging the tail, or the tail wagging the dog? Our industry, like many of our allied counterparts, is made up of a group of factions including architects, consultants, academians, marketers, advertisers, contractors, soundmen, pro-dealers, etc. The eternal question comes to mind: What role do each of these have in the business; and how do they all relate and interact from a technical point of view?

By simply looking at this diverse group of casually related concerns, the circle analogy—no beginning-no end—comes to mind at first. Bearing me at least this indulgance, let us break into the circle at this pseudo-randomly selected point—the contractor. Now a contractor is the poor guy who walks into his office Monday morning, after a rough weekend, to find a letter from the owner of a local auditorium job in progress. This job is the one just two months ago "he declined to bid as specified" because the *design* would simply not work. This is the job where the owner accepted the contractor's alternate proposal, and acknowledged the original designer's specification was inappropriate and would not even work at all! *Now* the owner says in his letter after all the equipment has been rushed in for this "fast track" project, prepped and fabricated; he is willing to pay restocking charges, and go to a new design by the consultant that got him into a big mess in the first place!

All the theory, marketing, technical info, and good design, all go out the window when the myriad of crafts, trades, and interests are not fully understood by the many segments of the circle.

Speaking of full circle, we are at a uniquely visible front of communications. As purveyors of communications technology it is only befitting that our sensitivity towards the concerns of all others involved be open-heartedly accepted into our thinking. Lighting, decor, HVAC, mechanical systems, etc., are all equally important component parts that must work in concert with each other in order for there to be a concert.

This is a doubly important month. From the multitude of audio-related technical gatherings there will be the first international conference of the Audio Engineering Society—strictly dedicated to sound reinforcement. Ted Uzzle has organized a diversified staff of practitioners in the field that promises a comprehensive discourse of the subject.

Just a few weeks later we will be in Reno at NSCA—where many of you will be reading this. This year's NSCA is showing continued healthy growth with almost 300 manufacturers, and more consultants in attendance than at any previous convention. Recent correspondence from Jim Gundlach, of The Audio Systems Group, talked about the possible formation of a group—possibly within the NSCA organization—dedicated to the sharing of information among consultants and contractors. The goal is to set some standards for consultants specifications, and communicate as a unified group with the manufacturers. From a technical point of view, this could very well be the highlight of this year's NSCA convention. Have a great show!

Jesse Klapholz
Technical Editor

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