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SEPTEMBER 1988

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SOUND & COMMUNICATIONS

Volume 34 #9
September 1988

COLUMNS

DEPARTMENTS

FEATURES

ON THE COVER
The Celebrity Cabaret at Claridge's Casino Hotel, Atlantic City, NJ.

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From Background To Foreground...

The business music industry is in the foreground this month as the International Business Music Association prepares for its 18th annual convention in Fort Lauderdale, FL, this October. The IBMA convention is an important event for this industry, providing business music suppliers and manufacturers with a much-needed sense of community and identity. More important is the opportunity the convention affords attendees to "network," to exchange ideas and information, an opportunity for communication that is crucial given the current climate of shifting ownerships and alliances.

Sound & Communications is going to be at the convention, and we'll be taking advantage of this opportunity to meet and talk with everyone in attendance. In an industry that is going through a period of rapid change, both in the technology it uses and in the way it does business, this gathering of all the major players should help clarify major trends and directions, and provide a glimpse of what the future holds in store.

We've included in this issue a preview of the convention agenda, as well as an intriguing article by Dynamic Sound's Don Hartley on transmitting music programming via microwave.

Also in this issue: another of our special pull-out guides for contractors, this time featuring microphones; a behind-the-scenes look at the sound systems of Atlantic City's casino lounges; and a profile of a sound system installation at the River Club in Washington, D.C.

And this month we're proud to present a previously unpublished paper by Harry F. Olson on the design and application of an artificial voice developed for RCA. This paper was discovered in the archives of the late Dr. John Emil Volkmann, former head of RCA's Camden, NJ, acoustical laboratories, and is the second in a series of articles to be published from the wealth of information compiled by Dr. Volkmann during his more than 50 years with RCA.

Of course, we're gearing up for the AES show in Los Angeles. We will once again be hosting *Crosstalk*, a series of talk shows taped "live" before a studio audience during the AES. Industry figures will meet in symposium to discuss the areas of audio, audio for video, and sound reinforcement. Make plans to be part of the studio audience (we'll be announcing studio taping times and locations in the next issue).

Bill Intemann
Managing Editor

Bill Intemann

Correction:

In our July feature on intercoms, we incorrectly reported that Ring Group Of North America*'s model* MCS-250 *annunciator/intercom is a 12-station system. The* MCS-250 *actually provides 256 stations.*

And, in that issue's Consultant's Comments, *we incorrectly identified Marc Beningson as being associated with Jaffe Acoustics. Marc has left Jaffe, and has established his own consulting practice in Norwalk, CT.*

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Editorial Director/Publisher
Vincent P. Testa

Managing Editor
Bill Intemann

Technical Editor
Jesse Klapholz

Editorial Assistant
Stacey Zable

Contributors
John Bareham, Marc L. Beningson, Gary D. Davis, Richard Feld, Daniel G. Fraas, Don Hartley, Mike Klasco, Steven J. Orfield, David Starobin, Ted Uzzle

Consulting Editors
Jerome J. Brookman, Chris Foreman

Technical Council
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Cross Country Consultants
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Phd, PE

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Judith Morrison

Editorial and Sales Office
Sound & Communications
25 Willowdale Avenue
Port Washington, New York 11050
(516) 767-2500

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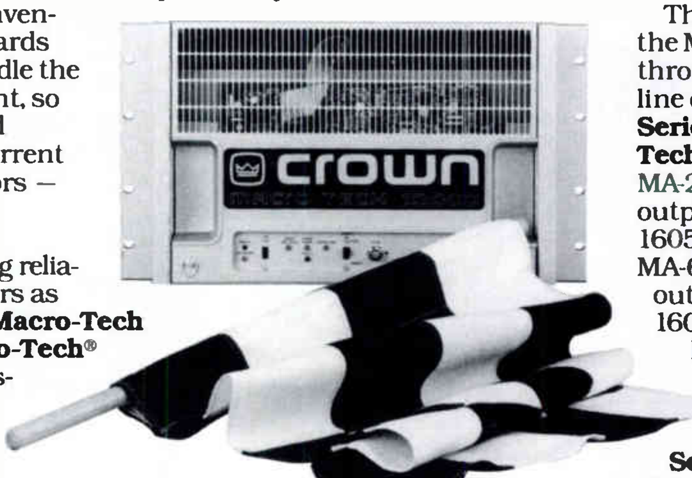

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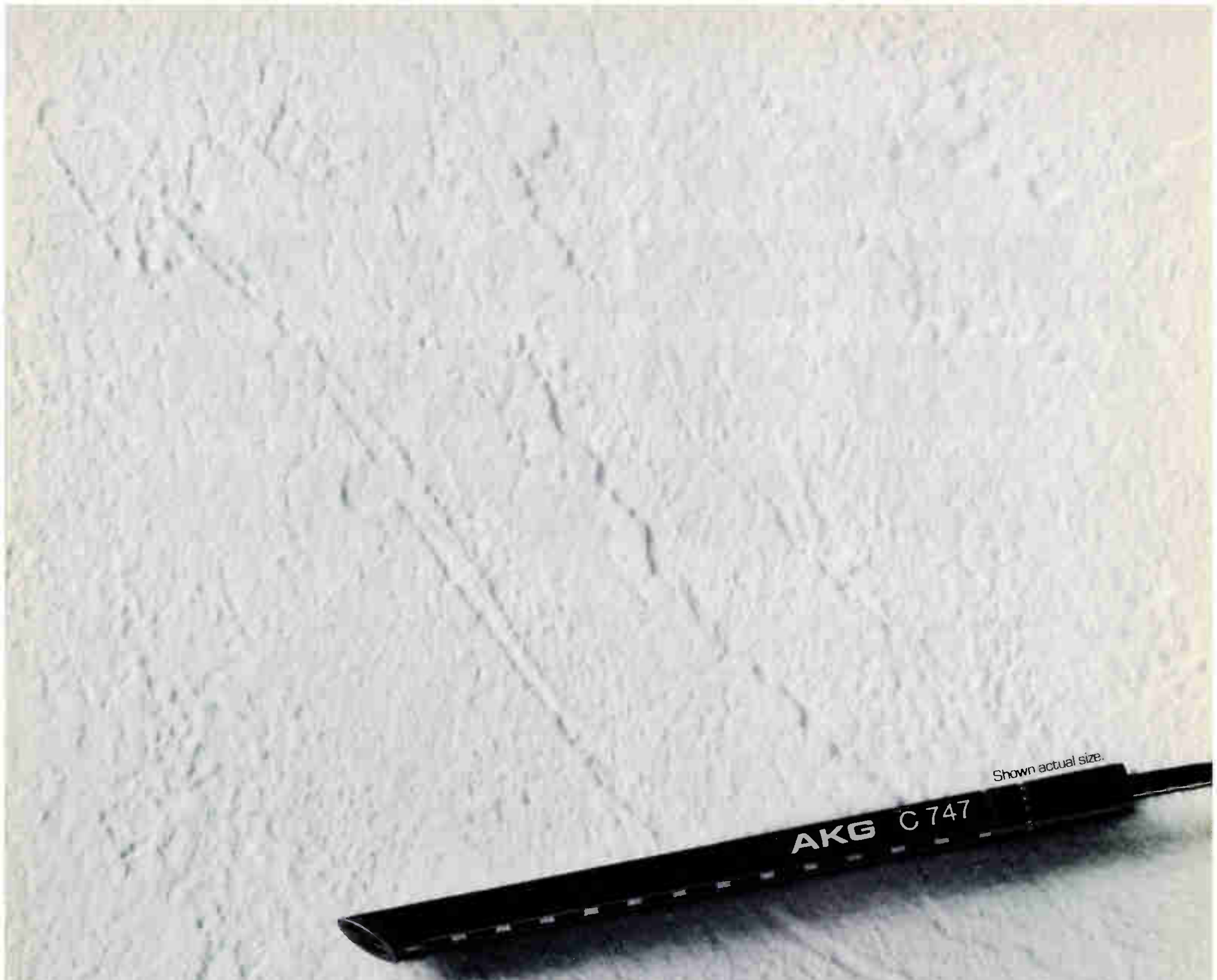

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NEWSletter

RAMSA UNVEILS INTERIOR SOUND SYSTEM

At press time, SOUND AND COMMUNICATIONS learned that Ramsa would be showing, first at the International Design Center in New York, and then at the AES convention in LA, its Interior Sound System, a new package with "psychoacoustic" properties that lends itself to customization within varied interior design concepts. While marketing plans are not yet firm, it is expected that commercial facilities such as stores and restaurants will be among the markets targeted, with sound contractors doing the installations. The system will allow "manipulation" of the sound and is "gorgeous," we're told.

YAMAHA REORGANIZES, NEW PRESIDENT NAMED

Yamaha has announced a reorganization of its American operations: the operations of Yamaha Music Corporation, USA will be merged into Yamaha Corporation of America, forming a single business entity. Mr. Masahiko Arimoto has been named the new president of this consolidated organization. According to Arimoto, these changes "will strengthen our company and allow us to respond better to the challenges and opportunities in the marketplace."

The merger became effective September 1, although the process is not expected to be complete until approximately the end of the month. According to Yamaha, its employees and national dealer network will not be affected by the reorganization.

ELECTRONIC SECURITY: A GROWING MARKET

Single-family and luxury home installations are leading the 20 percent annual growth rate in the U.S. electronic security equipment market, according to a recent survey of more than 2,000 professional electronic security system installers by STAT Resources.

SOUNDTRACS APPOINTS SHUTTLESOUND AS SOUND REINFORCEMENT DISTRIBUTOR

Soundtracs has split the distribution of its wide console range between Larking Audio for recording, VPP and other editing/production applications, and Shuttlesound for sound reinforcement, mobile or installed.

"The requirements of these two sides of what is loosely called professional audio are radically different," said Todd Wells, managing director at Soundtracs. While praising the job that Larking has done establishing Soundtracs as a major player in the recording industry, Wells feels the sound reinforcement side of professional audio (particularly installations) is a significant market segment that Soundtracs "wishes to exploit to the same level it has achieved with its recording consoles. Shuttlesound's products range now includes Crown, EV, Samson and Soundtracs.

GENTNER ACQUIRES TEXAR

Gentner Electronics Corporation announced its acquisition of Texar, Inc., of Monroesville, PA. Texar is a manufacturer of audio processing equipment for broadcast facilities.Russell Gentner, president of Gentner Electronics, said "We are excited about this acquisition. The purchase of Gentner establishes Gentner as an important force in the audio processing domain."

Gentner Electronics had recently restructured its R&D, manufacturing, and customer service areas, naming several new people to key positions in these departments, in anticipation of what the company expects to be "continued strong growth."

AEI SIGNS LETTER OF INTENT TO PURCHASE SEEBURG

Sound & Communications has learned that AEI Music Network, Inc. has announced to its employees and dealer network that a letter of intent to purchase Seeburg Music Satellite Network, a subsidiary of the Capitol Broadcasting Company, has been signed by AEI and Capitol Broadcasting, according to Roger Madison, vice president of corporate development for AEI.

ALTEC LANSING SPONSORS SOUND REINFORCEMENT CONFERENCE

Altec Lansing will be holding a two-day "All Technical Engineered Sound Conference" in Montreal, Canada, October 16-17. This conference will consist of short talks by industry experts who will speak on the technology that goes into modern professional sound products. The talks will be followed by discussion from the panel and from the audience.

Some of the technical subjects scheduled for discussion are: Differential versus transformer balancing; Opto-couplers versus VCA's; Electronic loudspeaker enhancement and protection devices; Technology considerations in wireless microphones; and RS 422 communications protocol in sound systems. All members of the pro audio industry are invited to take part in this forum.

JBL: PEOPLE'S CHOICE

JBL International has announced an agreement with the People's Republic of China to install JBL loudspeakers and electronics in the Great Hall Of The People in Beijing. "We are honored to be chosen for this complex and prestigious assignment," said Garry Margolis, vice president, marketing, for JBL International. Installation is scheduled to begin in Fall 1988.

JBL Professional products have previously been purchased by the People's Republic of China for installation in the studio facilities of China Broadcasting, and future projects with the Chinese government include the installation of JBL products in the Theater of Zhong Nan Hai (the Chinese "White House").

dbx/ADC AND BSR JAPAN ACQUIRED BY CARILLON TECHNOLOGY, INC.

Carillon Technology, Inc. confirmed that it has acquired the business operations of dbx/ADC and BSR (Japan) Ltd., divisions of BSR International PLC. A restructuring of dbx/ADC has been announced by Jacques Robinson, president of Carillon, a privately owned company based in San Bruno, CA.

Production and manufacturing facilities for dbx will be moved to the west coast and other locations. dbx operations, including marketing, sales, and engineering, will remain in the Boston area.

ADC, which had been operated and managed by dbx, has been reorganized as a separate company, Audio Dynamics Corporation. Its operations, including marketing and sales, are being moved to San bruno, CA. dbx engineers will continue to design and engineer products for the ADC and Audio Dynamics brands.

ANIXTER FORMS INTERNATIONAL GROUP

Anixter Brothers, Inc., Skokie, IL, has announced the formation of Anixter International, a new entity formed to facilitate the company's expansion throughout continental Europe. Bruce Van Wagner, newly-named chairman of Anixter International, said, "The reduction of trade barriers [within the European Economic Community], coupled with the adoption of international data and communications standards, provides a unique opportunity to extend our presence in Europe."

Hospital & Health Care Communications

We were most pleased to see the two-part article by Ron Rosen regarding nurse call systems. It contained much information that should be helpful to all, and it obviously reflects a great deal of research.

One point we thought might be of interest and possible importance to your readers is that centralized systems, pocket pager interfaces, and printer interfaces are all presently not Listed by the Underwriters Laboratories. To date none have been demonstrated to meet the American National Standards Institute requirements for safety and reliability (ANSI-UL1069) when used as hospital signaling equipment.

Since almost all hospital specifications call for the significantly increased safety provided by UL Listing under the above ANSI Standard for Hospital Signalling Equipment, the legal risks for the distributor involved in selling non-Listed equipment should be carefully considered. Obviously this is a business decision, but it is one that each distributor should be keenly aware of at all times. In some cases, the downside risk is a disastrous lawsuit.

In addition, the courts seem to take the view that it is the distributor's responsibility to explain to health care customers exactly what the situation is with respect to UL: the hospital needs complete information if it is to make an informed decision. And the distributor is on thin ice if he is guilty of failing to give his customer such information, perhaps especially so if it can be shown that he made more profit by not fully informing his customer.

Futher, we have found that hospital personnel sometimes decide to buy a product because of its features alone — ignoring questions of possible safety considerations. This is certainly their right, and often they have taken into consideration the question of safety, if only on the basis of their own judgement.

However, we have found that if the potential liability (of not using all UL Listed equipment) is pointed out clearly to the hospital's CEO and attorney, they almost always elect to use only equipment that has been demonstrated to meet national safety standards, in most cases UL Listed equipment.

Moreover, each of us has to decide whether or not national safety standards really have meaning: have the ANSI-UL Standards a scientific and engineering basis that is solid? Or do we just happen to know better what is safe for use in hospitals than the people who wrote the Standards? There is a moral question here that the courts will be quick to answer, even if we do not think it important. Surely the vast majority of distributors try to do everything right.

(continued on page 65)

How to make your best church sound systems disappear from sight!

Actual Size
Model AT853 Unidirectional
Condenser Choir Microphone

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Every congregation deserves the best possible sound, whether at the service or listening to broadcasts or tape. Now you can install superior sound without bulky microphones and awkward microphone stands that intrude on the services.

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Model AT857AM
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Technicians

by Marc L. Beningson

Technicians are like Rodney Dangerfield — they get no respect. Sometimes they don't even get the honor of a prestigious name like "technician." Often they're just called "installers," "field personnel," or "the guys at the site." Certainly they deserve better treatment, considering that the success of the project is largely in their hands. Salesmen bring in the work, project engineers figure out how to do what the salesmen sold, purchasing agents get the best deals on equipment and get it delivered, project managers oversee the installation, and the financial people count the beans and sign the checks, but it's the techs, both in your shop and in the field, who perform the work on which the reputation of your company depends.

Technicians build the racks, terminate the wires, and install the equipment in the field. The success of the project—acoustically and aesthetically—depends for the most part on how well the technicians understand the work that they are supposed to perform. And yet how much of your resources are dedicated to making sure that these critical people understand what is required of them?

Good help on all levels is hard to find. To ensure the success of your projects, and the ability to generate new, profitable work, you must start with good people. Technicians with experience in related fields (such as telephone or cable television installation or electrical contracting) may have a better understanding of electronics than someone who is (or thinks he is) familiar with audio. Check out references, and hire reliable people.

Familiarize new hires with how your work is done, and maybe show them some examples of projects that were done well. It is easier to know what a perfectly assembled rack looks like if you've seen one. It is most important that a technician—or any employee—knows the quality level that is expected of him. And of course, a technician must have the capability to perform his various tasks and that requires support. Management must supply him with the tools and the knowledge to perform the task at hand. A technician should not have to worry about where he is supposed to be—it is the responsibility of the project managers of the various projects to allocate resources, including people, equipment, and time.

Equipment, of course, means tools.

(continued on page 65)

by Steven Orfield

Metrodome Acoustics

In the field of professional sports, there tends to be no particular need to analyze success, but failure is another matter. In the 1987 baseball season, an unexpected occurence somewhat disarmed baseball commentators: the Minnesota Twins began to look like contenders for the Pennant. Through the final playoffs and into the World Series, the issue of acoustics in the Metrodome began to play prominently in the press and was seen to be the reason for the Twins success. And the terms "Homerdome," "Rollerdome," and "Thunderdome" were born.

The Twins had been a solid team for a number of years, but the issue of Metrodome noise was a far more interesting short-term story. St. Louis, the challenger for the Series, was so confident of a win against the Twins that they checked out of their hotel early assuming there would be no final game in this series. Concurrently, a St. Louis audiologist began to suggest revelations regarding harmful noise in the Metrodome.

Thus, an interesting question began to surface, one that has been circulating in the rock music field for years: "Is attendance at this event harmful to the long term hearing acuity of the audience?" One suggestion implicit in this question was a comparison between baseball games and rock concerts, and this comparison certainly was of interest to both the press and the general population.

After the World Series and before the opening game of the 1988 season, Orfield Associates was retained by the Metropolitan Sports Facilities Commission to measure and analyze the noise levels occuring during baseball games, in order to provide basic information as to the "noise events" and noise exposure at these games.

The problem is interesting in that there are many methods of assessing noise exposure, some based on statistical descriptors of the percentage of hourly exposure, and some based on the noise levels of specific events, such as a home run (or more typically, an aircraft overflight). The Occupational Safety and Health Administration (OSHA) has been clear in suggesting that noise exposure is a statistical problem based on the number of hours that a person is exposed to a specific average level of sound. Specifically, OSHA regulations are based on a concern for persons exposed over an 8-hour period to noise levels of 90 dBA or greater.

Figure 1.

MAXIMUM OCCUPATIONAL NOISE EXPOSURE		
NUMBER OF HOURS	MAX dBA (OSHA)	MAX dBA (EUROPEAN)
8	90	85
4	95	88
2	100	91
1	105	94
½	110	97
¼	115	100

The OSHA limits are assumed to be limits not of the average daily exposure but rather of the maximum exposure on any normal day of employment. The selected values chosen by OSHA are not particularly conservative in favor of the employee, and are, in fact, very modera.. compared with the more stringent limits set by some European countries, as can be seen in figure 1.

In addition to these OSHA regulations, there is some concern for the frequency distribution of the sound and for the "peak response" levels of this sound, in that all OSHA standards are based on "slow response" meter readings, which do not evaluate transient or "fast" noise events.

As we began to consider measurement of the Twins opening game, there was some concern over the types of measurement and the equipment selected. We wanted the measurements to be broadly based and beyond question in their coverage of the issues at hand. As a result, we selected three analyzers and general measurement formats for our testing: the Bruel and Kjaer 4427 Environmental Noise Analyzer (for continuous fast response plots of sound levels, LEQ, and LMAX), the CEL 393B Computerized Precision Sound Level Meter (for LEQ, L10, L50, L90, LMAX, and SEL), and the IVIE 40 PC Real Time Analyzer (for peak accumulated event spectra).

On the one hand, there was an interest in determining the maximum levels of noise events via standard measurements, and on the other hand, there was a desire to characterize the density of noise exposure to confirm or deny the statistical exposure types defined by OSHA or by the European community.

Actual Measurements

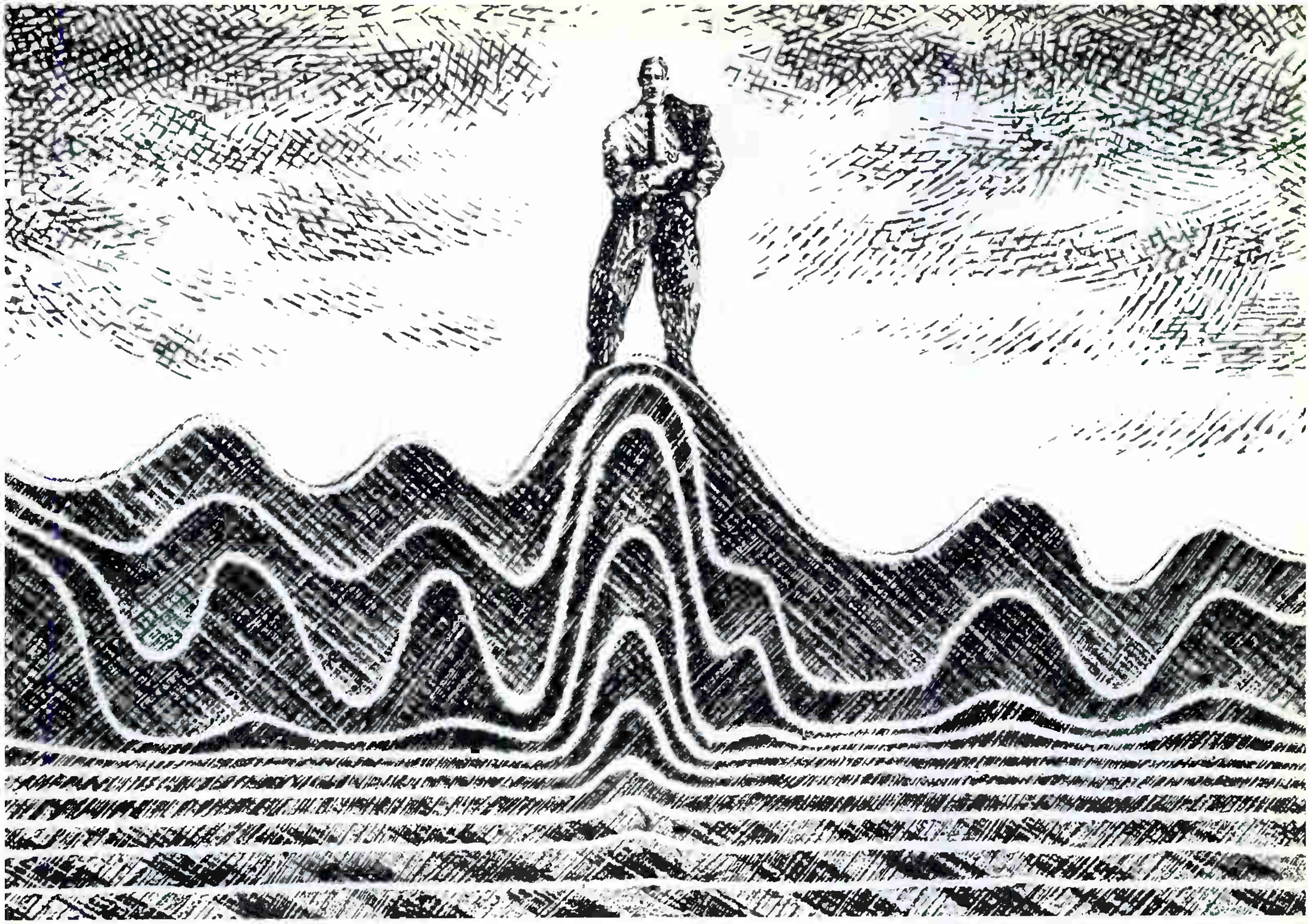
Having performed measurements of many other environmental noise exposures, including industrial, aircraft, and traffic noise, the initial impression during measurement of the Twins game was that the exposure was quite loud. My estimates would have suggested exposures in an average range of 90 dBA and over (Long-term LEQ). The actual measurements told another story, as can be seen in figure 2.

While individual events (such as runs, errors, and outs) exhibited short-term and wide variations, the typical ambient levels during the games were not as high as expected. Figure 4 shows the maximum plotted level for some of the short-term noise events measured during the games.

The opening game in which the Metrodome was completely filled provides a higher level of event noise than does the less attended game of a few

Figure 2.

DATE	ATTENDANCE	LEQ	L10	L50	L90
APRIL 8, 1988	50,000	83-97	93-100	82-85	81
APRIL 20, 1988	20,000	80-86	83-90	74-8	70-73



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weeks later. Keeping in mind that the exposure to any of these games is, at most, four hours in duration, OSHA standards would allow 95 dBA, based on their standards for 4 hour exposure. Neither of these games approached this minimum OSHA compliance value.

Audiologial Discussion

In addition to this confirmation of exposure limits, I contacted Dr. W. Dixon Ward of the University of Minnesota, president of the Acoustical Society of America, and an expert in hearing damage research, to discuss this data. Dr. Ward indicated that the predominant research information in the field suggests that there is no reason to believe that the levels of noise exposure at the Twins games has any permanent effect on hearing quality. In fact, the levels measured are very significantly below limits for

Figure 3.

NOISE EVENT MEASUREMENTS MAXIMUM PLOTTED LEVELS		
DATE/TIME	EVENT	MAX dBA
8 APRIL		
7:02	HIT	106
7:15	HIT	114
7:43	HIT	109
8:15	MANAGER EJECTED	112
8:56	HOME RUN	111
9:57	HOME RUN	112
20 APRIL		
7:16	HIT	102
7:21	HIT	107
7:34	THIRD OUT	105
8:06	DOUBLE/RUN	108
10:20	RUN	110

concern due to noise exposure.

Dr. Ward's characterization of the problem of hearing exposure suggests that short term exposures up to 125 dBA or 140 dBA peak do not cause hearing damage, and therefore, the levels of exposure at Twins games are significantly below the area of concern. One specific point made was that hearing research is becoming less concerned about levels in the range of this discussion due to the limited number of exposures for any individual: exposure does not, in any way, parallel that of occupational ex-

(continued on page 66)

FAST ACTION CARD

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COMPANY: ______________________

STREET: ______________________

CITY: ______________ STATE: ______________ ZIP: ________

SIGNATURE: ______________________

TELEPHONE: (   ) ______________ DATE: ________

SEPTEMBER 1988 EXPIRES 12/1/88

Do you wish to receive (continue receiving) *Sound & Communications?*
☐ Yes ☐ No

1 Primary Job Function (only one:)
- ☐ A Management/Owner
- ☐ B Engineering/Technical Mgt
- ☐ C Sales/Marketing
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- ☐ F Consultant
- ☐ G Advertising/Promotion
- ☐ H Other ________

2 Primary business of company (only one):
- ☐ 1 Contractor—Engineered Sound/Acoustical
- ☐ 2 Contractor—Interconnect/Intercom
- ☐ 3 Contractor—Fire/Alarm/Safety
- ☐ 4 Electrical Contractor
- ☐ 5 Pro Audio/Studio/Reinforcement
- ☐ 6 Architect/Designer
- ☐ 7 Engineering/Acoustical Consulting
- ☐ 8 Maintenance/Service
- ☐ 9 Dealer/Distributor/Rep
- ☐ M Manufacturer
- ☐ 0 Other ________

3 Your purchasing authority:
- ☐ A Final approval/Buyer
- ☐ B Recommend/Specifier
- ☐ C No Direct Authority/User

4 Intensity of your product need:
- ☐ 1 Have salesman call
- ☐ 2 Need within 3-6 months
- ☐ 3 Future projects

5 Number of employees at your company:
☐ A 1-3 ☐ B 4-10 ☐ C 11-25 ☐ D 26-100 ☐ E over 100

NEW PRODUCTS: (Please Circle)

			43	60	77
			44	61	78
			45	62	79
1	15	29	46	63	80
2	16	30	47	64	81
3	17	31	48	65	82
4	18	32	49	66	83
5	19	33	50	67	84
6	20	34	51	68	85
7	21	35	52	69	86
8	22	36	53	70	87
9	23	37	54	71	88
10	24	38	55	72	89
11	25	39	56	73	90
12	26	40	57	74	91
13	27	41	58	75	92
14	28	42	59	76	93

ADVERTISING PRODUCTS: (Please Circle)

			243	260	277
			244	261	278
			245	262	279
201	215	229	246	263	280
202	216	230	247	264	281
203	217	231	248	265	282
204	218	232	249	266	283
205	219	233	250	267	284
206	220	234	251	268	285
207	221	235	252	269	286
208	222	236	253	270	287
209	223	237	254	271	288
210	224	238	255	272	289
211	225	239	256	273	290
212	226	240	257	274	291
213	227	241	258	275	292
214	228	242	259	276	293

FREE SOUND & COMMUNICATIONS INFORMATION

Please send free information on items circled.

SOUND & COMMUNICATIONS

NAME: ______________________ TITLE: ______________

COMPANY: ______________________

STREET: ______________________

CITY: ______________ STATE: ______________ ZIP: ________

SIGNATURE: ______________________

TELEPHONE: (   ) ______________ DATE: ________

SEPTEMBER 1988 EXPIRES 12/1/88

Do you wish to receive (continue receiving) *Sound & Communications?*
☐ Yes ☐ No

1 Primary Job Function (only one:)
- ☐ A Management/Owner
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- ☐ 7 Engineering/Acoustical Consulting
- ☐ 8 Maintenance/Service
- ☐ 9 Dealer/Distributor/Rep
- ☐ M Manufacturer
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- ☐ 3 Future projects

5 Number of employees at your company:
☐ A 1-3 ☐ B 4-10 ☐ C 11-25 ☐ D 26-100 ☐ E over 100

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3	17	31	48	65	82
4	18	32	49	66	83
5	19	33	50	67	84
6	20	34	51	68	85
7	21	35	52	69	86
8	22	36	53	70	87
9	23	37	54	71	88
10	24	38	55	72	89
11	25	39	56	73	90
12	26	40	57	74	91
13	27	41	58	75	92
14	28	42	59	76	93

ADVERTISING PRODUCTS: (Please Circle)

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206	220	234	251	268	285
207	221	235	252	269	286
208	222	236	253	270	287
209	223	237	254	271	288
210	224	238	255	272	289
211	225	239	256	273	290
212	226	240	257	274	291
213	227	241	258	275	292
214	228	242	259	276	293

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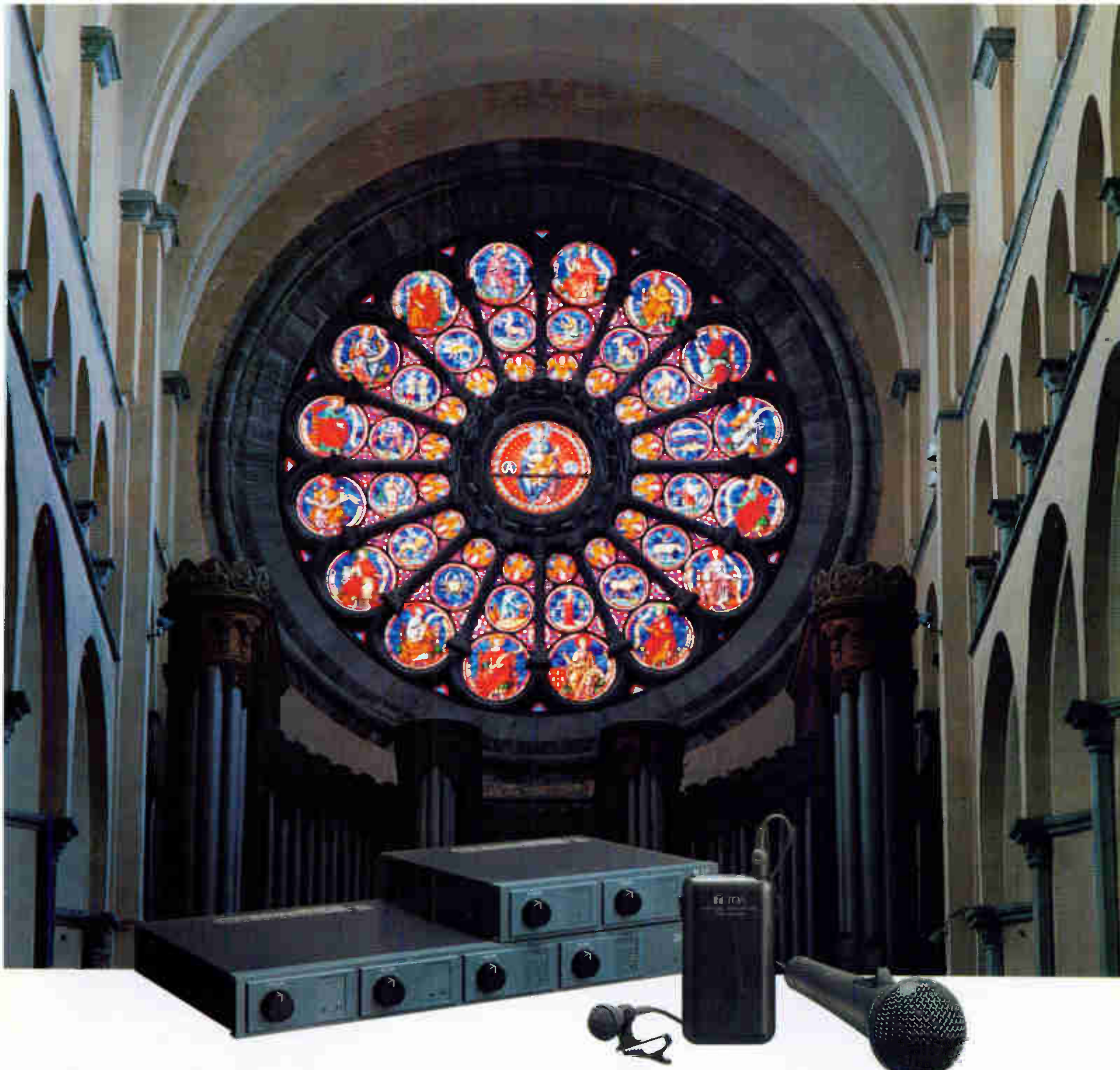

ARTIFICIA

Why?

by Jesse Klapholz

In specifying and designing communications systems today, the words intelligibility and articulation seem to be replacing "modern" and "state-of-the-art" terms of yesterday. Of course the ubiquitous test signal, "testing, one, two, three," still remains heavily entrenched in the lab and at the podium. In the old days—when labor was cheap, people were easily trained, and performed exactly as directed—the phonetically-balanced word lists were used with sufficient accuracy and repeatability.

However, in today's accelerated schedule of product and systems development, the engineer simply does not have the luxury of using this type of technology competitively. The operative word is competitively. Nobody is suggesting that machines can take the place of people talking—yikes! But when it comes to measuring the response of electroacoustical transducers with super-powered acoustical microscopes, standards ensuring accuracy, precision, and repeatability to be incorporated into some sort of machine-controllable system are necessary.

The need for such tools exists in any situation where a human being will be talking into a microphone whose output will be run through some communications channel. This includes headset microphones for intercommunications, and sound reinforcement; hand-held communications mics which can be used for PA as well; podium-type mics that will be "close-talked;" and "performer" type mics that are used in adverse, feedback-prone conditions—bordering at times in the 140+ zone. Anybody who has experience with the EQ going out the window once the performer gets on stage knows this problem intimately. On the intercom side of things, the TELCO standard of 300-3 kHz response is quickly vanishing, giving way to greater frequency response and more dynamic range. These increased standards in quality are the death knell of "testing, one, two, three."

Similarly, the increased use of high-resolution electroacoustic analysis will point out deficiencies in microphone systems that were not factors previously. In fact, these devices are rapidly

(continued on page 24)

Earphone And Microphone Measurement

by John Bareham

Microphones and earphones have one acoustic terminal and one electrical terminal. The input terminal of an earphone is electrical, and it is defined by its impedance. The earphone's output terminal is acoustic, so a measuring microphone can be used. But how should the microphone be coupled to the earphone? This is the same as asking: "What is the acoustic load impedance?" In actual use, the acoustic load impedance seen by an earphone will be the ear of a real human being.

The only inherently valid measurement involves subjective response studies on a group of subjects. Results must be averaged over a group of subjects, however, since acoustical characteristics of real ears vary.

The next step towards standardizing earphone measurements is to define the acoustic characteristics of a median adult. The resulting Head And Torso Simulator (HATS) is the most general, and the most valid, man-made device for objective earphone measurements.

No specialized couplers have yet been standardized for circumaural, lightweight supra-aural, and intra-concha types of earphones. The most valid measurements for these types of earphones, as well as most other types, can be obtained using a Head And Torso Simulator. Use of other couplers will give less valid results, sometimes by a wide margin.

The situation is somewhat similar for testing microphones. The acoustic input must come from some sort of sound source. For small, simple pressure microphones, a simple sound source will work well. But if the microphone under test is larger than 0.50 inches, or if it has noise cancelling or directional characteristics, then the sound source must simulate the soundfield distribution of a real human mouth. This is the purpose of a mouth simulator, [or artificial voice].

Bareham is an applications engineer with Bruel & Kjaer Instruments, Inc.

L VOICES:

Artificial Voice

by Harry Ferdinand Olson

Those familiar with Harry Olson remember him as the "voice" of RCA, i.e, he did all of the talking and writing for the many researchers there involved with acoustical and communications work. It is therefore fitting that we present a never before published article by Harry about an artificial voice developed at RCA.— ***ED***

The term "artificial voice" is used to designate a loudspeaker system which exhibits acoustic characteristics similar to those of the human voice.

The most common type of artificial voice is the one employed to test close-talking microphones. For this application, the acoustical impedance of the artificial voice should be the same as that of the human voice, so that both the artificial voice and the human voice interact in the same way with the microphone.

There are other applications where there is a need for an artificial voice, however, such as the testing of microphones for pickup conditions and distances of the kind and magnitude employed in speech reproduction in radio, television, sound motion picture and disk recording, etc. For these applications the acoustic impedance of the artificial voice is not as important. However, it is quite important for the directivity pattern of the artificial voice to be the same as the directivity pattern of the human voice so that the ratio of direct to reflected sound is preserved. In addition, the artificial voice should exhibit high-quality performance in the areas of frequency response and nonlinear distortion characteristics.

An artificial voice of this type could be driven by a high-quality tape reproducer, and used for A-B and articulation testing of microphones. This would make it possible to duplicate the performance of the "speaker" each and every time the program is played, as contrasted to the difficulties of obtaining similar repetition by a live performer.

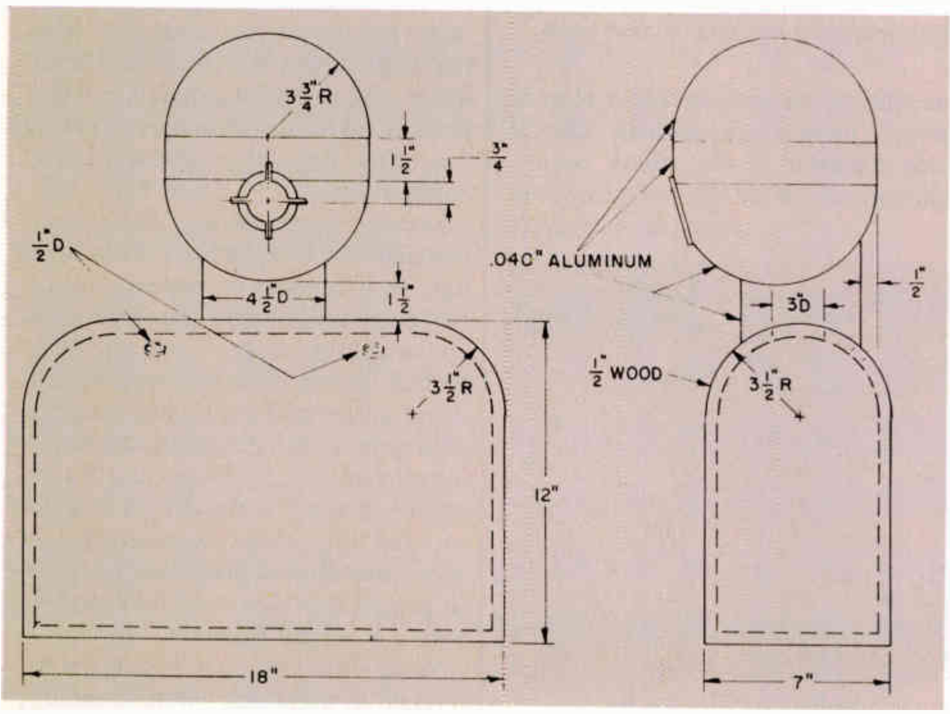

FIG. 1 — Front and side dimensional views of the artificial voice.

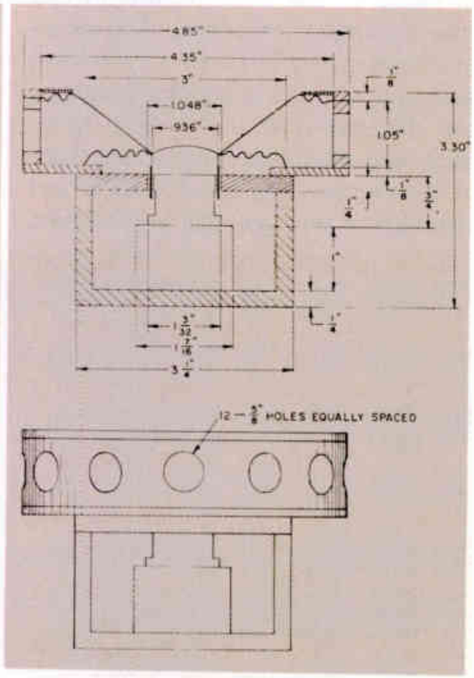

FIG. 2 — Schematic sectional view of the low frequency loudspeaker mechanism.

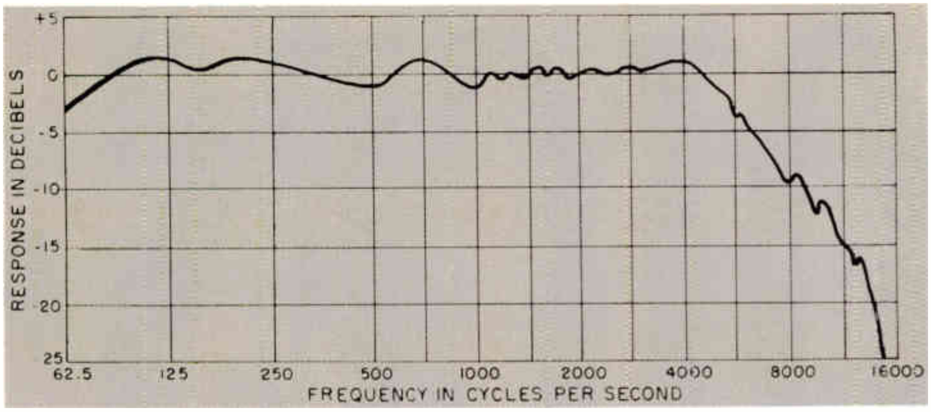

FIG. 3 — Frequency response characteristic of the low frequency loudspeaker mechanism mounted in a large flat baffle.

In order to meet the requirements for testing speech pickup equipment as outlined above, an artificial voice has been developed which exhibits a uniform frequency response characteristic, low nonlinear distortion at normal speech levels, and a directivity pattern similar to that of a human voice. This artificial voice consists of a two-way loudspeaker system located in an enclosure with the dimensions of the average human head. The frequency response of the artificial voice is within ±3 dB from 62.5 cycles to 12,000 cycles, and its directivity patterns are practically the same as those of the human voice throughout the frequency range from 62.5 to 12,000 cycles.

Description

Exterior dimensional views of the front and side of the artificial head are shown in figure 1. The head consists of two spun aluminum hemispheres 7.50 inches in diameter connected by a cylindrical section 1.50 inches in length. The shape and dimensions of the artificial head, neck, and shoulders approximate those of the average human head, neck, and shoulders to the extent that the reflection

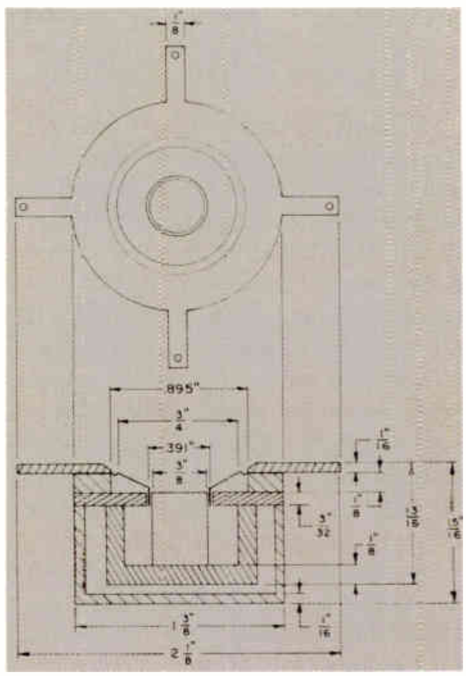

FIG. 4 — Schematic sectional view of the high frequency loudspeaker mechanism.

and diffraction characteristics will be the same as those of a human being. The outside diameter of the mouth opening through which the low frequency loud-

(continued on page 26)

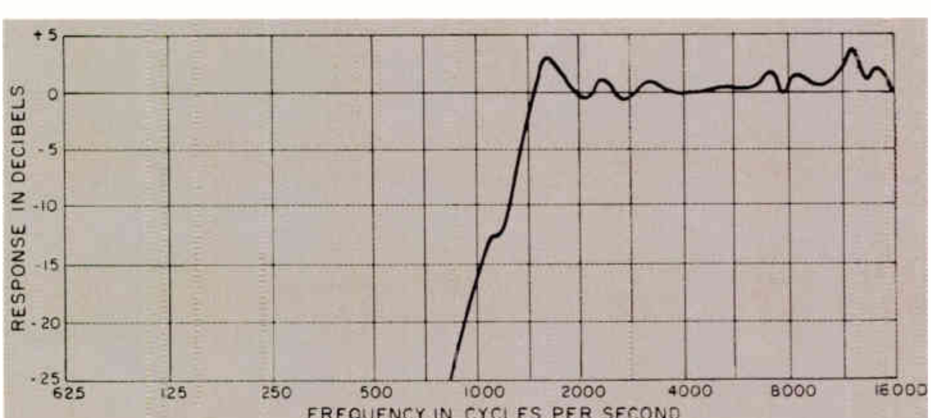

FIG. 5 — Frequency response characteristic of the high frequency loudspeaker mechanism mounted in a large flat baffle.

Why?

(continued from page 22)

growing in numbers at both the consulting and sound contractor levels. To wit, the over 400 Techron TEF systems in the field, not to mention the uncountable numbers of various FFT and other high-resolution spectrum analyzers.

If you haven't personally experienced it, perhaps you have read a sound reinforcement specification clause stating the condition of a "talker approaching a live microphone." Gates, automatic mixers, and other signal processors address these and similar problems, and are in many cases good solutions. But, they can sometimes be band-aids for serious wounds. Even in the rapidly approaching digital domain, the cost of processing increases when asked to perform a myriad of diverse functions, especially in real-time processing of dynamic signals with extended bandwidths.

The bottom line is that the level of performance for microphones used in ANY audio path is far more critical than ever. The ways in which manufacturers, consultants, designers, and installers measure, analyze, and diagnose electroacoustical systems have outgrown the trained sibilizing, P-popping, lyrical sound technician. The need to have a baseline for this diverse (but similar) group measuring the effects of the physical characteristics of the human head and torso on microphones is clear. The frequency versus directional characteristics, and chest-cavity resonances come into play. Also, the torso presents reflections, boundaries, and acoustical impedances which must be taken into account when using a comparatively small transducer in real applications.

During the early heydays of telephonic research, much of the basic information base we have today in matters concerning speech intelligibility were researched and established at Bell Labs and RCA. At Bell, Harvey Fletcher made tremendous contributions to our understandings of how the speech producing and receiving systems work. Dunn and Farnsworth's research in the power, frequency, and directional characteristics of speech and musical instruments are classic papers; their data is still valid, and the basis for current work.

While Bell Labs was principally interested in telephonic communications,

(continued on page 28)

"Hands-free" continuous wireless communications

QTR-1 Portable (top view)

"Q" PLUS—convenient full-duplex wireless intercom

- Eliminates trailing cables
- Operates full-duplex or simplex (push-to-talk)
- Up to six portables per system
- Interfaces with other wireless or wired intercom systems
- Long-range communications over low-noise, high-band VHF frequencies
- Installs easily...in minutes
- Many applications...
  - Stage managers and technical directors
  - On-floor crew coordination
  - Camera/lighting operators
  - Backstage conferencing
  - Production crew and setup coordination
  - Warehousing operations, including voice recognition and response
  - Public-safety
  - Sports and racing

Rugged, dependable, and easy to operate

Up to six Cetec Vega "Q" PLUS remote beltpack wireless intercom units (portables) can communicate full-duplex through a central master station. The six portables talk continuously ("conference" style) without pushing a push-to-talk switch or without the annoying one-person-at-a-time limitations and syllable cutoffs of VOX (voice-operated) systems.

The compact Model QTR-1 portables are built to take abuse, and are housed in a welded aircraft-alloy aluminum case.

The portables are very easy to use; they have only two operating controls — a combined on/off and headset volume control, and a push-button audio control switch.

The portables operate 8-10 hours on two inexpensive 9-volt batteries.

System audio is crisp and clear, with extended frequency response, low distortion, and audio processing for low noise.

Full monitoring with master station

The Model QX-6 master station has comprehensive provisions for control and monitoring, plus a user-programmable intercom interface and auxiliary audio inputs/outputs. Interfacing is DIP-switch programmable to a wide variety of wired-intercom systems, including Clear-Com, RTS, ROH, David Clark, most "carbon mic" systems, etc.

The master station operates on 115/230 Vac, 50-60 Hz, or + 11.5 to + 24 Vdc.

For more information, contact your nearest Cetec Vega dealer or sales representative, or call **1-800-877-1771**.*

Cetec Vega

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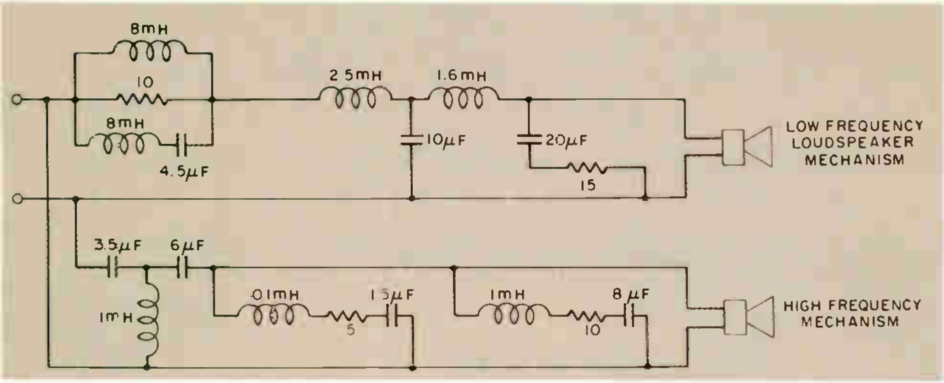


FIG. 7 — Electrical network for the artificial voice consisting of the dividing and compensating elements.

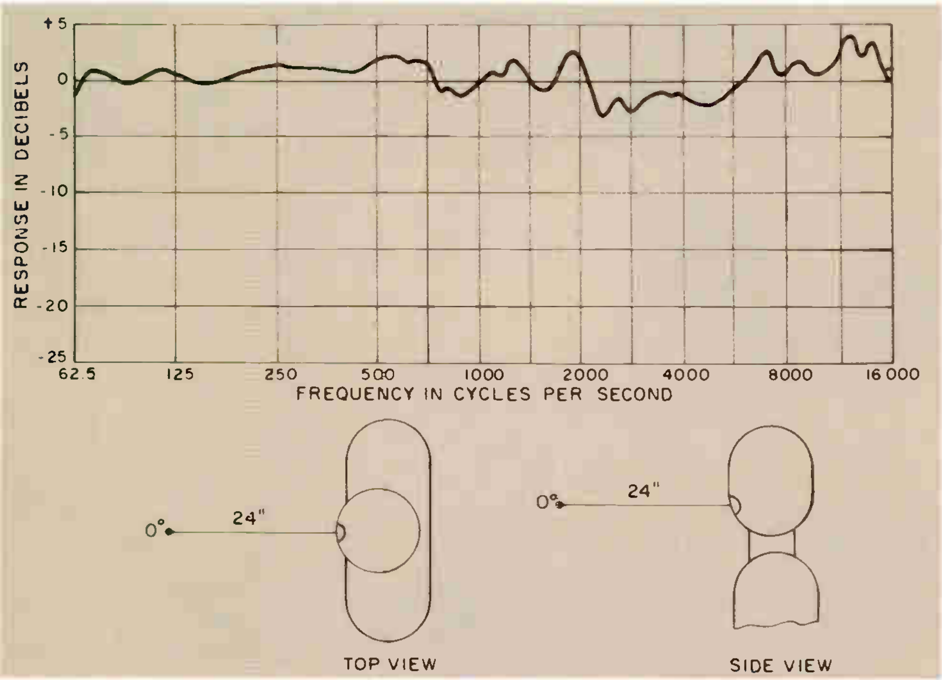


FIG. 8 — Frequency response of the artificial voice. The azimuth angle, Θ = 0° and the altitude angle, Φ = 0°.

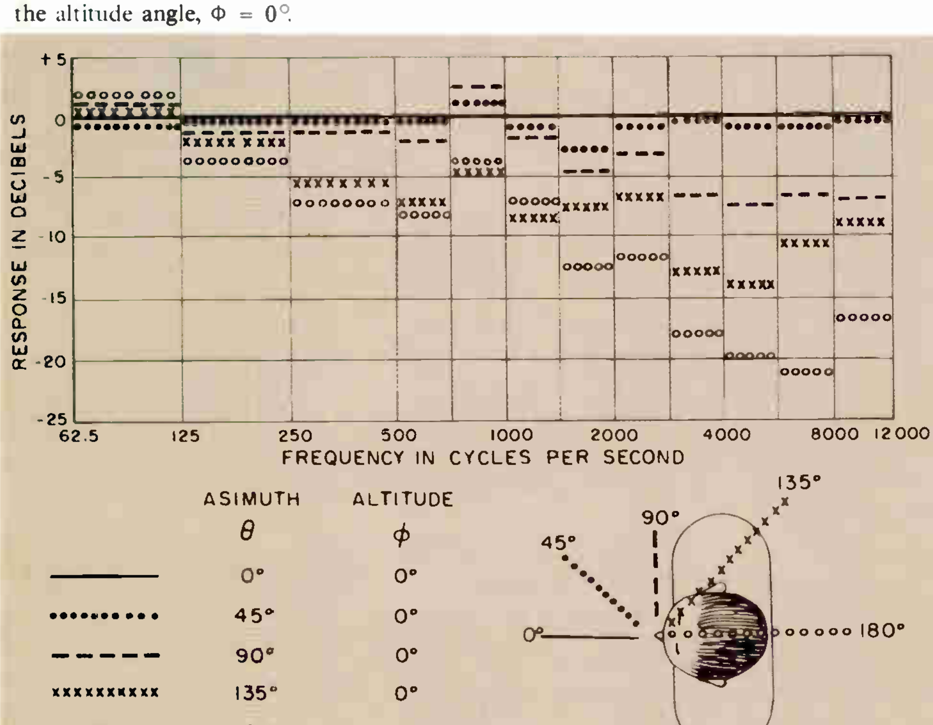


FIG. 9 — Frequency response of the human voice for altitude angle, Φ = 0° and azimuth angles, Θ = 0°, 45°, 90°, 135° and 180°. (After Dunn and Farnsworth).

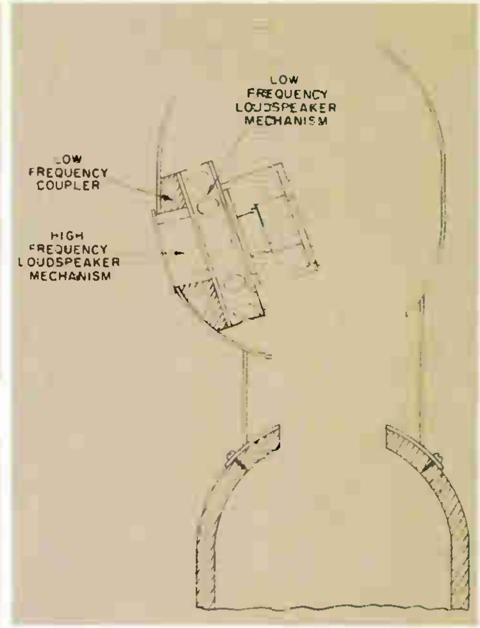


FIG. 6 — Schematic sectional view of the high and low frequency mechanism mounted in the head of the artificial voice.

Artificial Voice

(continued from page 24)

speaker mechanism feeds is 2 inches. The diameter of the cone of the high frequency loudspeaker mechanism is 0.75 inches. The dimensions of the low and high frequency loudspeaker mechanism were selected to simulate the effective radiator dimensions of the human voice mechanism.

An assembly sketch of the low frequency loudspeaker mechanism is shown in figure 2. A very large and compliant suspension system is provided to allow for a total amplitude of 0.25 inches. In order to provide a constant flux density-voice coil turn product for a maximum total excursion of 0.25 inches, the voice coil extends 0.125 inches in each direction beyond the top plate of the magnet structure. To prevent non-uniform response due to resonant breakup of the suspension, the outer suspension is damped with a layer of vinyl foam, also shown in figure 2. The free resonant frequency of the low frequency loudspeaker mechanism is 80 cycles. The response of the low frequency loudspeaker mechanism in a large flat baffle is shown in figure 3. It will be seen that the response is within ±2 dB from 62.5 to 5000 cycles. The flat baffle response frequency characteristic is a check on the performance of the loudspeaker mechanism.

An assembly sketch of the high frequency loudspeaker mechanism is shown in figure 4. In order to reduce the distor-

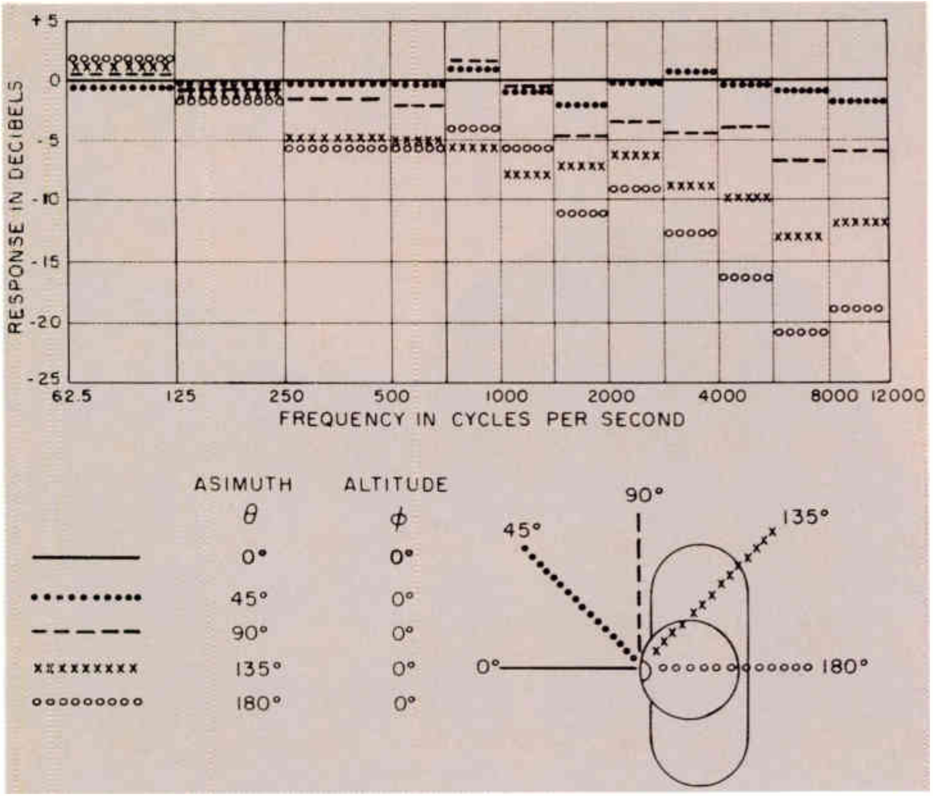


FIG. 10 — Frequency response of the artificial voice for altitude angle, Φ = 0° and azimuth angles, Θ = 0°, 45°, 90°, 135° and 180°.

tion introduced by the suspension system, the controlling compliance in the system is the enclosed air in the cavity back of the cone. The response of the high frequency unit in a large flat baffle is shown in figure 5. The response is uniform within ±2 dB from 1600 cycles to 16,000 cycles.

The network for allocating the electrical input to the low and high frequency units was designed for a crossover at 1500 cycles. Figure 6 is a sectional view showing the low and high frequency units mounted in the head. A coupler is used to connect the low frequency cone to the 2-inch diameter mouth opening. The front of the high frequency unit is mounted flush with the surface of the artificial head.

In the human voice mechanism there are low frequency components trans-

(continued on page 29)

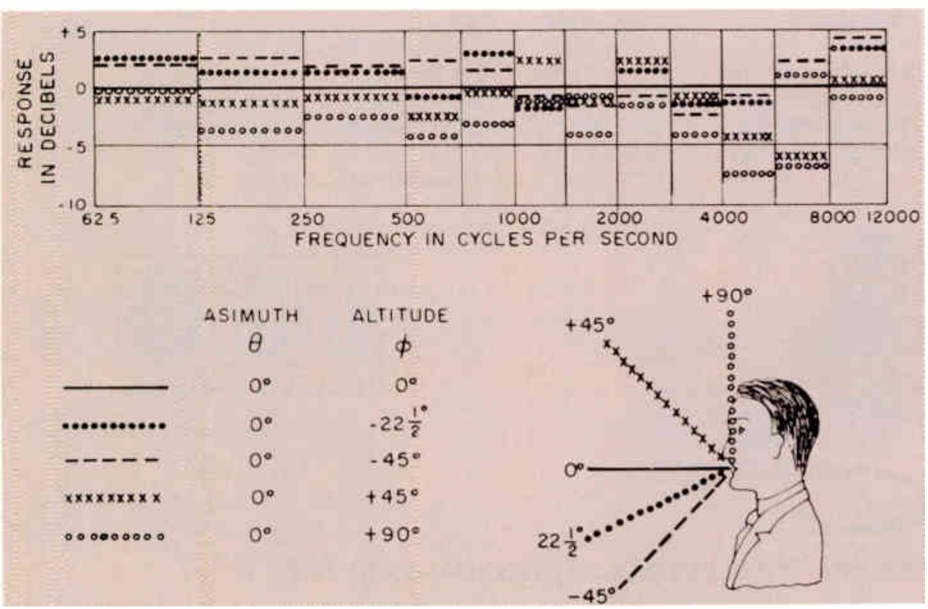


FIG. 11 — Frequency response of the human voice for azimuth angle, Θ = 0° and altitude angles, Φ = 0°, −22½°, −45°, +45° and +90°. (After Dunn and Farnsworth).

Why?

(continued from page 24)

their scope of products also included motion picture recording and reproducing equipment. RCA on the other hand was primarily involved in broadcast, motion picture, and sound reinforcement products. These two groups established a data base of information that will never be reproduced.

Bell Labs produced an artificial "Voice and Ear for Telephone Measurements," in 1931. It principally consisted of the Wente and Thuras receiver, with a simple mechano-acoustic coupler at its exit hole. This coupler provided an opening similar in size to that of a human mouth, and effectively matched the dispersion characteristics of its human counterpart. The frequency response was of course tailored to match the median energy dis-

> "RCA's interest in applications for an artificial voice ranged from audio to all branches of communications."

tribution of a large sample of human talkers. Not many of these units were made. In fact, in a later report by Olson regarding the leading acoustical labs, he mentions that RCA had one of six of the Bell Lab's artificial voices.

RCA was well known for their 44 and 77 series of ribbon mics developed during the 30s and 40s. Similarly, during the 50s they were known for their work in musical synthesizers. Not as commonly known in audio circles is their working multi-lingual phonetic typewriter. It could intelligibly vocalize text entered manually at the keyboard, and it could recognize speech in several languages, and store it on a magnetic drum in the form of text files. Nonetheless, RCA's interest and applications warranting an artificial voice ranged from audio to all branches of communications. Olson's work is of great interest to many of us today because of the basic data from both Bell Labs and RCA that are made available. ■

Artificial Voice

(continued from page 28)

mitted through the chest. This radiation is simulated by two 0.50-inch diameter holes located in the shoulder and connected to the chest cavity as shown in figure 1. (The head and throat are filled with loosely tufted ozite; the chest is filled with loose Kimpac.)

> "An artificial voice has been developed which exhibits a uniform frequency response and a directivity pattern similar to that of a human voice. . ."

In addition to the crossover network, additional networks are required to produce a uniform frequency response. The complete electrical diagram is shown in figure 7.

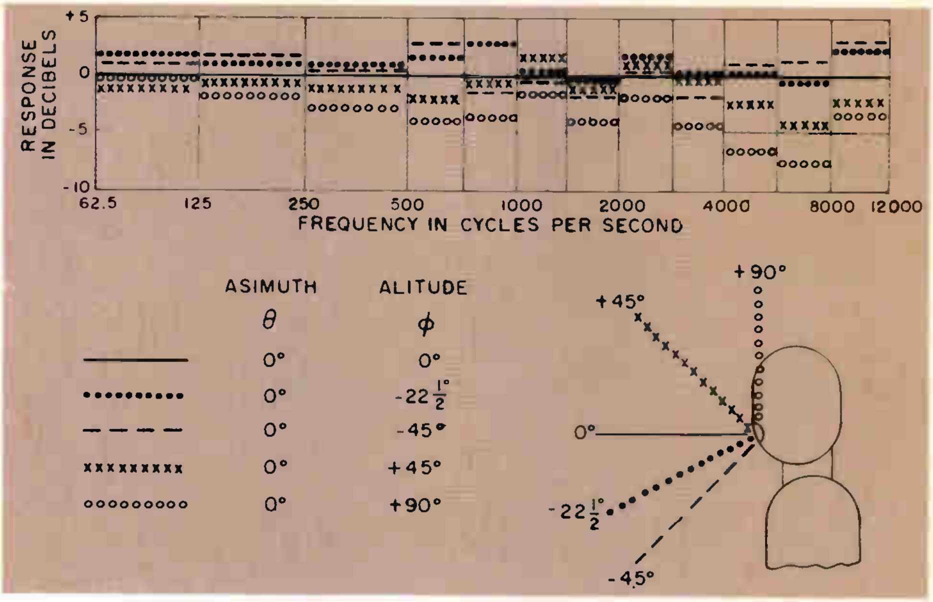


FIG. 12 — Frequency response of the artificial voice for azimuth angle, Θ = 0° and altitude angles, Φ = 0°, −22½°, −45°, +45° and +90°.

Performance

The frequency response of the artificial voice on the axis for azimuth = 0 degrees and altitude = 0 degrees is shown in figure 8. The response is quite smooth—the deviation is only ±3 dB from 62.5 to 12000 cycles.

Frequency response characteristics in various directions are shown for the human voice in figures 9, 11, and 13; for the artificial voice in figures 10, 12, and

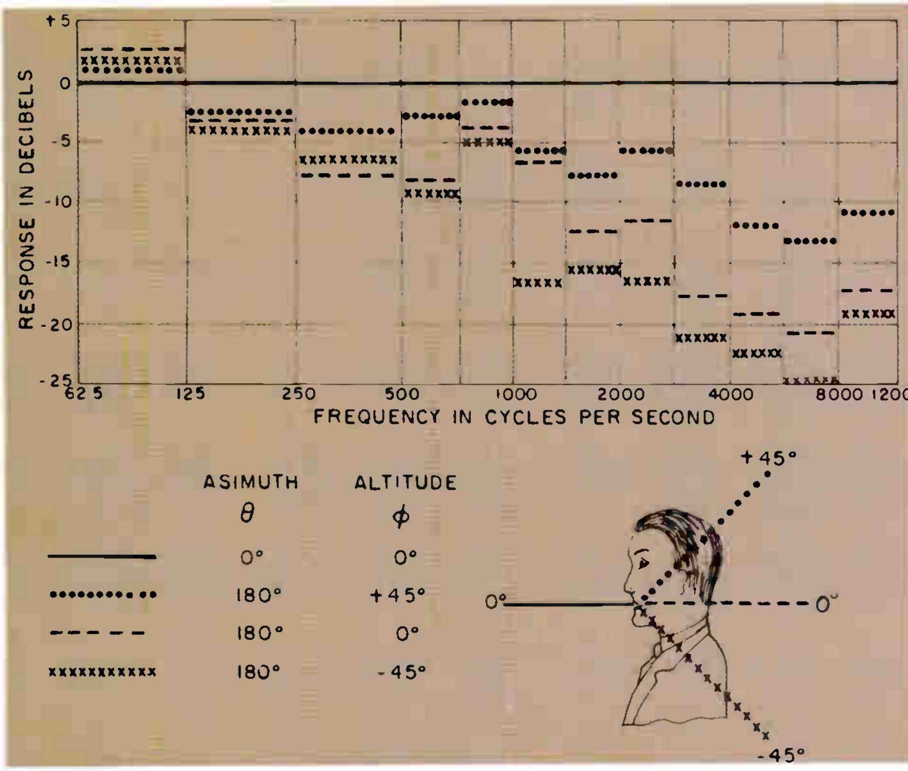


FIG. 13 — Frequency response of the human voice for azimuth angle, $\Theta = 180°$ and altitude angles, $\Phi = 0°, -45°, +45°$. (After Dunn and Farnsworth).

14. In all of these depictions, the average response in the intervals 62.5 to 125, 125 to 250, 250 to 500, 500 to 700, 700 to 1000, 1000 to 1400, 1400 to 2000, 2000 to 2800, 4000 to 5600, and 8000 to 12,000 cycles has been employed. The response for azimuth = 0 degrees and altitude = 0 degrees was normalized to uniform response, that is, no deviations from 62.5 to 12,000 cycles.

Comparisons of figures 9 and 10, figures 11 and 12, and figures 13 and 14 indicate a very close agreement between the directional characteristics of the human voice and the artificial voice. In view of the small deviations, the reflected sounds should be the same for the artificial voice as the human voice.

> "... the frequency response of the artificial voice is within ± 3 dB from 62.5 cycles to 12,000 cycles..."

The response for azimuth = 0 degrees and altitude = 0 degrees indicates that there should be negligible frequency discrimination in the response of the artificial voice.

The average sound level of a human voice for normal speech levels is 75 dB at one foot. If the input to the artificial voice is speech, with normal distribution in respect to frequency, the artificial voice can produce a level of 85 dB at one foot with no appreciable distortion.

> "... and its directivity patterns are practically the same as those of the human voice throughout the frequency range from 62.5 to 12,000 cycles."

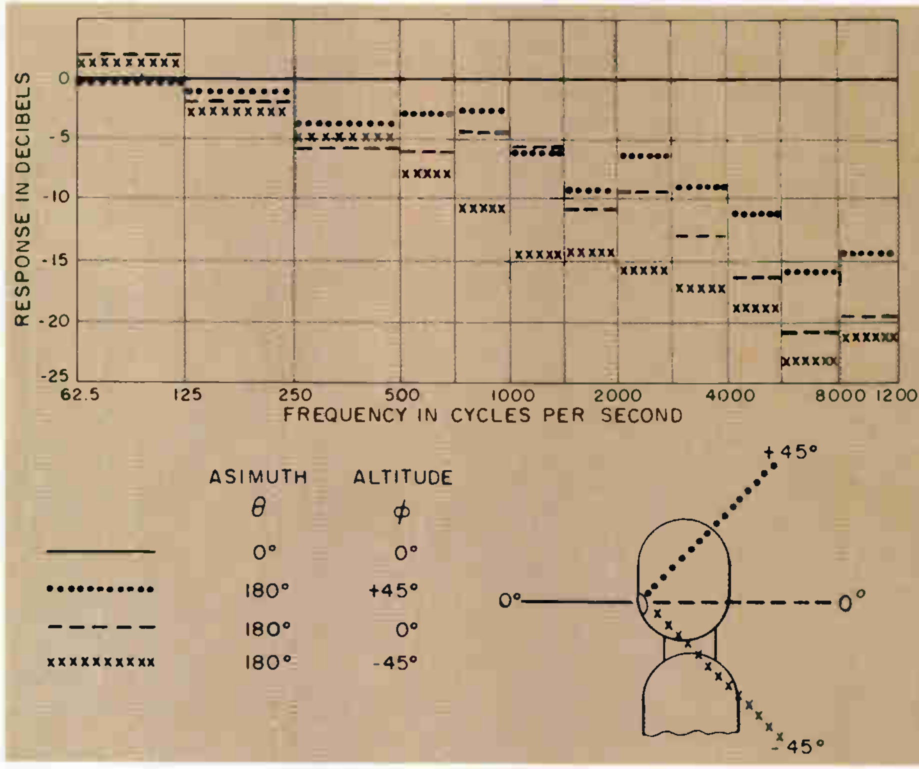


FIG. 14 — Frequency response of the artificial voice for azimuth angle, $\Theta = 180^\circ$ and altitude angles, $\Phi = 0^\circ\ -45^\circ$ and $+45^\circ$.

REFERENCE

Frequency response characteristics for the human voice, shown in figures 9, 11, and 13, were obtained from the following source:

Dunn, H.K., and Farnsworth, D.W. 1939. Exploration of the pressure field around the human during speech. *Journal of the Acoustical Society of America* 10 (no. 3): 184. ■

MICROPHONES

This time around, our special pull-out section offers a guide to microphones. The emphasis is on the word "guide"—this is strictly intended to place at your fingertips a representation of microphone models currently available. The specifications contained herein have been compiled from each respective manufacturer's literature, and are not intended to be definitive or exact comparisons.

After surveying a representative cross-section of consultants, contractors, and soundmen, we found that several key factors dominated in microphone selection. First of all was price—this can be a rough indicator of performance class, and budget is often the bottom line. Second was the element type—everyone wants to know if the mic is dynamic or condenser. Following element type as a selection factor was the mic's pick-up pattern.

These three factors were the major points that everyone looks at when choosing a group from which to make a final selection. Our guide addresses these three points, as well as including descriptions of some of the basic physical and electroacoustical performance characteristics. After reviewing this guide and selecting an appropriate group from which to choose, the manufacturer's specification sheets, feedback from others in the field, and your own hands-on experience should come into play in helping you make your final decision.

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

Model	Transducer	Directional Pattern	Impedance	Frequency Range	Sensitivity @ 1 kHz Open Circuit	SPL for 1% THD	Cable Connector	Weight (oz.)	List Price
AKG									
C-422	C	Var.	200	20-20kHz	-44.5dBV	133dB	XLR	15.2	$2,895.00
C-34	C	Var.	200	20-20kHz	-47dBV	132dB	XLR	9.9	1,995.00
Tube	C	Var.	200	30-20kHz	-40dBV	128dB	XLR	24	1,995.00
C-414B/TL	C	Var.	180	20-20kHz	-38dBV	140dB	XLR	11	1,195.00
C-414B/ULS	C	Var.	180	20-20kHz	-38dBV	134dB	XLR	11	995.00
C-451EB/CK9	C	SC	200	30-18kHz	-36.5dBV	128.5dB	XLR	12	960.00
C-522	C	HC	300	20-20kHz	-40dBV	128dB	XLR	10	950.00
C-460B/CKIX	H	C	120	20-20kHz	-42dBv	139.5dB	XLR	7	715.00
D-224E	D	C	260	20-20kHz	-58dBV	128dB	XLR	10	550.00
C-460B/CK62	C	O	120	20-20kHz	-42dBV	134dB	XLR	4.9	530.00
C-460B/CK61	C	C	120	20-20kHz	-42dBV	134dB	XLR	4.9	530.00
C-460B/CK63	C	HC	120	20-20kHz	-42dBV	134dB	XLR	4.9	530.00
C-451EB Combo	C	C	200	20-20kHz	-40.5dBV	120dB	XLR	4	470.00
C-451E Combo	C	C	200	20-20kHz	-40.5dBV	120dB	XLR	3.5	400.00
C-562BL	C	O	200	20-20kHz	-41dBV	128dB	XLR	11	395.00
D-202EI	D	C	300	20-20kHz	-56dBV	128dB	XLR	11.2	385.00
D900E	D	SC	240	60-12kHz	-51dBV	128dB	XLR	18	385.00
CK-8X	EC	SC	—	30-18kHz	-39dBV	135dB	Lemo	4.2	350.00
D-12	D	C	290	30-15kHz	-53dBV	128dB	XLR	17	350.00
C-535EB	EC	C	200	20-20kHz	-41dBV	128dB	XLR	10	325.00
C-568EB	EC	SC	200	20-20kHz	-42dBV	128dB	XLR	6.2	325.00
D-222EB	D	C	320	20-16kHz	-57dBV	124dB	XLR	9	320.00
CK-9	C	SC	—	30-18kHz	-36.5dBV	128.5dB	—	12	300.00
CK-5	C	C	—	20-20kHz	-40.5dBV	138dB	—	4	260.00
D-330NR	D	HC	370	50-20kHz	-58dBV	128dB	XLR	12	260.00
CK-8	C	SC	—	30-18kHz	-36.5dBV	134dB	—	2.5	250.00
C-567	EC	O	200	20-20kHz	-44dBV	132dB	XLR	3.5	250.00
D-112	D	C	210	20-17kHz	-55dBV	168dB	XLR	13.4	200.00
C-410	EC	C	300	20-20kHz	-50.5dBV	123dB	XLR	4.6	195.00
D-1200	D	C	200	25-17kHz	-52.8dBV	128dB	XLR	9	195.00
CK-1X	EC	C	—	20-20kHz	-42dBV	139.5dB	—	1.3	190.00
CK-2X	EC	O	—	20-20kHz	-44.5dBV	142dB	—	1.3	190.00
CK-3X	EC	HC	—	20-20kHz	-43dBV	140dB	—	1.3	190.00
D-321	D	HC	300	40-20kHz	-57dBV	128dB	XLR	11.6	190.00
CK-61	C	C	—	20-20kHz	-40dBV	134dB	—	1.1	160.00
CK-62	C	O	—	20-20kHz	-40dBV	134dB	—	1.1	160.00
CK-63	C	HC	—	20-20kHz	-40dBV	134dB	—	1.1	160.00
D-590	D	C	230	150-17kHz	-57.5dBV	128dB	Leads	10	155.00
D-125NR	D	C	210	100-18kHz	-54dBV	128dB	XLR	8	150.00
D-310NR	D	C	270	80-18kHz	-58dBV	128dB	XLR	9	150.00
CK-67/3	EC	O	—	20-20kHz	-44dBV	132dB	—	1	145.00
D-558B	D	HC	200	70-15kHz	-63dBV	128dB	Leads	11.5	145.00
CK-1	C	C	—	20-20kHz	-40.5dBV	138dB	—	1	140.00
CK-1S	C	C	—	20-20kHz	-40.5dBV	138dB	—	1	140.00
CK-22	C	O	—	20-20kHz	-42dBV	139.5dB	—	1.5	140.00
CK-3	C	HC	—	20-20kHZ	-40.5dBV	138dB	—	1	140.00
D-130	D	O	220	50-13kHZ	-55dBV	128dB	—XLR	9	135.00
Q-15	EC	C	2100	20-20kHZ	-63dBV	130dB	—	4.6	135.00
D-80E	D	C	210	60-15kHZ	-55.9dBV	128dB	XLR	7.25	130.00
D-510	D	O	230	100-15kHz	-60dBV	128dB	Leads	11.5	130.00
D-190E	D	C	280	30-15kHz	-53dBV	130dB	XLR	6.5	125.00
D-58E	D	HC/NC	240	70-12kHz	-63dBV	128dB	XLR	1.5	115.00

Model	Transducer	Directional Pattern	Impedance	Frequency Range	Sensitivity @ 1 kHz Open Circuit	SPL for 1% THD	Cable Connector	Weight (oz.)	List Price
D-109	D	O	240	70-12kHz	-59dBV	130dB	Leads	5.5	115.00
D541	D	C	720	120-16kHz	-52.8dBV	128dB	Leads	12.4	105.00
D-70ME	D	C	200	50-18kHz	-58dBV	128dB	XLR	6.7	80.00
D-70M	D	C	200	50-18kHz	-58dBV	128dB	¼"	6.7	70.00
ALTEC									
D646	D	SC	150	80-15kHz	-57dBm	—	XLR	8	$376.00
C649	EC	SC	150	40-18kHz	-45dBm	—	XLR	8	356.00
D645	D	SC	150	80-15kHz	-56dBm	—	XLR	6	348.00
C641L	EC	O	150	80-15kHz	-45dBm	—	XLR	.67	268.00
654A	D	C	200	50-15kHz	-56dBm	—	XLR	8	224.00
D90P	D	O	150/250	50-15kHz	-58dBm	—	—	16	220.00
C644	EC	C	150	50-18kHz	-50dBm	—	XLR	12	208.00
D91P	D	O	150/250	180-10kHz	-60dBm	—	—	4.5	152.00
ASTATIC									
JT50	C	C	150	40-20kHz	-49dBm	130dB	XLR	6.5	$188.00
JT5	D	C	150	40-16kHz	-55dBm	—	XLR	10	159.50
JT8	D	C	150	40-16kHz	-55dBm	—	XLR	8.5	148.00
JT11	D	C	150	50-16kHz	-54dBm	—	XLR	9.5	127.00
JT12	D	C	150	50-16kHz	-54dBm	—	XLR	9.0	105.75
JT17	D	C	150	60-14KHZ	-60dBm	—	XLR	9.5	82.75
JT30H	C	O	Hii-Z	30-10kHz	-49dBm	—	XLR	8.5	80.50
JT18	D	C	150	60-14KHZ	-60dBm	—	XLR	8.75	63.25
AUDIO-TECHNICA									
AT4071	C	N/A	250	30-20kHz	-25dBm	124dB	XLR	5.8	$830.00
AT4073	C	HC	250	30-20kHz	-27dBm	126dB	XLR	4.2	695.00
AT4031	C	U	100	30-20kHz	-44dBm	140dB	XLR	4.8	325.00
ATM5R	C	U	200	40-20kHz	-53dBm	140dB	XLR	4.0	265.00
ATM33R	C	U	150	30-20kHz	-45dBm	141dB	XLR	4.7	225.00
TM73	C	U	400	60-15kHz	-60dBm	140dB	XLR	1.1	225.00
ATM31R	C	U	200	30-20kHz	-55dBm	141dB	XLR	6.5	210.00
ATM11R	C	U	200	30-20kHz	-49dBm	143dB	XLR	6.0	205.00
ATM41A	D	U	250	50-16kHz	-56dBm	—	XLR	10	180.00
ATM15	C	U	400	50-20kHz	-50dBm	130dB	XLR	0.1	180.00
ATM21	D	U	600	50-15kHz	-60dBm	—	XLR	7.6	175.00
ATM63	D	U	250	50-17kHz	-56dBm	—	XLR	9.5	170.00
ATM31	C	U	600	60-20kHz	-55dBm	130dB	XLR	6.5	160.00
ATM11	C	U	600	50-20kHz	-56dBm	130dB	XLR	6	155.00
ATM10	C	O	600	40-18kHz	-48dBm	125dB	XLR	5.6	140.00
AT857AMI	C	U	600	30-20kHz	-50dBm	130dB	XLR	4	265.00
AT871	C	U	400	30-20kHz	-50dBm	130dB	XLR	14.8	260.00
AT857AM	C	U	400	30-20kHz	-50dBm	130dB	XLR	5.5	250.00
AT857QMI	C	U	600	30-20kHz	-50dBm	130dB	XLR	3.0	238.00
AT857QM	C	U	400	30-20kHz	-50dBm	130dB	XLR	4.75	220.00
AT855	C	U	400	30-20kHz	-50dBm	130dB	XLR	3.5	210.00
AT853	C	U	400	30-20kHz	-50dBm	130dB	XLR	0.5	210.00
AT859	C	U	400	40-18kHz	-50dBm	130dB	XLR	3.6	190.00
AT837	C	U	400	40-18kHz	-50dBm	130dB	XLR	5.0	150.00
AT815R	C	LG	200	40-20kHz	-43dBm	134dB	XLR	9.2	330.00
AT815A	C	LG	600	40-20kHz	-45dBm	120dB	XLR	9.2	260.00
AT835	C	LG	600	40-20kHz	-45dBm	115dB	XLR	7.5	235.00
AT813R	C	U	200	30-20kHz	-49dBm	141dB	XLR	6.5	198.00
AT814A	D	U	250	50-16kHz	-56dBm	—	XLR	10	159.00

Model	Transducer	Directional Pattern	Impedance	Frequency Range	Sensitivity @ 1 kHz Open Circuit	SPL for 1% THD	Cable Connector	Weight (oz.)	List Price
AT836	D	U	250	50-17kHz	-56dBm	—	XLR	8.5	147.00
AT831A	C	U	400	40-20kHz	-50dBm	130dB	XLR	0.1	150.00
AT813	D	U	600	40-20kHz	-55dBm	—	XLR	6.5	138.00
AT812	D	U	600	50-15kHz	-60dBm	—	XLR	7.6	135.00
AT811	C	U	600	50-20kHz	-56dBm	130dB	XLR	6.0	125.00
AT803A	C	O	400	30-20kHz	-49dBm	130dB	XLR	.09	125.00
AT801	C	O	600	40-18kHz	-48dBm	125dB	XLR	5.6	115.00
AT802	D	O	600	50-15kHz	-56dBm	—	XLR	5.0	110.00
AT838G	D	U	600	100-10kHz	-63dBm	—	XLR	12.35	99.00
AT805A	C	O	600	50-15kHz	-57dBm	130dB	XLR	.86	77.00
PRO-5	D	U	250	50-16kHz	-56dBm	—	XLR	10	150.00
PRO-6	D	U	250	50-15kHz	-56dBm	—	XLR	10	140.00
PRO-7	C	U	600	50-18kHz	-58dBm	—	XLR	0.1	85.00
PRO-4	D	U	250	60-15kHz	-57dBm	—	XLR	10	85.00
PRO-3	D	U	250	70-15kHz	-58dBm	—	XLR	7	53.00
PRO-2AX	D	U	500	70-14kHz	-59dBm	—	XLR	7	35.00
PRO-1A	D	U	50k	70-14kHz	-59dBm	—	¼"	11	31.00
AUDIX									
OM-1	D	HC	200	50-18KHZ	-78.5	130+	XLR	13	$225.00
OM-2	D	HC	200	45-20KHZ	-78.5	130+	XLR	9.8	189.00
UD300	D	C	200	50-18KHZ	-73	130+	XLR	11	159.00
UD360	D	C	200	50-18KHZ	-73	130+	XLR	11.5	159.00
ML-10	C	C	1K	30-17.5KHZ	-68dBm	100	mini XLR	2	95.00
MI-10M	C	O	1K	30-17.5KHZ	-68dBm	100	mini XLR	2	95.00
50-D	D	C	Dual	80-15kHz	-62dBm	120	XLR	9.5	92.50
50	D	C	200	80-15KHZ	-78dBm	120	XLR	9.5	82.50
CD11	D	C	200	50-16KHZ	-65dBm	125	XLR	11	95.00
BEYER									
MC740N(C15)	C	5	150	40Hz-20kHz	-133dBm	N/A	5 Pin XLR	13.8	$1,050.00
MC740N(C)	C	5	150	40Hz-20kHz	-133dBm	N/A	XLR	13.8	1,000.00
MC737N(C)PV	C	N/A	150	40Hz-20kHz	-110dBm	N/A	XLR	8.8	830.00
MC737N(C)	C	N/A	150	40Hz-20kHz	-100dBm	N/A	XLR	15.4	830.00
MC734PA	C	C	150	20-20kHz	-138dBm	N/A	XLR	9.5	790.00
MC734	C	C	150	20-20kHz	-138dBm	N/A	XLR	9.5	770.00
MC736N(C)	C	C	150	40-20kHz	-100dBm	N/A	XLR	8.4	750.00
MC736N(C)PV	C	C	150	40-20kHz	-110dBm	N/A	XLR	6.8	750.00
MPC50	EC	Hemi	200	20-20kHz	N/A	N/A	XLR	17.5	650.00
CK707	C	Lobe	N/A	40-20kHz	-132dBm	N/A	N/A	12	540.00
CK708	C	Fig 8	N/A	40-20kHz	-132dBm	N/A	N/A	7.5	490.00
CK706	C	C	N/A	40-20kHz	-132dBm	N/A	N/A	6.5	460.00
M130	R	Fig 8	200	40-18kHz	-152dBm	N/A	XLR	5.3	440.00
MCE80	EC	SC	190	50-18kHz	N/A	N/A	XLR	8.1	430.00
M160	R	HC	200	40-18kHz	-152dBm	N/A	XLR	5.5	400.00
M88	D	HC	200	30-20kHz	-145dBm	N/A	XLR	11.3	330.00
MCE81	C	C	190	50-18kHz	-50dBm	140dB	XLR	265g	325.00
M600S	D	HC	250	40-16kHz	-149dBm	N/A	XLR	8.6	315.00
CK704	C	C	N/A	40-20kHz	-132dBm	N/A	N/A	4.4	310.00
MCE5.11	EC	O	200	20-20kHz	-129dBm	N/A	XLR	.23	310.00
MCE6.11	EC	O	200	20-20kHz	N/A	N/A	XLR	.23	310.00
M600	D		—	—	-	N/A	XLR	8.6	300.00
SHM415	D	C	200	200-14kHz	N/A	N/A	N/A	N/A	290.00

Model	Transducer	Directional Pattern	Impedance	Frequency Range	Sensitivity @ 1 kHz Open Circuit	SPL for 1% THD	Cable Connector	Weight (oz.)	List Price
M500S	D	HC	200	40-18kHz	-150dBm	N/A	XLR	8.5	275.00
CK703	C	C	N/A	40-20kHz	-132dBm	N/A	N/A	4.4	270.00
CK702	C	C	N/A	40-20kHz	-134dBm	N/A	N/A	4	260.00
M380	D	Fig 8	600	15-20kHz	-	N/A	XLR	13	260.00
M500	R	HC	200	40-18kHz	-150dBm	N/A	XLR	8.5	260.00
M700	D	HC	250	40-16kHz	-149dBm	N/A	XLR	9.3	260.00
M260S	R	HC	200	50-18kHz	-150dBm	N/A	XLR	10.6	245.00
MCE-10	EC	HC	700	40-20kHz	N/A	N/A	6 Pin DIN	.53	240.00
M260	R	HC	200	50-18kHz	-150dBm	N/A	XLR	10.6	230.00
M111	D	O	200	60-15kHz	-155dBm	N/A	XLR	2.65	230.00
M101	D	O	200	40-20kHz	-149dBm	N/A	XLR	5.65	220.00
M201	D	HC	200	40-18kHz	-150dBm	N/A	XLR	7.8	220.00
CK701	C	O	N/A	40-20kHz	-134dBm	N/A	N/A	4	220.00
M260.80	R	HC	200	100-18kHz	-150dBm	N/A	XLR	8.1	215.00
M69SM	D	HC	200	50-16kHz	-145dBm	N/A	XLR	11.3	210.00
M400S	D	SC	200	40-16kHz	-146dBm	N/A	XLR	9.03	195.00
M5B	D	HC	200	40-20kHz	-57dBm	130dB	XLR	256g	190.00
M680S	D	C	200	100-12kHz	-152dBm	N/A	N/A	N/A	185.00
M69	D	HC	200	50-16kHz	-145dBm	N/A	XLR	11.3	180.00
M400	D	SC	200	40-16kHz	-146dBm	N/A	XLR	9.03	180.00
MCE5	EC	O	800	20-20kHz	-141dBm	N/A	6 Pin DIN	.23	170.00
MCE6	EC	O	800	20-20kHz	N/A	N/A	6 Pin DIN	.23	170.00
M420	D	HC	200	100-12kHz	-150dBm	N/A	XLR	5.3	160.00
M300S	D	C	250	50Hz-15kHz	-150.2dBm	N/A	XLR	8.6	155.00
MCE5.9	EC	O	N/A	20Hz-20kHz	-141dBm	N/A	N/A	.23	150.00
MCE6.9	EC	O	N/A	20Hz-20kHz	N/A	N/A	N/A	.23	150.00
M300	D	C	250	50Hz-15kHz	-150.2dBm	N/A	XLR	8.6	140.00
411S	D	C	200	200Hz-12kHz	-149dBm	N/A	XLR	5.3	140.00
M412	D	C	200	200Hz-12kHz	-149dBm	N/A	Tuchel	5.3	135.00
M411	D	C	200	200Hz-12kHz	-149dBm	N/A	XLR	5.3	130.00
M200S	D	C	600	50Hz-15kHz	-150.5dBm	N/A	XLR	4.8	125.00
M200	D	C	600	50Hz-15kHz	-150.5dBm	N/A	XLR	4.8	110.00
M64	D	C	200	100Hz-10kHz	-146dBm	N/A	3 Pin DIN	2.8	100.00
M640	D	C	200	100Hz-12kHz	-152dBm	N/A	3 Pin DIN	3.9	100.00
M422	D	SC	200	100Hz-12kHz	-152dBm	N/A	XLR	2.5	90.00
MPC60	C	BC	200	20Hz-20kHz	20mV/Pa	132dB	XLR	750g	—
BRUEL & KJAER									
4011	PG	C	180	40-20kHz	10mV/Pa	110dB	—	165g	—
4003	C			20-20kHz	50mV/Pa	135dB		150g	—
4006	C			20-20kHz	12.5mV/Pa	135dB		150g	—
4004	C			20-40kHz	10mV/Pa	148dB		150g	—
4007	C			20-40kHz	2.5mV/Pa	148dB		150g	—
COUNTRYMAN									
TVH	C	HC	600	70-15kHZ	-52dBv	140dB	XLR	.3	$310.25
ISOMAX 3-C	C	C	600	30-20kHZ	-58dBv	150dB	XLR	5	224.70
ISOMAX 3-H	C	HC	600	30-26kHz	-58dBv	150dB	XLR	5	224.70
ISOMAX 3-B	C	Bi	600	30-20kHz	-58dBv	150dB	XLR	5	224.70
EMW-X	C	O	1500	10-20kHz	-60dBv	120dB	None	.05	125.00
CROWN									
PZM-6FS	C	O	240	20-15kHz	-67dBv	148dB	XLR	5.0	$349.00
PZM-6R	C	O	240	20-15kHz	-65dBv	148dB	XLR	5.0	349.00

Model	Transducer	Directional Pattern	Impedance	Frequency Range	Sensitivity @ 1 kHz Open Circuit	SPL for 1% THD	Cable Connector	Weight (oz.)	List Price
PZM-30R	C	O	240	20-15kHz	-65dBv	148dB	XLR	6.5	349.00
PZM-20RG	C	O	240	20-15kHz	-65dBv	148dB	XLR	8.1	319.00
CM-300	C	Differoid	330	60-18kHz	-75dBv	146dB	XLR	—	259.00
GLM-200	C	HC	100	60-20kHz	-68dBv	126dB	XLR	3.7	229.00
CM-200	C	C	200	80-15kHz	-73dBv	140dB	XLR	7.0	209.00
GLM-100	C	O	240	20-20kHz	-73dBv	148dB	XLR	2.8	199.00
CM-100	C	O	240	20-20kHz	-72dBv	148dB	XLR	7.8	189.00
PZM-180	C	O	150	50-18kHz	-70dBv	120dB	XLR	2	189.00
PZM-125P	C	O	150	20-15kHz	-70dBv	148dB	XLR	2.0	139.00
Sound Grabber	C	O	1600	50-15kHz	-55dBv	120dB	Mini	2.0	99.00
ELECTRO-VOICE									
PL20	D	C	250	45-18kHz	-57dBm	160dB	XLR	26	$607.00
PL10	D	C	150	75-15kHz	-56dBm	140dB	XLR	11	354.00
N/D757	D	SC	150	25-22kHz	-50dBm	150dB	XLR	7.7	297.00
PL77B	C	C	150	50-20kHz	-50dBm	140dB	XLR	12	236.00
N/D408	D	SC	150	30-22kHz	-50dBm	150dB	XLR	6.7	228.00
PL11	D	SC	150	90-13kHz	-56dBm	140dB	XLR	6	224.00
N/D457	D	HC	150	25-21kHz	-50dB	150dB	XLR	7.05	222.00
PL80	D	SC	150	60-17kHz	-56dBm	140dB	XLR	12.3	219.00
PL78	C	C	150	50-18kHz	-49dBm	140dB	XLR	10.1	211.00
PL95A	D	C	150	60-17kHz	-60dBm	140dB	XLR	9.2	193.00
N/D308	D	C	150	40-20kHz	-53dBm	150dB	XLR	6.7	186.00
PL9	D	O	150	50-18kHz	-58dBm	140dB	XLR	6.5	181.00
N/D357	D	SC	150	25-20kHz	-53dBm	150dB	XLR	7.05	180.00
PL91A	D	C	150	60-15kHz	-59dBm	140dB	XLR	8	140.00
PL6	D	SC	150	90-13kHz	-56dBm	140dB	XLR	10.5	137.00
N/D257	D	C	150	35-19kHz	-53dBm	150dB	XLR	7.05	130.00
PL5	D	O	150	80-13kHz	-55dBm	140dB	XLR	6	124.00
PL88H	D	C	25k	60-13kHz	-57dBm	135dB	XLR	10.4	99.00
PL88L	D	C	150	60-13kHz	-58dBm	140dB	XLR	10.4	99.00
FOSTEX									
M-22	D	MS	600	40Hz-18kHz	-54.8dBm	N/A	XLR	N/A	$899.50
M-20	D	MS	600	40Hz-18kHz	-54.8dBm	N/A	XLR	4	795.00
M-88	D	Bi	600	40Hz-18kHz	-55.8dBm	N/A	XLR	N/A	539.00
M-11	D	C	600	40Hz-18kHz	-54.8dBm	N/A	XLR	N/A	499.00
M-77	D	C	250	40Hz-18kHz	-56dBm	N/A	XLR	N/A	399.00
M-51	D	C	250	80Hz-20kHz	-58dBm	N/A	XLR	N/A	179.00
HME									
HM58	D	C	600	80-14kHz	-75dB	—	XLR	—	$164.00
RM77	C	C	600	150-15kHz	-75dB	—	XLR	—	144.00
NEUMANN									
SM 69 fet	PG	Var.	200	40-16kHz	19mV/Pa	123dB	—	465g	3,840.00
USM 69i	PG	Var.	150	40-16kHz	10mV/Pa	132dB	A5F XLR	510g	3,490.00
RSM197S	SG	C							2,445.00
U 87a	PG	Var.	200	40-16kHz	8mV/Pa	122dB	A3F XLR	500g	1,875.00
TLM 170i	PG	Var.	100	40-18kHz	8mV/Pa	140dB	A3F XLR	525g	1,750.00
U 89i	PG	Var.	150	40-18kHz	8mV/Pa	134dB	A3F XLR	400g	1,700.00
KMS 84i	PG	C	150	40-18kHz	5mV/Pa	138dB	A3F XLR	210g	1,140.00
KMR 82i	PG	SG	150	40-20kHz	21mV/Pa	128dB	A3F XLR	250g	1,080.00
KMR 81i	PG	SC	150	40-18kHz	18mV/Pa	128dB	A3F XLR	145g	975.00

Model	Transducer	Directional Pattern	Impedance	Frequency Range	Sensitivity @ 1 kHz Open Circuit	SPL for 1% THD	Cable Connector	Weight (oz.)	List Price
KMF 4i	PG	C	150	40-20kHz	12mV/Pa	132dB	A3F XLR	20g	925.00
KM 83 i		0	200	40-20kHz	7mV/Pa	120dB	A3F XLR	80g	485.00
KM 84 i	PG	C	200	40-20kHz	10mV/Pa	120dB	A3F XLR	80g	485.00
KM 85 i	PG	C	200	40-20kHz	9mV/Pa	120dB	A3f XLR	80g	485.00
NUMARK									
UD940	C	U	250	45-60kHz	75dB	—	XLR	2.5	$154.95
UC935	EC/C	U	600	30-15kHz	68dB	—	XLR/¼"	2.5	107.95
UD925	C	U	600	60-15kHz	—	—	XLR/¼"	2.5	70.95
TC995	EC	0	800	50-16kHz	66dB	—	¼"	10	57.95
UD9200	C	U	600	50-12kHz	50dB	—	XLR/¼"	1lb	45.95
PANASONIC									
WM-S5	C	C	600	70-16kHz	-52dB	158	XLR	16g	$270.00
WM-S10	C	C	250	80-15kHz	-56dB	138	XLR	90g	210.00
WM-S1	C	C	600	50-18kHz	-42dB	148	XLR	16g	199.00
WM-S2	C	C	250	80-15kHz	-56	138	XLR	16g	160.00
PASO									
M800	D	C	250	40-18kHz	-57dBm	107dB	Choice	18	$201.30
M701	D	C	250	40-16kHz	-57dBm	107dB	Choice	18	156.20
M27	C	0	250	40-18kHz	-58dBm	104dB	Choice	6	149.00
M601	D	C	250	50-15kHz	-57dBm	105dB	Choice	18	124.30
M501	D	C	250	50-15kHz	-57dBm	105dB	Choice	18	101.20
M50	D	C	250	50-18kHz	-56dBm	101dB	Choice	12	76.50
PEAVEY ARCHITECTURAL ACOUSTICS									
PAA350	D	C	300	50-18kHz	-76dB	—	XLR/3PM	8	$209.00
PAA250	D	C	500	50-14kHz	-75dB	—	XLR/3Pm	8	109.00
SCHOEPS									
CMC56	C	O/Bi		40-16kHz	9mV/Pa	75dB	Tuchel/XLR	80g	$1,520.00
CMC55	C	0		40-20kHz	10mV/Pa	76dB	Tuchel/XLR	80g	1,210.00
CMC58	—	Bi		40-16kHz	10mV/Pa	75dB	Tuchel/XLR	80g	1,130.00
CMC541	HC			40-20kHz	13mV/Pa	77dB	Tuchel/XLR	80g	1,040.00
CMC52	0			20-20kHz	12mV/Pa	77dB	Tuchel/XLR	80g	930.00
CMC53	0			20-20kHz	10mV/Pa	76dB	Tuchel/XLR	80g	930.00
CMC54	C			40-20kHz	12mV/Pa	76dB	Tuchel/XLR	80g	890.00
SENNHEISER									
MKH 816 P48	C	LG	10	40Hz-20kHz	40mV/Pa	—	XLR	46	$1,179.00
MKH 30 P48	C	Fig 8	150	40Hz-20kHz	25 mV/Pa	—	XLR	4.0	989.00
MKH 20 P48	C	0	150	20Hz-20kHz	25 mV/Pa	—	XLR	3.5	925.00
MKH 40 P48	C	C	150	40Hz-20kHz	25 mV/Pa	—	XLR	3.5	925.00
MKH 416 P48	C	LG	10	40Hz-20kHz	25 mV/Pa	—	XLR	18	875.00
MKE 4032 P3	EC	SC	200	70Hz-20kHz	5mV/Pa	—	XLR	7.5	595.00
MD 441 U	D	SC	200	30Hz-20kHz	1.8mV/Pa	—	XLR	45	559.00
MD 441 U3	D	SC	200	30Hz-20kHz	1.8mV/Pa	—	XLR	42	510.00
MKE 212/K3U	EC	0	130	20Hz-20kHz	20mV/Pa	—	XLR	66	499.00
ME 80/K3U	EC	LG	130	50Hz-15kHz	5mV/Pa	—	XLR	7.2	449.00
MKE40/K3U	EC	C	110	50Hz-20kHz	1.5mV/Pa	—	XLR	4.9	439.00
MD 431 U	D	SC	250	40Hz-16kHz	1.4mV/Pa	—	XLR	28	429.00
MKE 2-3/K3U	EC	0	110	40Hz-20kHz	1.5mV/Pa	—	XLR	—	409.00
MD 421 U	D	C	200	30Hz-17kHz	2mV/Pa	—	XLR	31	399.00
ME 40/K3U	EC	C	140	50Hz-15kHz	3mV/Pa	—	XLR	6	375.00
ME 20/K3U	EC	0	120	50Hz-15kHz	3mV/Pa	—	XLR	6	322.00

Model	Transducer	Directional Pattern	Impedance	Frequency Range	Sensitivity @ 1 kHz Open Circuit	SPL for 1% THD	Cable Connector	Weight (oz.)	List Price
MD 409 U	D	C	200	50Hz-15kHz	1.18mV/Pa	—	XLR	6.3	269.00
MD 918 U	D	C	200	50Hz-15kHz	1.3mV/Pa	—	XLR	4.2	189.00
SHURE									
SM89	C	HC/Lobar	150	60-20kHz	-53dB	127dB	XLR	6.9	$900.00
SM7	D	C	150	40-16kHz	-79dB	N/A	XLR	1-11	542.00
SM80-LC	C	O	150	20-20kHz	-65dB	147dB	XLR	8	367.00
SM81-LC	C	C	150	20-20kHz	-65dB	146dB	XLR	8	367.00
SM87-LC	C	SC	150	50-18kHz	-74dB	142dB	XLR	6.3	329.00
SM84	C	SC	150	80-20kHz	-73dB	131dB	TB3M/XLR	1.58	300.00
SM90-LC	C	O	150	20-20kHz	-66dB	141dB	TB3M/XLR	9.3	300.00
SM91-LC	C	C	150	20-20kHz	-69dB	144dB	TB3M/XLR	9.3	300.00
SM15-CN	C	C	150	50-15kHz	-40.5dB	141dB	TB3M/XLR	2.8	275.00
SM85-LC	C	C	150	50-15kHz	-74dB	142dB	XLR	6.3	275.00
SM94-LC	C	C	150	40-16kHz	-69dB	141dB	XLR	8.8	250.00
SM96-LC	C	C	150	70-16kHz	-74dB	146dB	XLR	9.2	250.00
SM98	C	C	150	40-20kHz	-78dB	153dB	TB3F/XLR	.4	250.00
SM83-CN	C	O	150	80-20kHz	-69dB	—	TB3M/XLR	1.58	217.00
SM58-LC	D	C	150	50-15kHz	-75.5dB	N/A	XLR	10.5	173.00
869-LC	C	C	600	70-16kHz	-78dB	137dB	XLR	9.2	168.00
849-LC	C	C	600	40-16kHz	-71dB	132dB	XLR	8.8	168.00
SM78EB-LC	D	C	150	50-15kHz	-77.5dB	N/A	XLR	7.2	136.25
SM57-LC	D	C	150	40-15kHz	-75.5dB	N/A	XLR	10	134.00
SM48-LC	D	C	150	55-14kHz	-77.5dB	N/A	XLR	13.1	126.00
565SD-LC	D	C	HI/150	50-15kHz	-54dB	N/A	XLR	10.5	121.50
SM77EB-LC	D	C	150	50-15kHz	-79dB	N/A	XLR	6	111.00
545SD-LC	D	C	HI/150	50-15kHz	-55dB	N/A	XLR	9	109.50
SM17-CN	D	O	150	50-15kHz	-85dB	N/A	XLR	0.28	103.00
587SB-LC	D	C	150	55-14kHz	-77.5dB	N/A	XLR	13.1	94.50
588SD-LC	D	C	HI/150	80-13kHz	-59.5dB	N/A	XLR	10.0	57.75
515SD-LC	D	C	HI/150	80-13kHz	-59dB	N/A	XLR	9.0	47.25
SONY									
C-48	C	Var.	150	30Hz-16kHz	-41.0	128dB	XLR	550gm	$975.00
C-76	C	U	250	40Hz-16kHz	-38.0	126dB	XLR	415gm	975.00
C-74	C	U	250	40Hz-16kHz	-38.0	126dB	XLR	355gm	860.00
ECM-672	EC	U	250	50Hz-16kHz	-42.0	114dB	XLR	230gm	475.00
C-535P	C	U	200	30Hz-16kHz	-41.0	138dB	XLR	144gm	455.00
C-536P	C	U	200	30Hz-16kHz	-41.0	138dB	XLR	148gm	455.00
ECM-66 S/B	EC	U	100	70Hz-14kHz	-50.0	130dB	XLR	167gm	325.00
ECM-77 S/B	EC	O	150	40Hz-20kHz	-52.0	120dB	XLR	122gm	320.00
ECM-55 S/B	EC	O	100	30Hz-18kHz	-52.0	126dB	XLR	126gm	275.00
ECM-33F	EC	U	250	20Hz-20kHa	-54.0	132dB	XLR	185gm	225.00
ECM-44 S/B	EC	U	250	40Hz-15kHz	-53.0	122dB	XLR	121gm	170.00
ECM-23F	EC	U	250	20Hz-20kHz	-55.0	130dB	XLR	190gm	135.00
TOA									
K-Y	C	C	250	20Hz-20kHz	-65dBm	130dB	XLR	470gm	$499.50
K-4	C	C	250	20Hz-20kHz	-46dBm	130dB	XLR	162gm	429.50
K-3	C	C	250	30Hz-20kHz	-53dBm	145dB	XLR	180gm	249.50
K-2	C	C	250	30Hz-20kHz	-53dBm	145dB	XLR	180gm	249.50
J-3	D	C	250	50Hz-18kHz	-56dBm	145dB	XLR	268gm	199.50
J-2	D	C	250	40Hz-18kHz	-56dBm	145dB	XLR	268gm	199.50
J-1	D	C	250	30Hz-18kHz	-53dBm	145dB	XLR	240gm	149.50
K-1	C	C	250	30Hz-20kHz	-53dBm	145dB	XLR	180gm	149.50

Model	Transducer	Directional Pattern	Impedance	Frequency Range	Sensitivity @ 1 kHz Open Circuit	SPL for 1% THD	Cable Connector	Weight (oz.)	List Price
TELEX									
TE10	C	C	200	30-20kHz	-75	N/A	A3F	7.4	$166.00
TD13	D	C	250	50-16kHz	-76	N/A	A3F	9.2	138.00
TD11	D	C	250	50-16kHz	-76	N/A	A3F	9.2	130.00
UNIVERSITY									
US1772	EC	C	150	50-18kHz	-49.0	—	XLR	10.16	$171.00
US681L	D	C	150	60-14kHz	-59.5	—	XLR	8	143.00
US-1	EC	C	150	50-18kHz	-50	—	XLR	12	142.00
US664A	D	SC	150	90-13kHz	-55.5	—	XLR	18.5	138.00
US690	D	SC	144	60-20kHz	-50.0	—	A3M	17.8	133.00
US690F	D	SC	144	60-20kHz	-50.0	—	XLR	18.4	133.00
US660	D	SC	150	90-13kHz	-55.5	—	XLR	10.5	112.00
US660A	D	SC	150	90-13kHz	-55.5	—	XLR	10.5	112.00
US631B	D	O	150	80-13kHz	-56.0	—	XLR	6	112.00
US688L	D	C	150	60-13kHz	-58.0	—	XLR	10.4	90.00
US658L	D	C	Low Z	80-13kHz	-61.0	—	XLR	8.9	64.00
US658H	D	C	Hi Z	80-13kHz	-60.0	—	XLR	8.9	64.00
YAMAHA									
MZ203Be	D	C	200	40Hz-18kHz	-76dB/uBar	150dB	XLR	9.7	$295.00
MZ205Be	D	C	250	40-18kHz	-77dB/uBar	150dB	Ra-XLR	6.53	275.00
MZ204	D	C	250	20Hz-18kHz	-77dB/uBar	150dB	Ra-XLR	7.94	275.00
MZ103Be	D	C	250	40-18kHz	-75.5dBm	150dB	XLR	9.9	210.00
MZ105Be	D	C	250	40Hz-18kHz	-77dBm	150dB	XLR	9.7	180.00
MZ102Be	D	C	250	40H-18kHz	-76dBm	150dB	XLR	9.4	170.00
MZ106S	D	C	250	40Hz-18kHz	-77dBm	150dB	XLR	8.3	130.00
MZ104	D	C	250	30Hz-17kHz	-77dBm	150dB	XLR	9.9	130.00
MZ101	D	C	250	40Hz-17kHz	-76dBm	150dB	XLR	9.4	120.00

MICROPHONE MANUFACTURERS

AKG Acoustics Inc.
77 Selleck Street
Stamford, CT 06902
(203) 348-2121

Altec Lansing Corp.
PO Box 26105
Oklahoma City, OK 73126
(405) 324-5311

ASTATIC
PO Box 120
Conneaut, OH 44030
(216) 593-1111

Audio-Technica
1221 Commerce Drive
Stow, OH 44224
(216) 686-2600

Audix
5635 W. Las Positas
Pleasanton, CA 94566
(415) 463-1112

Beyer Dynamic Inc.
5-05 Burns Avenue
Hicksville, NY 11801
(516) 935-8000

Bruel & Kjaer Instruments, Inc.
185 Forest Street
Marlboro, MA 07152
(617) 481-7000

Countryman Associates Inc.
417 Stanford Avenue
Redwood City, CA 94063
(415) 364-9988

Crown International Inc.
1718 W Mishawaka Rd
Elkhart, IN 46517
(219) 294-8000

Electro-Voice Inc.
600 Cecil Street
Buchanan, MI 49107
(616) 695-6831

Fostex
15431 Blackburn Avenue
Norwalk, CT 90650
(213) 921-1112

HM Electronics, Inc.
6675 Mesa Ridge Road
San Diego, CA 92121
(619) 535-6092

Neumann
1790 Broadway
New York, NY 10019
(212) 765-3410

Numark Electronics
503 Newfield Avenue
Raritan Center
Edison, NJ 08837
(201) 225-3222

Panasonic Industrial
Two Panasonic Way
Secaucus, NJ 07094
(201) 348-7000

Paso Sound Products
14 First Street
Pelham, NY 10803
(914) 738-4800

Peavey Architectural Acoustics
PO Box 2898
Meridian, MS 39301
(601) 483-5365

Schoeps
142 West 26th Street
New York, NY 10001
(212) 242-3737

Sennheiser Electronic Corp.
48 West 38th Street
New York, NY 10018
(212) 944-9440

Shure Brothers Inc.
222 Hartrey Avenue
Evanston, IL 60202
(312) 866-2200

Sony Professional Audio
1600 Queen Anne Road
Teaneck, NJ 07666
(201) 833-5200

TOA Electronics
480 Carlton Court
South San Francisco, CA 94080
(415) 588-2538

Telex Communications
9600 Aldrich Avenue
S. Minneapolis, MN 55420
(612) 788-0201

University Sound
600 Cecil Street
Buchanan, MI 49107
(616) 695-6831

Yamaha Music Corp.
PO Box 6600
Buena Park, CA 90622
(714) 522-9011

"Great Expectations"

For 18th Annual IBMA Convention

by Bill Intemann

Marriott's Harbor Beach Resort, Fort Lauderdale, FL.

More than 250 people are expected to attend the 18th annual International Business Music Association Convention being held October 12-15 at Marriott's Harbor Beach Resort in Fort Lauderdale, FL. At press time, over 30 manufacturers and associate members were scheduled to display their latest products on the exhibit floor. "Last year's show was larger than in previous years, and we're expecting this year's show to be as big or bigger," said Joe Elum, IBMA president.

This year's convention, titled "Great Expectations," will feature keynote speaker J. Peter Grace, president and CEO of W. R. Grace & Company since 1945. Mr. Grace, who has been an advisor to three Presidents, is expected to speak on subjects ranging from the economic implications of this country's staggering debt, to the proper expense allowances for a businessman's car.

The convention will feature a special guest speaker as well: Mike Vance, business consultant and one of the five most-requested speakers in this country (according to *USA Today*), will give a talk on "The Entrepeneurial Spirit."

Seminars

Two seminars will round out the convention program: Jerry Anderson, president of New England Sound & Communications (no relation to this magazine) will moderate a panel of banking, restaurant, and retail business leaders who will discuss "Why We use Business Music." And Monroe Porter, of Proof Management, will address the topics of company image, selling, advertising, and promotion in his seminar titled "Selling The Job At Your Price."

Industry Trends

"More changes have occurred in our industry recently than have occurred in the last 20 years," according to Joe Elum. He has referred to 1987 as "the year of the acquisition," in the business music industry. During that period of time Muzak merged with Yesco, then bought Musi-Call of Chicago, IL, and AEI purchased Sound And Music Environments of San Francisco, CA. It is a trend that seems to be continuing this year: AEI (now AEI Music Networks, Inc.), has announced that it has signed a letter of intent to purchase Seeburg Music Satellite Network.

"There's a lot happening in this industry," agrees Jim McGohan, manufacturer's rep for the IBMA board of directors. "It's difficult to keep track of what's going on." McGohan feels that's one reason why this convention is so important to this industry—all the key players are in attendance, and the convention is structured so that information can be disseminated at informal gatherings as well as at the scheduled meetings and seminars.

The complete convention agenda is provided below.

1988 IBMA AGENDA

OCTOBER 12		OCTOBER 13		OCTOBER 14		OCTOBER 15	
8:30 AM	IBMA Golf Tournament	*8:00 AM*	Continental Breakfast	*8:00 AM*	Continental Breakfast	*8:00 AM*	Continental Breakfast
12:00 PM	Early Registration	*8:30 AM*	Welcome Introductions	*8:30 AM*	Reports 1989 Convention Report	*9:30 PM*	Monroe Porter: "Selling The Job At Your Price"
4:30 PM	Board of Directors Meeting	*10:00 AM*	Coffee Break	*9:00 AM*	J. Peter Grace: Keynote Adress	*11:30 AM*	Adjournment
6:00 PM	Registration and Cocktail Party	*11:00 AM*	Mike Vance: "The Entrepeneurial Spirit"	*10:00 AM*	Jerry Anderson: "Why We Use Business Music"		
		3:00 PM	IBMA Tennis Tournament	*6:00 PM*	Cocktail Party		
				7:00 PM	Dinner Party		

BBE MODELS 822 AND 401

by Jesse Klapholz and Richard Feld

As soon as one hears the mention of the word "Barcus-Berry," usually connotations of, "Oh Yeah, that distortion thing...," are evoked. The authors too were somewhat guilty of similar fluff-off comments. But as any afficionado of audio gear can attest to, "We've heard it all before, and yes I know how it works." While committed to the confines of our homes air-conditioned inner sanctums this sweltering summer, we decided to play around with the Barcus-Berry — so on to the field.

Barcus Berry offers two models for the professional market, the 822, and the 401. The 822 is a two-channel device that features low- and high-impedance inputs, and is capable of +24 dBu (ref. 0 dBu =0.775 V RMS) into 600 ohms. The 401 is a single-channel unit that has a hi-impedance −20 dBu nominal input, and a low-impedance XLR microphone input. Phantom power of +24 volts is provided; however, if present at the unit that is connected to the 401's output, and the phantom voltage is greater than 24 volts, it will pass through the 401 to the microphone. The 401 provides for 30 dB of gain. Both units have front-panel low-frequency contour, definition controls, in/out switches (with LED indicators), "traffic type" red/amber/green LEDs that dynamically indicate the level of processing, and clip LEDs. The 822 has a maximum output level of +24 dBu, and the 401 has a maximum output level of +16 dBu.

Set-up of the units is very easy. Each should be the last unit in the processing chain directly ahead of any electronic crossovers. There are only two controls: Lo Contour, and Definition. The Lo Contour is a "phase compensated bass equalization," centered at 50 Hz with a 10 db range. The Definition Control regulates the amount of dynamic high-frequency amplitude gain increase, which is indicated by the "traffic light" LEDs. This control is set by ear, and since its effects are immediately apparent, is a very quick procedure.

While it did not seem to be a problem during our evaluations, headroom should certainly not be overlooked. Because of the nature of the dynamic/frequency gain circuit, with its crossover point at 1.2 kHz, the medium, or loudspeaker type, needs consideration. For loudspeakers, the relationships of size versus frequency, and power compression are factors. For example, do not expect to produce high-frequency response in an 18-inch woofer.

The first tests were listening—entirely subjective. An experience recently described to us by Jim Brawley as "shimmering highs, just dancin' in your face," is what we expected from the unit by all the reports we got. Therefore, we hooked the unit up with a CD player and loudspeakers representative of what the average consumer listens to at home (the loudspeakers happened to be Panasonic Thrusters). And what we heard set the stage for lots of listening, head scratching, more listening...

Our initial observation was that the unit did wonders for these economy-grade bookshelf speakers. This being the case, listening proceeded through studio monitors. Significant articulation and definition improvements are immediately apparent by any listener. Therefore, the scope of the ensuing listening and subsequent tests was to identify what the unit did sonically (from a subjective point of view), and in what type of situations it could be applied to sound systems.

The first thing we tried was a cassette tape that had very poor high-frequency response. The results were remarkable. The signal-to-noise ratio did not increase but the amount of high-end perceived was greatly improved. With this simple demo it became clear that there are other similar situations where the unit could be used, for instance to clean up optical and magnetic sound tracks for film, and TELCO lines.

We set out to see what effects the unit might have on acoustic feedback loops, speech intelligibility, compression-driver/horns, and four-inch loudspeakers used in music/paging systems. The latter was of particular interest because of the multi-tap transformer, and enclosure resonance interactions. Some time ago the authors made on-axis measurements of a four-inch loudspeaker at each of the taps, and ever since have never used more than two taps below the highest watt tap.

Inevitably, we really had to pay more attention to what the true claims were that the manufacturer actually made. While the subjective descriptions talk about sonic and aural maximization, and definition, the technical section describes the unit in terms of what can be called a phase compensation circuit, or phase equalization circuit if you prefer. Actually, there are three main features to the circuit. These are based on a median performance model of real-world loudspeakers.

First, the signal is divided into three audio-bands, with cross-over points at 150 Hz, and 1.2 kHz. All-pass phase delay is then introduced in the lower

two bands, with 2.5 ms in the low frequency section and 0.5 ms in the high-frequency section. This gives an overall "tilt" to the system phase response which is known in the signal processing world as pre-apodization — or pre-distorting. This technique does not introduce distortion as we normally think of it conceptually, i.e., it does not add any non-linear components.

Another way of looking at these phase characteristics is observing sets of complimentary phase and frequency response curves. A good review of these can be found in the work of Preis. Simply stated, what BBE is doing is observing the complimentary phase slope of a low-pass frequency response function. This low-pass function is a descriptor, in the frequency domain, of loudspeakers, limited bandwidth recording media, and telephone lines (a few typical examples). In the time (or phase) domain, this low-pass frequency response function results in a time, or phase lag.

These effects manifest themselves in typical subjective descriptions of smeared, muddy, or dull. Objectively, transient response may be somewhat improved, spectral balance can be high-frequency biased, and harmonic components may be phase and amplitude compensated, thus altering the timbre of the sound. Overall, muddy, smeared, dull, and perhaps unintelligible sounds may be improved and "cleaned up."

TESTING

Testing such a unit certainly lends some difficulty, especially when results would need lots of explanation. Because of the subjective nature of the unit and its intended applications, objective testing of any kind would by definition require a subjective scope of both the measurements and their interpretation. Hence, let us observe the two main aspects of the system—one is static, one is dynamic. The phase compensation portion is fixed (static), and can therefore be easily measured with a swept sine-wave stimulus, for example. This test signal along with conventional analysis will present the phase response. It is then up to the observer to apply these curves as "overlays" to typical system responses, and interpolate resultant improvements in phase response.

The high-frequency-band leveling (dynamic) is a bit harder to test by conventional means. A swept sine-wave will not trigger the unit—by definition the signal will not be present in the mid- and high-frequency bands at the same time. Pink noise—which by definition has equal energy by octave comparison—will not trigger the circuit either. The unit requires a dynamic signal to function. A measure of its performance whose intended use is for dynamically changing speech, and music signals requires dynamically complex signals as a test stimulus.

Speech and music recordings can be fed to the unit, and its input and output can be monitored by a two-channel spectrum analyzer. Such an analyzer would have to be capable of integrating data over a period of time equal in duration to the speech, and music signal, and still maintain adequate bandwidth. This data would then have to be presented in displays over time, average spectra, mean spectra, or peak spectra. Typical display resolutions would more than likely present too much data to present a useful picture. Therefore, one-third octave integration would reduce the amount of data, and present a much clearer picture.

More directly, we used the dbx third-octave analyzer that features input/output difference analysis with average and peak displays. This allowed us to use speech and various types of music recordings, and display how they were affected in high-frequency level changes. The dbx unit integrates third-octave spectral values over user-selectable time periods, and statistically samples and weighs input versus output spectral energy information of the device under test against its referenced dynamic input. As the software becomes confident of the validity of the results, the display in that band darkens. Screen display "snapshots" may be taken at any point along the way.

The overall results show that the unit does not increase the high-frequency gain to the degree that one perceives—that is good for power

(continued on page 70)

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.

MDS: MUSIC PROGRAMMING VIA MICROWAVE

BY DON HARTLEY

Suppliers of background (or, increasingly, foreground) music services who transmit on subcarrier frequencies of existing FM radio stations are at the mercy of the station's equipment, and limited to only two channels.

Satellites add a new dimension to commercial music possibilities. More channels and better sound quality make customers happy, but suppliers only maintain the leased equipment. And programming originates from a central source in an addressable system that can be shut down for various reasons.

Now, thanks to microwave technology, commercial music suppliers can own the entire system, from transmitter through down converters to digital receivers. And this system can supply many channels of music with digital disk quality.

This technology has only recently become available to business music suppliers. In March of this year, the FCC decided to allow microwave transmitters to start carrying music services. Dynamic Sound, Exeter, NH, obtained the first license ever for this technology, and adapted an existing MDS station in Cape Cod to carry commercial music. (Dynamic Sound is currently building the first ever MDS music transmitting facility in Reno, NV.)

The distribution of program music services is a new but permissible use of MDS (Multiple Distribution Service) facilities under the rules of the Federal Communications Commission. Until recently, MDS was exclusively a video service, primarily devoted to pay TV in areas not yet penetrated by cable television. MDS operators were required, under the FCC's rules, to offer a video transmission service to the public, on a common carrier basis, that is, "first come, first served." In 1987, however, the FCC dropped the requirement that MDS licensees operate as common carriers. This enabled operators to offer their own programming, and to be more flexible in tailoring their service capabilities to the specific needs of their customers. Then, in the Spring of 1988, Dynamic Sound, through its Washington communications counsel, J. Geoffrey Bentley, of the firm of Birch, Horton, Bittner, Cherot and Anderson, carried the message to the FCC staff that the needs of the rapidly diversifying program music industry justified more flexible regulation of the MDS transmission systems. On July 25, the FCC awarded Dynamic Sound an authorization for a new, eight-channel audio-only service on a vacant MDS channel at Reno, NV.

Several waivers of various sections of the FCC's rules were required. It is a matter of demonstrating the compelling need of program music companies for more channels, and that this was a way to utilize spectrum that otherwise was largely going to waste. As a result of Dynamic Sound's efforts at the FCC, the agency will soon approve the first audio-only MDS transmitters. This should make the application process more routine and eliminate a substantial amount of paperwork.

The groundbreaking effort for the MDS transmission of commercial music began with Dynamic Sound's Cape Cod reconversion project. Getting this system up and running involved the creation and testing of a whole new technology. This new technology enables one MDS or MMDS (Multiple-channel Multiple Distribution Service) channel to transmit up to 40 different monaural channels. This transmission system replaces the TV Modulator usually associated with the MDS transmitter with special multichannel audio modulators, but otherwise can use an existing MDS transmitter.

Field tests conducted by Dynamic Sound at the Cape Cod MDS transmitter during the first week of April, 1988, were highly successful.

Each audio channel of this new MAMDS (Multiple-channel Audio Multiple Distribution Service) system transmits 20 Hz to 20 KHz with a dynamic range of 85 dB, rivaling the actual performance of digital disc recording. Not only is the music transmission noise-free and crystal clear, but it also retains these characteristics without degradation out at the extreme limits of the service area. The signal sounds completely noise-free until the signal drops below the FM threshold (13 dB carrier-to-noise ratio). There are no "degraded service areas."

The transmission system uses FM modulation with ± 40 KHz deviation and a carrier spacing of 150 KHz. The superior noise performance is produced by a new companding system designed and produced by F M Systems, Inc. Aggressive dynamic companding, combined with dual-band operation, and special program-dependent attack and delay time constants, assure noise-free reception.

The modulators operate at the 41-47 MHz I.F. input frequency of the MDS transmitter. The MDS up-converter translated these frequencies to the MDS or MMDS channel chosen to transmit the MAMDS service. In the case of MDS channel 1, that would be 2150-2156 MHz. Figure 1 shows the frequency plan and block diagram of the transmitter equipment.

At the receiving end, an MDS antenna and a specially-modified down converter are used. This down converter translated the MAMDS signals into the channel frequency assignments of the decoder. The decoder is also fully addressable so that the MAMDS operator can enable or disable any decoder from the MAMDS transmitter or control studio site.

The field test started by setting operating levels for each of the five channels. The object of this test was to establish a per-channel power level that would hold third-order intermodulation (spurious signals) to acceptable limits. It

Hartley is president of Dynamic Sound, Exeter, NH, and is a member of the IBMA.

was found that this 100-watt transmitter could support five channels at 12 watts each for a total of 60 watts transmitted.

A vehicle was equipped with a 120 VAC power converter and a decoder, several different size antennas, and an audio power amplifier and speaker system. This enabled the performance of critical listening tests, but not the measurement of the actual field strength of the signals.

The transmitter was modulated with five F M Systems modulators. Five Compact Disc players played five different types of music continuously for this test to enable critical listening and to provide the highest possible quality for field evaluation.

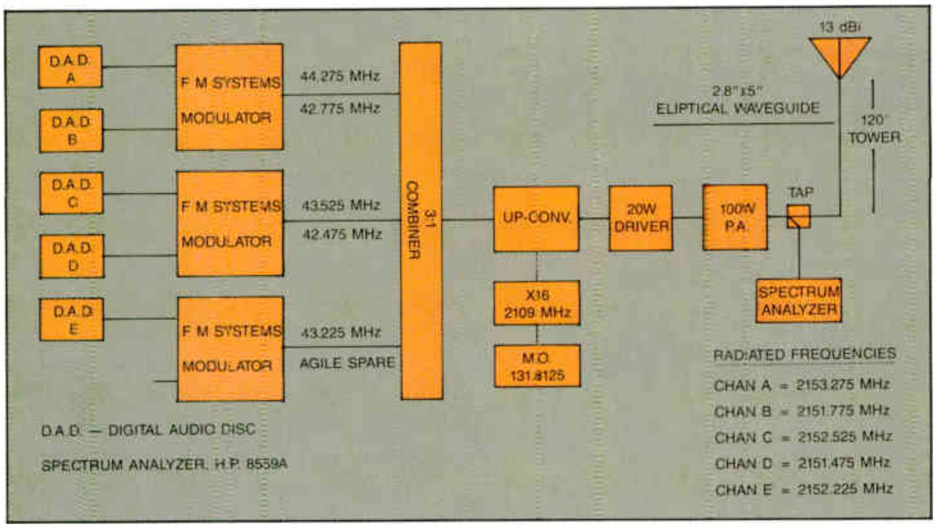


Figure 1. Frequency plan and block diagram of transmitter equipment, Dynamic Sound at Cape Cod.

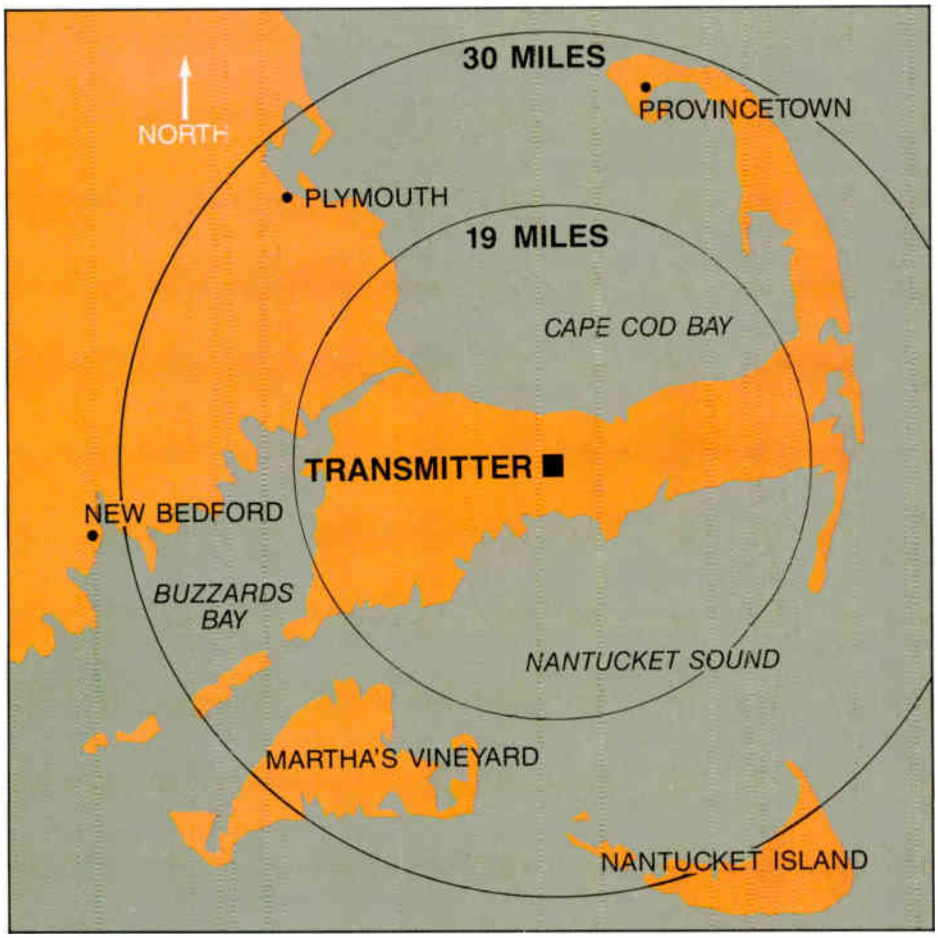


Figure 2. Map showing area serviced by transmitter. Grade A contour radius at 19 miles, grade B contour radius at 30 miles.

Over a period of several days, this portable "sound lab" was driven to many locations on the Cape Cod peninsula as well as many miles into the mainland. Most of the tests were "over the horizon," in that the transmitter tower could not be seen from any test location. When approximately five miles from the transmitter (but not in sight of the antenna), the music was received perfectly, even with the reflector removed and the down converter placed *under* the vehicle. No portable tower was available for the tests: all subsequent tests were performed holding the receiving antenna on the end of a short metal pole. The center of the antenna in all tests was about 9 feet above local ground level at the road. The transmitter antenna has 13 DBi gain, is fed with 5 x 2.8-inch flexible eliptical wave guide and is 120 feet above the average terrain. Very heavy local tree cover, present over the entire area, caused very rapid signal level increase with even a few extra feet of elevation above eye level at the road.

During the field test, it was observed that the signal did not deteriorate in signal-to-noise ratio as the test sites moved farther from the transmitter. When the fringes of the service area were reached (maximum tested distance was 34 miles), even a few extra feet of antenna height (about 10 feet off the ground at 34 miles) increased the signal strength — the quality of reception with the antenna at 34 miles was virtually the same as with the antenna right next to the transmitter.

With 12 watts per channei and 13 dBi antenna gain, the ERP for each audio channel was 25 watts. Close-in tests were performed with 18-inch (16.3 dB gain) receiving antennas, while in the fringe areas we used 24-inch (20.2 dB gain) antennas. The extra 6 inches of reflector thus provided an additional 4 dB of gain, or 2.5 times the received signal strength. (Larger reflectors are available but were not tested.)

We classified two signal level contours, A and B, based on receiver antenna beam-width (the angle the antenna could be rotated without losing the signal). By this measure, the grade A contour radius was 19 miles (38 miles in diameter) and the grade B contour was 30 miles (60 miles in diameter), as can be seen in figure 2. All tests were made at a receiver antenna elevation of 9 feet. We used the

24-inch reflector in the grade B area. There was no difference at all in the signal-to-noise ratio between the grade A and grade B areas; the only difference was in the size antenna reflector used. The distance in the fringe area can be expanded by raising the antenna higher or using a larger reflector.

The tests showed ample coverage for the entire length of Cape Cod, Martha's Vineyard, Nantucket Island, and a good portion of the Massachusetts mainland bordering on Buzzards Bay and Cape Cod Bay.

A second phase test in this area is now being prepared at Cape Cod. Ten locations will be equipped with music service on a round-the-clock basis preparatory to full music distribution operation.

Implementation of service in Reno will begin in a few months, with a view to starting commercial service prior to winter snowfall. The weather at the transmitter site (on Slide Mountain) can be very severe in the winter months, so a standby generator is on hand in case of power outage. A satellite dish will receive the music channels for re-transmission on the MAMDS system; the MAMDS is fully automatic and the operator has full control of the music distribution system.

The down converter to be used at the Reno site is the Texscan Model TLC-MZK, a high-stability down converter that has been specifically developed for use in hi-fidelity music distribution for background and foreground music operators.

The local oscillator in the TLC-MZK has been stabilized with a crystal heater and a special high temperature pre-aged crystal. This results in a frequency conversion stability of ±10 KHz from −40 degrees to +60 degrees C (−40 degrees to +140 degrees F) ambient temperature.

The TLC-MZK operates in the 2150-2162 MHz MDS frequency band. This 12 MHz bandwidth has typically been used for distribution of two 6 MHz-wide video or by television channels; however, in the music application, the output frequency of the down converter has been modified to a range of 65 to 77 MHz to provide multichannel music distribution.

This down converter provides the operator with features previously unavailable to the audio distribution market. Crystal controlled for no-drift performance, it includes a low wind resistant, partial parabolic Lance antenna with continuously variable polarization adjustment for optimum reception of either single- or dual-polarized systems. The operating distance from the transmitter can be increased by simply using a larger partial parabolic antenna screen. Antenna screen options of 18, 21, or 24 dBi gains are available and are interchangeable by the installer.

The Reno installation will also feature an MDS Audio Transmitter system developed by Information Transmission Systems (ITS) Corp. of McMurray, PA.

While ITS is building a transmitter for just this service, any existing channel 1 or channel 2 system can be converted to the channel of music by incorporating the F M System, as used in Cape Cod, in the unit.

Microwave transmission: this exciting new technology offers music suppliers options they have never had before: top quality music, with ownership and control over their products. That's the good news. The bad news is that there exists from the FCC only one or two MDS channels in any city or area. Anyone interested has better act fast before they're snapped up. ■

NIGHT CLUB SOUND REINFORCEMENT

THE CASINOS OF ATLANTIC CITY

By David Starobin

From the high-roller stepping from a limousine flashing a seemingly endless bankroll, to the slots player stepping from a bus clutching a roll of quarters, visitors to Atlantic City's casinos have one thing in common—they want to strike it rich. So do the casino owners, who all want a piece of the action in what some say is fast becoming the entertainment capitol of the world.

Casinos go to great lengths to keep those vistors coming through the doors—free transportation, meals, and lodging, and entertainment facilities designed to suit every taste. There are elaborate broadway-style showrooms and intimate piano bars, ball rooms and meeting rooms, lounges big and small—and each venue requires its own sound system. This article will focus on lounge systems, with future articles taking a look at showroom systems, and "back of the house" systems (ballrooms, house music, meeting rooms, conventions, etc.).

"We want this to be the premier lounge in town, as far as technology is concerned," Pete Morucci told me about the Viva Lounge at Trump's Castle. The Castle may have done just that: Viva is a great-sounding, high-energy room. Bill Schmal, lead technician, explained the room's evolution. The Castle was originally a Hilton hotel. Pierce-Phelps supplied the system (basically Altec), and George Thomas Howard was the consultant. Hilton's primary focus was on the showroom system; the lounge system was put together with extra showroom components.

Then Donald Trump bought Hilton: enter Bill Schmal. With the change in management came a change in the concept for the lounge. Schmal was given a decent budget and asked to put together a good-sounding room. He found use for the Altec speakers elsewhere and spec'd out a new system for Viva's.

Morucci handles most of the mixing there and gave me the soundman's tour. Here is a large, open-ended room that works. The seven flown EAW's and two EAW subs (two 18's in each) keep things clean and clear. Ceiling mounted units insure that the back tables get enough sound, too. An amp rack just off stage contains QSC MS1500's for the PA and subs. Around the stage are four PAS coaxial wedges and two small Fostex monitors for the band.

The tech crew built an attractive and functional rolling guitar rack, with a Mesa Boogie amp on a tilting shelf, and a Shure SM57 mounted on an integral gooseneck. Sennheiser 431's are used for all vocals. The drums have Sennheiser 421's on toms and kick, and a Shure 81 on snare. The mixing booth, located above the floor, is equipped with a Yamaha 1516A console, a Lexicon Super Prime Time II and a Yamaha Rev 7. A Kliegl Entertainer controls the more than one hundred lighting instruments mounted on trusses over the stage.

The 1516A mixer is from the old Hilton days and Schmal says one of its limitations is that it has only two foldback busses: he needs more. But he's come up with an innovative solution. The drummer, whose monitor requirements can be demanding (and different from the rest of the band), mixes his own monitors with a small, rack-mounted, six-input Yamaha 406 mixer; a 1/3rd octave EQ amp; and a PAS coaxial wedge. He gets fed everything but drums. The bass and keyboards are split to him before going to the house console, and he gets the vocal foldback from the house board as

initially consisted of two boxes, one with four ten-inch drivers and the other with a single fifteen. The fifteen blew the first day! Schmal called the company and explained the problem to Mr. Hartke himself, who suggested that the blown fifteen be replaced by a second 4x10 cabinet. It worked: plenty of level and no more blown drivers.

The room is tuned flat, and the on-stage wedges are tuned to the vocal mics. Schmal also feeds his subs directly from a matrix output from the board. Many places send a program feed of everything to the crossover and let the circuits do the splitting. By dedicating a sub-woofer feed, he can get a much cleaner, feedback-free signal.

Hans Kennon, the Castle's entertainment director, was instrumental in bringing the Viva Lounge its new focus. Seeing the trend towards dance-oriented entertainment growing stronger, Kennon wants Viva to be an "active" room: "People don't want to just sit there when they're listening to heavy dance music...they want to get up and move!"

So, six months ago Hans had a dance floor put in, along with four additional sub-woofers, egg strobes, color changers, a strobe chandelier and revolving "dice"

(continued on page 62)

well. There is also room for any electronic drums that are part of the set-up. This makes for a happy drummer, and allows Morucci to keep the same two monitor mixes for all of the shows in the lounge.

The keyboard send, by the way, comes from two TOA 4x1 mixers. The keyboard player mixes all his synthesizers into two TOA 4x1 mixers and into his own Community Light and Sound wedge, modified by Schmal. This is the same signal that goes to the drummer's mixer, as well as to the house console. Even the bass player has his own TOA 4x1, if necessary. For bassists using different axes, this saves re-plugging and resetting levels and EQ each time instruments are switched during a set. With over ten shows a night involving three different bands, any minimizing of change-over is a real blessing.

The bass plays through a Gallien Krueger head into a Hartke system, that

The Quality Gamble

According to Starobin, the quality of sound in a given Casino lounge varies with the clarity of upper management's concept for that lounge (and with the amount of money budgeted for its sound system):

"Sometimes management doesn't have a very clear idea of what type of entertainment a lounge should feature, as can be seen by the many changes some lounges have been through in a very short period of time. A consultant hired to spec out a system for a lounge faces a severe handicap if he's not told whether that lounge will feature a lone jazz pianist or a six-piece rock act. And how is the tech who's supposed to mix the sound going to make a hard rock act sound good over a system that was originally designed for quiet jazz?

"Lack of communication and lack of funds are two important factors contributing to the uneven quality of sound in some lounges. There are a lot of people involved in putting together a well-conceived and well-executed lounge — upper management, the marketing director, the entertainment director, the consultant, the contractor, the lead tech, and the crew — and they all need to communicate and coordinate or the result will be chaos. And budget certainly has an effect on sound system quality. If there is no planning beforehand, and equipment is added only as funds become available, you wind up with a system lacking coherence and integrity."

THE RIVER CLUB

By Mike Klasco

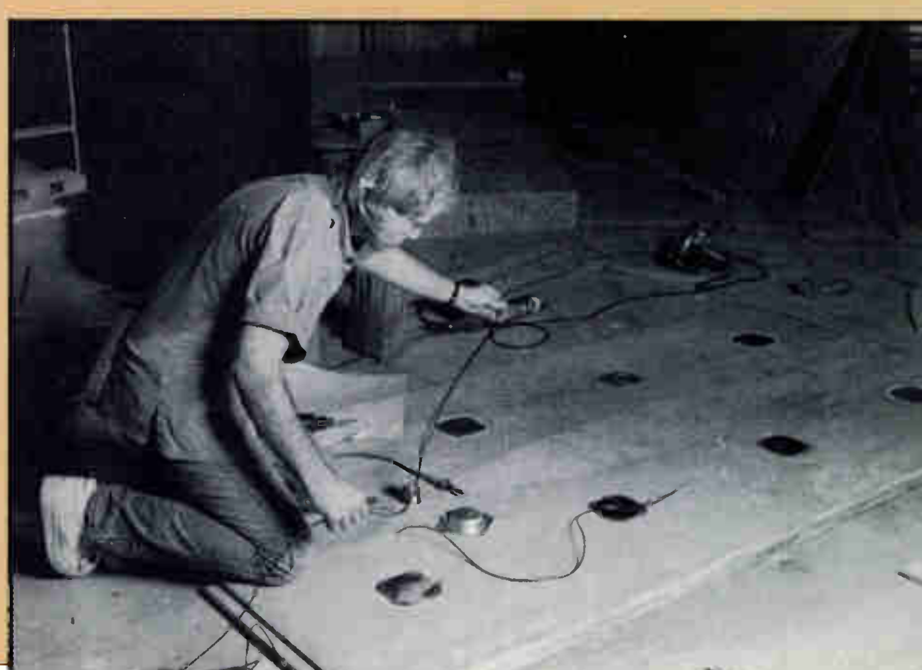
Formerly a nightclub owned by the great jazz guitarist Charlie Byrd, the newly re-opened River Club has become one of the most exclusive and elegant restaurants in Washington, D.C. Architect Leonard E. Horowitz (of the Horowitz Design Group) designed the soft curves and long, flowing lines of its luxurious art deco interior. The elegant ambience is enhanced by rich Italian marble, delicate etched glass, an eight foot waterfall—and a fountain built right into the bar! The focus of the club, however, is the dance floor.

Roger Goodman and Associates, Biloxi, MS, was the primary designer and installer of the sound equipment and acoustical modifications; my company, Menlo Scientific, Berkely, CA, provided acoustical and audio consulting.

The new design presented several problems. It called for dynamic and powerful sound on the dance floor that would not interfere with normal conversation at nearby dining tables, and at the same time prohibited the placement of visible speakers on, near, or over the dance floor.

Our solution to these problems was to put the dancers in the near-field of the sound system. The cut-glass ceiling had black geometric areas worked into the design—areas that proved to be ideal locations for the loudspeakers, providing excellent coverage of the dance floor. The ceiling varied in height from eight to nine feet above the dance floor, so the distributed sound system would typically be only two to three feet above the heads of the dancers, effectively placing them in the near-field. (The near-field in acoustics is where the direct sound from the source is predominant. In recording studios, for example, speakers used for monitoring are located on the meter bridge of the console, placing the listener in the near-field and minimizing the influence of the control room's acoustics on the listener.)

Another attribute of close-in monitoring is that the sound level drops off quickly when critical distance from the source within the near field is reached. Critical distance is the location where the level of the direct sound has dropped

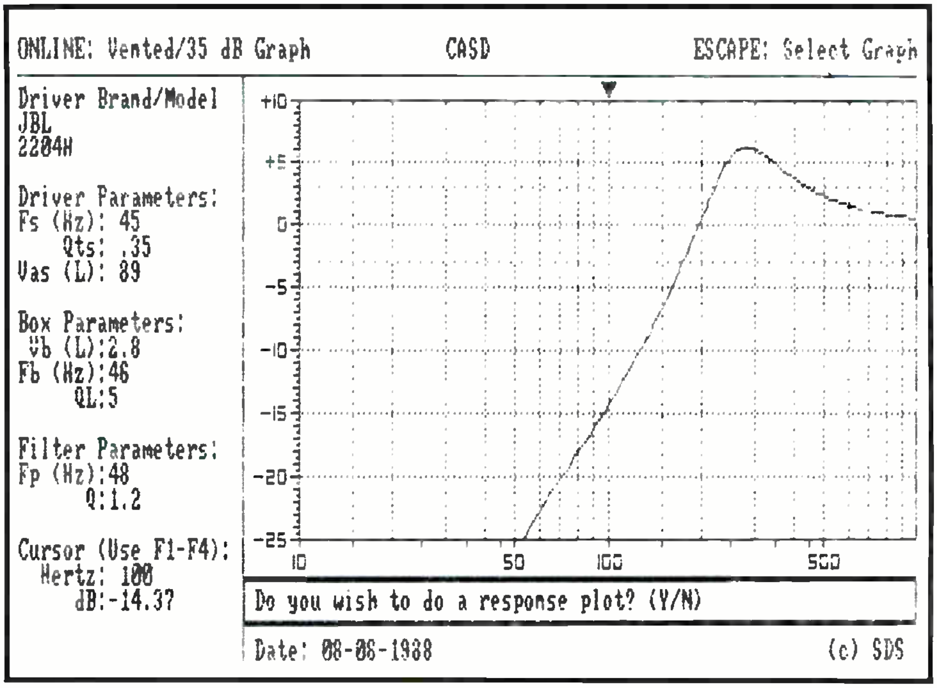


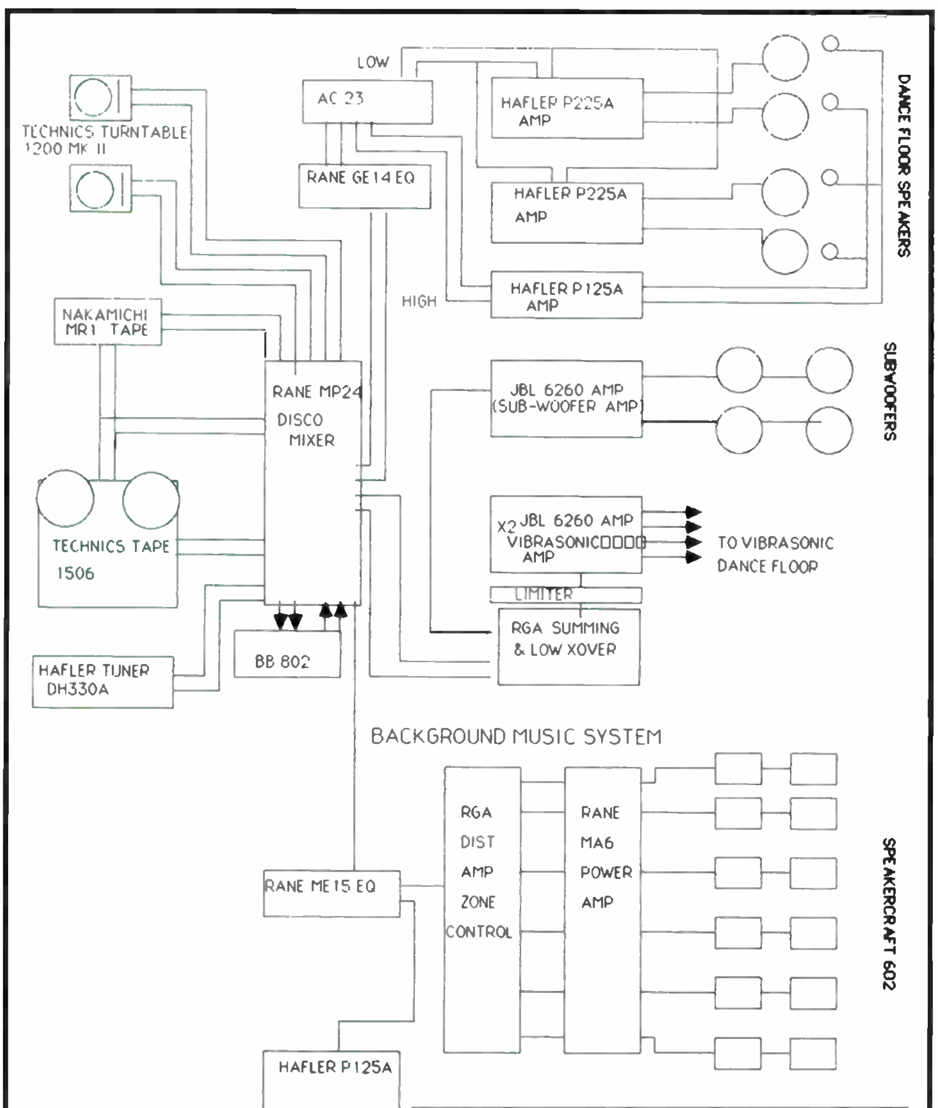
down to the level of the reverberant field. Beyond the critical distance, the reverberant field dominates, and the sound level is fairly consistent (although intelligibility is not).

At the club, the critical distance is reached about 15 feet from the speakers — off the dance floor, but before the dining tables. Viewing a floor plan, some dining tables appear closer than this to the dance floor, but the required distance is still achieved as the ear height is less than 4 feet from the floor, while the speaker height is typically 8 feet. Of course, dancers are standing rather than seated, increasing the sound level that they will hear. Therefore, very wide, uniform coverage on the dance floor was required or "hot spots" in the sound field would have resulted.

The cone loudspeakers (camaflouged with black fabric) were crossed over to JBL bi-radial super-tweeters. The 100 x 100 degree pattern of this speaker was ideal for our requirements. While pattern control in the mid and high frequency range in a distributed ceiling system is achievable with careful engineering, pattern control of low frequency sound would have required a bass horn mouth larger than the dance floor! The solution to the problem of keeping the dominant bass energy directly on the dance floor was to use vibrational energy rather than sound energy. In other words, low-frequency vibrations would be coupled directly to those who want to experience the "disco" sensation.

To achieve this, Vibrasonic bone conduction transducers, which reproduce audio signals from 10Hz to 100 Hz, were built into the dance floor. Vibrasonic is a proprietary design (patent pending) of Menlo Scientific. You can both hear and "feel" music; Vibrasonic produces music you can feel. The transducers use a moving magnet configuration with a stationary voice coil. The low frequency audio signal passes through the stationary voice coil, causing the magnetic system





RIVERCLUB RESTAURANT SOUND SYSTEM FLOW CHART

to attract and repel in response to the signal. A reactive force passes through the suspension and device casing into the floor.

Powered by a conventional amplifier (a JBL 6260), preceded by an electronic crossover, 32 transducers were used in the 250 square-foot parquet dance floor. The Vibrasonic devices are less than 2 inches deep and are mounted on the underside of the dance floor. Vibrasonic was not used in lieu of bass speakers, but as a way to significantly reduce the level of the bass speakers—yet on the dance floor profusely deep bass is perceived.

There are numerous advantages in having the bass energy emanate from the floor, including enhanced perception of the rhythm by the dancers, and reduced resonances in the dancers' sinus cavities (meaning less listening fatigue even at high intensity levels). Upon leaving the dance floor the bone conduction effect is completely eliminated and no vibrational energy is structurally transmitted beyond the dance floor itself.

A sub-woofer was built into the waterfall pillar for situations (such as private parties) where deep bass would be desired throughout the club. Other sub-woofers were disguised elsewhere throughout the facility. The sub-woofers are vented boxes, designed with the help of Scientific Design Software's Computer-Aided-Speaker-Design program. The drivers are JBL 2404H in 2.8 cubic foot enclosures using B6 alignments tuned to 46 Hz. An active filter is set for 48 Hz with a Q of 1.2. (see sds graph).

Direct sound to off-dance floor areas is provided by Speakercraft 602 plate speakers operated at low levels. These units use a 6.5-inch woofer and dome tweeter. While the sound quality is good, the power handling and efficiency are only fair, and the 602 is best suited for low level operation. These flush mount speakers have various grill options (perforated screen or grill cloth), are attractive and reasonably priced. Six zones with separate level controls allow the sound levels to be matched to the local ambient noise levels and desired sound pressure levels. The control console is a Rane MP24 disco mixer. Music sources include the inevitable Technics 1200 mkII turntables with Stanton cartridges, Nakamichi MR1 cassette deck, Technics 1506 open reel tape deck, and a Hafler DH-330A tuner. Signal processing includes a BBE 802 for "aural enhancement," Rane GE14 and ME 14 graphic

(continued on page 67)

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BOOK REVIEW

by Ted Uzzle

Survey of Modern Acoustics

ARCHITECTURAL ACOUSTICS
by M. David Egan, McGraw-Hill,
$39.95

After reading many books on acoustics, one might get the impression that their first chapters were all written by the same person. These books all use the same examples (often the same graphics) to explain the same concepts. The first chapter of *Architectural Acoustics* is titled Basic Theory, and right away one can see that this book is a little different. Professor Egan has taken a fresh look at basic acoustic theory. Frequency, for example, is related to wavelength, to musical pitch, to period, and to ordinary household noises such as vacuum cleaners. Formulas are invariably given, usually followed by a nomograph or other simplified computation method. It is hard to imagine a more effective conceptualized introduction to the basics of sound.

The second chapter deals with sound absorption, and is one of the few introductory discussions of this subject to delineate clearly the different physical mechanisms by which sound energy is converted to other (inaudible) forms of energy, and thus dissipated in ways we cannot hear. It is very easy to understand why absorption by porous materials, by undamped panels, and by cavity blocks all behave differently, but most published lectures don't even attempt an explanation.

One could quibble with the introduction of the reverberation time concept in this chapter. After a lengthy conceptual discussion of absorption coefficients (where they come from, what they mean, how they're measured), there is a short introduction to the concept of reverberation time. There's a thorough discussion of calculating reverb time, and numerous examples, but the concept itself isn't dealt with in much detail. Areas of particular difficulty, such as absorption by people in an audience or on a stage, are only referred to obliquely (in footnotes to a data table).

The third chapter, Room Acoustics, is the very heart of the book. It's with this chapter that the book really comes alive for an architect, and demon-

(continued on page 67)

JBL PRO PRODUCTS IN USE

JBL Professional has reported some new installations using their products. Rosner Custom Sound, Inc., located in Long Island, New York has just completed a renovation of the New York Philharmonic Orchestra/Metropolitan Opera Mobile Park concert sound system.

The new installation includes a 24-channel Soundcraft 500 console, four JBL 6230 power amplifiers, twelve JBL 6260 power amplifiers and two UREI 562 feedback supressors. Each of the three-way speaker towers houses eight 2225H woofers in 4550BK enclosures, two 2350 horns with 2440 and 2441 drivers, four 2356 horns with 2440 and 2441 drivers and twelve 2405 tweeters in a curved array. The speaker towers retract hydraulically onto their own forty-foot trailer bed. The system was designed by Klepper Marshall King Associates in New York.

JBL also reports that numerous JBL components were just installed in the Lutcher Theater in Orange, Texas. The new system includes six JBL 2445 compression drivers, two 2366 biradial horns, four 2365 biradial horns, and six 2405 compression drivers. The house sound is mixed through a 32-channel Soundcraft 600 console. The Pentecostal Gospel Lighthouse in Sulphur, Louisiana has installed JBL components in their main sanctuary. The installation includes three JBL 2385 biradial horns, three 2445J compression drivers and three 4648 dual 15-inch loaded low frequency systems. The system is mounted above the flat ceiling, designed to project sound through a grill mounted in the ceiling.

Cinema Sound System In Mall

Bose Corporation and R/C Theatres in Reisterstown, Maryland jointly announced the installation of the Bose Cinema Sound System in the R/C Theatres at the New River Valley Mall in Christensburg, Virginia.

The Bose Cinema Sound System feature the Acoustic Wave Cannon System, a loudspeaker developed by Bose specifically for the theatre industry. The system was installed by Standard Theatre Supply.

Scoreboard Control Room To Metrodome

Video Midwest, the video equipment division of Vaughn Communications, Minneapolis, is installing a scoreboard control room at the Humphrey Metrodome in Minneapolis. Joining them will be the Jumbotron Division of Sony, who will be installing the world's largest indoor scoreboard, measuring 19 x 33 feet.

The new scoreboard and studio-control room system includes equipment from Sony Broardcast, Grass Valley, Dubner, Hitachi and Sony Jumbotron. Video Midwest designed and sold the system.

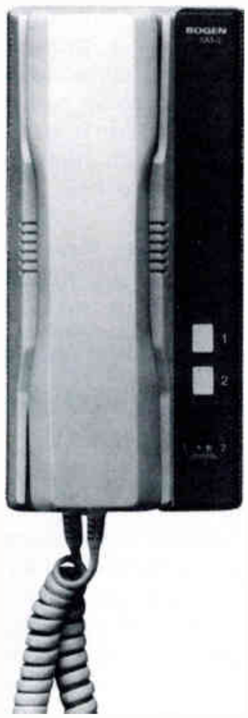
QSC Audio Update

The Lakewood Church in Houston, TX, is using eleven QSC model 3800's and eight model 3500's to power their main sound reinforcement system. L.D. Systems in Houston handled the sale and installation.

Crystal Taylor Systems, Inc., in Bensalem, PA, has just sold and installed fifteen QSC 3800 amps for the lawn sound system at The Mann Music Center in Philadelphia. The amplifiers are being used with Turbosound speakers to cover the 10,000 lawn seat system. Mann Music Center is home for the Philadelphia Orchestra's summer outdoor season, and hosts summer touring acts. Crystal has also just purchased 20 QSC model 3800's for their main house system, currently out on national tour with The Jets, and their monitor system has recently been updated with eighteen QSC model MX 1500 amplifiers.

Carpenter's Home Church Installs Sony Video

Sony and the Carpenter's Home Church, Lakeland, FL, have announced the installation of a Sony video projection system. Carpenter's Home Church is the largest church sanctuary in North America. The size of the building established the need for a large-screen video system to enable everyone to see services on the stage. The Church uses two stacks of VPH-1040Q projectors, one on either side of the 120-foot wide stage. In addition, the church uses single VPH-1040Q's in various sections of the complex. It fills a seven-foot screen in either of the two conference rooms, and is used in conjunction with 16-foot screens in chapel auditoriums for church-sponsored classes. The institution owns a full line of Sony production equipment, including Betacam VTRs, one-inch machines and U-matic decks, as well as a BVE-900 edit controller and an MXP-29 audio mixer.



New Products from Bogen Communications, Inc.

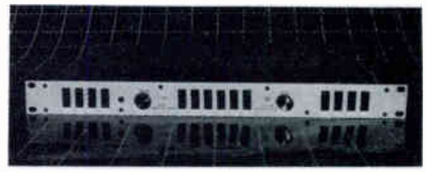
Bogen Communications Inc. has introduced the SM-3, an interphone designed to help improve productivity and customer service in supermarkets and other retail or wholesale businesses. From two to 50 interphones can be connected to any standard paging/background music system to provide instant paging or other store-wide announcements from any station, as well as two-way intercom.

Circle 4 on Reader Response Card

Panasonic Introduces New CCTV Product Line

The Panasonic Industrial Company (PIC) Closed Circuit Video Equipment Division made the largest product introduction in its 23-year history at the ISC show held recently in New York. PIC unveiled four series of solid-state cameras, two ultra-small solid-state cameras, seven lenses, a time lapse recorder, an intermittent time lapse/event recorder, and an indoor housing unit. The new product line features many engineering breakthroughs and incorporates the latest in CCTV technology, according to the company.

Circle 5 on Reader Response Card



Wohler's Self-Powered Stereo Monitor

Wohler Technologies has introduced AMP-1, a self-powered stereo monitor speaker system in a single rackspace (1.75-inch) package. The bi-amp design uses four 10-watt power amps to drive three speakers, with the bass region of each channel combined into a center channel. Response extends below 100 Hz and above 10 kHz. The maximum SPL is 102 dB at two feet.

Circle 6 on Reader Response Card

Tannoy Monitor Introduced

Tannoy has introduced the PBM-8 playback monitor for the mixing engineer. The compact enclosure employs an eight-inch poly cone mid bass transducer, using a long-throw, high power voice coil. Low frequencies are controlled by an optimumly tuned port located on the rear of the loudspeaker. High frequencies are provided by a one-inch ferro fluid cooled polyamide dome tweeter which extendes high frequency bandwidth beyond 20 kHz. Transducers and crossover assemblies are housed in a partical wrap cabinet designed to minimize cabinet resonance and high frequency reflection.

Circle 7 on Reader Response Card

Aiphone Introduces Access Control System

Aiphone Corporation has introduced an access control system that enables users to release any of 40 doors with a press of a button. Callers can be identified by voice at any one of a multiple of entrances throughout a facility. Once an identification is made, the user can press a button located on the system's master station to allow visitors into the building. The button operates a door strike at the substation that is in communication with the master station.

Circle 8 on Reader Response Card

Two Models Announced by Orban

Orban's Model 787A Programmable Mic Processor is designed for mic- or line-level applications where the ability to store and recall processing can increase efficiency and provide a constant result. The 787A features a three-band "constant-Q" parametric equalizer, a compressor with adjustable release time, a de-esser, a noise gate and/or compressor gate, and effects send and return ports. The system, which fits in a two-rack space, has a complete control setup that can be stored in 99 memory registers.

The Model 642B Parametric Equalizer/Notch Filter from Orban features dual four-band or mono eight-band configurations that are selectable by a front-panel Cascade switch. Each band is tunable over a 20:1 frequency range. The "constant-Q" design of the filters provides +16 dB boost and 45 dB cut in each band. "Q" bandwidth is continuosly variable from 0.29 to 5.0.

Circle 9 on Reader Response Card

Audio Distribution Amp Available from FSR

The ADA-4, by FSR, Inc., is a 1 x 4 audio distribution amplifier. The ADA provides a balanced high impedance bridging input that accepts levels up to +22 dBm. The amp also features four outputs that are transformer coupled (600 ohms) with short circuit protection and XL type connectors for simple hook-up. The ADA-4 can be mounted on a table or a rack.

Circle 10 on Reader Response Card

Loudspeaker Models Added to Prologue Line from Shure

Shure Brothers Inc. has announced the introduction of two loudspeaker models. Both are additions to the company's Prologue line of sound reinforcement components. The Prologue 250 is a two-way vented enclosure system, designed to handle up to 20 watts of power. The Model 250 weighs 12 pounds and is for small-room sound reinforcement in paging and background music applications. The Prologue 260 is a weather-resistant horn projector loundspeaker. The Model 260 is capable of developing 114 dB of output from a 20-watt input; it features a directional horn constructed of Armo-Dur and incorporates an attached 20-foot cable. The 260 can be permanently affixed to walls or ceilings, or mounted on any 5/8-inch microphone stand.

Circle 11 on Reader Response Card

Rack Mount from Nova Electric

The Galaxy 3KVA Uninterruptable Power System (UPS) by Nova Electric, Inc. is an on-line system designed to be mounted in a 19-inch equipment rack. UPS provides complete isolation from power outages without switching. It operates at 120 VAC, 208 VAC, 220 VAC and 240 VAC and at 60 Hz or 50 Hz. Nova's system also has a built-in static transfer switch.

Circle 16 on Reader Response Card

a closer look

by gary d. davis

Crown International's CM-310 Differoid Mic

The CM line of hand-held microphones (the CM-100, CM-200, and CM-310) are electret-condenser types, provide studio-quality sound, yet are rugged enough to withstand hard professional use in the field. All have built-in pop filtering for effective suppression of explosive breath noises. All are designed to minimize handling and other mechanically induced noise. And each CM microphone can withstand repeated drops and abuse, as well as extremely loud sound pressure levels without distortion.

The outputs are balanced, with low impedence, allowing long cable runs without hum pickups or loss of high-frequency signal. Each microphone can be phantom-powered from the console or another remote power source.

The Crown CM-310 Differoid reflects advanced technology in high-level sound reinforcement microphones. Combining some of the best qualities of the cardioid mic and the differential mic, this smooth, 60Hz-17 kHz condenser mic is perfect for stage vocal use.

Crown's unique, patented methods of improving rear discrimination, far-field rejection, and high-frequency response give the CM-310 meaningful performance advantages over other, more conventional microphones in high-level sound applications.

The CM-310's differential (noise-cancelling) capsule provides exceptional gain-before-feedback. The CM-310 can be operated with extremely high stage-monitor levels without feedback. But the greatest benefit of the CM-310 is the control of the mix that it offers. With conventional directional mics, the background sound level of musical instrument amps/speakers and stage monitors is so high that the sound from the vocalist can't be differentiated by the microphone. If the voice channel is brought up, the background level comes up with it. It is very hard to pull the voice up out of the mix. The CM-310 differentiates between near and distant sound and favors the closer sound of the vocalist by as much as 30 dB.

Comments

Crown has sold microphones for years, but until they picked up on Ken Wahrenbach's PZM (Pressure Zone Microphone) technology, repackaged it and promoted it heavily, Crown had kept a fairly low profile in the professional mic market. The an-

(continued from page 62)

SUPPLIES SERVICES SUPPORT

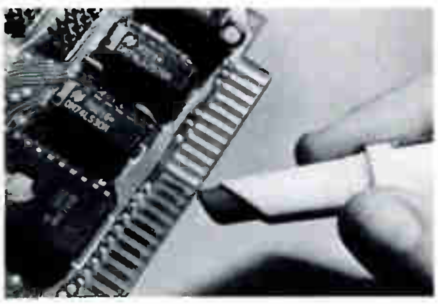
B&K-Precision Portable Test Bench

A hand-held test instrument called the Test Bench, Model 388-HD has been unveiled by B&K-Precision. This digital multimeter includes a 41-range voltmeter, ammeter, ohmmeter, frequency counter, capacitance tester, logic tester, transistor tester, diode tester and continuity tester.

Among some of the specifications, DC accuracy is within 0.5 percent and AC accuracy is within 1.25 percent from 40 Hz to kHz. Input impedance on DC and AC is 10 megohms, and current measurement capabilities extend to 20 amps, with resistance measurement to 2,000 megohms.

The Test Bench features an oversized LCD display and is packaged in a drop-resistant yellow safety case.

Circle 1 on Reader Response Card



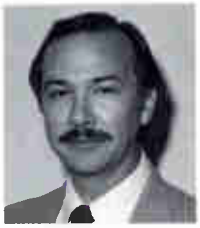
Micro-Circuits Field Service Kit

Micro-Circuits Company is introducing a field service kit, No. 4c3k, which transforms the "quick fix" into a permanent repair. The kit was previously available to primarily telephone engineers and managers.

The popular "quick fix" consists of opening and closing all connectors in a malfunctioning circuit to temporarily clean up the one or two marginally defective connections which may be causing the problem. With the 4c3k Kit, the quick fix is made permanent by applying a thin layer of 4c3m gold replacement to the connector while it is open. The procedure takes about six seconds per connector and costs approximately 12 cents in materials.

Circle 2 on Reader Response Card

FACES AND PLACES



Spriggs Named National Sales Manager

Dave Merrey, president of Altec Lansing, Oklahoma City, OK, has named Jerry Spriggs as national sales manager, responsible for the management and supervision of Altec Lansing's sales force and sales operations department. A member of the AES, Spriggs was previously district sales manager at Altec.

Klark-Teknik Appoints Sales Manager

Sam Spennacchio has joined Klark-Teknik as national sales manager. Besides overseeing the national sales rep network, Spennacchio will be coordinating all advertising and public relations activities. In addition, he will be involved in product planning and development for Klark-Teknik and its affiliates: DDA, Midas, Milab and Celco Lighting. Spennacchio was previously director of sales and marketing for C-T Audio Marketing, Inc. He is a graduate of the University of Miami School of Music with a degree in Recording Engineering Technology.

Kalliches Joins Edge Distribution

Danny Abelson, vice president of sales and marketing for Edge Distribution Corporation (EDC), has recently appointed Tim Kalliches as the company's applications engineer. Kalliches will provide applications and technical support for product lines distributed by EDC, including Turbosound and BSS Audio. He was previously with Altel Sound Systems.

Promotions At Pro Co Sound

Pro Co Sound, Inc., Kalamazoo, MI, has announced the promotion of two managers in their marketing and sales division: Jerry Smelker (formerly national sales manager) has been named vice president, professional products, and Jeff Garstick (formerly eastern regional sales manager) has been named vice president, commercial sound products.

Bogen Names New Sales VP

David A. Chambers has been named vice president, sales, sound products, at Bogen Communications, Inc. He will be responsible for the marketing and sales of all Bogen products in the sound contractor and electronics distributor markets. Chambers has served as Bogen's national sales manager since 1986, and previously spent seven years with Atlas Sound.

Allen & Heath Exec Appointed

Allen & Heath has announced the appointment of John Ball to chief executive. Ball was previously with Wharfedale Speakers as deputy managing director, and was later a partner at KEF Electronics Ltd. He managed the Auditorium Services division of the Rank Organization and then became managing director of Theatre Projects, a leading sound and lighting equipment hire and sales company. Four years ago he joined the Robert Luff organization. In addition to his work with Allen & Heath, he is on the boards of various other companies in the world of entertainment technical equipment.

LETTERS

(continued from page 12)

It is not our aim here to be promoting UL: as for all manufacturers, they can be a pain in the neck for us. Nonetheless, with the extremely high tendency for lawsuits today, it is no longer prudent for any of us to conduct our businesses as if it was 1950.

Robert S. Fisher
President
Fisher Berkeley Corporation

CONSULTANT'S COMMENTS

(continued from page 14)

You can't attach wiring without the proper punch-down tool, you can't carry heavy equipment without a hand truck or dolly, and you can't look for a ground loop without an appropriate oscilloscope. The most important tool of all is knowledge. How can you be sure that your technicians aren't doing something that will have to be undone later? Most importantly, give your techs the correct information—they should be working with the latest approved shop drawings, and have access to all the installation manuals they need. Wiring a piece of equipment incorrectly through sloppiness or laziness is one thing—and it certainly is not acceptable. But having to rewire something because a tech had to make a guess because the correct information was not available, or because the drawings were not updated, is even worse—it could just as easily have been done correctly.

Technicians should have direct access to the project manager for procedural questions and to the project engineer for technical questions. If they don't get quick and effective answers, work will not get done, or will be done wrong. Another important tool is a proper system of procedures—how quickly can they obtain missing or replacement parts, and how long does it take for the manager or engineer to get the answers back to them in the field.

Failure to respond to the technician can result in an attitude problem. A tech, as well as his foreman or field supervisor, can easily get the impression that the main office has its priorities somewhere else. Depending on the personality of the tech, he'll either get the idea that not caring about the project is an acceptable attitude, or he'll become a martyr, the only one in the company who can get the job done. Neither attitude will lead to a successful completion of the job. The simple courtesies of returning phone calls, answering questions without making the asker feel foolish for asking (Remember that the only foolish questions are those that you do not ask), and giving the impression that you are behind them all the way. A simple site visit with a few "attaboys" and an occasional round of beers (or whatever is appropriate) after work will do wonders. And while everyone knows that sooner or later there will be a crunch that requires extra work from the techs in the field, fifty to seventy hour weeks should never be the norm. Tired workers who haven't seen their families or friends recently just don't work as efficiently. Finally, working late to get the system nearly perfect before the consultant arrives is one thing, working late to finish before an unrealistic deadline because some important equipment arrived at the last minute is quite another.

Perhaps the most important thing

is to make sure your technicians stay informed about the sound industry. Providing magazines and books to read is a start, and taking them to a local convention or trade show (even though it might not pertain to their day-to-day work) helps them realize that they are part of a specialized industry. While there are educational opportunities for project managers, engineers, and salesmen, advancing the knowledge of your technicians can be more difficult. There are certainly electronics and servicing courses available at many technical schools and colleges, but it is not often that these courses pertain specifically to audio. (If you know otherwise, I would like to hear from you) From what I have observed in the field, an informal "apprenticeship" is a very effective way of passing along all but the most advanced skills. Technicians with less experience are put on a project with your "old timers" and learn while working with them. Please note that your less experienced worker won't learn much if he is doing "gofer" type work and not working alongside the more experienced technician (much of the success will depend on the personality of the teacher—make sure he realizes the importance of the apprentice aspect). There must be time for questions and discussions, and if you include time for this in your budgets, you shouldn't feel any pressure from the inevitable loss of efficiency. This is an investment that you are making in a future resource.

When I make an interim inspection on a project during its last phases of completion, I usually like to hang around in the rack room with the technicians during the last hour of the day. From them, I almost always get a more realistic idea of how the job is going and when it will actually be completed. As the system designer, I like to be accessible to the technicians, because I get excellent feedback from them about the design and how it might be more easily (and thus less expensively) done next time. Frequently, the fact that they were able to talk to the consultant makes them feel that they were making a contribution to the overall project. And by the way, I have been known to say "thank you" to the technicians for installing a successful system that helps make me look good. Do you do the same?

THEORY & APPLICATION

(continued from page 18)

posure. As hearing damage assessment continues, it is tending more and more toward considering the overall lifetime acoustic energy exposure, and these intermittent events are therefore averaged and concluded to be non-significant.

Audio Discussion

This does suggest some interest in the parameters under which the audio system must function during a major sporting event, in that the old rule of attempting a 25 dB signal-to-noise ratio would be an unreasonable objective in cases of high levels of sports noise. It would be interesting to determine the actual S/N of these games, and this is under evaluation at this time. I suspect that a 10 dB S/N would more appropriately characterize the actual performace of audio systems under these loud conditions, and we are attempting to confirm this at this time.

This raises an interesting point with regard to ambient noise sensing or monitoring at games: what is a reasonable level for sound system operation under such widely varying conditions (and how is this best implemented)? This is also a matter of current study at the Metrodome. ■

ATLANTIC CITY

(continued from page 49)

lights. The groups he hires are the "latest, greatest bands" in the city. He wants groups that have been working together as a unit for a long time. "A consistent group that works together all the time is a better group for dance material than a put-together band that just doesn't have the funk that a working unit does."

Kennon is quick to explain that "the lounge won't make or break the hotel. If we had only Viva's we'd be crazy!" The high-energy Viva Lounge is balanced by the Casino Lounge, an intimate cabaret-style lounge that offers quality entertainment. Headliners include Joe Williams, J P Morgan, Allan and Rossi, and Don Cornell, as well as the better jazz and lounge locals like Melanie Rice and Marilyn Lipton. For the star acts there is a tech on lights and sound (the lounge groups are left to fend for themselves). The room has an adequate system (two Yamaha 406 mixers, a small Kliegl board, Altecs, and ceiling speakers), quieter [than Viva's system] because of its proximity to the active casino floor.

Player's Lounge in the Sands Hotel and Casino is another high-energy room. Two technicians run sound and light for the shows there. Jay Venetianer, the entertainment director, sees the Player's Lounge as a "mini-showroom," featuring acts like Thelma Hosuton, Maria Muldaur, and the "Roberts-Meisner Band," along with the better rock and top 40 groups in town. Jim Black, lead tech, designed one of the city's best-sounding rooms. Two Yamaha boards serve for mixing, and a Leprechaun board controls the lights. The stage and outboard racks are well equipped, with plenty of power for a clean sound, and adequate bass, thanks in part to the two JBL 18-inch subwoofers.

The lead tech at the Claridge, Leigh Hartsfeld, (better known around town as "Pirate,") overcame tough obstacles to create a little gem of a lounge: the Celebrity Cabaret. A showcase for such talent as Billy Daniels, Jose Greco, Sal Richards, and others, the Celebrity had one small problem—there was no budget for a system. So Hartsfeld took (pirated?) components from his showroom cluster and used them as stacks in the lounge. The sound booth has a Yamaha board and decent outboard gear.

The Top of the Trop is the Tropicana's jewel. It is located on the 20th floor and offers a commanding view of the city and ocean. It was a bar that featured a local live radio broadcast for years, and recently underwent renovation. Nick Oliva, the lead tech, put in a three-cabinet Bose system and a CD player. The room features premier jazz talent and has become quite popular.

There are a number of smaller lounges around town that are worth mentioning for the quality of their sound: Billy's Pub at Bally's Park Place, Pirate's Cove at the Showboat, The Punchbowl at the Sands (a set-it-and-forget-it soundman's delight), and Gatsby's at Bally's Grand (one of the best-sounding rooms in town).

Entertainment plays a significant role in the story of casino competition, and audio is a vitally important part of entertainment. Each casino has its own lounge, and each lounge has its own entertainment style—from small, intimate piano bars to flashy dance clubs, from jazz to rock. Only those casinos whose sound systems are competently managed, designed, and operated will succeed in providing a level of entertainment befitting the "resort capitol of the world," Atlantic City. ■

RIVER CLUB

(continued from page 52)

equalizers, and proprietary Roger Goodman and Associates electronic crossovers (originally fabricated by Rane for Richard Long and Associates). The amplifier racks were placed in a remote location to conserve revenue-producing space. Except for the JBL 6260 amplifiers powering the Vibrasonic floor and sub-woofers, the amplifiers were Haflers.

The block diagrams shown here illustrate the system interface and the equipment used. The diagrams were prepared with MacDraw for Macintosh computer, which is a handy program for Mac users (such as Bose Modeler users). Alternatively, Patton and Patton's Flow Charting program (for IBM compatibles) can be used by JBL's CADP, Prohs and Harris PHD, and Altec's Acousta-Cadd and AutoCADD users. Flow Charting and MacDraw are quite easy to learn and faster than AutoCadd for the preparation of block diagrams, even if you are already using AutoCadd for mechanical design tasks.

Preliminary predictions of the room's reverberation time (before remodeling) were prepared with TPM software's OPTORT60 program. OPTORT60 is one of a number of acoustical design programs TPM offers; other programs aide in the determination of AI (Articulation Index), STL (sound transmission loss, i.e., sound mechanically transmitted through walls and floors), and prediction of road noise.

The combination of a fairly low ceiling, the close proximity of (acoustically absorbent) dancers to the speakers, and carpeted floors resulted in satisfactory reverberation time curves. Excellent diffusion was achieved due to the cut-glass contoured ceiling and multi-faceted walls. Some acoustical treatment was required above the dance floor ceiling to suppress resonances in the ceiling structure due to secondary radiation from the overhead speaker enclosures. Secondary radiation is caused by speaker enclosure panel resonances, diffraction off the front baffle and other closely coupled surfaces (grill cloth frames, etc.). The air cavity above the ceiling over the dance floor was damped by semi-rigid acoustical fiberglass and SAMCO (class-I fire rated) acoustical foam wedges.

For analysis of the room's acoustics and calibration of the sound system we used the computer-based Sigma System RS-4000 one-third octave spectrum analyzer /reverberation timer. This instrument is a real-time spectrum analyzer, and it captures and displays time/energy curves for speaker time alignment, calibration of electronic time delays, transient response measurement, and three-dimensional analysis such as spectral decay (time/frequency/energy plot of RT60). Additionally, within the same computer, an IQS FFT analyzer was installed for calibration of the electronic crossovers, echograms and vibration response of the Vibrasonic dance floor. Measurement of the dance floor energy/frequency curve (frequency response) was accomplished by the IQS system, generating a test impulse of linear transfer function (flat response), amplifying the impulse, and sending it to the Vibrasonic transducers in the floor, then measuring the response with a PVDF (polyvinylidene fluoride) piezo film accelerometer manufactured by Pennwalt. Because this device has a very wide frequency range, and is not resonant (as are many commonly used ceramic units), it is very linear. Also, the PVDF device is very thin (typically 12 to 110 microns), a single layer of film that's easy to apply to just about any surface, and does not add any mass (which can be a problem with conventional ceramic or magnetic transducers).

The job was completed on time, sounded terrific, and everyone got paid—the true test of client satisfaction! Good reviews in the newspapers helped spread the word on the River Club, and the Vibrasonic floor created quite a sensation. Just as this article was completed, plans for an expansion of the River Club arrived! ■

BOOK REVIEW

(continued from page 56)

strates to all others what architects must attend to for acoustical success in their buildings.

Drawings of buildings and building details abound, sometimes three or four to a page. Here we see audience seating related to both sightlines and to sound distribution, both in plan and in section. Architectural elements that reflect, diffract, and diffuse sound are described in detail, and the calculation of sound paths is shown. (Sound path manipulation involves such simple requirements as echo avoidance, and such complex achievements as satisfactory lateral reflections in most seats of a concert hall.)

Architect's checklists are included (for lecture halls, worship spaces, multipurpose auditoriums, etc.); they are practical and direct. Architects will find these checklists to be of great benefit during the design phase of a project. Also, sound and communications professionals will find them to be credible authorities when settling the many disputes that inevitably arise with architects.

The chapter concludes with four case studies, from the very large (Boettcher Concert Hall in Denver) to the very small (a mixing studio at Todd-AO in Hollywood).

Architectural Acoustics next turns to the topic of sound isolation, followed by a look at noise and vibration from mechanical systems. This pair of chapters may be the most interesting section in the book to readers who specialize in sound systems. Too often, noise control is thought of as

Ad Index

"black magic" (even by those very experienced in sound systems and reverberation control). These chapters will leave the attentive reader with an excellent understanding of the principles of noise control.

Noise can be transmitted through the solid stuff of a wall or other structure, or it can be transmitted through small openings and leaks, called flanking paths. Both methods of transmission are described in great detail, as well as transmission through composite structures (for example, high-isolation masonry pierced by low-isolation windows). Then follow discussions of walls, doors, ceilings, and windows, and the special requirements of particular occupancies (schools, dwellings, offices, medical facilities). Finally, outdoor noise control, for highways, airports, and the like, is included.

Then it's on to the subject of noise and vibration from mechanical systems. Heating, plumbing, air conditioning, elevators, and other types of mechanical systems and devices are reviewed in depth in chapter 5, and the general noise control principles shown in the previous chapter are applied to them.

Vibration isolation (through the use of springs or rubber) is a function of the deflection and system resonate frequency. Getting the right isolator requires a simple computation; getting the wrong isolator means you can spend just as much money and achieve nothing. The chapter concludes with a look at the always complex problems of ductwork (dealt with at length), and the containment of noise within equipment rooms.

The next chapter examines speech privacy. Ordinarily we take this to mean sound masking systems for open plan offices, but Professor Egan has produced a much broader and more rewarding discussion. The general issue of speech perception is introduced, and there is much information about speech privacy in enclosed offices, as well as design criteria and techniques for the open plan offices. Examples and checklists are included.

The final chapter deals with electronic sound systems. It touches on all the topics—central clusters, multiple clusters with delays, distributed overhead and distributed column loudspeakers, seatback systems, etc. There is little here that will come as news to the seasoned sound system professional, but very much that will help him in discussions with architects (particularly architects not fortunate enough to have read this book). For example, Professor Egan deals quite frankly with the issue of the high visibility of central loudspeaker clusters to an audience. He also shows relative costs and directional realism for central clusters versus pewback or overhead loudspeakers. It's an important discussion, and well-handled.

Appendixes summarize useful formulas and unit conversion factors, sound power level data, NC and RC curve data points, and include an articulation test work list.

Architectural Acoustics is for the intelligent, college-level beginner, with a desire to learn basic concepts, as well as practical computation and design methods. There is nothing else in print that covers as broad an area of acoustics, and covers it in as much depth. It would take a library of a dozen titles to duplicate what's in this one book, and still that library would not be as current (would these titles include references to quadratic-residue diffusers?), or as well-illustrated, or as useful in the hands of an architect. ■

CLOSER LOOK

(continued from page 62)

nouncement of three new hand-held models is, to this author, particularly exciting because it introduces a completely new sort of technology, the 'Differoid' (CM-310).

As the name 'Differoid' implies, it combines aspects of differential and cardioid sensitivity. Of course, you realize that cardioid refers to the actual sensitivity pattern (heart-shaped), whereas differential refers to the method of construction—typically two elements placed back-to-back and wired in reverse polarity. Cardioid patterns can be obtained by using dual elements, but are more often obtained by careful use of ducting both sides of the diaphragm such that rear sounds are cancelled, but frontal sounds are not.

Cardioids have become the de facto standard for hand-held directional vocal mics for two reasons: they reject sound originating from behind the mic, thus allowing the mic to be used in front of a stage monitor speaker with some hope for acoustic gain in the system, and they exhibit so-called 'proximity effect,' whereby low bass frequencies are strongly emphasized if the mic is close-talked. The proximity effect is preferred by many performers who wish to selectively add deep bass, but it can be used to further improve gain-before-feedback; the performer must hold the mic close (within an inch of the lips) to preserve the proximity effect, in which case the sound engineer can complementarily roll-off the bass with EQ thus restoring correct "nominal" frequency balance while attenuating bass leakage into the mic which may have been generated by the sound system. Cardioids, however, do not reject distant sounds per se, and their rear rejection is limited; turn up the level, and feedback will occur.

Differential mics work somewhat differently. They reject sound that originates from more than a few inches away, period. They are not especially directional—just distance insensitive. Moreover, most differential mics are limited or uneven in high frequency response characteristics. Few differential mics have been successfully applied to vocals (they have been used for straight paging applications, however, where wide bandwidth is not necessary). What Crown appears to have done is to blend the two technologies into a single handheld case.

The CM-310 Differoid exhibits proximity effect, but it cannot be used by a performer who is used to swinging the mic wildly from lip-contact distance to arm's length; at a few inches distance, the sound will simply "go away." Ah, but if the performer has a more controlled mic technique, there is a major advantage of vastly increased gain-before-feedback provided by the significant rejection of all distant sound — not only of rear-located monitors, but also of sidefills and leakage from the other monitors and house speakers.

Somehow Crown claims to have provided relatively smooth high-end response, actually with a characteristic rise in the 3 to 8 kHz region (which is typical and desirable for vocal

CLASSIFIEDS

Culture and Technology

Communications-related technology as we know it today was principally developed by the industrial thrust of major business concerns. The leader in this area was of course Bell Labs, who brought us the decibel, filter theory, digital electronics, and audio ushering us into the lightwave communications era. The Bell Labs Technical Journal—which has survived and is known today as the AT&T Technical Journal—is a constant source of technology for those in the audio and related communications engineering disciplines.

Typically, technology is available far in advance of society's willingness to buy it. For example, RCA first demonstrated Home-FAX using television in the early 40s. This example may be extreme, but it was practical from a marketing point of view. It was just an idea too far ahead of the marketplace appetite—and perhaps of our culture. European culture changed with the invention of orchestral instruments. The advent of the practical distribution of electricity into the home, the introduction of the telephone, radio, television, and computers have all had their individual (and collective) roles in changing the face of our culture.

However, the gap between the introduction of technology and mass-market appeal is narrowing. Lorne Greene's dog-food commercial reminded us about the difference between dog- and human-years. To borrow from that genre, technology-years are increasingly growing in their proportion to human-years. Some technology is in fact obsolete by the time it is introduced to the public. Nevertheless, where do we as designers and suppliers fit into the picture of the goods and services related to these growing and expanding technologies?

When a technology is new, markets are created by selling benefits to customers who never had them before. As time goes on, and the technology grows, we find ourselves providing solutions. However, once the technology has been around long enough—and may even show up in some forms on the shelves of our local Radio Shacks—we find ourselves selling *commodities* competitively. As we can observe, the older the technology, the more competitive the marketplace becomes due to common practice.

As we climb the ladder, uniqueness and specialization diminish, reducing the competitive edge. New technologies and shortcuts offer short-term or stop-gap solutions. As such, new markets allow individuals and businesses alike to re- queue into the top of the hierarchy of technology growth. To stay at the top of this hierarchic technology ladder means both looking ahead by following the latest in research science, following trends in culture, and finding a commonality of where society is likely to persuade industry in applying new scientific methods to products for the marketplace.

Yesterday's specialty consulting projects are today's contractor's bread and butter. Today's contracting specialties are tomorrow's Radio Shack's sales specials. We as consultants, systems operators, manufacturers, and contractors will decide the fate of the hardware and software communications industry of tomorrow. It is this cooperative circle that must all work together in composing today's dreamware to create tomorrow's realities.

Jesse Klapholz

Technical Editor

presence), and shows useable response to 17 kHz. The mic has −77 dB re: 1 V/µbar sensitivity (−77 dBV output for 74 dB SPL input) when close-talking, yet sensitivity drops 7 dB at 2 feet (due to loss of proximity effect) and rear rejection is as much as 25 dB beyond that (due to differential plus cardioid effects). S/N ratio is 72.5 dB at 94 dB SPL. The CM-300 may be powered by 12 to 48 V DC, and is finished in black satin with an aluminum alloy case.

We have not discussed the CM-200 or CM-100 mics; no prejudice here, but this month's column addressed the model which we see as more of a radical departure from traditional mic technology. Crown has shown some innovation here, and the spec sheets were certainly enough to arouse our curiousity. Of course, the bottom line with any mic is, 'how does it sound,' which is why we feel the new Crown CM-310 deserves your *Closer Look* (and Listen)! ■

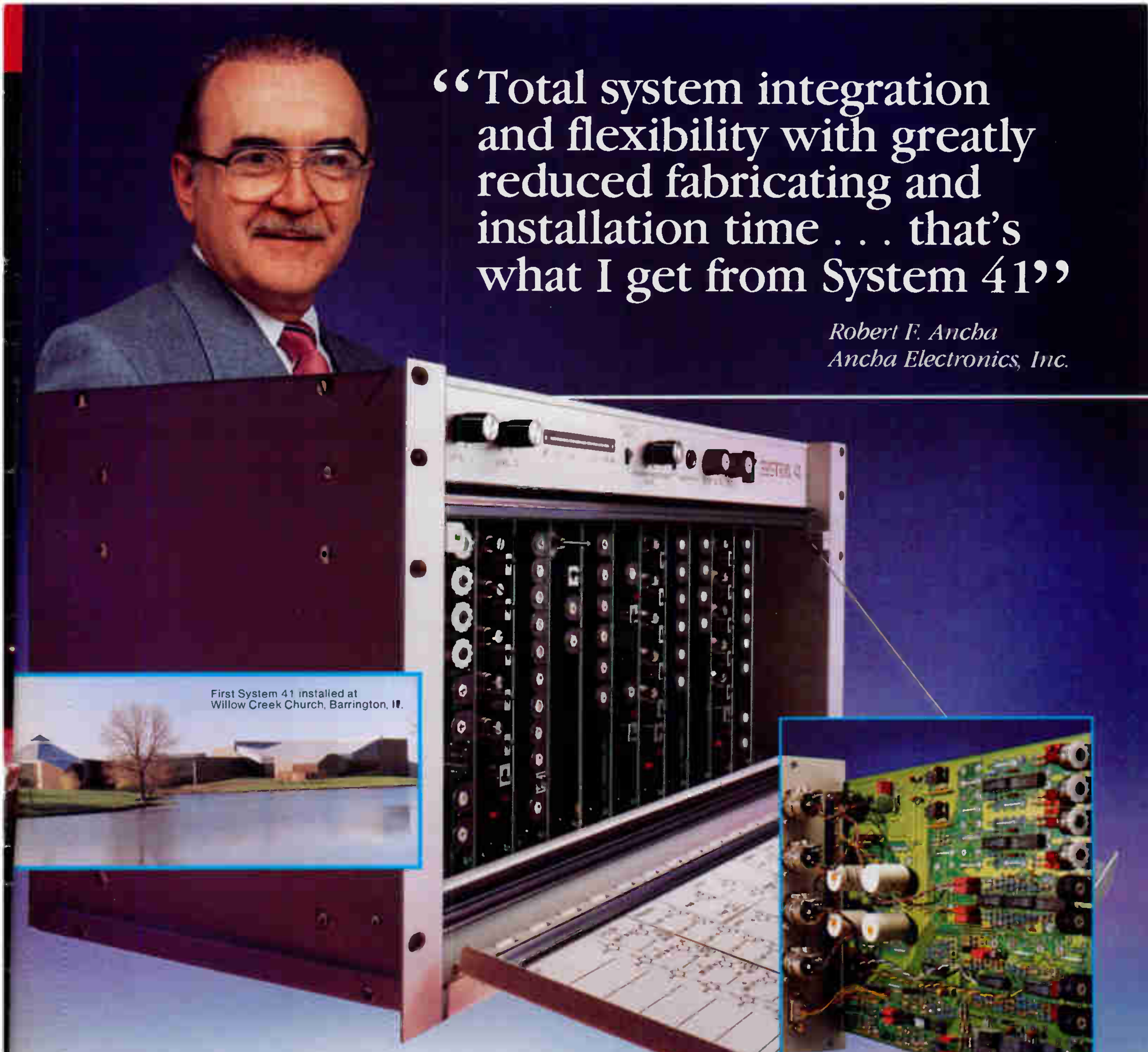
Davis is president of Gary Davis & Associates, Topanga, CA, and is the author (along with Ralph Jones) of the Yamaha Sound Reinforcement Handbook.

Circle 3 on Reader Response Card

FIELD TEST

(continued from page 43)

and/or dynamic considerations in both loudspeakers, and other media. The BBE units are extremely easy to set up, and if desired may be calibrated with a sine wave function generator, and DVM. For the return on their modest investment, we feel that these units should be seriously considered when fidelity, and intelligibility performance are considerations in a sound system. ■



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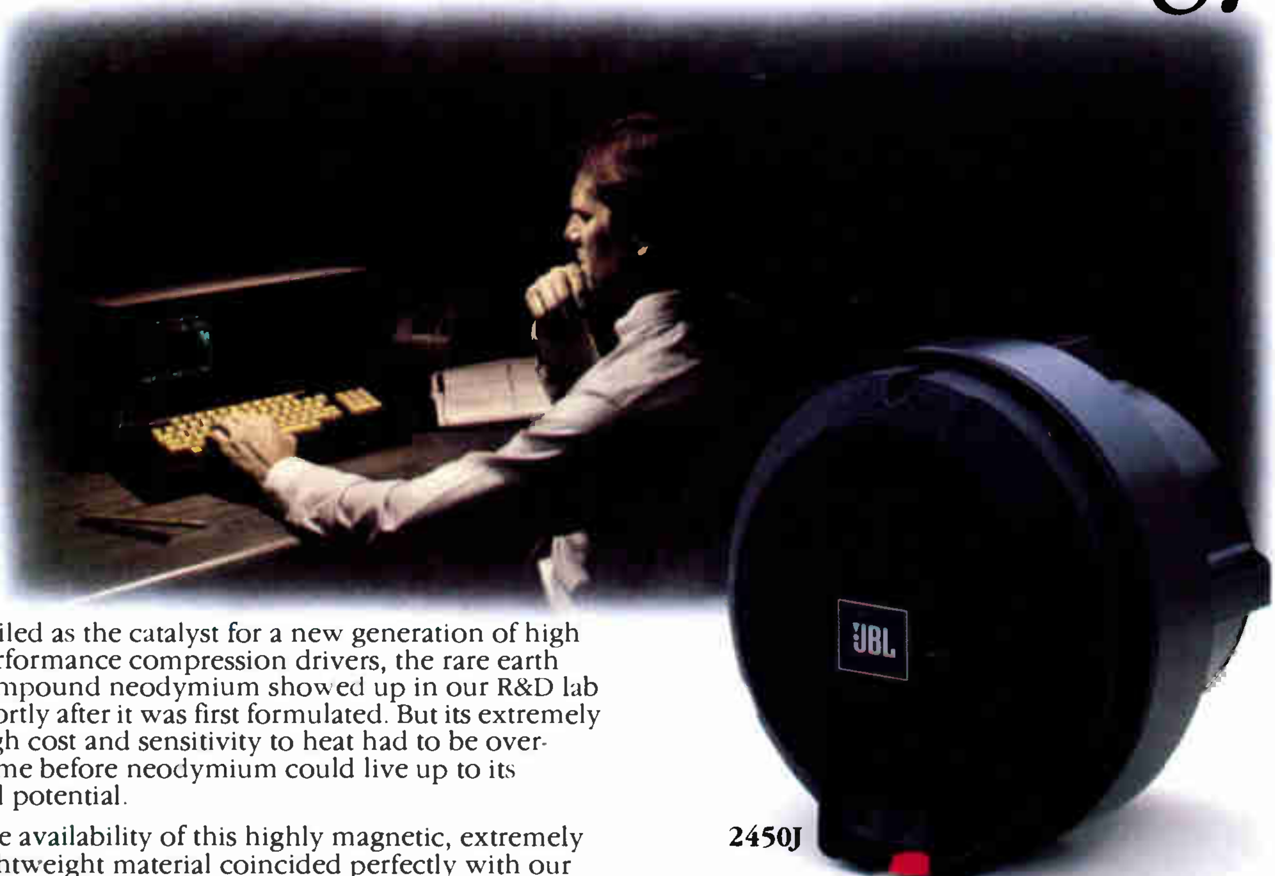
It Takes More Than A Little Neodymium To Change The Face Of Driver Technology.



2450J

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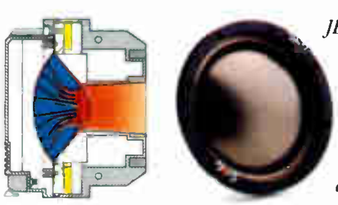

JBL's 2450J Neodymium Compression Driver with Coherent Wave™ phasing plug provides in-phase combining of sound waves for extended high frequency performance. JBL's patented diamond surround titanium diaphragm with new embossed dome greatly reduces distortion and damage at high SPL.

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

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

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

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