NOVEMBER 1983

SOUND & COMMUNICATIONS

EV PRO SOUND PRODUCTS

FEATURE-FOR-FEATURE, IT'S TOUGH TO EQUAL EV PRO SOUND PRODUCTS. DOLLAR-FOR-DOLLAR, IT'S IMPOSSIBLE.

The competition in the professional sound field is pretty fierce. Ask anyone who has ever competed for a contract with EV Professional Sound Reinforcement products and they'll tell you that on a head-on, feature-for-feature, dollar-for-dollar basis, there's really no competition at all. Especially when EV's "Sound in Action" line is pitted against Altec and JBL. The truth is that many of their basic products are based on technologies that go back more than 50 years, to the first sound motion pictures. But designing sound products that are capable of filling a theater, concert hall, auditorium or stadium with high quality sound is a lot more demanding than reproducing the sound tracks of yesterday's talking pictures. In addition, the mechanical design and manufacturing processes of today and yesteryear are miles apart. (We ought to know, since EV's been making transducers since 1927).

For example, you've been hearing recently a lot about the sophisticated theories of A.N. Thiele and Dr. R. H. Small, as applied to low-frequency systems. What you probably *don't* know is that Electro-Voice applied these theories to product design ten years ago. EV *invented* the Constant Directivity™ horn. And we developed the first high-performance compression driver that can really "take it," and handle high-level inputs on a long-term basis. In other words, EVexamined what was wrong with yesterday's products and combined up-to-date design, manufacturing techniques and materials in a product line that provides better acoustic performance, as well as significant weight, size and cost advantages.

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To put EV Pro Sound Action on your side, send for our new catalogue and get a good look at the EV position. Write to: Jim Long, Electro-Voice, Inc., 600 Cecil Street, Buchanan, MI 49107

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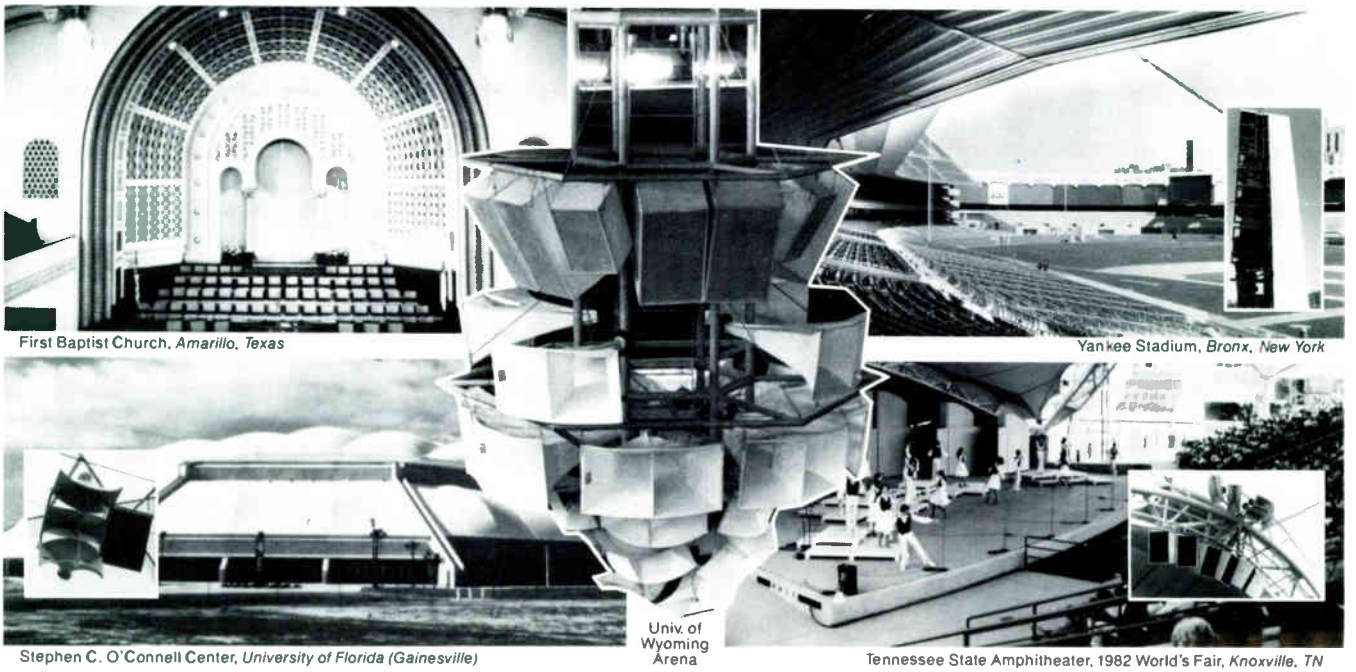

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SOUND & COMMUNICATIONS

devoted to the professional and business interests of independent contractors, dealers and distributors of private communications systems, employing audio, radio and telephone circuits, in mixes of interconnect/intercom, sound distribution/reinforcement, 1-way/2-way radio paging and life-safety/security systems; in industrial, commercial, institutional and government applications.

NOVEMBER 1983, VOLUME 29, NUMBER 7 Founded 1955

ARTICLES

DEPARTMENTS

This month's cover: The interior of the Crystal Cathedral. See story page 10.

combining SOUND MERCHANDISING & MODERN COMMUNICATIONS

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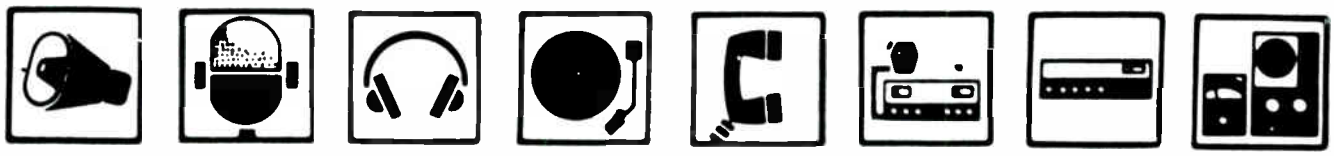

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LATE LINES

The NATA Convention & Exhibition Showcase runs from November 28 through December 1.

NATA management expects 5000-plus people at the Exhibition Hall/ Sheraton Washington (D.C.) Hotel.... to see interconnect phone products, systems and accessories....to listen to a score of seminars....to leave Washington D.C. armed with information on how to be a more realistic manager of one's interconnect business.

The seminar program (published elsewhere in this issue) testifies to NATA's concern with the survival of the interconnect business.

Management and record keeping are the dominant topics! Some reasons for this paramount position are obvious. What isn't obvious—and needs underscoring here—is the scrambling for business in the local areas. AT&T's forced divestiture of 22 BOCs is the unknown X in the proposition: how big, how withering is the competition for the sale, lease, or rental of terminal gear to the subscriber who's been "set free" from the public utility.

More: the unknown X to the next power, meaning: how many authorized dealerships will be cancelled, or absorbed by the supplying maker of switches and keysets? What's the size of the order the prime supplier will sell to the local area telco? For how long a period does the "telco contract" run? How does one compete offering the same brand in a local area—and survive?

The past sixteen months have seen many changes in products. Newer generations of systems have been pushed into the market, many being peddled to a market that appears saturated, for the moment. Yet a limited hop-scotching survey among some product and hardware merchants indicates that the "big stuff" is going in and absorbing a "humongous amount" of wire and associated products. What these merchants do not know is the time element—when did the bid go in and when was it awarded?

The limited survey also indicated that keysets were maintaining their sales level; that more than a half-dozen new suppliers have come upon the scene. In some markets, among some suppliers, prices are plopping!

What progresses with phantom speed is peripheral gear that fits all makes and sizes of keysets!

What's disappearing with phantom speed is the number of independents—small dealers with 200 or 300 installed lines—who are being caught up in the whirlwind buying spree by the large and well-heeled dealers!

The mutation going on in the interconnect industry is identical with the auto industry history: fewer suppliers selling to fewer dealers, and witnessing an expansion of product lines and dollar sales for the remaining few!

NATA is aware of these developments and is moving to enrich its members

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with ideas for improving sales, for instituting procedures to better control men and product and servicing contracts. The speakers—most of them—are not one's competitive neighbor. Rather, they come from outside the industry. This is a cross-pollenization, as it were, to breed a newer and stronger strain of dealer, especially, who will survive and prosper during the Age of Divestiture.

The Age of Divestiture has begun to suffer infant cholic: the FCC is in a bind to make its "access charge" stick. The Congress' House and Senate Subcommittees on Transportation & Communication, under the stewardship of Timothy Wirth in the House and Bob Packwood in the Senate, press for no charge or, at best, for a reduced charge for phone service. They're worried about disenfranchising a segment of the population from common phone service.

AT&T lobbies with verve and vivacity to cut off the shackles and iron chains that are meant to reduce its area of operations.

Meanwhile, IBM has climbed into Rolm's bed to create a phone to compete with AT&T. General Electric has tip-toed back into the interconnect market with a servicing program for the PBX. RCA Service has expanded its outlets for sales and service of customer-provided equipment. Western Electric has chosen a number of large distributors of telephone equipment—Anixter-Communications, for one—to handle sales of W.E. gear to the interconnect dealer. And cellular radiophone licenses are being gobbled up by the MCI's, U S Wests, Ameritechs and the larger and lesser among the public utilities, to the horror of the RCCs.

It's a scramble. It's a bumpy ride. But the ruts, soft shoulders and detours in the road leading to an eventful 1984 may all be handled by the driver's guide furnished at the NATA Exhibition & Convention, at the Sheraton Washington Hotel, Washington, D.C., November 28 through December 1.

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Finally, a ceiling speaker that solves all of the problems progressive sound consultants, sound contractors and architects have been dealing with for years. From office/conference room applications to theatre sound surround systems; from parking ramp paging to special sound effects for theme parks; from restaurants to church halls and auditoriums...
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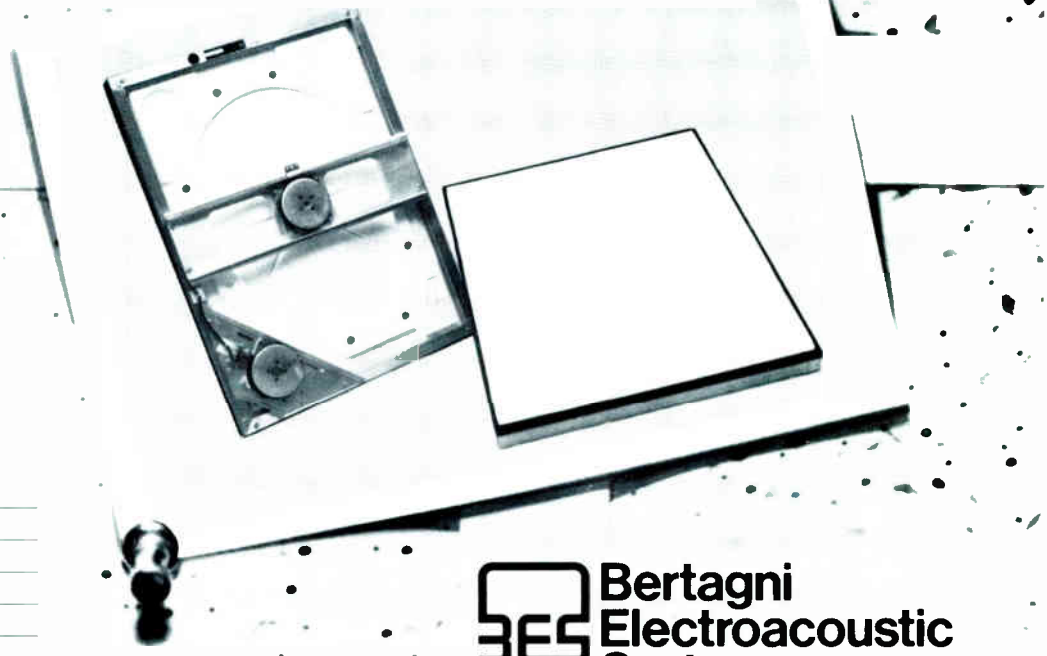

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For more information on Panasonic Commercial Sound Systems, please contact: Commercial Sound Systems Department, Audio-Video Systems Division, Panasonic Industrial Company, One Panasonic Way, Secaucus, NJ 07094.

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Crystalline Sound

by David H. Bryan

David Owen, director of sound services for the Crystal Cathedral, in Garden Grove, near L.A., looks around the church's interior. "Yes, it's magnificant and it's big. At Christmas we run five services, for 4,000 people per service here—2,900 in the pews and another 1,100 of overflow in the aisles or standing in the back—so it really isn't quite big enough."

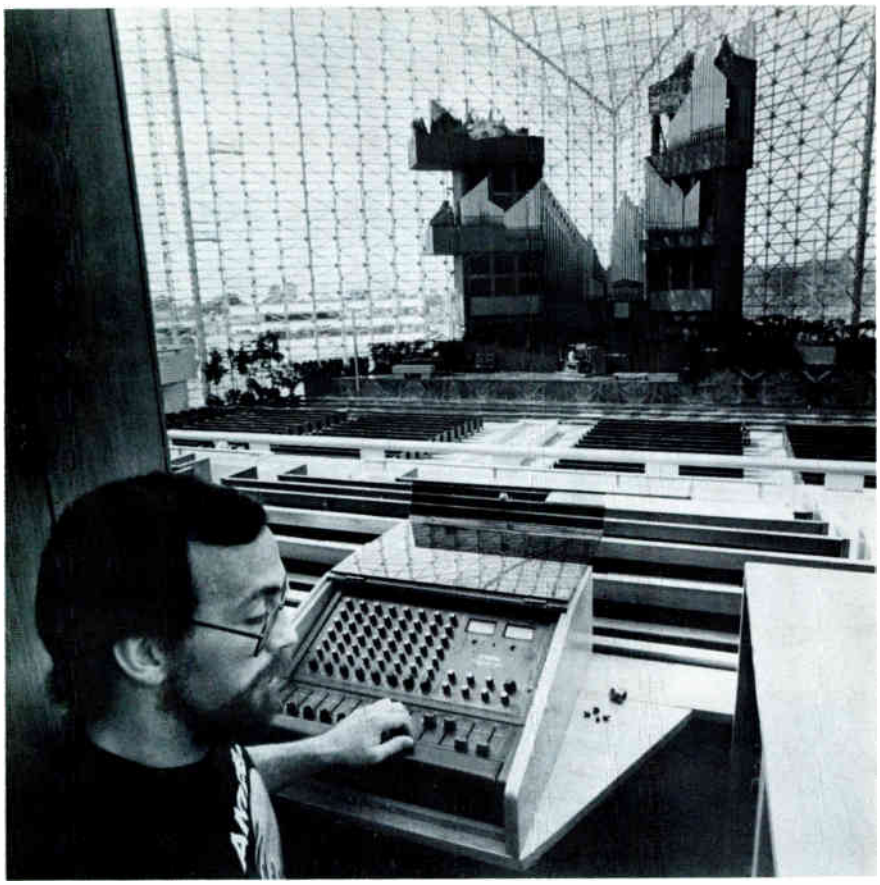
The cathedral encloses 3,000,000 cubic feet of uninterrupted, continuous space. The all-glass walls and roof are supported by an open trusswork of interlocking steel triangles, painted white; this five-foot-thick steel shell is built to take 100-mile-per-hour winds, and earthquakes up to eight on the Richter Scale. Owen remarks, "The glass is a-quarter-of-an-inch thick, some even heavier, and it's a form of safety glass. The panels on the roof will break into pieces like a coarse dust—if they break at all—and the wall panels will crackle into little squares like miniature hail stones." The glass panels are bonded into place with silicone, a method approved by consultants. Owen concludes, "Nobody is ever going to be hurt here by falling glass." He looks upward towards a catwalk near the roof: "That walk is over 100 feet up; there're two more even higher, but they're hard to see at this distance." He smiles, "At night you can look up through the roof and see the stars, but from the outside the walls and roof are mirrors."

Dave Owen at the main console.

The cathedral is big: 415 feet long, 207 feet wide and 128 feet high—it's bigger than Notre Dame in Paris. The mirrored walls and roof help prevent a greenhouse effect, and the motor-operated 550-plus windows keep the interior temperature moderate. Owens remarks, "I've seen the building quite plainly from a small airplane flying at 10,000 feet, and from two miles away when I was driving in on the freeway." The cathedral's floor plan is a four-pointed star with a raised chancel or stage in one "point"; the other three contain balconies of pews which add to the main floor seating.

A feature all visitors look for is the pair of giant 90-foot-high doors directly behind the raised pulpit in the chancel. During services, the doors are opened to heighten the sense of unity with space for those inside, and to allow worshippers seated in their automobiles in the parking lot to see their minister, Dr. Robert H. Schuller. The sound of the

Photos by Guy Sappington.



Owen at the small console in one of the balconies.

services is broadcast on 540 kHz from a loop buried underneath the parking lot—a feature much appreciated by disabled worshippers forced to remain in their cars.

Clifford Hay, director of operations for Paramount Sound systems in Glendale, talks about the cathedral: "It's like a big glass tent—probably the biggest one in the world. Glass is reflective to sound; it bounces around in there, and the place is so big that sound takes something like a third of a second to get from one end of the building to the other." he adds, "When those giant doors open, the acoustics change a lot, as they do with humidity and temperature shifts. There're winds inside the place—strong enough to blow potted plants off their perches. Small flocks of birds fly in and out during services." He frowns and says, "The design of a satisfactory sound system for the cathedral gave Dr. Schuller a lot of trouble."

Doug Pearson, vice president of Paramount Sound Systems, remarks, "The design of the sound system for the cathedral was uncharted ground for everybody involved—I don't think there's ever been anything like it before."

Dr. Schuller and the architects, Philip Johnson and John Burgee, of New York, worked to get a structure that was light and non-confining. To help create this feeling of freedom and unity with space, distracting objects, such as loudspeakers hanging near the stage, were voted down. Instead, pew-back loudspeakers were installed every six or eight feet along the pews.

After the cathedral was built, part of the criticism of the pew-back system was that it put a lot of sound energy into the congregation's knees, but not much into their ears. More than a year after the original sound system had been installed, many amplifiers and delay units were found inoperative—and this was traced to the fact that *black* colored wiring is ground in the audio electronics industry, while *white* coded wires are considered ground by the electrical trades. A technician at the cathedral says, "I think we got a few minutes of 'help' from someone in the wrong trade; it's the only way I can explain the damage."

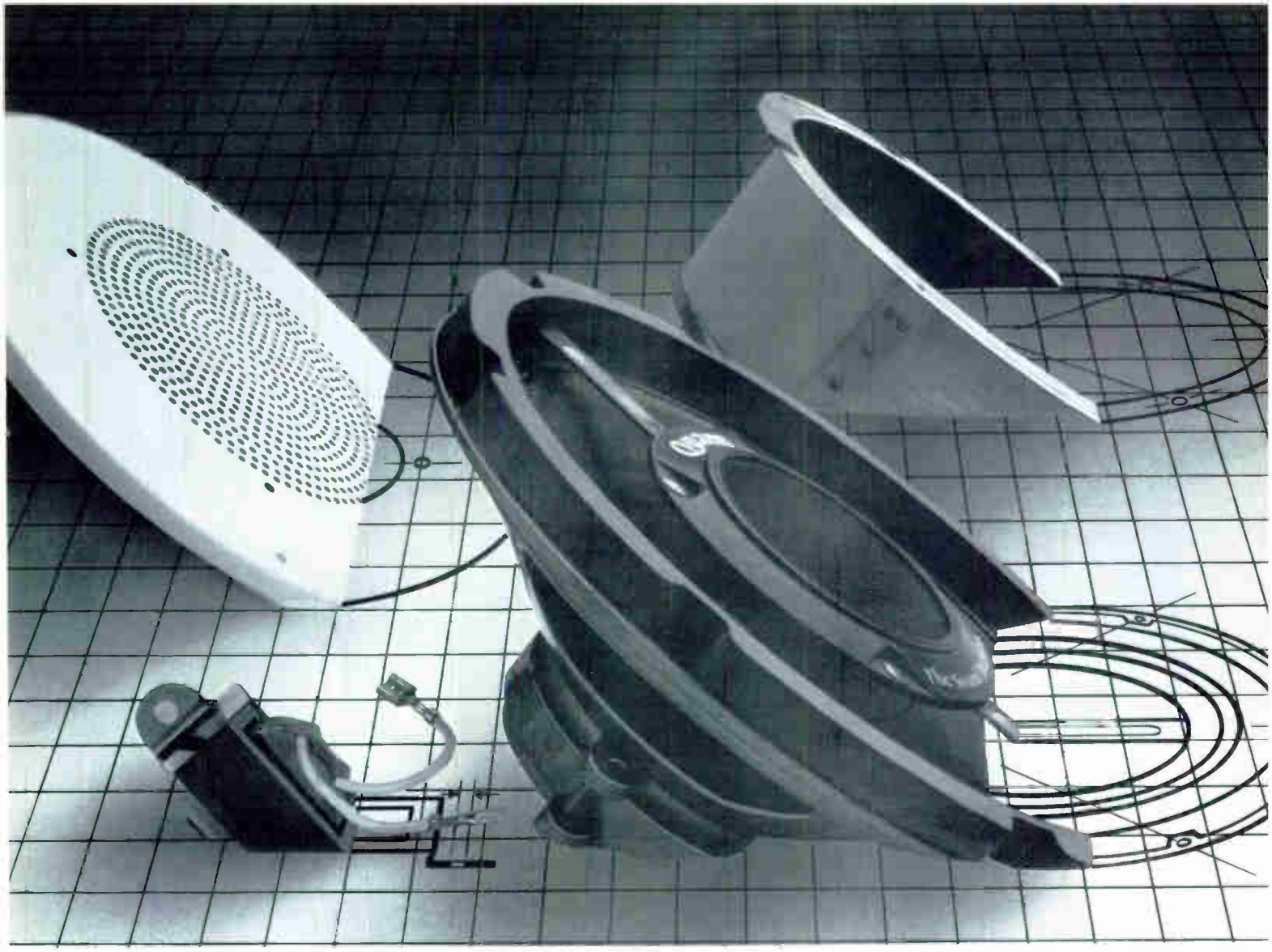
Another problem resulting from the pew-back loudspeakers was that worshippers sometimes felt the sound of Dr. Schuller's voice was coming from behind them and over their shoulders, *not* from the stage up front where they could see him talking.

In addition to these problems, after the cathedral had been in operation for some time, the original goals for the sound system were changed to accommodate the additional needs for *The Glory of Christmas* and other special productions. Eldon Sparrow, director of broadcast engineering for the Southern Baptist Radio and Television Commission, of Fort Worth, Texas, says, "These special productions are important; last year 58,000 people attended them at Christmas—3,000 to 4,000 at a time." He adds, "I'd heard of the special productions; I'd visited the site of the cathedral even before it was built, and I wanted to design a special sound system for it. Then, later, I had an opportunity to meet Dr. Schuller when he came to Fort Worth to speak. That's when he invited me to come to the cathedral and look over their sound problem."

Asked how the special productions differed from the regular services, Sparrow explains, "There was a shift in emphasis in the directions of the sound sources. During the regular services, the sound always came from the chancel or main stage, but during the special performances, the sound originates from *any* of the three balconies or from the main stage—and the sound source could change among those different locations from moment to moment." He notes, "I knew we'd have to use some sort of overhead loudspeakers in addition to the pew-back system, to give listeners some degree of localization; the problem was how to do it without destroying the aesthetics of the cathedral."

Sparrow was greatly encouraged by statements Dr. Schuller made: "No matter how beautiful the cathedral is, if people can't hear the gospel preached, it won't be of any use to them. In time, practical use will dominate aesthetic appearances."

The solution was brilliant: use invisible loudspeaker horns and bass bins made out of transparent,



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A corner of the main TV sound control console.

clear plexiglass. They wouldn't show against the glass roof and walls backlighted against the sky. Dr. Schuller was enthusiastic enough to pick up his telephone and call Dave Swedlow, a member of the congregation and president of Swedlow Incorporated—a giant plastics company that covers several city blocks in nearby Garden Grove. Swedlow agreed to help, and eventually his company made the necessary invisible horns and bass bins out of plexiglass. Sparrow was appointed consultant for the cathedral's new sound system, and Paramount Sound Systems was designated the contractor for the installation.

Clifford Hay describes their first day at the site: "Sparrow wanted to check out the building and see if it was acoustically solvable, so he made some tests. A wedding rehearsal was going on there at the time." He chuckles, "We got some strange looks—those people must have

thought we were all a bit crazy."

Sparrow says, "My original plan was to make some measurements, build a mathematical model of the church, and then see if the problems were solvable. We checked the reverberation time with a pink noise generator at 250, 500, 1,000 and 4,000 Hz. We found out how many sabins of absorption there were. We measured the interior dimensions of the room using a laser to put a spot of light where we wanted it, then we measured the distance to that spot with an optical range finder. We discovered how temperature and humidity changed in the room as the day passed, and we tested the effects of opening and closing the windows and the gigantic 90-foot-high doors behind the chancel. We checked everything!"

The result? Sparrow says, "We were quite pleased to find the build-

One of the crystal clusters that has been lowered to main stage level.

BOOK SHELF

MOBILE RADIO SERVICING HANDBOOK by Leo Sands, is designed to offer answers to the many problems arising out of a breakdown in operations—either base station or transceiver. Data is complete in text and illustration. Technicians need this volume.

Soft cover $14.95

COMMUNICATIONS STANDARD DICTIONARY by Martin H. Weik, D.Sc. clearly defines terms used by designers, developers, manufacturers, vendors, users, managers, administrators, operators and maintainers of communication systems and components. All entries are arranged in alphabetical order and every significant word in a multiple-word entry is also featured in the main listing. There are illustrations, cross-references and easy-to-spot italicized terms.

Hard cover $39.50

SPECIAL COMBINATION OFFER. Two reprints from SOUND & COMMUNICATIONS' series on PABX systems, written by Douglas Green, and long considered the "standard" work by the interconnect industry. The work has been hailed by sales managers for its thoroughness in presentation, its clarity, its sweep of the subject, and its expertise. Service managers have declared it the definitive work for training installation crews.

2 pamphlets $6.00

CONCEPTS IN ARCHITECTURAL ACOUSTICS by M. David Egan is the "textbook" used by Bob Davis/Altec Lansing in his technical seminars on sound distribution systems. Mr. Egan created this work for the professional seeking answers to: How to Ensure Speech Privacy. How to Provide Effective Isolation. How to Choose the Best Room Surface/Shape. Packed with illustrations, tables and step-by-step computations for help in understanding the behavior of sound in the environment.

Hard cover $44.50

SOUND SYSTEM ENGINEERING, by Carolyn & Don Davis, is the masterwork of the professional/engineered sound system field. Starting with basic system configurations, individual chapters discuss Audio Environment, Interfacing the Electrical & Acoustic Systems, Equalizing the Sound System, and Instrumentation. This volume explains fully the steps in designing, testing, installing and maintaining a sound system, along with photos and graphs that enhance the text. Don Davis has included test questions (with the answers) about the mathematical science in acoustics, to hone your skills.

Hard cover $22.00

PRACTICAL GUIDE FOR CONCERT SOUND by Bob Heil is the sum collection of notes, experiments and logs of a man who spent over half a decade building/servicing/fashioning sound amplification systems for some of the country's best known travelling musical combos and rock concert stars. There are 19 chapters, ranging over the full line of amps/mikes/speakers/compressors/crossovers . . . but, there is also a spelling out of balanced and unbalanced lines; the care and feeding of cables, and the interfacing of hi-fi gear with pro sound equipment.

Soft cover $10.95

LEASING PRINCIPLES & METHODS by Jack Leonard Green, 320 pages/hard cover, grew out of a series of articles that first ran in SOUND & COMMUNICATIONS on money management. The author expanded the six articles into a full explanation of leasing—its advantages over outright purchase—and fleshed out the work with 32 pages of documents and financial instruments, covering every financial exigency. Interconnect phone dealers and duplex intercom distributors will find this volume of exceptional use in crafting lease arrangements for telecommunications systems. $49.95

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HANDBOOK ON ESTIMATING is the combined knowledge of four men who've accrued almost 100 years of experience in the sound system business, estimating jobs price-tagged from a few hundred dollars to over a hundred thousand dollars. You won't find a circuit diagram, nor a discussion of acoustics, time delays, or installation techniques—this is strictly a volume devoted to the plain arithmetics concerning time, materials, men, overhead, insurance and taxes, that are a vital part of the estimate that brings in the dollars, and MAKES A PROFIT! Each element of these items—and more—are given their proper treatment, and are shown in their relation to one another, broken down into pennies (an hour's time for a technician is broken into its 60-minute segments, and the price for that minute is scored and tallied with the rest of the estimate). Equipment suppliers are invited to seek quantity purchase price discounts.

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MODERN COMMUNICATIONS SWITCHING SYSTEMS/2nd Edition by Marvin Hobbs is a step-by-step treatment of telecommunication switching techniques by the telco, into crossbar and microcomputer switching techniques for the customer-owned system. The elements of Stored-Program Control are detailed, as well as Time-Division Switching Systems. There is a complete presentation of PBX systems. This work will find a ready audience among the interconnect dealers whose installation and servicing crews are "crossing over" daily with the telco.

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VIDEO SECURITY SYSTEMS, by Keith Bose, is a work of increasing importance now that security systems are becoming more sophisticated and an integral part of the communications system for industry, commerce, institution, school, and the leisure/housing markets. The technical aspects of the CCTV camera and its peripherals are presented in word and picture —from installation tips to maintenance practices. Two chapters are of especial interest: Cameras, Monitors and Video Recorders covers the range of tubes, signals, night viewing cameras. Signal Processing, Special Effects and Color deals with amplification, equalization; then special effects, screen splitting and character displays.

Hard cover $16.95

ing's acoustical problems solvable, but there were conflicts. We felt we needed to keep the reverberation time long enough to insure the nearly ideal performance of the church's pipe organ, but also reduce the reverberation time to a point where articulate speech could be distributed by the sound system."

He continues, "We made the decision to try to attenuate the high and mid frequencies' reverberations, while allowing the very low (250 Hz and below) frequencies to have reverberation times on the order of four to five seconds. Our decision was based on the fact that the only convenient location for placing acoustical absorptive material was the floor. So that's what we did, using specially woven, extra-long-plush pile carpet over 50-ounce padding; it added approximately 35,000 sabins of absorption to the room. This change brought the reverberation time—on a relatively average day with the temperature around 75 degrees and with three to four thousand people in attendance—to about three seconds (measured at 500 Hz centerband, one octave wide of pink noise)."

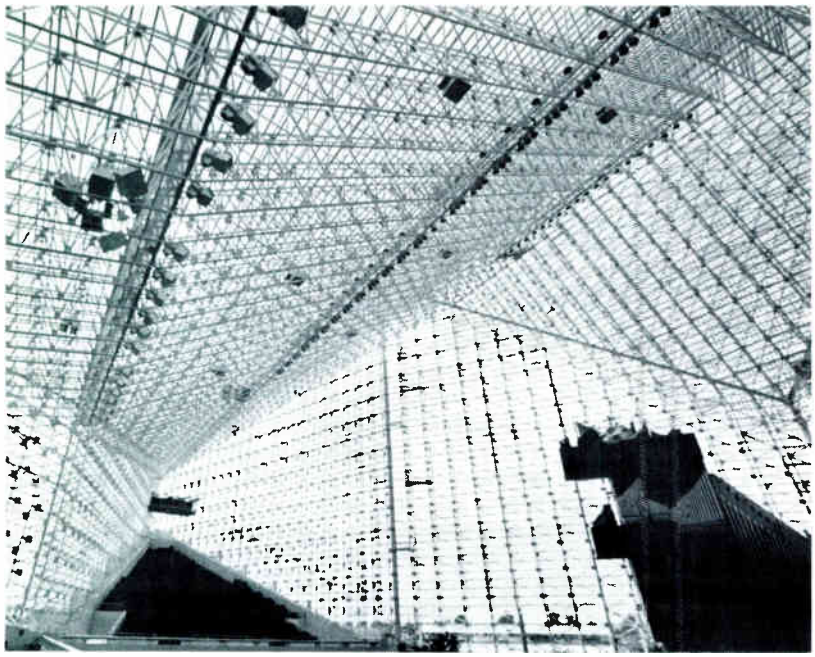
Even in southern California, it's not always summer and Sparrow discusses the effects of weather on the church's acoustics. "In the rainy season, and when the temperature dropped to the 50s and lower, comfort of the worshippers demanded the 550 or more windows and the giant doors be kept closed. Unfortunately, the closures resulted in an increase of the reverberation time by one to two seconds." He notes, "We've sought some method to add absorption to the auditorium, to offset the absorption lost by shutting the windows and doors—it's about 10,000 sabins."

There were geometrical problems too. "A strong reflection from the glass ceiling was apparent in the front ten rows," Sparrow says, "also the choir and the main pulpit locations were asymmetrical with respect to the building, and that caused a problem."

His solution to the design of a sound system is based on the fact that if localized or directional sound reaches the ear just *before* non-localized or "fill" sound does, assuming the levels are about equal, the brain interprets what the ear hears as 100 percent localized sound. Sparrow notes, "It's an illusion—like magic—but it works."

Providing the necessary localization required overhead loudspeakers at the chancel, one for the minister and one for the choir, plus overhead loudspeakers for *each* balcony—because sound could originate from *all* these points. Sparrow originally intended to use the pew-back loudspeakers to provide the fill sound.

Two models of the "acoustical church," were made: one real, the other mathematical. Sparrow explains, "We built an actual scale model of the church by constructing a small tower and stringing threads marked off in a scale of one-eighth-inch per foot. Using this model we measured the distances between the various overhead loudspeaker locations and the different listener areas—there were twelve such areas or zones. By dividing the entire seating area into twelve zones, we could insure there would be no more than 25-milliseconds difference—to a listener in any zone—between



A view of the ceiling.

the arrival of the direct or localizing sound from an overhead loudspeaker *and* the electronically delayed fill sound from a pew-back."

The 25-millisecond-maximum difference between the arrival to listeners of sounds from different sources was held to because the human ear trends to ignore such small time differences. Longer differences become apparent to listeners as a disturbing "echo." Sparrow found he could hold to the 25-millisecond-time "window" by dividing the cathedral's seating into a mere twelve zones. His method is to calculate the normal—through air—delay from an overhead loudspeaker to a listener, then delay the signal *to* the pew-back's amplifier slightly more—so it would reach the ear later but within the desired time limit.

The delay devices are made by Lexicon, Incorporated. Sparrow comments on the units, "They're right out of the computer age—entirely digital. The input audio is sampled at a rate that's at least twice the highest frequency to be handled, digitized and stored in RAM or random access memory. That is, the samples of 'audio' are stored in memory for many milliseconds. The maximum delays used in the church's system are nearly 250 milliseconds. When the delay time is up, the numbers representing digitized samples of the original audio signal are outputted to a digital-to-analog converter, passed through a low-pass filter to remove the sampling frequency, and amplified. This final output is clean, crisp audio, but delayed by whatever time we've selected." The system uses 19 of Lexicon's Model 92 delay units; they cost about $1,800 apiece.

Building an acoustical model of the cathedral, making plexiglass horns and bass bins, testing the building for acoustical properties, putting down padding and carpet to increase the cathedral's absorption of sound, shooting for a design that would enhance the performers' sounds but also permit the organ music to be at its best, allow the localization point to be shifted from balcony to balcony to the main stage *during* performances and specials—these are things that Sparrow didn't do alone. He says, "I got a lot of help! I knew changing the direction of the sound source from the balconies to the main stage and back again would involve some complicated switching of the delays needed, and for that I needed an expert. I got Edward D. Burquez, president of Sound Engineering Service Company of Birmingham, to design the interfacing parts of the system—including the switching matrix." Ed Burquez made a major contribution to the system design that greatly reduced the number of necessary delay units: a logic switching box. Sparrow says, "It was a very major accomplishment. Burquez is a graduate engineer in Telephony from Georgia Tech and is an expert in matrix switching; he's one of the best in the business."

Sparrow continues, "A lot of people helped. I got Bill Fowler, president of Altec Corporation—he lent invaluable support. Also there was the time and expertise of Paul Spranger, Robert T. Davis, Ted Uzzle and Hal Schnackenberg—all key management people at Altec, who helped with the new plexiglass horns and bass bins. By the way, the horns are plexiglass duplicates of Altec's 311-60s."

Asked about the other, "mathematical" model of the church, Sparrow replies, "Yes, it was purely mathematical and Ted Uzzle did it; he used a Hewlett Packard Model 41 for the job. He'd already designed a computer model of a sound system; it's fantastic. It gives a calculated 'footprint' of a horn's sound pattern in a particular environment."

Three of the contractors involved are Acro Media, Paramount Sound Systems, and Sound Engineering Service Company. Sparrow remarks, "Each company is well qualified and all have met their contractual requirements; the only reason for getting them all involved is that the purpose of the sound system changed as time passed. Acro Media put in the original pew-back loudspeakers system, because at that time that's what the church and architects wanted; it was the only way to avoid using overhead, hanging loudspeakers. Later, Paramount sound helped in the engineering design and installed the plexiglass speaker assemblies—we call them *crystal clusters*. Sound Engineering got involved because of their experience in designing matrix switching systems... It's been a long process."

The two *crystal clusters*, plexiglass assemblies of horns and bass bins, hang 45 feet above the main stage; each one is over a source of localized sound. The minister's cluster is on the right; the choir's is on the left. Sparrow says, "Altec tested the horns thoroughly and gave us the surprising news that they performed as well as Altec's original; we're very pleased." Each cluster consists of three bass bins plus six horns—all

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fashioned from plexiglass. They're visible to the worshippers, but a person seated in a pew must look very carefully to spot them. Truly, they're almost invisible."

The stack of bass bins are angled 40 degrees apart, and a horn is mounted on each end of each bin. The individual horns have a 40-degree vertical coverage, 60 degrees horizontally, but the completed assembly of all horns and bins in a single cluster covers 120 degrees vertically and 110 degrees horizontally. Sparrow makes a point: "By control of the power into each driver, we can shape the footprint of the assembly in such a way as to put more reach or energy into the far end of the auditorium—and that's what we're doing." Each driver is fed by its own amplifier.

The crystal clusters cost $22,000 apiece. The boxes are held together with quarter-inch thick boiler plate; each cluster has been tested to hold at least twenty times its actual weight of 900 pounds. Sparrow says, "It took 17 men a total of 34 days to make 18 horns and nine bass bins." A total of three clusters was made (one was for the former auditorium adjacent to the Crystal Cathedral).

The clusters over the three balconies are conventional, *not* plexiglass, but they're unusual in that all are double units. The forward facing part is to allow the congregation in other balconies and in the main central pews to hear a localizing source from the performers located in that particular balcony; the three balcony clusters also have reverse facing horns to put more sound into the back rows. Each balcony has a completely independent sound system including: a mixing console, equalizers, power amplifiers, and delayed feeds to the other balconies.

Final testing revealed two problems. The footprints of the crystal clusters fell off near the walls, and that was exactly where worshippers were most likely to be distracted by sounds coming in through the open windows. Additionally, there were certain areas, the aisles and rear overflow portions, which the pew-back loudspeakers couldn't reach. Some additional fill was necessary, and it had to be accurately controlled to properly mask outside noises and to compensate for the falling off of the clusters' footprints.

Sparrow says, "We couldn't fill the dead spots in the aisles with pew-backs, so we checked out the idea of using eight overhead clusters that could be pointed straight down to fill the entire auditorium with delayed sound. That's finally what we did; it greatly augments the pew-back system."

The combination gives excellent results.

Another use has been found for the existing pew-back loudspeakers. The cathedral draws about 15,000 tourists and visiting congregations a week; several sections of the main seating are used for these visitors, and the pew-back loudspeakers in these special sections allow the tour guides to address the visitors.

A requirement for any large auditorium is enough redundancy in the sound system so it can *never* be put entirely out of operation—too many worshippers attend services to allow a complete failure of the system. The present system has enough overlap and redundancy to guarantee some level of performance; the crystal clusters alone, just the pew-backs, or the overhead fill loudspeakers by themselves, will provide sufficient audibility for emergencies. Dr. Schuller insists on such precautions.

Systems tests showed that the sound level in all parts of the 3,000,000-cubic-foot interior was within half a dB of the targeted levels. Amazingly, opening and closing of the 550 windows or the giant doors behind the chancel caused no *major* change in the acoustics that the operator couldn't compensate for. Sparrow says, "Opening and closing the doors and windows does bring in more birds and noise, but we can handle it. You see, what we've got here is a giant garden, and I think the birds add to the worshippers' sense of being non-confined. That's partly what this cathedral is all about—a sense of returning to The Garden."

The final tests included switching the sound originating point from the main stage to each balcony. Sparrow notes, "Of course, this changes all the delays and power levels required, but it happens in many special productions, so it's been made an almost automatic process for *The Voice of the Cathedral*, which is what we've named the

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sound system."

Although it might be considered a minor point, Sparrow and Burquez discussed the importance of combining different sound sources to get proper loudness and clarity. Sparrow says, "We perceive loudness from bass frequencies, but articulation and clarity from the higher frequencies; the right combination is crisp and clear to our ears." This remark followed a discussion of the output characteristics of different kinds of loudspeakers as used in the pew-backs, overhead fill and the various clusters.

The only two areas in the cathedral where pure theory was difficult to apply perfectly was near the open windows in the balconies and in the front, center area of the main seating near the stage. Sparrow notes the cures: "We had to boost the sound *near those windows* by three dB to partially mask the noise of outside trucks and traffic; we used the pew-backs for the job. The front center area of the main seating got a strong reflection of sound from the glass ceiling, and that was cured by putting more audio power into the pew-backs located in the first seven rows up front." Both cures are called "masking."

The cathedral contains an amazingly large number of microphone lines. There can be up to 25 microphones around the orchestra, the same number for the choir on the main stage, more on each balcony. Sparrow says, "There are a total of 119 microphones inputs in the building, and we can select and use up to 56 of them at any time." Each balcony has a mixing console; the main one is directly opposite the main stage, but there can be active operators at the other two—there usually will be during special productions."

David Owen, director of sound services for the cathedral, shows his master control and mixing console located in the balcony opposite the main stage. "It's a Yamaha PM 2000, 32-input panel with eight matrix outputs. We have far smaller Yamaha type 508 consoles in the other two balconies, and in this balcony too, but I can control everything from here." He notes, "We've assigned the eight matrix outputs for our convenience. For instance, if I punch up matrix number eight, I've automatically got all individual loudspeaker groups at their preset levels activated. That's pattern eight."

Pattern eight activates the two main crystal clusters over the main stage, the eight overhead distributed or fill speakers, the main balcony clusters and all the pew-backs used in the church. All delays and amplitudes are properly set.

Owen adds, "When we're having an evening service, there won't be too much of a crowd here and we don't need to activate the balconies. I just hit matrix number two and that gives us the overhead systems and the pew-backs in the main, central area." He describes other useful combinations; the eight patterns available seem to cover all needed possibilities. He says, "The whole place can be reconverted just by throwing a few switches. If I've got performers in the balcony, I can switch all the delays around and put the balcony as the source of sound for the whole building—I do that quite often."

The Yamaha console isn't modified at all; it's standard.

Owen talks of Dr. Schuller's voice characteristics and what is required of the minister's microphone channel. "His voice is very bottom heavy, sibilant, and ragged in the mid-range. His dynamics are great; sometimes he speaks in whispers, and later on he's practically shouting. So I handle his microphone line in a special way." Owen points to a couple of accessory devices on his console: "This is a model LA-4 compressor/limiter made by UREI, and that's an Aural Exciter made by EXR. Schuller's voice first goes through the limiter, then into the exciter." Owen explains, "The exciter enhances the top end of the mid-range voice frequencies; it gives them more gain. The reason I use both devices is because using just the limiter alone would be too drastic, so I mix the limiter's output with the normal *and* the excited signals. The result is a normal sounding voice that is clear and understandable—but it doesn't miss any of the punch and delivery Dr. Schuller puts into it."

Sound control is as much of an art as a science.

Owen talks about the hour-by-hour changes. "Between an eight AM service and another at noon, there's a difference in the cathedral of 20 to 25 degrees; the humidity changes from 15 to 25 percent;

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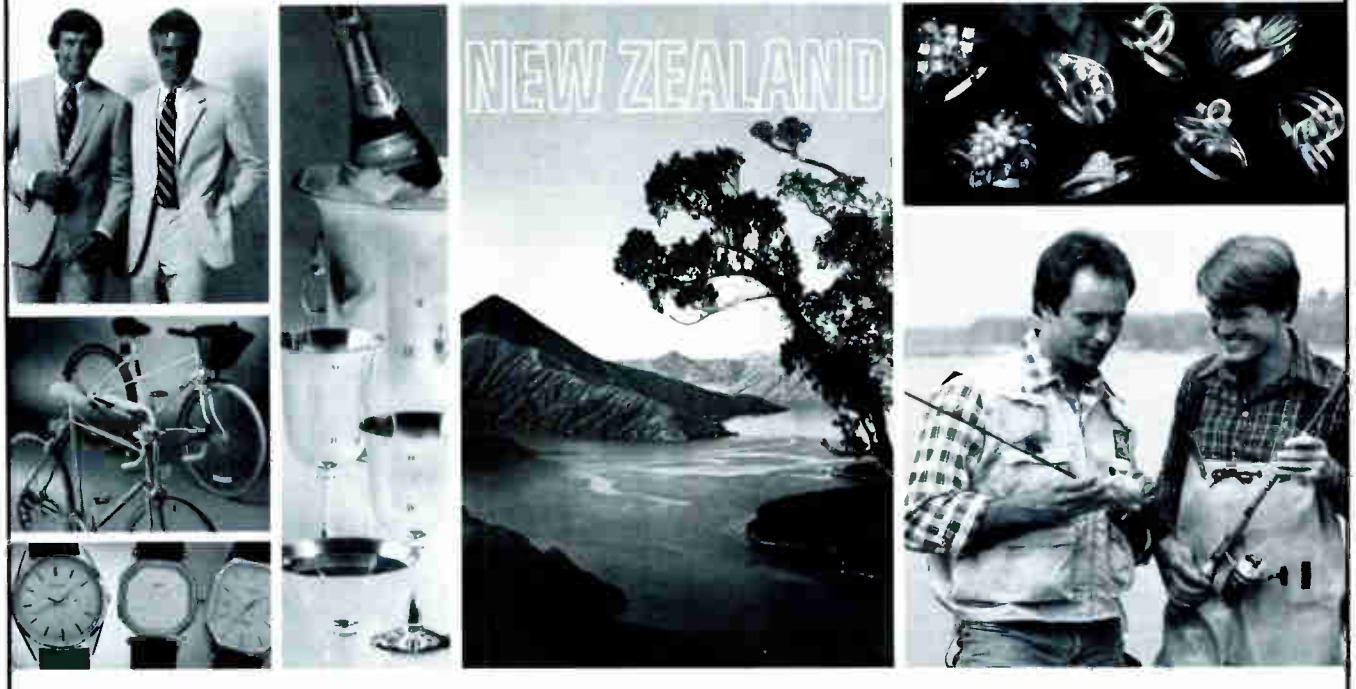

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these changes affect the sound a lot. I compensate for the changes by resetting the equalization as much as plus or minus six to twelve dB." He comments, "I think we'll be going to a digital board when they're available, and when that happens we'll need automatic sensors for temperature, humidity, telling the computer if the doors are open or closed, sensing the number of people here, and other things like that which can affect the sound system." He notes, "I've noticed the flutter time inside the place changes when it warms up and the many windows and those big doors are opened; the flutter seems to go from seven seconds to about two and a half. That's, by the way, why we need the limiter for Dr. Schuller's voice; when he claps his hands or says something sharp—you wouldn't hear anything else he says for the next few seconds, but the limiter fixes it okay."

The cathedral's sound system extends beyond its walls. Owen describes the parking lot and "south porch" coverages. "There're twenty-four loudspeakers taking care of the parking lot, another dozen in the various obelisks in the south porch—that's the park-like area behind the chancel, outside the building." He emphasizes, "They're necessary! There're people all over this place—thousands of them at times." He adds, "I can cut into these external systems to page for missing people. The cathedral sound is carried to the offices below the main floor to help in the management of our productions."

Regarding the television broadcasts from the cathedral, Owen says, "Television audio here has the final word. If the building audio is too loud on occasion, they'll call me and I'll pull the level down a little." The show goes to 160 cities, and the viewing audience is estimated to be 32 million.

Recording audio from the choir is one thing, that from a congregation of non-professional singers is another. Asked about this, Owen replies, "I have a special way of doing it. In order to record the sound of the congregation singing—when they don't know the words and therefore don't sing very much—I take the sound of the choir off the tape, delay it a bit, run it through a reverberation unit, then mix it with the original taped choir and *some* of the taped sound of the congregation singing. It sounds just great! It sounds exactly like almost everyone in the congregation is actually singing much better than they really are."

A feature of the Crystal Cathedral is the largest—or second largest—pipe organ in the world. As it stands the instrument has over 13,000 pipes, 226 ranks (as in instruments of an orchestra), and a history. Owen explains, "It's a combination of an original Fratelli Ruffatti organ, made in Padova, Italy, plus an Aeolian-Skinner organ from Lincoln Center in New York. Mr. Ruffatti put it all together, and I've heard rumors the whole package is worth over two million dollars."

Burquez comments, "The organ goes down to 16 Hz; that's so low you can only *feel* it. Sparrow notes, "The organ can put out so much audio power—far more than the 15,000 watts of audio in the cathedral's sound system—that it can reach the pain level rather easily." Owen remarks, "The pipes are split up into several locations; some are behind the choir up front in the chancel, but the rest are located in the rear of the other three balconies and that causes a strange effect." He explains, "The audio system here is properly delayed to account for the travel time of sound from various parts of the cathedral to the listeners—but the organ music *isn't*. This tends to bother new members of the choir when they're singing in one of the balconies; they sometimes think they're leading the organ music, or that different parts of the organ music aren't quite synchronized." Owen laughs, adding, "But they get used to it pretty fast, and the effect doesn't seem to be noticeable to the congregation."

One of the major changes Sparrow made in the system was to go from a pew-back system as the *only* sound source available to listeners to a multiple sound source approach—directional or localized sound from overhead clusters *plus* delayed fill sound from pew-back loudspeakers or from overhead loudspeakers. Ed Burquez comments on some of the problems that became apparent as soon as both sources of sound were used. "They've got to be in phase with each other." To check this he used a device made by Zounder Electronics of Mill Valley, California. It's a phase detector or receiver connected to a pulse generator. He says, "Everyone in the sound business wants one of these phase detectors; everybody has thought about it, but nobody has built one except the Zounder Electronics Company." Sparrow notes, "We checked all the pew-backs and corrected the phasing of 253 out of the 940 plus loudspeakers involved. It was a long job."

Quizzed about the future of *The Voice of the Cathedral*, Sparrow says, "There will be changes, improvements due to new technical innovations, that's progress. When that happens I want to be asked to help accomplish the changes that will make *The Voice of the Cathedral* even better."

Designing and building an organ must be something like designing and building a cathedral's sound system, but they both have to be properly played—used—for the best effect. Regarding this usage of the sound system, Owen says, "Almost everyone here got their basic training from the New York stage." He seems quite confident that *The Voice of the Cathedral* will remain in capable hands. □

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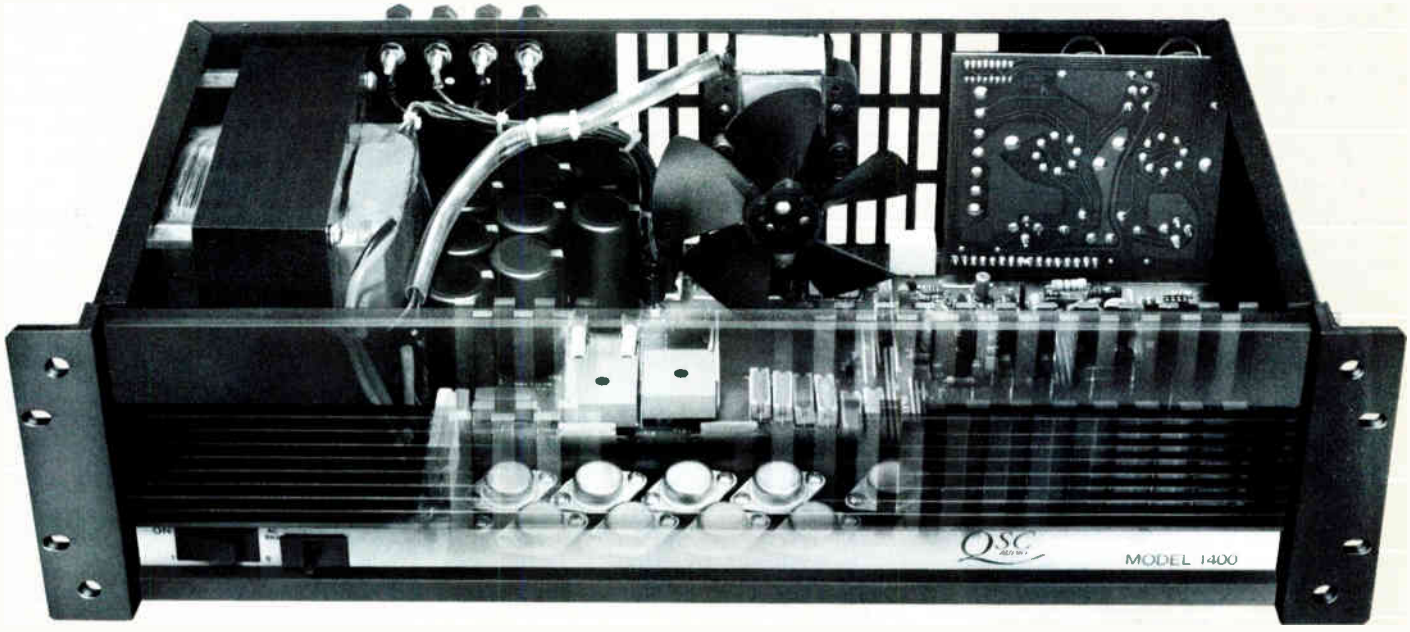

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A series of loudspeaker assemblies, UL-listed as fire protective signalling speakers and audio signal appliances, is designed for use in public address and background music systems, emergency alarm systems and other indoor applications that require fire-retardant, moisture-resistant assemblies. The assemblies meet or exceed all applicable requirements of Underwriters Laboratories Standard 1480. The heart of each assembly is an 8" loudspeaker with a flame-retardant molded cone. The speaker employs a 10-ounce barium ferrite ceramic magnet and a 1" high-temperature voice coil. Frequency response is 60 Hz to 12 kHz, with a power handling capacity of 15 watts (EIA). Not only the cone, but all of the non-metallic parts and adhesives are flame-retardant. The ceiling baffle is an epoxy-coated white steel unit with a two-step contour and hidden loudspeaker mounting studs. The round backbox enclosure is made of rust-resistant, heavy-gauge galvanized steel undercoated with a flame-retardant material which also serves to eliminate mechanical and acoustical resonances. The backbox is designed with four knockouts for conduit spaced at 90 degrees and perforated steel mounting straps.

The series offers a choice of 70.7 or 25-volt transformers, and four-microfarad, 10-microfarad or no line supervision capacitor. The transformers are supplied with dual color-coded leads. One set of the parallel leads is for permanent installation, the other for in-circuit testing during installation and troubleshooting. The setups are supplied completely preassembled, except for the separately packaged backbox enclosure.

☐ For more information write 526 on the inquiry card. Or write: Quam-Nichols Co., 234 E. Marquette Rd., Chicago, IL 60637.

DIGITAL REVERB

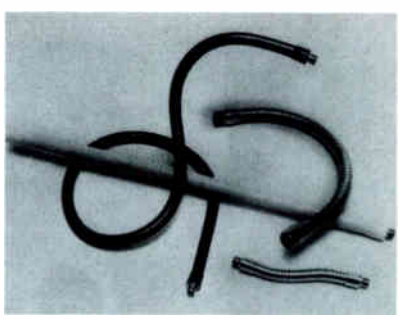
The REV1 digital signal processor can accurately simulate the natural acoustic properties of virtually any environment. It gives the user control over such variables as sound directly from the source; "early reflections" bouncing off surfaces; and "subsequent reverberation" in which the reflections are multiplied. Total electronic control can be maintained to compensate for, or simulate, the acoustic properties of any environment, accounting for such variables as room size, room shape, contents, acoustic absorption coefficient, and listening positions. With its combination of hardware and software, the REV1 can create and control up to 40 early reflections and provide up to 99 seconds of subsequent reverberation, even the relative timing between early reflections, their absolute level, and when they begin is controllable. Users can adjust the delay and reverberation independently and, as with the early reflections, the delay before onset of reverberation can be precisely set, as can the reverberation density and absolute level. The liveness of sound can be altered by changing the level of "later" early reflections relative to the "early" early reflections. Reverberation time can also be adjusted differently in each of the four frequency bands, and the crossover frequencies are selectable. Once the ratio of reverberation times in the various frequency bands has been set, "basic" reverberation time can be changed with a single adjustment. The other three bands then automatically track the mid-band reverberation time, if desired, to save adjustment time and retain a given sound quality. These features allow the necessary control to create anything from a "no additive effect" to a totally "live" room. The front panel of the 19-inch rack-mountable main unit includes basic controls for recalling any of 30 preset and 60 user-programmable effects and modifying them to some degree. The remote control unit includes 64 pushbuttons (most of which are illuminated), 10 control knobs, LED numeric display windows, twin 16-LED level displays, and a very high resolution (5⅛" X 1½") LCD window that graphically depicts adjustments

as they are being made. Once a desired effect is achieved, it can be stored in any of the 60 memories for instant recall, and there are 30 additional memories for factory preset sounds. All 90 can be completely edited. LEDs on the remote control panel reflect the set value or indicate how to move the knob to match the value of the recalled sound, revealing exactly which settings produced the sound. An RS-232 computer interface permits the REV1 to be contolled by computer, allowing for automatic effects switching to handle split-second synchronized dubbing of preset film or video effects. The REV1 is also useful for multi-image effects and time delay or assisted resonance for sound reinforcement.

☐ For more information write 527 on the inquiry card. Or write: Yamaha International Corp., P.O. Box 6600, Buena Park, CA 90622.

GOOSENECKS

Flexible arms (goosenecks) are offered in a variety of colors, with vinyl covering. They can act as a conduit for electrical wire, hold an object in position with the ability to be repositioned at will, etc. A wide range of diameters, lengths and finishes is available, obediences and rigidity may be specified, and there is a broad choice of end fittings (ferrules).



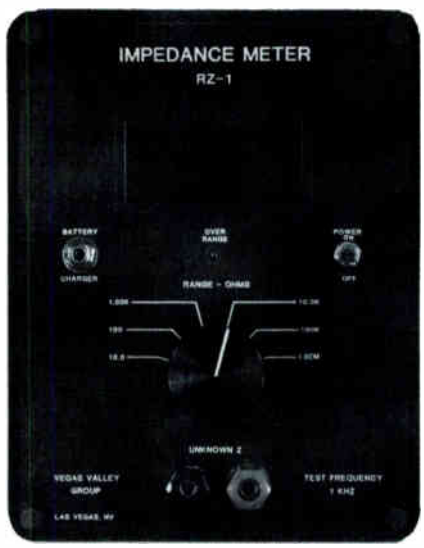
☐ For more information write 528 on the inquiry card. Or write: Uniprise Corp., c/o Hirsch Associates, Inc., 15 Hickory Dr., Roslyn, NY 11576.

MUSIC SYSTEM

The MINI foreground music system features a polypropelene woofer. Finished in a handsome walnut grain, the system handles 30 watts RMS and 50 watts peak power per speaker. The 5-inch, 12-ounce midrange speaker has a ferro fluid voice coil with a 1-inch, 10-ounce soft dome tweeter. Frequency response is 50-20,000 Hz. Adjustable mounting brackets are included.

☐ For more information write 529 on the inquiry card. Or write: M G Electronics, 32 Ranick Rd., Hauppauge, NY 11788.

IMPEDANCE METER

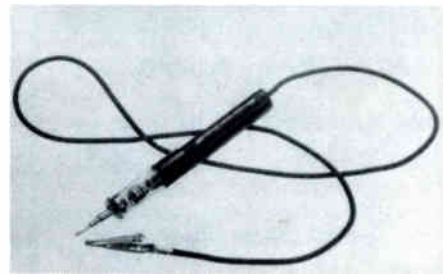


A digital impedance meter, Model RZ-1, gives direct digital AC impedance measurements of telephone lines, networks, transformers, components and equipment termination. It is a direct-reading, easy-to-use instrument with a range of 00.1 ohms to 1.20 megohms, at the industry standard frequency of 1 kHz. Processor time is one conversion per second, with accuracy of ±2%, ±1 digit. The unit has a three-digit LED display and is battery powered, with an optional bipolar rechargeable battery supply and charger available.

☐ For more information write 530 on the inquiry card. Or write: Vegas Valley Group, 3694 E. Tompkins, Las Vegas, NV 89121.

CONTINUITY TESTER

The Model 132 continuity tester has been given an extended input range by the use of an LED in place of the usual incandescent lamp.



With the LED, the instrument will light with an input impedance of up to 1500 ohms. The LED also reduces the current flow to 160 ma at 3 volts, which offers protection to current-sensitive components. Additional benefits include polarity detection and greatly extended service life.

☐ For more information write 531 on the inquiry card. Or write: Desco Industries, Inc., 761 Penarth Ave., Walnut, CA 91789.

RADIO PAGER

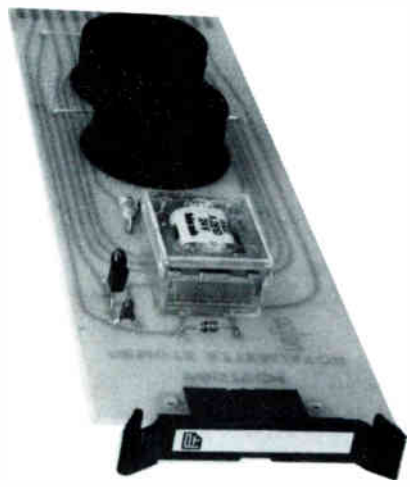
The TVC-1 is a tone and voice pager, approved by the FCC for use with subcarrier channels of FM radio stations. It may be used with local paging systems or with the supplier's nationwide one-way communication system. Audio output is 150mw, and will operate up to one year without changing the batteries.

Optional features include group calls, a vibrator operating independently of the voice signal, and an on/off switch.

☐ For more information write 532 on the inquiry card. Or write: Reach, Inc., 301 S. 68th St., Lincoln, NE 68510.

ATTENUATORS

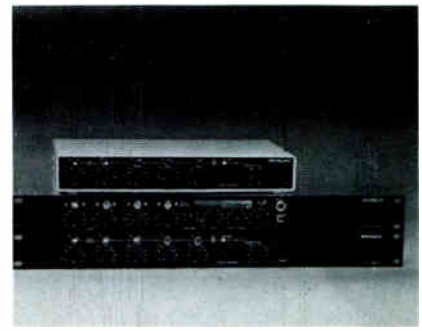
The Integra III plug-in audio modules operate on voltages from 18 to 24 VDC, with on-board voltage regulators provided. Model 725RAM (mono) and 725RAS (stereo) are economical remote attenuators based on special optical circuits which allow continuously variable attenuation, while maintaining a constant 600-ohm impedance, and without introducing noise. An on-board relay permits the unit to be switched in or out of an audio circuit, with the bypass position switched through a 12-dB pad.



☐ For more information write 533 on the inquiry card. Or write: Protech Audio Corp., Flowerfield Bldg. 1, St. James, NY 11780.

MIXERS

The Primus P-4M and P-5MX mic/line mixers come in mono and stereo versions and are available in 1¾" table-top or rack-mount configurations. The P-4M provides for mixing channels and six balanced inputs, with selectable Hi/Lo shelving EQ for channels #1, #2 or All. Other features are selectable Peak/VU solid state meter ballistics, phone driver, phones, master and monitor controls and cue on all inputs. The P-5M is designed to function as both an expander for the P-4M (combined they will provide 11 inputs and 9 channels) and as a stand-alone 5-channel mixer with send/receive on each channel. Both units feature XLR type connectors, balanced inputs and outputs, gain select on all inputs, (mic thru +26 dBm, s/n of −83dB, .008% distortion and a response of +0, −1.5 dB, 10 Hz-20 kHz. All units utilize conductive plastic controls and long-life switches.



☐ For more information write 534 on the inquiry card. Or write: Ramko Research, 11355-A Folsom Blvd., Rancho Cordova, CA 95670.

HEADPHONE AMP

The SP-100 is a rugged belt pack headphone amplifier suitable for monitoring mic or line level signals, as well as general audio system troubleshooting. It can even be used as a signal tracer to trace the audio path through an amplifier. The unit's high input impedance allows for minimum circuit loading, is ideal for tuning wireless microphone receivers, setting up and balancing piano pick-ups, quality testing microphones and as a "listen only" intercommunication headset amp with variable gain, all within a 4-oz. micro-size belt pack. The unit features long battery life, low noise, wide frequency response and can accommodate almost any audio signal source, high or low impedance, balanced or unbalanced, mic or line level.

☐ For more information write 535 on the inquiry card. Or write: AXE, P.O. Box 2331, Menlo Park, CA 94025.

POWER/COMMUNICATION LINE EXTENDER

An innovative system for bringing power and communications lines down from grid-type suspended ceilings to open offices, retail areas and work stations, EZ-Poles are versatile, decorative units made up of three snap-together extruded aluminum channels. A typical standard unit would incorporate an electrical power channel, a divider channel and a communications channel.

Whenever more capacity is needed, additional channels can simply be snapped on to the side of the pole at any time. The standard power channel comes with four pre-wired electrical outlets at desk level for the operation of office equipment. The basic low-voltage communications channel can accommodate as many as 12 telephone-type cables, each carrying 25 pairs of wires. The poles are finished with a fade-resistant baked-on acrylic in a selection of five colors: ivory, white, dark brown, dark bronze or black. Installation and trim hardware is included with the pole. It consists of a T-bar mounting clamp for fixing the top of the pole to the ceiling grid; a top cover and grounding plate; an adjustable-height non-skid foot assembly; a ceiling trim plate and a 6-inch high decorative black vinyl boot which also serves as the communications outlet. The standard 10-foot, 6-inch pole can be used with ceiling heights from 8 to 10 feet. It is approximately 2 inches square in the standard two-channel configuration.

☐ For more information write 536 on the inquiry card. Or write: Dual-Lite, Inc., P.O. Box 468, Newton, CT 06470.

COMMUNICATION HEADSETS

"Phantom-Powered" headsets are designed to interface with TV camera circuits. They combine high-fidelity microphones and speakers with self-contained amplifiers, providing clear signals without hum, buzz or hiss. High output levels and dynamic impedances assure good performance even under severe loading and ambient conditions.

The two-way headsets are supplied with dynamic microphones and use three-position in-line mic switches which can be off, momentary on, or locked on. The line remains loaded with the switch in the off position; there is no popping when the switch is activated. Single-speaker and dual-speaker versions are available.

☐ For more information write 537 on the inquiry card. Or write: Setcom Corp., 1400 Stierlin Rd., Mountain View, CA 94043.

DIGITAL DELAY

To meet the need for a solid state digital delay loop with long delay capability, Model ADM-4096, the Echotron, offers a delay ranging from 256 to 4096 ms, all at full 16kHz bandwidth. The unit also provides Infinite Repeat capabilities for storing sound digitally, without any signal degradation. Sound-on-sound can be added by using the feedback control, in conjunction with the Infinite Repeat, allowing the user to produce over four seconds of repetitive, high quality audio digitally.

☐ For more information write 538 on the inquiry card. Or write: DeltaLab Research, Inc., 19 Alpha Rd., Chelmsford, MA 01824.

NYC's Largest On-Site Phone System

by George Leon

There were several reasons why the municipally owned Bellevue Hospital decided to drop the leased Bell telephone system in favor of buying a system from Northern Telecom, each reason good enough to substantiate the $3,465,000 purchase.

Bellevue is the oldest hospital in New York City and among the oldest in the U.S. Then called simply "The Infirmary," it was built in 1736. It has now grown to an 895-bed hospital plus psychiatric ward for the mentally disturbed, as well as a holding center for the criminally insane, not to overlook its emergency ward which operates 24 hours a day. Above all, it is the home of the nation's leading teams of surgeons working in the field of micro-surgery.

The original building has long since been replaced by a medical complex covering some five square blocks. Three more floors are being added to serve the ever-growing medical needs of one of the world's great metropolises.

Economy—though important—was not the only factor in the decision to leave Bell for a proprietary system. Savings of $12,000,000 will be realized over the next 10 years, according to Joe Lawless, Project Manager, Office of Telecommunications Control (OTC). "And", added Maurice Curran, Director of OTC, "the payback will be in less than three years."

Was the telephone system adequate to complement this progression? The answer was, "NO."

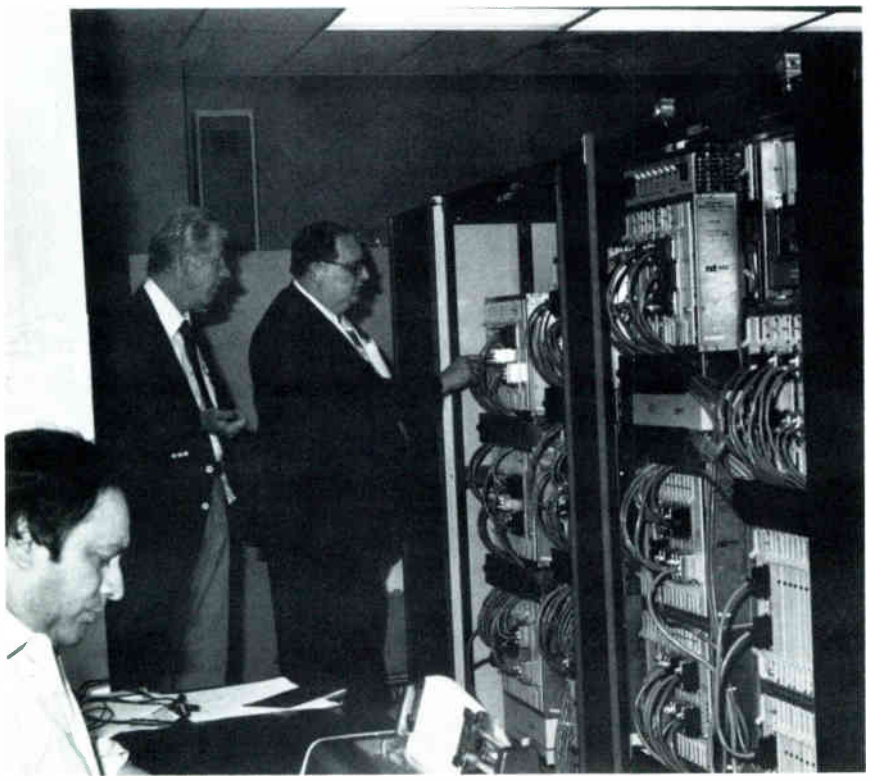
The older system was leased from N.Y. Bell. There were, in effect, two systems:

1. An administrative system with 3000 lines. (This system was updated 19 years previously.) It was a Centrex 701 (modified) with a switching train.

2. The patients' system with 600 lines. This was updated four years ago. A patient paid a flat amount for the daily use of the telephone in the room. Of course, there were call restrictions imposed upon each unit.

Viewing the economy factor from another angle, one reason for deciding to leave Bell was that Bellevue's costs, including switchboard and lines, were about $500,000 per year.

The addition of almost 300 beds made it clear that the system was inadequate to handle not only the extra patients' lines but the other 700 lines that were found necessary for the administration division's use. The space gained from the smaller mainframes would be reserved for the nurses' use.



Joe Lawless examining some wiring, accompanied by Murray.

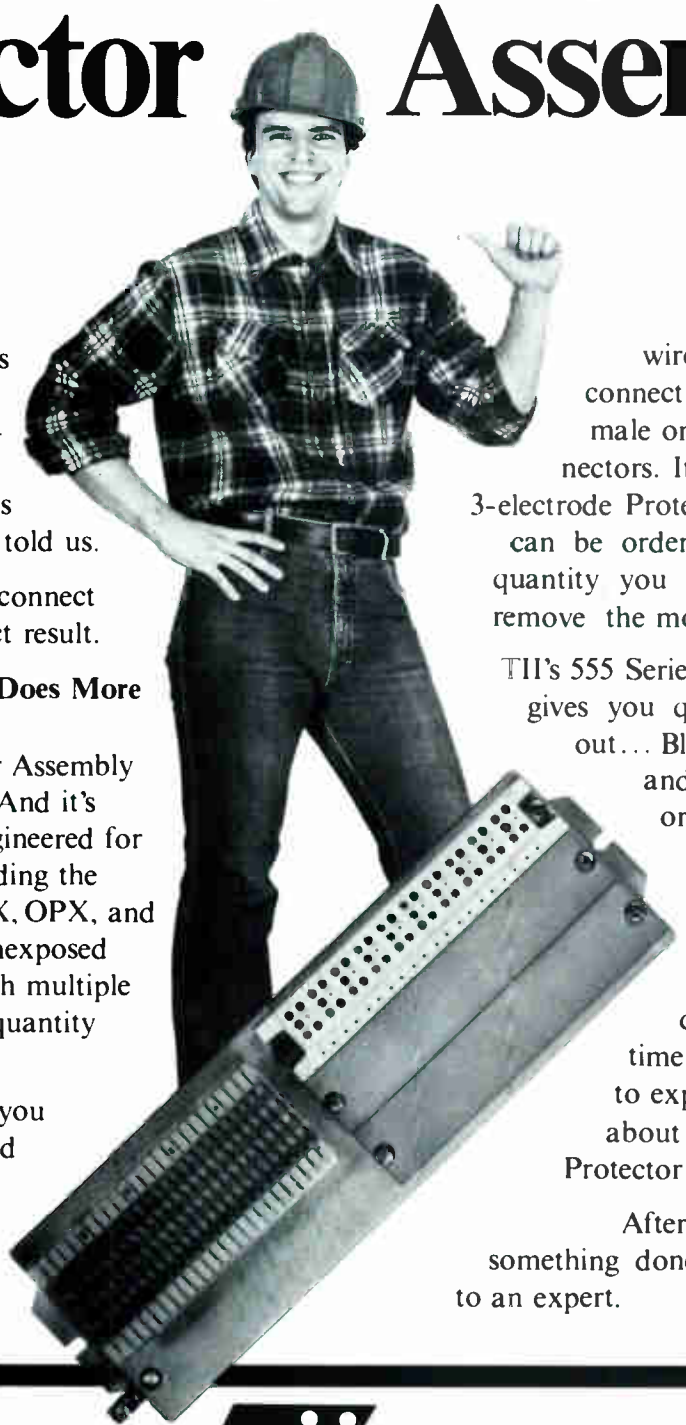
The new system will handle 3700 lines, but the total capacity is 9000. Joes Lawless hastened to say, "We will have fewer trunks with a return of 50 percent of the space formerly dedicated to the telephone room."

Director Curran said that another reason that prompted the change was that the administration area had to be rearranged, and this would have meant additional costs. Bell would charge to make those changes. Northern Telecom would reduce these changes via software. This meant any changes could be carried out more easily and faster than before.

To sum up the elements desired from a new system, it had to fulfill present needs and anticipate growth while reducing monthly costs substantially.

Requests for proposals (RFP)

Meet the expert behind TII's new Interconnect Protector Assembly.



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TII's Interconnect Assembly Does More and Costs Less.

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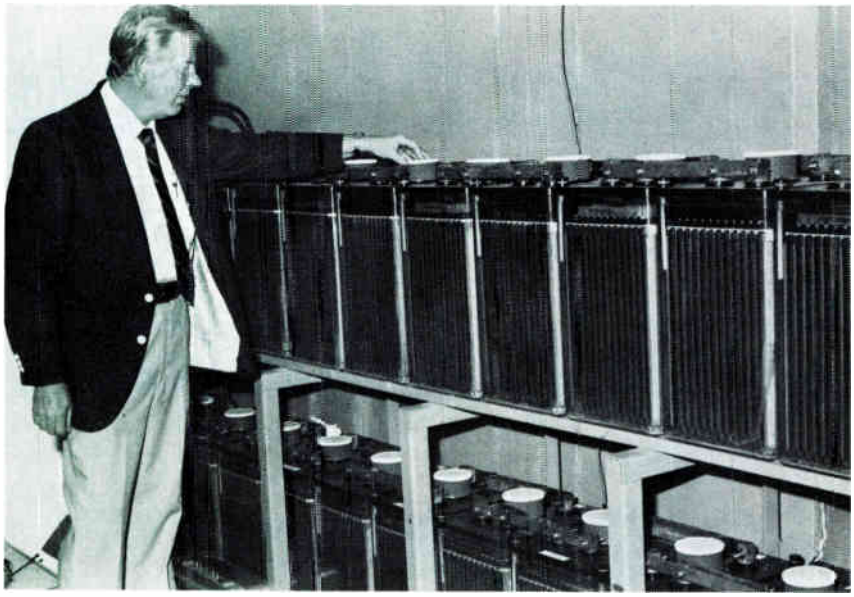


Fred Murray checking a standby battery in the telecommunications room.

The SL-1

Northern Telecom's Model SL-1 offers many features, but above all it gives the user an enormous amount of flexibility. As an example: call restriction can be programmed into each desk set. However, an authorization code enables the caller to override restrictions by dialing this confidential code. This feature permits the owner of the code to dial, when away from his or her desk, a call from someone else's desk. Should the telephone being employed be restricted, the authorization code allows usage of this telephone as though it were the caller's.

The desk set is worth describing. Apart from the usual 12 keys, there are 13 other keys. Seven are feature keys—although this number may vary depending on the need of the owner; three are directory number keys—for direct inward dialing, plus volume controls and a hold key. Ringing is heard through the built-in loudspeaker.

Also available are the following:

- automatic route selection,
- a message center to hold calls until the owner of the telephone returns,
- add-on conferencing,
- station transfer,
- speed calling.

The Paging System

A paging system is a virtual necessity in a modern hospital. The "meet me" pager at Bellevue is a Bogen System used to contact a nurse or a doctor. While a doctor usually depends on his beeper to alert him to call the main desk, the nurses have no such aid. A nurse may leave her station to attend to a patient and cannot answer the telephone at the desk. So to contact her a zone pager is employed. The "meet me" feature tells her to go to a certain station from which she can answer the page. This is not a redundancy of the telephone system; a phone system, no matter how sophisticated, must be complemented by a paging system to avoid tying up telephone lines for purely internal use. Internal calls are more often than not utilized for administrative purposes. The pager solves problems that would otherwise have to be handled by the telephone.

were listed in the City Record, a newspaper that furnishes information such as this about the various branches of the municipality. The RFP went out in April 1980. Eight companies responded. Many companies did not bid, realizing the size of the system required. Of the eight, Northern Telecom was chosen on three counts: it was the lowest bidder, the system offered was judged to be the best, and the company was financially sound. The contract was signed in mid 1981. Further studies were then made. The installation took nine months and Bellevue went on-line with the new system in June of 1983.

"This is the largest single on-site telephone system ever installed in New York City," explained NT's president, Desmond Hudson.

Combining both the administrative and the patients' system in one means nurses do not have to leave their charges' room to call for a doctor. They can make the necessary call from the room itself.

Lawless pointed out another factor. Many transferred calls were lost. "This has been reduced greatly. Each station can do its own transfer now. 'Add-on' conferencing, 'Ring Again' and 'Speed Calling' are now all available," he said.

To avoid any down time during power failures, a battery-operated power supply can furnish up to eight hours of electrical current. As a precaution in case of electronic malfunctions within the system, the SL-1 is redundant.

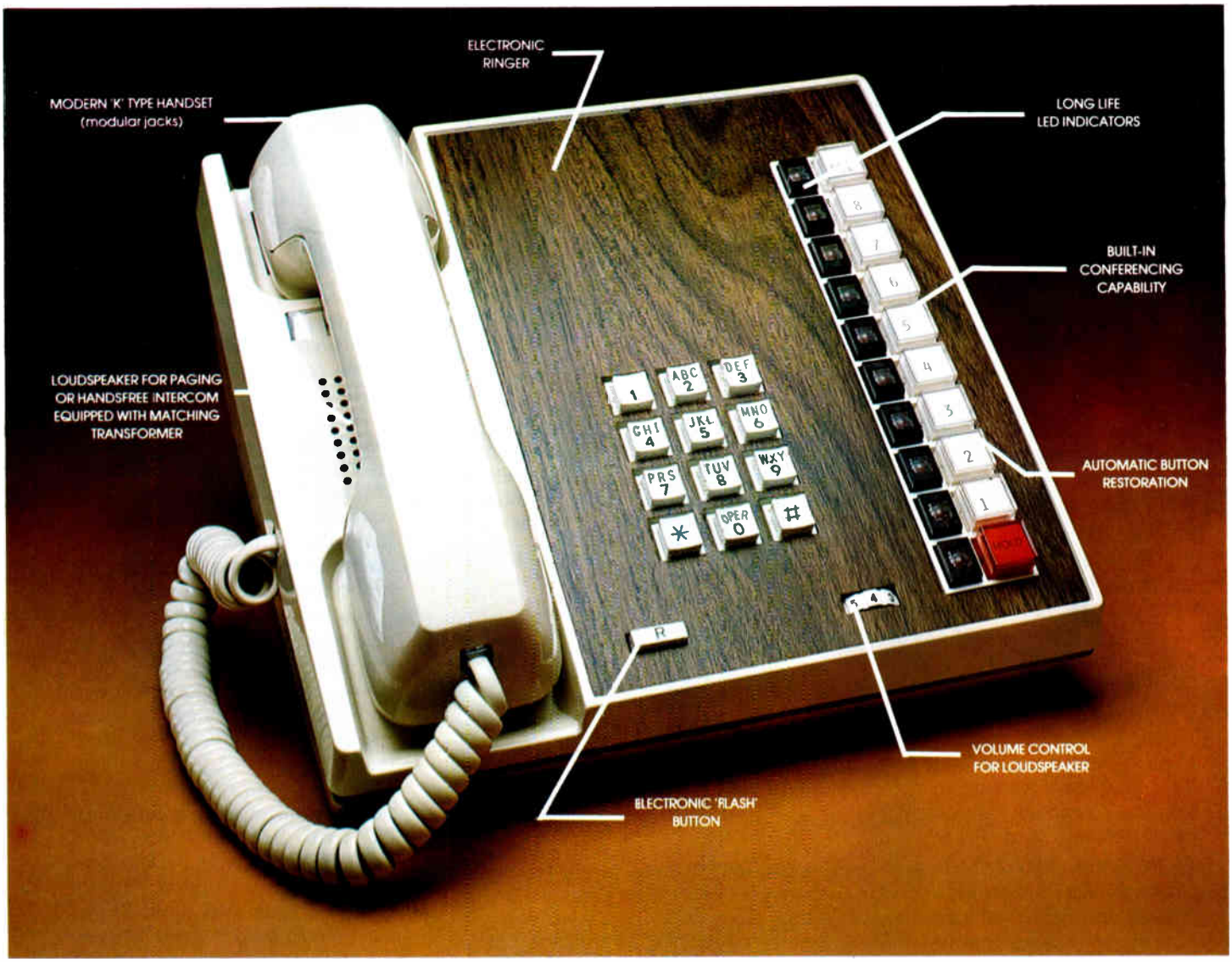
Technicians are on the premises, headed by Fred Murray, project supervisor for NT. The photo on Page 36 shows the banks needed to handle the telephone traffic. While not all could be included in the one photograph, this is a substantial reduction of the space demanded by the older system.

There were, as to be expected in a system of this magnitude, some problems encountered at the onset. Noticeable hum was detected within the paging system, as well as fading and some lack of resolution. A technical check revealed the close proximity of the cabling at one point between the paging and telephone systems created EMI. Once this was detected and corrected, no further problems were found.

The system was bought outright, with free maintenance for the first

THE PERFECT '1O' BY XTEL

ELECTRONIC 1O BUTTON 1A2 TELEPHONE



Modern new look and additional features for stand-alone 1A2 installations and behind PBX

The PERFECT '1O' offers these standard features:

- 1A2 plug compatible
- Modern styling
- LED indicators
- Electronic ringer
- Electronic 'FLASH' button
- Built-in loudspeaker for paging or intercom
- Conferencing capability

Now you no longer need to sell and install the same old tired looking key telephones. With Xtel's PERFECT '1O', you can give your customers attractive telephones plus useful features they need and want.

Long life LED's replace standard incandescent bulbs for line status indication and a pleasant electronic ringer alerts you to incoming calls

Paging and handsfree intercom needs are provided for by the built-in loudspeaker and transformer. And, an electronic 'FLASH' button makes PBX call transfer and other feature activations simple. Just touch the button and the electronic circuitry 'flashes' the line for you....perfect timing, every time.

Set yourself apart from your competition with Xtel's PERFECT '1O'. Call today, 405-946-1500 or write Xtel, 3908 N.W. 3rd St. Oklahoma City, OK 73107.

Xtel

Keysets: Still in Favor

by Fred Goldstein & Nelson Hanover

Multiline telephone sets have been around for decades, and telephone systems built around them are the most common form of business phone system for smaller users. These systems are called key telephone systems because "key" is telephone jargon for switch; the line buttons on each telephone enable individual users to switch between multiple outside telephone lines, as well as intercoms.

For a business user with need for more than a single telephone line or two, and less than about 25 to 50, key systems provide an ideal solution to voice communications needs. Most American businesspeople are very comfortable with key telephones; key systems are easy to use, provide most necessary and desirable telephone features, and grow easily to match a dynamic or fast-moving business.

Small PBX systems have been popular in Europe for decades, but in the Northern American marketplace they are relatively new and unpopular. Keysets are considered friendlier, and generally cost less than comparable PBX installations that use regular single-line telephone sets. And let's face it: Many people enjoy the feeling of status they get from a multi-button telephone.

Centrex—A New Market

There's a second market for key telephones, one which may be enjoying an unparalleled opening this year. PBX systems traditionally required large numbers of keysets for special functions, such as secretarial answering. But since most new PBX systems include proprietary electronic telephone sets which take the place of standard keysets, this market has been shrinking for several years, and in any case it was usually met by PBX vendors and the local telephone companies. But the divestiture of the Bell Operating Companies from AT&T has led to the recent revival of Centrex service, which uses Central Office lines to simulate a PBX.

While Centrex has been enhanced to provide many features most often associated with fancy electronic PBX systems, it doesn't support electronic sets. Standard, electromechanical key telephone sets are still popular with Centrex users. And there's a vacuum developing where the "embedded base" of Centrex keysets may be "orphaned" when AT&T takes ownership of them next January.

Electro Mechanical and Electronic Technologies

Electromechanical key telephone sets are basically a commodity item. Many, including those used in most Bell installations, are of the so-called 1A2 variety, which is the current (post-1950s) version of a rather venerable design. The basic 5-line (plus hold button) set, generally called a type 565 (rotary) or 2565 (tone dial), requires a cable with 25 wire pairs going to a large "ribbon" connector.

In type 1A2 key sets, each of the telephone lines picked up on the particular set (i.e., station) has its own set of wires within the 25-pair (50-wire) cable. Each line's leads include:

Tip and Ring—the 2-wire talking path, found in single-line sets; A and A1—these two connect to each other when the line goes off-hook, L and LG—line button lamp power and lamp ground.

In addition to these six wires per line, a separate pair is reserved for each set's ringer, and another pair per set is needed for an intercom buzzer, if one is used, for a total of four wires per station. However, since LG can be made common among all lines, a maximum of 9 lines can be connected to a station with a 25-pair cable. Larger sets, such as 19-line and 29-line models, require 50-pair and 75-pair cable, respectively.

These "fat" cables terminate in a cabinet called a KSU (key service unit). A KSU in turn contains a line card, called a KTU, for each separate line picked up by one or more keysets. The total size of the system, and which lines appear on which set, are both determined by the wiring. A 1A2 key system is extremely flexible, since KSUs can be expanded or additional ones added to a key system as the need occurs. There is no "common equipment" other than the KSU cabinet and power supply. This makes the system very reliable.

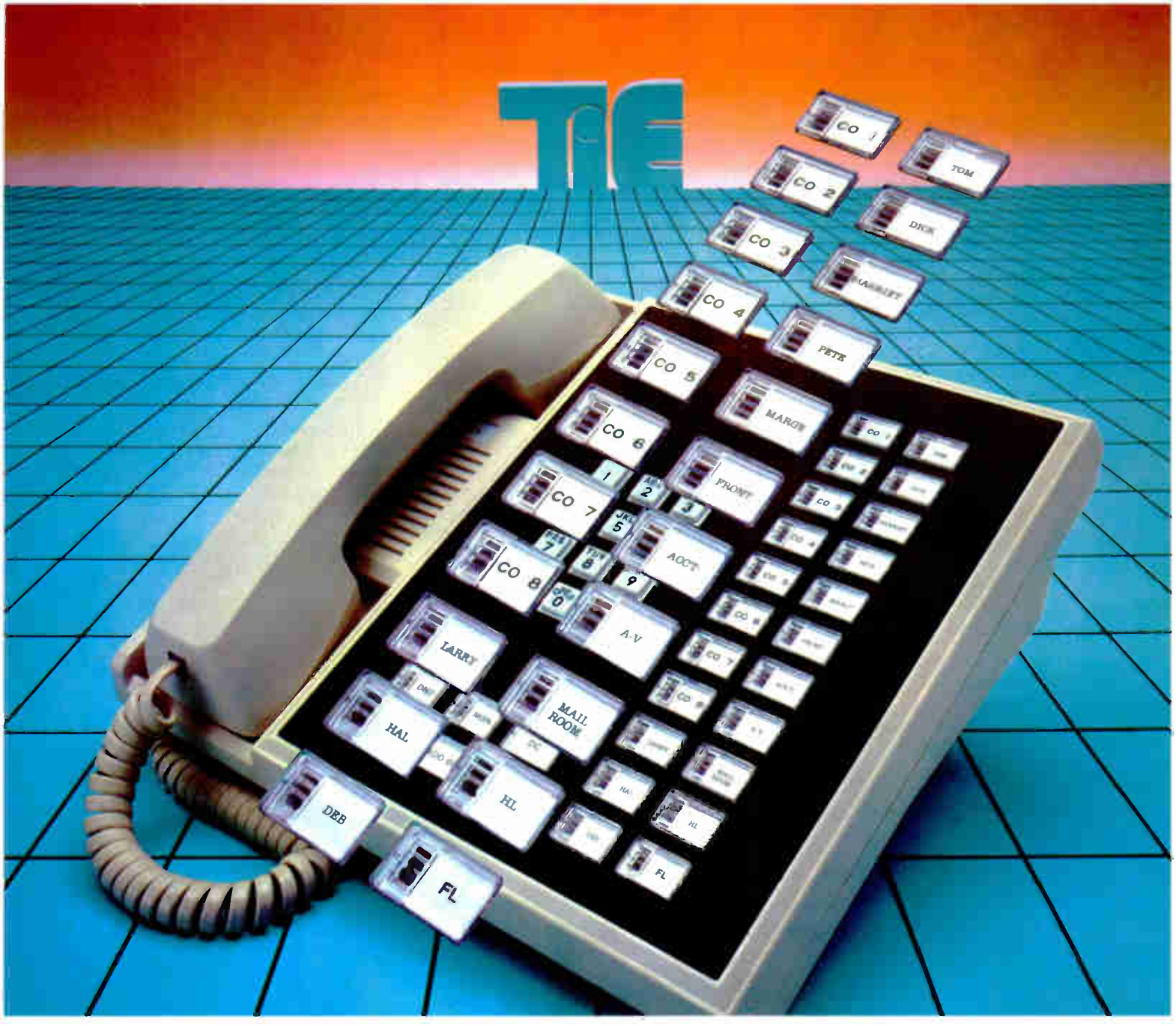
A KTU performs its task by means of a rather clever arrangement of relays and other simple components. When a line is picked up by any set on which it appears, the A and A1 leads conduct; this tells the KTU to turn on the light. Ring voltage on the line is picked up by the KTU and causes it to flash the light. Ringing on the line is regenerated and can be directed to any combination of sets on the KSU. Thus, when the power goes out, lines may not ring even though they are still fine for dialing and talking. (Electronic systems, unless equipped with battery backup, fail totally during power outages.) Some newer KTUs have a power failure circuit which makes a direct connection between lines and sets, complete with ring.

Whenever a user puts a line on hold, the KTU attaches a resistor across the line, and winks the lamp. When any set picks up that line, it links A and A1 again, and the hold relay is released.

Optional features can be built into a 1A2 key system, like music-on-hold, dial intercoms, hands-free announcers, and any kind of gimmick (dialers, speakerphones, etc.) that can be built into or attached to sets. Systems can also be built combining different sizes of sets, such as 6-button, 10-button and single-line sets which are wired (with A-lead control) to the KSU.

Electronic Sets Put Wiring on a Reducing Diet

Electronic key telephone systems have been coming on strong during the past decade, and stand to become more popular as improving microprocessor technology drives down costs and improves features and functions. A myriad of vendors now offer them, and more enter the marketplace each month. What they offer, compared to 1A2 and other electromechanical equipment, includes new features, flexible



BUSINESSCOM SELECT™

Calls Tom, Dick, Harriet and others on staff — direct.

A boon to the busy office. The computerized BUSINESSCOM SELECT telephone has up to 14 DSS keys which can be programmed to make direct contact with other phones simply by touching one key.

Here's how it works. BUSINESSCOM SELECT displays the extensions in use so time is saved by not ringing and waiting for busy parties . . . When an outside call is busy, you can redial automatically by touching just a couple of keys . . . Memory dialing* of up to 10 phone numbers is available for individual extensions in addition to the 80 number system memory . . . No caller is left hanging because unanswered calls go back to the attendant . . . You can even program a reminder signal so that when a call is on hold you get both an audible and visual reminder.

BUSINESSCOM SELECT. Accommodates 2 to 20 extensions and fits in with the larger capacity BUSINESSCOM family which grows to 60 extensions. It's a system that suits small to midsize companies whose initial investment can be preserved by adding compatible equipment and simply changing or adding cards for feature updates.

Sell smart. Sell new BUSINESSCOM systems or add-ons. The family that opens more doors and closes more sales.

TIE® TIE/communications, Inc.

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San Francisco 415-571-0281
Atlanta 404-447-1314
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Available through leading telephone equipment supply houses.

*Optional

expansion, and a potential reduction in cost. While 1A2 equipment is not particularly expensive to purchase, it involves high cable and labor costs. Revising button layouts, adding lines and making other changes require considerable effort by trained technicians.

Electronic systems, on the other hand, cost less to operate, largely because microprocessor control allows them to do with two or three-pair cable, with standard modular jacks, what 1A2 multiline sets do with heavy cables and complex wiring. Many electronic systems allow changes to be programmed in, without rewiring, thus reducing labor costs. The higher initial first cost of the hardware is recovered by lower costs over the life cycle of the equipment.

The typical electronic key system has a KSU which includes a processor, power supply, and separate interface circuits which connect to electronic station equipment and to the incoming lines. The sets typically run on two or three pair, with one pair carrying the actual speech path and the others carrying control information (which lights to light, which buttons were pressed) and power. One of the major differences between makes and models is the number of wires needed and how power is provided to each set; newer systems tend to require fewer pairs, and one-pair all-digital keysets may soon come out.

Many PBX-type features are available on electronic keysets. Among these are programmable toll restriction that permits individual extensions to be allowed to call only specific numbers, call forwarding that allows intercom calls to be diverted to an alternate location when someone is not at his phone, and speed dialing that lets users press one or two buttons to dial a predefined number. Such convenience and cost control features aren't common on electromechanical systems, though they often can be provided with add-on components at some cost.

One potential disadvantage of many electronic systems, though, is their uniformity. Single-line extensions can only be accommodated on a few systems, and the variety of line sizes may be limited. But as a rule, while the installed cost of a 1A2 set rises almost directly in step with the size, the heavy common equipment cost of an all-electronic system means that extra buttons don't add much to the price of the set.

Add-ons Increase User Friendliness

A basic key telephone system inherently provides a number of features, such as visual indication of line status, line selection, hold and conference. Many electronic systems add more; however, a number of additional functions can be provided with additional hardware. Standard 1A2 systems accommodate any number of special devices, because the tip and ring connections, including dial pulses and tones, are identical to those of single-line sets. Thus devices like autodialers, speakerphones and answering machines can be attached.

The A-lead must be controlled if the device is to pick up the line, but many accessory devices are built with A-lead control, using the same configuration as a single-line set in a key system. That requires an additional jack for the device. A simple way to get that jack, though, is to use a readily available in-line adaptor (or splitter) in series with the 25-pair ribbon connector to present each (or some) of the set's lines as a separate RJ-11 size (single-line set) jack.

In addition, there are keysets with integral speakerphones, as well as with dialers and other features. Electronic sets, of course, may have them built in, but since most electronic sets have proprietary signalling schemes, other vendors' hardware may be hard to interface to them. Selecting an electronic key system, then, may simplify or limit a choice of special features, depending upon how adequate the manufacturer's support is.

Tomorrow's Applications Are Already with Us

Stand-alone key systems have remained popular for small business users, even though PBX systems are frequently cost-competitive. New systems continue to add features, many of which were previously only available to sophisticated, larger PBXs. Hybrid key/PBX systems are also becoming popular. They combine multibutton telephone sets with PBX-style dialing.

When a telephone company offers flat-rate business service (no message unit charges for local calls), the rate for each trunk line going into a PBX is higher than the rate for a line going into a key system. The distinction is made based on how the user selects the line. If he must press a line key or dial a specific line selection code, then it's a key system. If the system selects one line from a group, it's a PBX. A hybrid may offer both options, so a cost-conscious user can set it up as a "key system" in a flat-rate area, or as a "PBX" when message units apply (in which case, there is generally no surcharge for going into a PBX).

Another very useful feature of PBXs and some hybrids is Automatic Route Selection, which allows a station user to dial a call and have the system select the appropriate local, WATS or Foreign Exchange line. This results in a lower cost for the customer's calls by preventing mis-dialing of calls on the wrong line. Toll Restriction is a more common feature; it can limit an extension's dialing range to, say, local calls, or at least force toll calls onto WATS lines by blocking them from local circuits.

PBX and Centrex users, though, represent a different type of market for key systems. With the impending breakup of the Bell System, two major new markets are opening up for key systems. Centrex requires 1A2 key systems to provide secretarial functionality. A group of five users might share a secretary, who needs a keyset to answer their calls. With 1A2 key, each of them gets a single-line set with A-lead control, and the secretary gets a multi-line set. A KTU is needed for each line. Keysets can also be given to the individuals, on an as-needed basis, with any combination of lines on any set.

Centrex has many options of its own, including Automatic Route Selection, Toll Restriction, call transfer, group pickup (pickup of other ringing lines within a group from a single-line phone), and call forwarding. Thus, most fancy features of electronic systems are unnecessary. Hence most Centrex users are happy with 1A2 keysets. But the Bell Telephone Companies are losing ownership of all of their existing 1A2 key systems with divestiture. AT&T, which will acquire them, has no interest in keeping Centrex alive competing with its PBXs. So AT&T has refused (to date) to commit itself to providing support

to Centrex key systems. This has created a tremendous market for other vendors, who can sell replacement systems.

Even though most PBXs have their own electronic sets, many users prefer to keep older-style systems intact. In most areas, the Bell companies' installed base of older PBXs (including Dimension) is being offered for sale to the customers who are now renting them. Someone will be needed to keep their systems going, and while the local companies can sell maintenance services, it will be a competitive market. With no monthly rental fees anymore, companies who buy their old PBXs will need ongoing keyset support. □

Hybrid Systems Combine Features of Key and PBX Systems

Hybrid key/PBX systems have been growing in popularity for the past several years. They are electronic, computer-controlled systems which combine the multi-line sets typical of key systems with "dial-9" outside trunk access typical of PBX systems. Hybrids also support single-line sets, with some, but not necessarily all, PBX-like features.

The most widely-known hybrid, AT&T's Horizon, supports about 80 stations, including Multibutton Electronic Telephone (MET) sets which look like keysets and provide access to multiple lines. Outside calls are made by dialing "9" or "10x" trunk access codes, so PBX rates for trunks apply in flat-rate areas. But private trunk appearances are also possible, so an outside call can go straight to a designated MET set or group of sets. Otherwise, the most common way to receive calls is with a panel which provides one-button direct station selection, transferring calls as on a PBX console.

Other hybrids are available in the interconnect market, and provide additional features (automatic route selection, for example) not found on Horizon. They provide a good bridge for customers who are too big to use ordinary key systems, but who aren't comfortable with full-scale PBX systems.

NEW PRODUCTS

BUSINESS PHONE

Tymecom is a business telephone system available for up to 24 lines and 48 stations. Among the 36 dedicated standard features included are add-on conferencing, memory dialing, executive override of system privacy on C.O., and PABX call ringing with operator recall.

☐ For more information write 514 on the inquiry card. Or write: Tymetek Communications, Inc., 770 Church St., Elmhurst, IL 60126.

MOBILE PHONE ANTENNA

A cellular mobile telephone antenna works directly through the glass, without the need to drill holes in the vehicle. Easily mounted on the windshield or rear window, with a special adhesive, the antenna can also be removed without leaving a trace. A special device mounted on the inside surface of the glass couples the antenna to the radio capacitively.

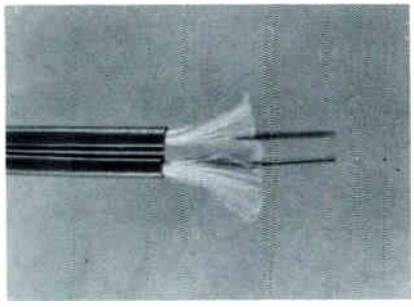
☐ For more information write 515 on the inquiry card. Or write: Antenna Specialists Co., 12435 Euclid Ave., Cleveland, OH 44106.

KEY SYSTEMS

Multikey 205 (2 trunks, 5 stations) and 410 (4 trunks, 10 stations) key systems are suited for use in place of 1A2 key systems. The economical systems combine electromechanics and electronics to offer DTMF dialing and such options as last number redial, 10 number memory dialer, intercom, paging, music-on-hold, and speakerphone. Installation is by 25-pair connector and may be easily connected to existing cable.

☐ For more information write 516 on the inquiry card. Or write: Multitel, 505 N. Lake Shore Dr., Chicago, IL 60611.

FIBER OPTIC CABLE



A line of duplex fiber optic cables is custom fabricated from individually strengthened and jacketed single fiber cables. The cables may be supplied with a variety of jacket materials and colors, with or without factory-installed connectors.

☐ For more information write 517 on the inquiry card. Or write: Optical Cable Corp., 870 Harrison Ave., Salem, VA 24153.

INPUT/OUTPUT TERMINALS

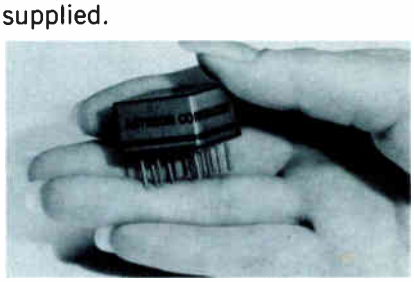
Discrete hi-speed Voice Input/Output Terminals are available to enhance the usefulness of computers. The SR-100 Voice Input Terminal is designed to put the computer at the user's verbal command. Programming is simple, as instructions, data or commands need only be spoken once and the sound becomes part of the unit's vocabulary. Using a unique internal dynamic programming (DP) method, the SR-100 has a 120-word recognition capacity in any language, with a recognition ratio of over 99%. In addition, it has the capability to interface not only with a mainframe, small business or personal computer, but also with numerical control (NC) machinery, medical equipment, and more. This makes it suitable for use in data input for business, control of industrial processes, or information retrieval. The AA-100 Voice Output Terminal allows the computer to talk and can "register," or remember, up to 120 seconds of spoken words, messages, announcements, or instructions. When needed, the unit can repeat them over and over again. Because these messages are in digital form, they can be stored in the floppy disk unit of the host computer. The terminal is equipped with a built-in analysis circuitry which permits fast, easy, on-the-spot registration. Through the use of a sophisticated bandwidth compression technology, called adaptive differential pulse code modulation (ADPCM), the Voice Output Terminal has an extremely high-quality voice output. When connected to a host computer or computer terminal, this single compact, economical unit lets the user configure a complete, high-performance voice output system. Applications include public announcement systems for airports, train stations and bus depots; voice instruction systems in giving step-by-step directions for a process; warning systems in factories when dependability is crucial; and instructional systems for self teaching where the next instruction depends on the user's response. Combining the AR-100 with the SR-100 makes it possible for both speech recognition and verbal response. In this combination, the SR-100 recognizes spoken words,

acting as an "ear" for data input to the system while the AR-100 functions as the "mouth," outputting data from the computer. It can also be used as a voice response terminal to confirm that the operator's verbal instructions have been accurately recognized by the system. Utilizing the Output/Input system in conjunction with two-way radio equipment, a wireless voice-operated control system can be configured for use in equipment yards, warehouse complexes, and the like. The computer terminal can be installed in a central office, and the operator, using a low-power transceiver and headset or a walkie-talkie, can input instructions to and receive verbal output from the computer. Such a system can expand the operator's sphere of activity and dramatically increase work efficiency, because there is no need for the operator to be confined to the display terminal area.

☐ For more information write 518 on the inquiry card. Or write: NEC America, Inc., 532 Broad Hollow Rd., Melville, NY 11747.

INTERFACING

A compact, low signal loss 2-wire/4-wire, 4-wire/2-wire hybrid interface unit, the Hybrid Interface, features less than 4 dB forward and reverse signal loss between 300 and 5000 HZ and 60dB or greater isolation. Interfacing any phone/computer, (voice grade circuits) it requires no power supply. Equipped with .3" long pins, the all-passive component measures 1" square X 5/8" high, weighs 2 oz. and is U.S. patented. To enable true balancing, an optional balanced circuit can be supplied.



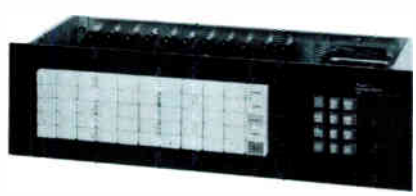
☐ For more information write 519 on the inquiry card. Or write: Astreon Corp., 23 Shaffer St., Lowell, MA 01854.

PHONE/CLOCK-RADIO

The Electra Telephone Clock-Radio boasts a distinctive design in a choice of silver or beige-and-almond finishes. There is pushbutton pulse or electronic dial tone, 10-number memory for automatic dialing and last number automatic redial. The unit includes a hands-free speaker and an index for 10 numbers. The radio is AM/FM and the digital clock features alarm and snooze.

☐ For more information write 520 on the inquiry card. Or write: Com Vu Corp., 432 Park Ave. S., New York, NY 10016.

DIAL BACKUP CONSOLES

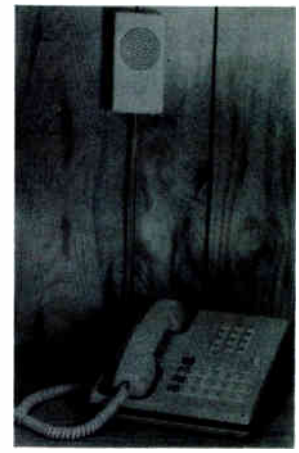


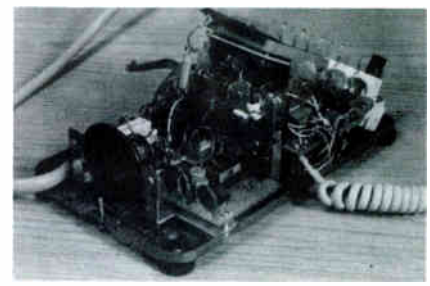
Up to 200 voice and/or communications circuits may terminate in these desk-top or 19" rack mount consoles. Compatible with standard 1A2 key telephone systems, the consoles are available in all telephone set colors. Modular handsets or headsets may be used. Transmit and receive pick-up keys indicate the status of each line whether idle, busy, on hold (Data Mode) or incoming.

☐ For more information write 521 on the inquiry card. Or write: Plant Equipment, Inc., 28C75 Diaz Rd., Temecula, CA 92390.

PHONE CHIMES

A compact and economical all-electronic device permits simple retrofit or enhancement of any existing telephone instrument or system to provide pleasant chime tone signals. "Telchime" is available in three packages and can immediately replace ringing and warbling telephones in practically every conceivable location and application: executive and professional offices and general office areas; quiet areas such as hospitals and libraries; residential; and low frequency/loud tones for the hearing impaired. For direct installation inside the standard telephone, a simple screwdriver hookup of a printed circuit assembly replaces the phone's original ringer. A second package, an attractive compact (4-3/4" x 2-3/4" x 1-3/4") easy-to-install wall-mounted plastic case, is placed between the telephone and the wall-mount connection block. The connections are made through the existing standard telephone jack and the plug. The third package is a rugged die-cast enclosure (6-1/2" x 5" x 2-5/8") for wall mounting that offers higher sound output for institutional application, or for use in larger areas where greater sound coverage is required from a single signal source. The packages, available in either grey or tan, operate directly off telephone line power, have low ringer equivalence and adjustable sound level with a volume control that can be accessed from the outside in the two wall-mounted devices. All packages have FCC registration for direct connection to the telephone network. Low voltage AC and DC models are also available for key telephone systems or general purpose signalling and paging systems. Sound output ranges from 60 to 85 dBA at 10 feet.





☐ For more information write 522 on the inquiry card. Or write: Wheelock Signals, Inc., 273 Branchport Ave., Long Branch, NJ 07740.

RECORD/PLAYBACK UNIT

A record/playback unit and console for users of continuous, repetitive messages, the Digital Choice and Digital Sequencer Console are suitable for shopping centers, parking lots, highway construction sites, amusement parks, etc. The solid state, digital record/playback unit functions like a conventional cart tape machine, but has no moving parts. It uses a digital memory bank as the storage medium rather than a conventional record/playback head and magnetic tape. The unit is virtually maintenance-free. It uses little electricity and does not generate heat. Neither message quality

nor speed are affected by temperature changes, repetition or moisture. Digital Choice reproduces true voice quality and accommodates variable length messages automatically. Accessory boards are available to increase the basic unit message capacity of two minutes, 10 seconds to more than 30 minutes. An accessory telephone interface system allows users to check and/or change messages from remote locations. The units can be custom-designed to meet a user's specific needs. The Digital Choice Sequencer Console converts multiple units into a small, progammable automated system. It will automatically sequence, time, play and monitor from two to sixteen units at once.

☐ For more information write 523 on the inquiry card. Or write: Digital Recorders, Inc., 1908 Ridge Rd., Raleigh, NC 27607.

HANDSETS

Contemporary styling highlights the 1200 "Twiny" series of two-piece telephones. They are fully modular and offer adjustable ringers and LED power indicators. Available features include touchtone, touch pulse, adjustable tone/pulse and last number redial. The units come in two-tone black and white, almond, cocoa brown, burgundy, yellow and turquoise.

☐ For more information write 524 on the inquiry card. Or write: LeTEL Electronics, Inc., 17923 Western Ave., Gardena, CA 90248.

TIP & RING

JOHN R. JESTER HAS BEEN NAMED PRESIDENT/EXECUTONE INC., a wholly-owned subsidiary of Continental Telecom Inc. Jester had earlier served Executone as executive vice-president, directing the operations of a network of 230 independent sales and service locations nationwide.

Before joining Executone, Jester served in various posts at the parent corporation, Continental Telecom, both at headquarters and in the Eastern Region. Jester holds a B.S. in finance from the University of Maryland. He and his wife, Judy, and their children, Brian and Karen, will continue to live on Long Island.

TIE/COMMUNICATIONS, INC., SHELTON, CT, REPORTED THE HIGHEST LEVEL OF QUARTERLY SALES AND NET INCOME IN ITS HISTORY FOR THE QUARTER ENDING JUNE 30, 1983, and for the first six months of 1983. Net income for the second quarter rose to $7,672,000, compared with $3,640,000 for the second quarter of 1982, a 111% increase. Second quarter sales for 1983 increased to $81,798,000 from $39,731,000 during the second quarter of 1982, a 106% increase. Primary and fully-diluted earnings per share for the second quarter of 1983 were $0.49 and $0.48 respectively, compared with $0.30 for the second quarter of 1982.

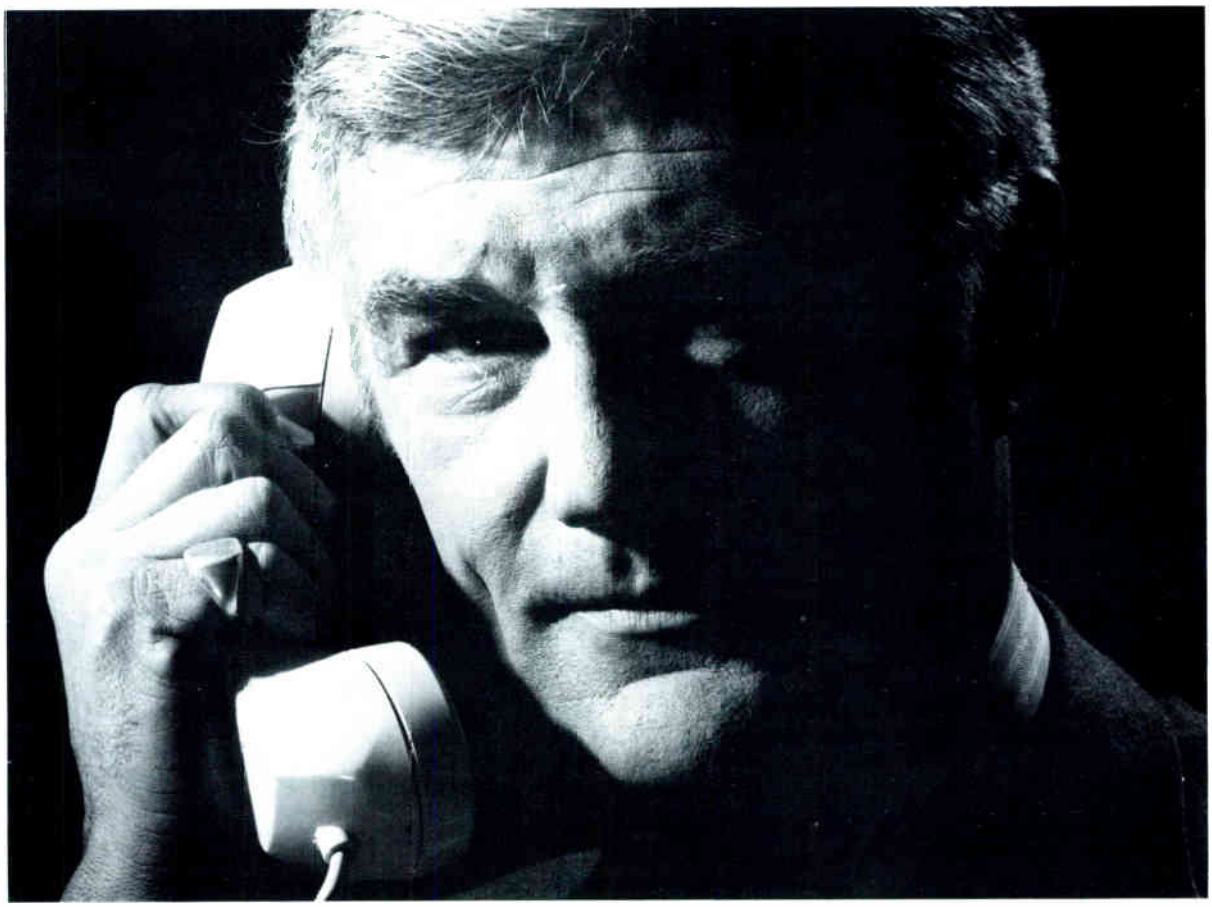
For the first six months of 1983, the company's net income was $12,600,000, compared with $5,798,000 for the first 6 months of 1982, an increase of 117%. Sales for the first six months of 1983 were $144,237,000 against $71,686,000 for the same period of 1982, a 102% increase. Primary and fully-diluted earnings for the first six months of this year were $0.83 and $0.81 respectively compared with $0.47 for the same period in 1982.

TIE/Communications further announced that they, together with Technicom International, Inc., had signed a 2-year agreement to sell $8 million of their electronic key telephone and hybrid systems to Rotelcom Supply. Under the agreement, TIE will provide Rotelcom Supply with its Meritor, hybrid Meritor HX, Businesscom V/VI/VII and fully-electronic 1A2 replacement key systems. Technicom International will provide Rotelcom with its Smartcare, Smartset, Homefone/Businesscom 106, Businesscom I and II and Paragon systems.

UNIVERSAL TELEPHONE SERVICE LEGISLATION NOW PENDING IN CONGRESS COULD STIFLE COMPETITION AND TECHNOLOGICAL DEVELOPMENT IN TELECOMMUNICATIONS, according to a statement issued by the Computer & Business Equipment Manufactures Association. The pending Congressional bills are concerned with assessing long-distance charges to subsidize local service costs and taxing private systems that bypass the local telephone network, in an attempt to keep phone service rates at a minimum.

Vico Henriques, president of the trade association, contends that the measures could reduce incentives for U.S. industries to develop new technology.

SMART MOVE!



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U S WEST, A DENVER TELCO, HAS SIGNED AGREEMENTS WITH NEC TELEPHONES, INC., TECHNICOM INTERNATIONAL, INC. AND TIE/COMMUNICATIONS, INC. to supply communications system and terminals to U S West's soon-to-be-named business communications subsidiary. U S West has announced preliminary agreements with Ztel, Inc. and AT&T Information Systems for similar equipment and communications systems to be supplied to the U S West subsidiary.

The NEC agreement calls for U S West to market the newly announced NEAX 2400 Information Management Systems. U S West will offer the 416 from Technicom, as well as other specialized business terminals, larger key systems and the digital Voice Data Systems from TIE; the PBX from Ztel; and the Merlin from AT&T Information Systems. Richard Perry, president of the new subsidiary, said that during the terms of the agreements U S West purchase over $100 million in products.

BELL ATLANTIC HAS REACHED AN AGREEMENT WITH NEC AMERICA, INC. TO MARKET ITS NEW, ADVANCED NEAX (R) 2400 INFORMATION MANAGEMENT SYSTEM NEXT YEAR. The NEAX is one of the first systems to integrate all communications functions—voice, data, text and voice mail, facsimile, store and forward, packet switching and local area networking using fiber optics. It serves from 200 to 200,000 lines.

Bell Atlantic will offer installation service, pricing options, and maintenance contracts as part of its marketing effort.

At the time of Bell System divestiture, Bell Atlantic will be the regional holding company that includes New Jersey Bell, Bell of Pennsylvania, Diamond State Telephone in Delaware, and the four C&P Telephone Companies serving Maryland, Virginia, West Virginia and the District of Columbia.

1983 NATA CONVENTION/SHOWCASE SEMINAR PROGRAM

November 28

- "Telephone Bypass: Impact and Opportunities for the Telecommunications Industry"
  Dr. Jerome Lucas, president, TeleStrategies Inc., McLean, VA
- "Total Marketing for Communications and Data Equipment"
  Scott Ward, president of marketing, The Wharton School, Philadelphia, PA

November 29

- "Accounting and Financial Management for a Telecommunications Contractor"
  Thomas G. King and Joan F. Schweizer, Touche Ross & Company, Washington, DC
- "Selling Profitably in the Telecommunications Industry"
  Gerry Freisen, publisher, Teleconnect Magazine, and Harry Newton, president, Telecom Library Inc., New York, NY
- "Networking"
  Alina Novak, financial analyst, The Equitable Life Assurance Society, New York, NY
- "What Criteria a Hospital Considers in the Acquisition of a Communications System"
  J.D. Epstein, partner, Wood, Lucksinger & Epstein, Houston, TX
- "National Defense Requirements for Telecommunications in the Decade Ahead"
  William H. Brill, William Brill Associates, Washington, DC, and Lt. General Lee M. Paschall, USAF (Ret.), president, American Satellite Company, Rockville, MD

November 30

- "International Trade Opportunities"
  Andrew M. Rizzo, president, AMR International Services, Washington, DC
- "The Harry Newton Extravaganza"

UPCOMING

November 28-December 1: **NATA 1983 Convention & Exhibition Showcase,** Sheraton Washington Hotel, Washington, DC. (North American Telecommunications Assoc., P.O. Box 75196, Washington, DC 20013. 202 547-4450)

December 5-7: **International Tele/Conferencing Symposium,** Boulder Hilton Harvest House Hotel, Boulder, CO. (Cross Information Co., 934 Pearl Mall, Boulder, CO 80302-5181. 303 499-8888)

January 17-19: **Southcon/84 High Technology Electronics Exhibition** and Convention, Orange County Civic Center, Orlando, FL. (Electronic Conventions, Inc., 8110 Airport Blvd., Los Angeles, CA 90045. 213 772-2965)

January 31-February 2: **Communications Networks Conference & Exposition,** Washington Convention Center, Washington, DC. (CN '84, Box 880, Framingham, MA 01701. 617 879-0700)

February 20-22: **1984 Office Automation Conference.** Los Angeles Convention Center. (American Federation of Information Processing Societies, Inc. 1815 N. Lynn St., Arlington, VA 22209. 703 558-3613)

April 4-11: **1984 Electrical/Electronics Hanover Fair,** Fair Grounds, Hanover, West Germany. (Hanover Fairs Information Center, P.O. Box 338, Whitehouse, NJ 08888. 800 526-5978; in NJ, 201 534-9044)

April 25-27: **Electronic Distribution Show & Conference '84,** Hilton Hotel, Las Vegas. (Electronic Industry Show Corp., 222 S. Riverside Plaza, Chicago, IL 60606. 1 312 648-1140)

April 24-26: **1984 Contractor Conference & Expo,** Sahara Hotel, Las Vegas. (National Sound and Communications Assoc., 5105 Tollview Dr., Rolling Meadows, IL 60008. 312 577-8350)

May 14-17: **International Conference on Communications,** RAI Conference Center, Amsterdam. (Dr. T.A.C.M. Claasen, Philips Research Laboratories, 5600 MD Eindhoven, Netherlands. 31 40-742131)

May 15-17: **Electro/84 High Technology Electronics Exhibition and Convention,** Bayside Exposition Center, Boston. (Electronics Conventions, Inc. Address above)

May 15-17: **Mini/Micro Northeast-84 Computer Conference and Exhibition,** Hynes Auditorium, Boston. (Electronic Conventions, Inc. Address above)

June 12-14: **Ohmcon/84 High Technology Electronics Exhibition and Convention,** Franklin County Veterans' Memorial Auditorium, Columbus, OH. (Electronic Conventions, Inc. address above)

CELLULAR RADIO

NOVATEL COMMUNICATIONS, ATLANTA, HAS RECEIVED FCC CERTIFICATION FOR ITS AURORA CELLULAR MOBILE PHONES. NovAtel says its handset is compatible with both cellular and IMTS mobile radio systems. Meaning... says David A. Frye, vice-pres./U.S. Operations... "that using the same handset (you) can operate either our 800 MHz cellular or RF package or (our) IMTS RF package, or both. In order to have both all (you) need to do is connect (our) IMTS and (our) 800 MGH packages to each other in the trunk of (your) car."

MCI AIRSIGNAL IS NOW OFFERING BOTH TONE-ALERT AND VOICE-MESSAGE PAGING SERVICES in Duluth-Superior and surrounding areas, and will begin offering advanced display paging sometime this fall. MCI Airsignal provides paging and mobile communications services in more than 50 cities nationwide and has applied for licenses to operate a cellular service in dozens of metropolitan areas.

MCI Cellular Telephone Company and McCaw Cellular Communications announced that they have combined their cellular radio applications in the Denver and Kansas City markets. Under the agreement, MCI will take a 65% interest in the Denver partnership and McCaw will take an 80% interest in the Kansas City partnership.

The partnership will now compete in comparative hearings before the FCC against four applicants in Kansas City and three in Denver. All applicants applied for authority to operate cellular systems in the two markets on June 7/82.

A WALL STREET JOURNAL ANALYSIS OF CELLULAR RADIO concluded... "the system has generated a lot of static in the investment community in the past year. Investors have been bidding up the shares of a number of companies that appear poised to begin marketing the equipment and supplying the phone service that is expected to make cellular a reality

beginning late this year or early in 1984.

"Companies whose stocks have benefited from the hoopla include Motorola, Graphic Scanning, Millicom, Western Union, Metromedia, MCI Communications, LIN Broadcasting and FMI Financial.

"Existing companies and venture capital groups, hoping to cash in on the projected multi-billion-dollar bonanza have, by some estimates, poured more than $4 billion into research and development and license applications to the FCC. But for all the enthusiasm on Wall Street for cellular radio, there is strong suspicion in some quarters that profits may be harder to come by and further away than many expect.

"Prices for the mobile units currently exceed $1500. Gerald H. Taylor, president of MCI Air Signal, projects initial monthly leasing fees of $65 to $75 plus toll charges that could add $130.00.

"The Yankee Group—a Boston-based research concern, projects that equipment prices will decline slowly because most of the cost savings already have been squeezed out.

"Newer technologies that could compete at substantially lower prices could be on the market as early as 1985.

"We think cellular will be a helluva market five years from now," said Taylor, "but will be limited until then."

Martin Cooper, research director for Motorola, commented: "The people who will be shocked by the limits on the marketplace for cellular will be those who think it is a consumer market with tens of millions of subscribers." The company has spent an estimated $100 million to develop equipment for the industry.

Investing in cellular "is a minefield. It's grotesquely difficult," said Harry Tsoukanelis, an analyst with the New York-based Buckingham Research Group. He has studied the industry closely and recommends avoiding equipment makers such as Motorola and Graphic Scanning, which also hopes to operate phone systems. He sees equipment sales growing rapidly in the beginning, as systems are built, but then falling off just as sharply as the limitations of the market become apparent.

Protective Devices

Part 3

by Graham A. Clarkson

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Digital Noise—Local Computer-Type Networks

In long distance wireline communications circuits, the noise encountered is normally of quite low frequency content. Because of noise reduction techniques, together with the inherent low pass filter effect of the transmission lines, reasonable signal-to-noise ratios can usually be attained. As has been mentioned, high frequency type noise is attenuated very rapidly, and is of secondary importance in conventional communications. The type of noise encountered in computer type applications can extend out to many megahertz, and is attenuated via the transmission wires to negligible proportions in distances of a few hundred feet, perhaps two or three thousand at the very worst.

Although this distance is negligible from the point of view of conventional communications, several problems can occur within the relatively small area of interest.

Some examples are:

Coin-operated electronic games have been known to cause severe interference to communication systems.

Digital equipment can cause severe interference to nearby TV receivers.

Dangerous interference can occur to aircraft navigational aids by digital circuits close to, or in, airport areas.

Cause of Digital Noise

The offending digital equipment operates at very high bit rates. Additionally, each square-wave bit

consists of an infinitely large number of odd harmonics. (Infinite in theory; in practice the fifth harmonic is probably the highest of significance).

This bit rate is, of course, in effect the basic signal of the digital equipment. However, if the equipment screening is poorly shielded, much energy will be radiated, and will appear as noise to nearby equipment. Also, dependent upon digital equipment design, a certain level of bit voltage or power will be transferred to the input power lines and will be conducted along them. This conducted noise power will be greatly attenuated by the lines, but nevertheless can cause significant interference effects over short distances.

This noise is, of course, classified as man-made. The minimization of *radiated* noise is beyond the scope of this article. However, careful screening, grounding, bonding, etc. techniques are essential. The minimization of *conducted* noise is accomplished as described in the following paragraphs.

FCC Rules & Regulations

The pertinent requirements for allowable noise radiated and conducted from the equipment being considered are laid down in Part 15, Subpart J of the FCC Rules and Regulations for Digital Electronic Products.

Only conducted noise is considered here, and the frequency range of the noise voltages extends from *450 kHz to 30 MHz.*

NOTE: The VDE, a German agency, requires noise frequency voltage limits extending from *100 kHz to 100 MHz* to be met.

The rules and regulations pertain *only* to the actual digital equipment per se. A knowledge of the frequency ranges is necessary. For the purpose of this article, all other requirements, such as actual noise voltage levels, etc., can be obtained from the subject literature by interested readers.

Practical Noise Measurements

It is stipulated that all noise level measurements at the frequencies given above be made from each phase lead, separately, to ground. This means, for example, that a computer operating at 240 VAC, 3-phase, would need to have three separate measurements to validate

conformance to requirements.

In the case of new equipment, it is the responsibility of the manufacturer to ensure that the noise limits are met.

Even so, there are many applications where the FCC and VDE requirements are not sufficient, and additional reduction of noise is needed. With older equipment, predating the FCC requirements, added noise reduction methods and components are almost essential.

Method of Noise Reduction

A simple low pass filter is connected in series with each phase lead, as per Figure 4a.

The cut-off frequency of the filter would be 450 kHz or less for FCC requirements and 100 kHz or less for VDE requirements. Note that a filter for VDE requirements would automatically meet those of FCC.

This filter will pass the required power frequency with negligible attenuation, but will attenuate frequencies above its cut-off frequency (the noise frequencies) by an amount dependent upon the design parameters of the filter.

Filter Specifications

There are *no* frequency V attenuation specifications for this type of noise filter. Any labels, such as UL, VDE, CSA given on these filters indicate only that the filters meet the appropriate agency safety requirements. However, it is self-evident that the higher the attenuation over the given frequency ranges, the better.

In the order to give high attenuation over the enormous frequency ranges specified, the cost of the filter would be prohibitive. A compromise has therefore to be reached between performance and cost.

The filter shown in Figure 4a is practically industry standard, and variations between good and bad filters depend almost entirely upon quality of components, length of connecting leads, avoidance of right-angle bends in leads, etc., together with cut-off frequency.

Consider first Figure 4b as a 115V noise filter assembly. It has been mentioned that neutral should always be considered as being ungrounded. Under these conditions, the circuit should be considered as *two separate filters,* L1 C1, connected each in series with phase and neutral with respect to ground.

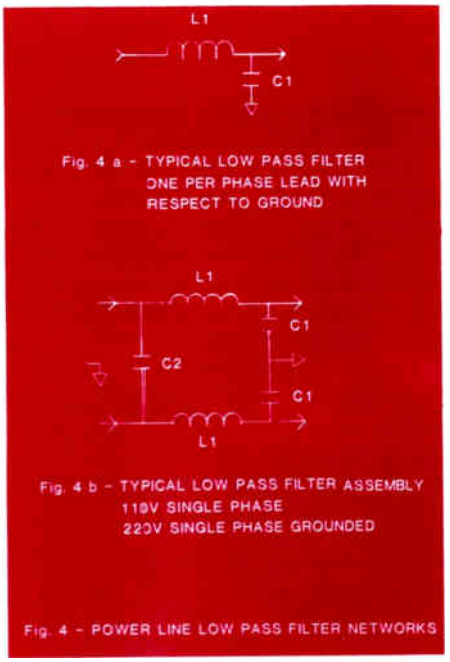
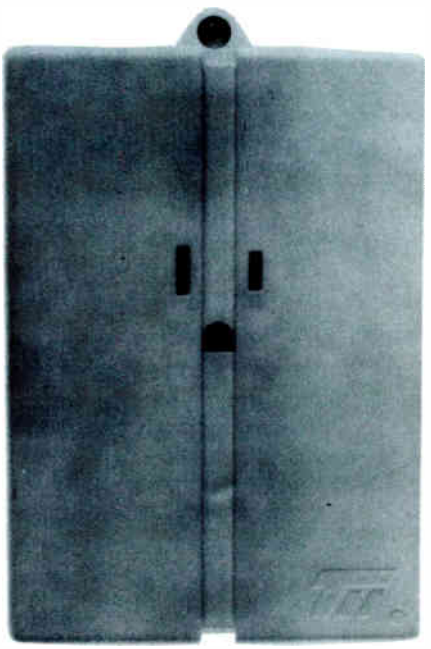


Fig. 4 a - TYPICAL LOW PASS FILTER ONE PER PHASE LEAD WITH RESPECT TO GROUND

Fig. 4 b - TYPICAL LOW PASS FILTER ASSEMBLY 110V SINGLE PHASE 220V SINGLE PHASE GROUNDED

Fig. 4 - POWER LINE LOW PASS FILTER NETWORKS



Model 433 by TII is a combined powerline protector and noise filter. It protects sensitive AC powered equipment from high voltage transients and filters out line noise. The self-contained unit plugs into a standard 120 VAC, 15A three-prong grounded receptacle. outlet.

This meets the FCC requirement of longitudinal (normal mode) operation. By connecting capacitor C2 between phase and neutral, as shown, differential (common mode) rejection is also accomplished.

There is no significant change for 220 VAC single phase grounded operation because the 220V center

tap is grounded and there is no neutral.

Power Line Noise Filter Frequency v Attenuation Response Curve

Although there are no official specifications for this parameter for noise filters, it is generally conceded that, bearing in mind economy versus the large noise frequency range, 30 dB rejection is a very good figure, and 20 dB good.

Figure 5 illustrates that the filter under consideration could be classified as very good for FCC requirements, and good for VDE.

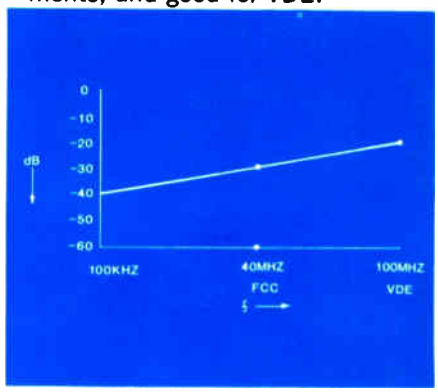


Figure 5. Typical low-pass noise filter response curve. Derived from Til's Model 433.

NOTE: Standard filter theory would indicate that for a low pass filter, the attenuation would increase with frequency. Figure 5 shows that in this case the reverse is true. The reason for this apparent contradiction is that the series inductors, L1, must have shunt capacitance and the shunt capacitors must have series inductance (lead length). Therefore, as the frequency increases, the *effective* values of both L and C decrease. This effect is normally not noticeable in filters because their frequency band requirements are usually relatively small.

Bi-Lateral Action of Noise Filters

Because of FCC requirements restricting noise voltages generated by digital equipment from getting into the power lines, this is the approach that has been taken.

However, the reciprocity theorem shows that filters perform in substantially the same manner with both directions of transmission.

(This statement does not apply to active filters). Therefore, if a noise filter is connected to the power terminals of equipment, it will also prevent noise at the applicable frequencies from getting *into* the equipment.

It is obviously preferable to prevent noise getting out of the source. However, in many instances this is not possible, and in these instances it will be justifiable to equip the victimized equipment with a noise filter.

Radio Frequency Interference

Besides minimizing the effects of noise, as has been discussed, the noise filters will also reject any discrete radio frequencies lying within the FCC spectrum of 450 kHz to 30 kHz, and the VDE spectrum of 100 kHz to 100 MHz, depending upon the characteristics of the filter. The filter illustrated in Figure 5 would perform well in both cases.

One example of such use would be minimizing the effects of a CB transmitter on a TV receiver.

Combined Protector and Noise Filter

If protection and filtering are combined into one unit, in addition to performing their individual functions the protector and filter can be made to mutually assist one another, providing their characteristics are co-ordinated correctly (as has been done in TII Model 433).

The reasons for this are twofold: The noise filter consists of series inductors and shunt capacitors. Due to the basic action of an inductor, any lightning or switching transient should be reduced in amplitude by a level equal to L di/dt. The shunt capacitors will bypass some of the transient energy to ground. Therefore the filter will also serve as a fast acting secondary protector.

NOTE: CAVEAT EMPTOR

The above statement, although true, can be misleading if taken out of context. Some suppliers advertise their protectors as having extremely low response time, even as low as picoseconds, because of this. The response time of importance is that of the primary protector—gas tube, Transzorb, MOV, etc., *as measured in situ*.

The other reason is that the primary protectors have shunt capacitance. The capacitances of MOVs, Transzorbs, etc., are of a value similar to the actual value of capacitors used in the noise filters. This protector capacitance should be integrated into the filter design parameters.

NOTE: Very good noise filters can be obtained as stand-alone units. However, if they are used in a system using stand-alone protectors with high capacitance, their frequency V attenuation response curves could be severely degraded.

Therefore, if both primary protection and noise filtering are required for any application, it is highly recommended that a combined unit be obtained from a reputable supplier. □

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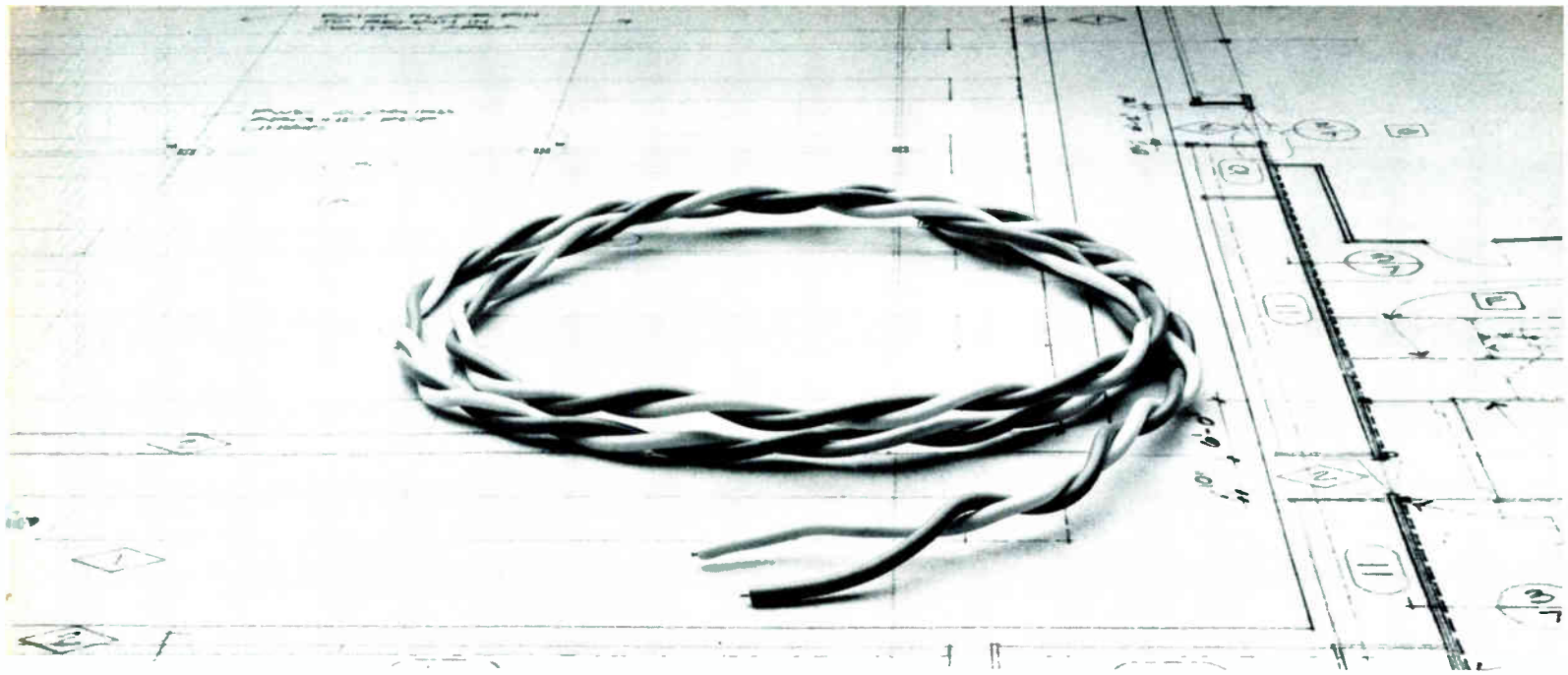

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