1989

Radio World ANNUAL

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RADIO WORLD ANNUAL

A Note From The Publisher

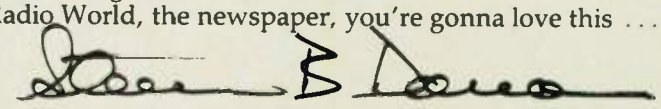
Welcome to the 1989 Radio World Annual, the first of its kind. Inside, you'll find a fascinating collection of articles, reference material, vendor information and equipment reviews, all aimed squarely at the radio industry.

If you're expecting to see the usual listings of manufacturers and distributors surrounded by a few short articles and as many ads as possible, I think you'll be pleasantly surprised.

Within these pages, you'll find an industry portrayed more thoroughly, more completely and more honestly than has ever been done before. And you'll find an insight into radio that could only come from people who love what they're writing about.

I thank them all, and especially the Radio World crew who worked so hard to put it all together.

If you like Radio World, the newspaper, you're gonna love this . . .



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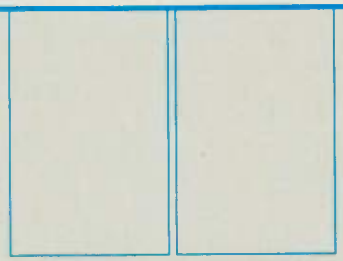
THE YEAR IN REVIEW

The Top Ten Stories of 1988

Earwaves



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AM Band Aid

First Steps Towards AM Improvement Are Taken By the FCC

The beleaguered AM band got a welcome dose of attention from the FCC in 1988. Action from the Commission included the opening of a number of dockets regarding improvements to the band, such as a review of technical rules and terms for adoption of the National Radio Systems Committee (NRSC) 75 μsec pre/deemphasis standard.

The ground-breaking moment at the FCC for AM improvement came in July of 1987, when the FCC issued a Notice of Inquiry to institute a comprehensive review of the Commission's AM technical criteria. Among the topics listed in the FCC's notice were protected contours, minimum usable field strength, atmospheric and manmade noise, and co-channel and adjacent channel protection ratios.

Initial comments on possible improvements to the FCC AM band policies included a suggestion from the NAB that a freeze be implemented on granting new AM stations and major changes to existing stations.

The suggestion drew vocal opposition from a number of broadcasters. Opinions ranged from concern about possible problems for existing licensees desiring facility modifications to a continued enforcement of the FCC's current "go/no-go" acceptance standards for stations.

NAB studies

Before making further comments on the inquiry, the NAB commissioned two studies of the issue: "AM Technical Assignment Criteria" by consultant Harrison Klein, and "AM Radio Interference Study," by the consulting firm of B. Angell and Associates. Preparation of the studies required an extension of the comment deadline from the FCC.

However, findings of the studies became a cornerstone for the NAB's subsequent comments on the review, in particular, the "AM Technical Assignment Criteria" study. That investigation concluded that current protection ratios do not prevent adjacent channel interference, and proposed, among other things a 25% exclusion RSS calculation to more accurately portray nighttime service contours.

As for the "AM Radio Interference Study," its authors used psychoacoustic listening tests to determine an audience's tolerance to interference. The tests were conducted to determine whether listener preferences had changed from the time AM rules were first instituted by the FCC and if so, to what extent.

The listener study determined, among other things, that tolerance to interference was dependent to some degree on program content, and that the minimum acceptable desired-to-undesired ratio for co-channel interference was 26 dB.

Pitching a curve

In other improvements to the AM band, the FCC took a first step toward making the NRSC 75 μsec pre/deemphasis standard mandatory. However, the Commission also included a complementary RF emission standard, to which some broadcasters objected.

A Notice of Proposed Rule Making adopted 20 June sought comments on those two elements, as well as a provision which would give stations the option of creating facilities whose coverage area would be subject to some interference from other stations.

Comments on the FCC proposal were wide-ranging, with a number of suggestions on how to implement the NRSC standard—by now broken down to "NRSC-1" for the audio portion and "NRSC-2" for the RF emission standard.

A majority of the filings advocated implementation of the audio standard first, with the NRSC-2 standard to be adopted later, rather than jointly with NRSC-1, as the FCC proposed. Other comments, including those from the NAB and the SBE, suggested the notion of "presumptive compliance," in which a station might be assumed to be operating within the NRSC-2 standard if they instituted NRSC-1.

By the end of the year, the FCC had taken additional measures towards improving AM with four separate proposed rule makings that addressed technical criteria, some of which were based on responses to the AM technical review docket.

At a 13 October meeting, the FCC unanimously proposed changes to its rules to facilitate enhancement of nighttime operations, to improve methods for calculating skywave and groundwave field strength and to review methods of calculating nighttime protection.

In one of the proposals approved for comment, the FCC would allow Class II-S and Class III-S AM stations to establish a separate nighttime antenna system without having to meet the minimum power, city coverage or minimum operating schedules that would otherwise apply to such a change in nighttime operations.

Other proposals included replacement of existing AM broadcast skywave propagation curves with a newly-developed model and a change in the exclusionary RSS calculation method from 50% to 25% for co-channel stations.

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Acquisitions Abound in Radio Market

RW 2

A maelstrom of mergers consolidated a number of businesses in the radio industry in 1988.

One of the major transactions of the year was the employee-led buyout of Capitol Magnetics. The sale of Capitol created the new company Audiopak, and effectively put an end to a short-lived concern about the supply of cartridges and back-lubricated cart tape.

Capitol Industries had announced in late 1987 the intended shutdown of its broadcast cartridge division, located in Winchester, VA. The company blamed losses in its cassette manufacturing division due to fierce overseas competition.

News of the possible closing sent a minor shock wave through the industry.

Some suppliers speculated the shutdown might cause a run on tape, and projected a possible shortfall in supply. But behind the scenes at Capitol, a number of potential buyers were trying to purchase the company, with Moorestown, NJ-based tape manufacturer Fidelipac on the front lines.

In the end, however, it was a group of employees which came out the winner. Led by Nick Krassowksi, former VP of operations for Capitol's Magnetic Products Division, the employees purchased the broadcast cartridge operation from Capitol in a February sale.

The new company, dubbed Audiopak after the name of the carts they produced, was manufacturing tape at the Winchester plant by May, dispelling supply worries. A new facility some eight miles away was operational by late fall.

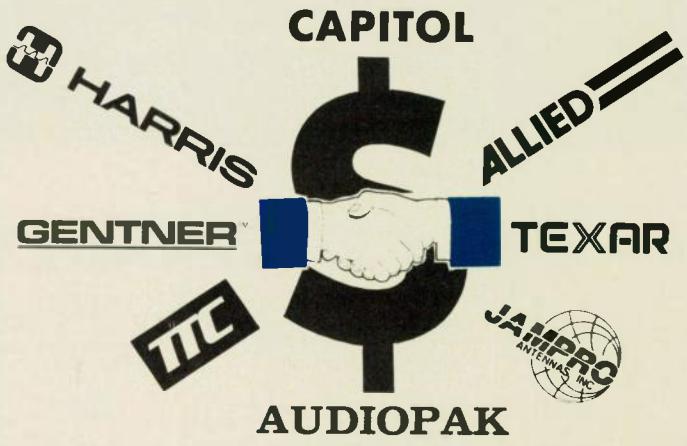
As things at Audiopak were getting back to business as usual, a flurry of other acquisitions began. Notable in the sales activity during the fall of 1988 was the purchase of Allied Broadcast Equipment Corp. by Harris Corporation.

Harris announced at the end of August that it had agreed to acquire Allied's radio equipment distribution business for an undisclosed sum. Under the agreement, Allied founder and CEO, Roy Ridge, continued as head of the acquired business.

The two companies had been working under a joint sales agreement for a year and a half before the announced merger. That agreement allowed Allied and Harris to sell equipment from both companies.

Reaction to the acquisition was mixed, although cautious. Some observers theorized that Allied might weaken under Harris, opening up competition more evenly among smaller companies.

Others speculated the buyout of Allied could give Harris products an unfair advantage in the marketplace, leaving companies hesitant to use Allied as a distributor. Broadcast Electronics President Larry Cervon went as far as to consult with company attorneys to determine whether the sale had any "anti-competitive characteristics."



Still, the effects of the buyout on the two entities and on industry counterparts will best be determined by time. As Neil Glassman, sales manager of Bradley Broadcast Sales observed, "Both Harris and Allied have well-deserved reputations in the business. To speculate on what their position in the industry is going to be ... is just a bit premature."

Only days after the announced Harris-Allied union, Gentner Electronics entered the audio processing market with the purchase of Texar, Inc. Gentner President Russell Gentner said the deal was an asset purchase and that Texar was acquired in a cash transaction, although he declined to comment on the sale particulars.

The purchase of Texar was the latest in a round of acquisitions for Gentner. The company first bought Advanced Design Technology, then entered the world of digital audio by acquiring MEI, which marketed the DigiSound digital audio storage and playback unit.

The entire Monroeville, PA Texar operation was moved on 3 September to the new, larger facility occupied by Gentner in Salt Lake City.

Several parts of the manufacturing facility were shipped to the Gentner plant by overnight express, according to Gentner "to permit uninterrupted delivery of Texar products and service."

Texar President Glen Clark said he decided to sell the company because of "other things I wanted to do," mentioning specifically consulting on RF design and FCC matters.

The acquisition announcements did not end with the Texar buyout, however. In a deal still pending, Television Technology Corp. (TTC), a manufacturer of television and radio transmitters, also stated in late August that it reached an agreement in principle to purchase Jampro Antennas, Inc.

According to TTC, the company has agreed to pay $1 million cash to Jampro stockholders within six months of signing of the purchase agreement. TTC placed $2 million in seven year subordinated convertible notes to finance the purchase.

At press time, however, the purchase agreement, which was to have been concluded in October or November of 1988, was still unsigned.

FCC Backs Away from AM Stereo Controversy

RW 3

Broadcasters looking for a single standard in AM stereo—a choice which has boiled down to either the Kahn ISB or Motorola C-QUAM systems—got no help in 1988 from the FCC, which preferred to continue the markeplace approach to the issue.

In a unanimous vote, the Commission on 14 January 1988 decided not to take any further action on an AM stereo standard. The FCC also refused to require the manufacture of multimode receivers or to protect the pilot tones on AM stereo systems.

With its decision, the FCC dismissed three petitions on the AM stereo issue. Texar, Inc., an audio processing equipment manufacturer, had asked the FCC to select a single AM stereo system, without specifying a preference between the Kahn ISB or Motorola C-QUAM systems.

Also, New Jersey's Press Broadcasting and Washington, DC engineer Winifield Standiford, in separate petitions, asked the FCC to require that receivers be outfitted with multimode decoders, so that either system could be used by broadcasters.

The petitioners each contended that the marketplace had failed to select a standard. In 1982, the FCC put its confidence in the marketplace, and had avoided the selection of a single AM stereo system.

Moving towards a standard

The 14 January decision upheld that FCC action of five years earlier. In a notice released after the action, the FCC said that "although it had taken longer than anticipated," the market was moving towards selecting a standard.

In particular, Chairman Dennis Patrick acknowledged the existence of a "considerable convergence on a de facto standard." He stressed that the FCC also wanted to avoid the "costly litigation" and dissent which would result from a reopening of the AM stereo rulemaking process.

In supporting its decision, the Commission cited a study by the National Telecommunications and Information Administration (NTIA), released in 1987, which indicated that of the approximately 10% of AM stations which have gone stereo, some 70% have chosen C-QUAM, and 100% of available receivers are C-QUAM compatible.

"The market appears to be moving on its own toward selecting an industry standard. As a result, government intervention ... at this time would prove counterproductive and detrimental to the development of AM stereo broadcasting."

... The FCC said ... the market was moving towards selecting a standard.

The Commission failed to heed a suggestion put forth in the NTIA study which would have established interference protection for the pilot tones of AM stereo systems which could meet acceptance criteria determined by the FCC.

Although the FCC noted a "substantial amount of convergence has already occurred in the case of AM stereo ... the process of establishing protection for one or more pilots could cause further delay and uncertainty in the marketplace and hinder establishment of AM stereo."

The FCC also opted against requiring multimode receivers, saying the measure was "neither appropriate or necessary," and would "place unnecessary burdens on receiver manufacturers which could be costly for them and the public."

For the opposing teams in the AM stereo arena, the decision by the FCC not to choose a single system could be interpreted in at least two ways.

Reading the decision

Kahn Communications President Leonard Kahn declined to comment to **RW** regarding the decision. However, the decision by the FCC not to select a single standard clearly left buyers the option of selecting the ISB system.

On Motorola's side, AM Stereo Manager Chris Payne said the FCC confirmed that a de facto standard had been reached, and that it was C-QUAM. He said the company felt "somewhat officially blessed" by the FCC decision.

Observers were not surprised by the Commission's action. John Wright, president of Delta Electronics, which makes C-QUAM exciters, commented that the FCC had been faced with a "no win" situation. If it had selected Kahn's system, it would have had to respond to the majority of AM stations which have already gone with C-QUAM.

If the C-QUAM system had been selected, Wright added, it would have faced a "legal battle" with Kahn.

The debate over AM stereo has not subsided yet, however. A bill, expected to be reintroduced to Congress later this year, would require the FCC to choose an AM stereo standard within six months after the legislation goes into effect.

Originally introduced during the final hours of the last session of Congress in 1988, the bill, spearheaded by Rep. Matthew Rinaldo (R-NJ), did not have time to move through the legislative process before Congress adjourned.

Translators Come Under FCC Scrutiny

The mere mention of translators in 1988 was enough to provoke some broadcast groups to dash out a series of scathing comments discouraging any potential liberalization of the signal extending equipment.

But, in fact, two dockets aiming to accomplish just that matured during the year, both crawling through the Commission process with hot contest from opponents and equally passionate response from supporters.

First, the Commission issued a June Notice of Inquiry regarding MM Docket 88-140, which aimed to study the role of FM translators in radio broadcast service.

In it, the FCC asked for comment on translator issues including the concern that relaxation of translator rules would cause a shortage of spectrum because translators require a second frequency, and the fear that added competition from loosened rules might financially strain current full-power stations.

Comments on the issue primarily focused on the negative results of the liberalization of translator usage. The NAB called potential action a "willingness to open up a Pandora's box."

The Federal Trade Commission, however, supported the FCC's suggestions, claiming they would create greater competition, thus allowing more options for consumers.

While no action had been completed on 88-140 at year's end, the Commission in March did pass a ruling after nearly two years of discordant discussion allowing noncommercial FM translators owned and operated by their primary station to use alternative signal delivery methods.

Such methods include satellite or terrestrial microwave, which are designed to substantially increase coverage area over feeding a translator from the station's over-the-air signal.

The result: a near year-long tug of war between some broadcasters who argued that the ruling, contained in MM Docket 86-112, would create a new low-power FM service and those who stood by the ruling, claiming it would allow coverage of public radio where it previously was unavailable.

The issue of a station using alternative-signal delivery in conjunction with a translator first caught the attention of the industry when Chicago-based Moody Bible Institute asked the FCC in 1981 to allow it to feed its translators by methods other than over-the-air feeds.

Three years later, the FCC turned down Moody's request and asked the institute to file again after the Commission could study the issue. Moody filed again in 1985 and was given approval with the Commission's ruling 24 March.

In May, four broadcasting groups—the NAB, National Public Radio (NPR), the National Federation of Community Broadcasters and the Association of Maximum Service Telecasters—filed a motion of stay to halt the ruling.

The groups claimed the action would "deplete limited noncommercial FM spectrum availability and result in irreversible harm to the development and expansion of public radio," while also creating the potential for interference.

NAB's opponents called the argument exaggerated and unfounded and the Commission struck down the motion for stay.

In July, three NPR representatives and three public radio station executives met with FCC Mass Media Bureau Chief Alex Felker regarding a May Petition for Reconsideration filing.

Felker suggested that to make translator licensing more stringent, the Commission could require applicants placing translators beyond a certain distance from the primary station to show the existence of at least one vacant noncommercial FM channel for the proposed service area.

The NAB, meanwhile, continually regurgitated arguments that the ruling would irreparably harm FM noncommercial service, presenting carbon copy arguments from previous filings.

The complaints apparently were to no significant avail. No documented changes in the ruling had come about by the end of 1988.

Class A's Clash with NAB

Some Leave in Protest

All year long in 1988, debate over a proposed blanket power increase from 3000 W to 6000 W for Class A FM stations put a strain on the NAB's relationship with its Class A members.

By the end of the year that strain had taken its toll, as a number of Class A stations chose either to withhold dues from the NAB or resign from the organization entirely.

The push for an across-the-board power hike for Class A's was spearheaded by the New Jersey Class A FM Broadcasters Association. The group was led by Robert McAllan, VP of Press Broadcasting in Asbury Park, NJ, which owned the Class A station WJLK in Asbury Park.

Originally proposed in 1987, the power increase issue found the New Jersey Class A organization and the NAB at loggerheads throughout 1988.

The New Jersey side argued that the FCC had changed many longstanding FM allotment and assignment policies in recent years. As a result of those changes, the group stated, Class A stations now are competing with much larger class stations in the same communities.

An overall power increase from 3000 W to 6000 W would have very little effect on existing stations, the group maintained.

The NAB, however, took an opposite view, calling for power hikes on an individual basis—for those stations meeting increased separation requirements. NAB argued the increased separation distance requirements were necessary to reduce the effect of the power increase on existing stations.

Commission action

It was the Class A's, however, who prevailed with the FCC. The Commission included the power hike in a No-

continued on page 14

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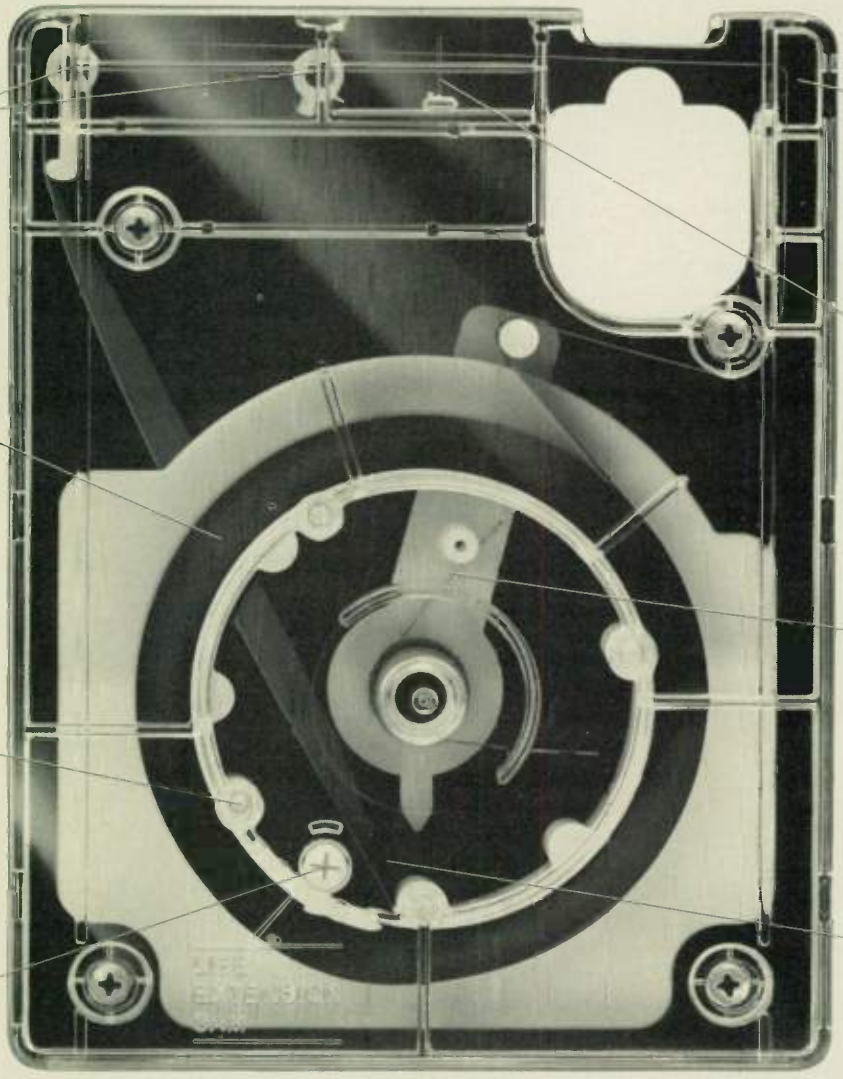

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from page 12

tice of Proposed Rule Making issued at its July meeting, along with a proposal establishing a new intermediate FM station class.

The intermediate class—dubbed Class C3—would allow some stations to upgrade to 25,000 W with antenna heights of 100 meters. NAB viewed the C3 proposal as a possible compromise.

But with each new round of filings, the dividing line was becoming more clear. The sides were polarized on the issue of an across-the-board hike.

Late in the year, as the FCC filing deadline approached, a number of Class A broadcasters began holding meetings with fellow radio owners and operators. It was at one of those meetings, which had been held in at least six states, that broadcasters seized on the idea of withholding dues from the NAB.

The Class A's supporting the action had become frustrated with the NAB's stand against a blanket increase. In one case, Nutmeg Broadcasting President Michael Rice said the idea to withhold dues was a "spontaneous consequence" of the NAB's "taking a very specific side where they should have ridden the fence."

NAB stays cool

Through all this, the NAB remained firm in its position. NAB Joint Board Chairman Wallace Jorgenson commented that the NAB could not back away from controversial issues.

"If we did that, because NAB is so diverse, we would be neutralized on about everything," he explained.

At year end, NAB's Senior Radio VP David Parnigoni reported that only two Class A members notified NAB of their desire to withhold dues. Other reports had as many as five broadcasters resigning from the organization.

As the story of the resignations and withholdings unfolded, however, another development was taking place. Press Broadcasting, whose Robert McAllan had been the standard bearer for the Class A's, announced its intention to sell its WJLK-AM/FM combo, opting to purchase Class B WBUD-AM in Trenton, NJ.

McAllan said that despite the sale of the Class A WJLK, Press Broadcasting was still committed to the cause.

"We might be selling a Class A station, but we are not selling our interest in Class A's," McAllan explained.

FMX Gains Industry Supporters

RW 6

Broad strides were made by the FMX stereo extension system in 1988. The year saw the endorsement of the FMX system by CBS Radio for its FM stations, and the departure from the NAB of FMX co-developer Tom Keller, who left to devote more time to implementing the system.

FMX is a noise reduction system designed to allow listeners in the fringes of an FM's coverage area to receive a clean FM stereo signal without the hiss that normally accompanies distant stereo signals.

The system was the joint effort of CBS, under the hand of Emil Torick, and NAB, where it was guided by Tom Keller, who had served as chief scientist for the NAB since December 1987, and Science and Technology vice president for six years before that.

The FMX system was acquired in 1987 by Broadcast Technology Partners (BTP), and in July of 1988 Keller left the NAB to become a consultant for the new company.

Several months earlier, FMX had taken a large step forward with the formal endorsement of the stereo extension system by CBS Radio. The network said that, in an effort to encourage Japanese receiver manufacturers to produce FMX radios, CBS Radio would convert its 11 owned FM stations to FMX transmission by August.

CBS Radio President Robert Hosking said in making the announcement in early April that testing by CBS at WODS ➤

in Boston showed FMX transmission did not degrade reception on traditional receivers, yet improved the signal for FMX-modified radios.

The radio group president also emphasized that Japanese receiver manufacturers should interpret CBS's conversion as support for this mode of transmission for the future.

At BTP, reaction to the CBS statement was enthusiastic. BTP President Emil Torick, who with Keller co-developed the system, said the CBS decision gave a "special impetus" to the FMX program.

By December of 1988, Jim Monahan, a spokesperson for BTP was anticipating that up to seven manufacturers would display FMX—for the first time—at the Consumer Electronics Show in Las Vegas in January.

According to Monahan, BTP was encouraged by the number of FM stations that have shown interest in FMX. He said at the time that 100 stations have either installed the company's system in the US or are preparing to install FMX equipment, compared with five or six stations at the NAB convention in March.

Stations also have installed the system in Canada, Denmark, Sweden and Thailand, he added.

For BTP, whose officers saw FMX through hard times early on because of problems with the system, the rapid acceptance of FMX by broadcasters came as somewhat of a vindication.

"We've been working on actually getting stations on the air for the reasons of stimulating receiver manufacturers and proving FMX viability," Monahan said. "In view of . . . questions about some of the early difficulties (of FMX) which have since been resolved, the hundred (US) stations have proven that FMX does indeed work."

Buckley Broadcasting in Hartford, CT, seems convinced of the promise of the technology. The company, whose Hartford WDRC-FM was the first station to equip itself with the FMX technology over a year ago, has installed or bought FMX gear for all nine of its stations.

Others agreed. In the late fall of 1988, FMX got the nod from the Car Audio Specialists Association (CASA), a group of aftermarket car audio equipment manufacturers, retailers and sales reps. The group's president, Hugh Whiteman, called the new technology "the new standard for quality in FM broadcasting."

Who's Minding the Store?

FCC Nominees Still in Limbo, One Year Later

RW 7

The wheels of progress are grinding slowly for Bradley Holmes and Susan Wing, White House nominees to two vacated positions on the FCC board. It's a story that began with the resignation of former FCC Chairman Mark Fowler in 1987.

The FCC has been operating with only three commissioners since December 1987, when Mimi Dawson gave up her position to become deputy secretary of transportation. The other FCC post has been vacant since April 1987 when Dennis Patrick took over for Fowler, who resigned to pursue "entrepreneurial" ventures in broadcasting.

The vacancies remained unoccupied throughout the year, despite nominations for both of the slots by former President Ronald Reagan.

Bradley Holmes, chief of the Policy and Rules Division of the FCC's Mass Media Bureau, was nominated in November 1987 to fill the unexpired term of Fowler, which ends June 1990. Susan Wing, an attorney with the DC-based law firm of Hogan & Hartson, was nominated in December 1987 to replace Dawson for a term which expired in June 1988.

But confirmation hearings for the two have been stalled in Congress, due to political maneuverings. Sen. Ernest Hollings (D-SC), who recently stepped down as chairman of the Senate Commerce Appropriations Subcommittee, had by some accounts delayed the confirmation process, maintaining his belief that the Senate would not approve either nominee.

Some observers of Capitol Hill had ➤

Nominated to the FCC over a year ago, Bradley Holmes (top) and Susan Wing (bottom) have still seen no action from Congress

continued from page 15
speculated that the hearings were stalled in part as a punitive measure in response to President Reagan's veto of the Fairness Doctrine and the FCC's sometimes heated dispute with Congress over the same issue.

The notion of a punitive slowdown was not lost on the White House. At the 1988 NAB convention in Las Vegas, President Reagan criticized Congress for not scheduling confirmation hearings, and linked the slowdown with his position on the Doctrine.

However, Reagan upheld his action, saying, "There is no reason to substitute the judgment of Washington bureaucrats for that of professional broadcasters."

Reagan also noted that "until these nominations (of Holmes and Wing) are confirmed by the Senate, the FCC cannot operate effectively . . . "

Neither of the two nominees would comment on the disposition of their cases. In late June of 1988, Holmes would say only that he was "disappointed that I haven't had an opportunity to have a full and fair hearing."

Recent political developments, however, may soon affect the issue of the understaffed FCC board. Late in 1988 Hollings declared his intention to step down from the Appropriations Subcommittee, naming Arkansas Democrat Dale Bumpers as his replacement.

However, a move in Congress to codify the Fairness Doctrine will be opposed on the Hill by the NAB. Although FCC Chairman Dennis Patrick has urged broadcasters to reject a codifying measure.

Still, the change of command in the US has led some observers to suggess that the approval process for Holmes and Wing may once again move forward. Other industry whisperings speculate one or both may be granted an interim appointment, lose their nominations, or be renominated by President George Bush.

For the time being, however, there are still only three Commissioners occupying positions at the FCC currently—Chairman Dennis Patrick and Commissioners James Quello and Patricia Dennis.

Quello, serving his third term, was appointed until 1991. Dennis is filling the unexpired term of Henry Rivera, which will expire in June of this year. Of the remaining Commissioners, hers may be the next slot to be vacated, as political gossip at press time reported Dennis to be a hot contender for a high post in the Department of Labor.

As for Commissioner Patrick, his term is not slated to expire until June 1992.

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Broadcasters Argue Over Use of Expanded AM Band

When the Commission finally decides on a way to develop the spectrum from 1605 to 1705 kHz, chances are national licensing will not be their choice.

That is, not if they listen to the responses elicited from a Notice of Inquiry into the use of the expanded band by the AM broadcasting service. Comments generally opposed the concept of national licensing, whereby a single licensee would develop a single channel nationwide.

But commenters who opposed national licensing did not necessarily agree amongst themselves on how the extra spectrum should be allocated.

A variety of issues

When the FCC in February announced its inquiry—the fourth such into the issue of the expanded band—a variety of issues were to be examined. The inquiry not only was to look into new users, but to gather information on the class of station which should operate in the band, minimum power, protected contours, ground and skywave propagation, coverage and daytime skywave propagation.

Still, regulatory options were of key concern. According to the FCC's Mass Media Bureau, the Commission was taking advantage of the emptiness of the band to investigate alternate methods of allocating spectrum.

While broadcasters were making their opinions known in filings to the Commission, 22 Western Hemisphere countries met in Rio de Janeiro, Brazil in June for a conference of the International Telecommunications Union.

Under the plan developed at the meeting, even-numbered channels—1620, 1640, 1660, 1680 and 1700 kHz—were alloted to the US within 33 kilometers of the borders with Canada and Mexico at 1 kW. Beyond that distance, the US was alloted all 100 channels and can operate up to 10 kW.

Opposition mounts

Back in the States, meanwhile, comments continued trickling in, with the bulk showing opposition to the FCC's proposed national licensing concept and advocating some allocation criteria of their own.

The National Telecommunications and Information Administration (NTIA) encouraged the FCC to utilize AM band expansion to improve the quality of existing AM radio service, not just to add new stations.

This could be accomplished, the NTIA said, by moving daytimers, second adjacent stations and translators into the expanded band. The move would allow those broadcasters to provide more extensive service to their communities.

Not necessarily, said the Washington-based National Black Media Coalition (NBMC), which supported the idea of preference to minority and noncommercial broadcasters.

"Daytimers voluntarily chose to operate on their frequencies. Nobody forced them onto the air. At least they have frequencies on which to operate," NBMC pointed out.

Another group advocating preference to noncommercial stations was WNET, a noncommercial educational station in Newark. The group proposed assignments of some of the available added spectrum to large markets underserved by high-power educational stations.

WNET spoke out against national licensing, noting "few public broadcasters can afford to construct and operate a national network of broadcast stations, and many would lack legal authority to do so." Licensing also ignores the overcrowding problems rampant in the educational FM spectrum, the station commented.

DAT Debate Continues to Rage

Controversy Over Copyright Has Snarled, But Not Stopped, DAT Use

A political tug-of-war over possible copyright infringement has kept Digital Audio Tape (DAT) from gaining broadcast acceptance as quickly as its proponents would like. Still, the recording system is making some inroads in production.

Opponents of the technology, in particular the Recording Industries Association of America (RIAA), have argued from DAT's earliest days that the digital tape recorder would pave the way for "bootlegged" recordings unrecognizable from the originals.

Political pressure from the RIAA and similar organizations led to the introduction in 1987 of legislation in Congress that would ban the sale of DAT machines unless fitted with an anti-copying device.

The device, known as the CBS Copycode, would impose a notch in the au- ➤

dio of recorded material and cause the DAT machine to shut down if recording of "notched" material were attempted. The Copycode, its supporters held, would defeat digital-to-digital piracy.

However, Copycode detractors contended that the notch required to make the device work affected the audible quality of sound encoded by it. The National Bureau of Standards (NBS) was tasked with determining through listener studies whether audio was truly degraded by the notch.

The NBS study, released in March, concluded not only that the system diminished the recorded quality of material encoded with the Copycode, but that an electronics technician with the proper circuit schematics could bypass the system in at least five ways, for approximately $100.

So the Copycode debate finally became inert. That, however, did not prevent the RIAA from maintaining that it would sue any equipment manufacturer from importing DAT machines before the issue was "resolved." Wary manufacturers, therefore, kept DAT machines off the shelves.

Later in the year, Japanese and European audio equipment manufacturers, weary of delays in debuting DAT technology in the US, met to discuss the introduction of a standard anti-copying device.

The process, known as Unicopy, would allow recordings to be made on DAT recorders from compact discs. Subsequent recordings, however, cannot be made from one DAT tape to another DAT tape. The CD to DAT transfer imparts a digital code that prevents copies.

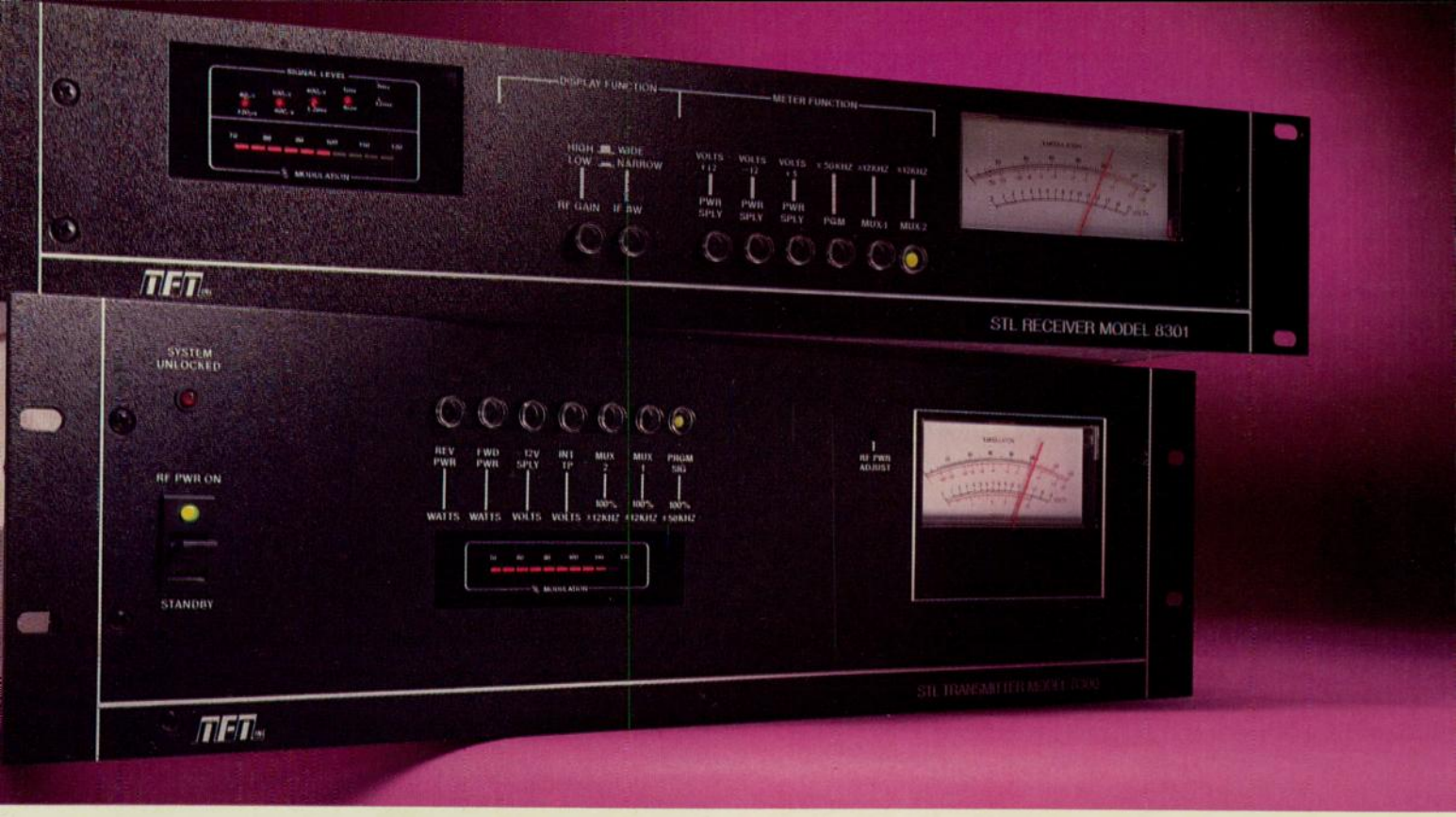
Before any action could be taken on implementing such a system, it would have to be approved by the International Federation of Phonogram and Videogram Producers (IFPI), the European equivalent of the RIAA.

So far, word from the IFPI has been slow in coming. But that has not stopped some more adventurous souls from using the technology—which has been available on the "grey market" for some time—in special applications, such as electronic field production.

Notable in this groundswell of acceptance has been National Public Radio, whose Flawn Williams and Alex Chadwick tested the Technics SV-MD1 in Vietnam for the network's special on that country.

Other early players in the DAT game include Marantz, which is poised to appoint dealers/distributors for its own machines, and currently is invovled in negotiations with a number of candidates.

Although hampered in its growth by anti-copying groups, DAT still turned heads at trade shows like the NAB.



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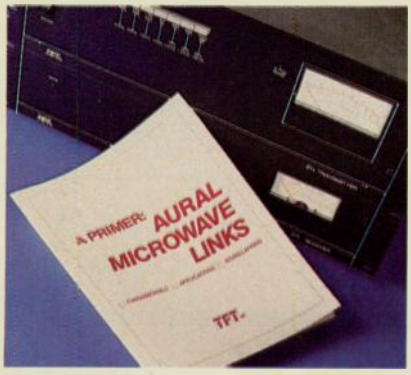

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NBC Bows Out of Radio Broadcasting

RW 10

The end of an era? Maybe not, but when NBC decided in the early months of 1988 to divest itself of its owned and operated (O&O) stations, it sold properties dating back to the 1920's, with the formation of what became WNBC-AM in New York.

The divestiture also kicked off a long chain of related transactions and other changes to the face of radio in 1988, including the eventual retirement of WNBC after 66 years.

Through January 1988, the network, in addition to WNBC, also held the licenses of WYNY-FM in New York, KNBR-AM and KYUU-FM in San Francisco, WKQX-FM in Chicago and WJIB-FM in Boston, as well as WKYS-FM in Washington and WMAQ-AM in Chicago.

The first sign of NBC's divestiture began with that Chicago AM; WMAQ was sold to Group W/Westinghouse in a transaction approved by the FCC 21 January.

Keeping mum

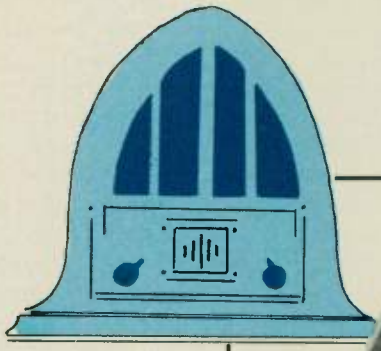
At the time, then NBC Radio Division President Randall Bongarten would not reveal the potential value of the deal or any of the firms with which NBC was negotiating. "We are talking with a small number of investors for the sale of our (other) radio properties," Bongarten said.

The transaction was speculated to be worth as much as $150 million, with another $45 million or so for the sale of WKYS, which was being handled separately.

Names of possible purchasers for the stations included Emmis Broadcasting, which already owned stations in New York, Washington, DC, and Los Angeles, and Westwood One, a program distributer and owner of the Mutual Radio Network.

In July, Westwood had already acquired from General Electric the NBC Radio Network, The Source and Talknet.

But it was Emmis which in March purchased five of NBC's radio properties, with an offer of $121.5 million. That transaction was the catalyst for a number of other sales and maneuverings by Emmis, in its efforts to conform with the FCC's one-to-a-market rules.



Two of Emmis' new stations—WYNY and WNBC-AM—served New York, but because the company already owned

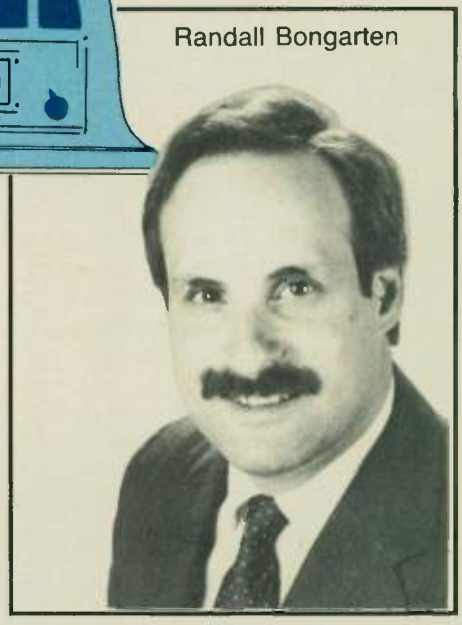
WQHT-FM and WFAN-AM in New York, it was forced to sell one AM and one FM.

The moves

The company chose first to retire the venerable WNBC, moving the all-sports WFAN from its place at 1050 kHz to WNBC's now vacant 660. Emmis then sold the license for 1050 kHz to the Spanish Broadcasting System.

On the FM dial, Emmis decided to retain WQHT, selling WYNY to Westwood One for $39 million and other undisclosed considerations. Before the sale, however, Emmis swapped transmitter sites and frequencies between WYNY and WQHT, giving the latter station a more consistent signal and a more competitive place on the dial.

Despite the presale changes in site location, the purchase of WYNY was still regarded as a major step for Westwood One. Westwood CEO Norman Pattiz



said at the time, "I'm extremely pleased that our first radio acquisition is in New York. It's clear that there is a major place for country radio in the nation's number one market."

By the end of the Emmis transactions, even manpower saw changes, which included the hiring of NBC's Bongarten to the position of vice president at Emmis.

Once the dust settled on that side of the story, however, NBC again found itself the focus, when it accepted an offer from Boston-based Albimar Communications of $47.5 million to purchase WKYS-FM in Washington, DC. Albimar, a minority-owned company, also owns KDAB-FM in Ogden, UT and is the former owner of KEZO-AM and FM, Omaha, NE.

The various transactions which took place throughout the year have left KBNR-AM in San Francisco as the last remaining NBC O&O.

The Envelope, Please . . .

Dubious and Real Achievement Awards for 1988

by Judith Gross, Radio World Editor

It's time once again for *Earwaves'* **Dubious Achievement Awards**—an idea stolen fair and square from another prominent publication.

In the spirit of generosity, I'll also single out some **Real Achievements** for the year. But first the dubious.

1988 offered **many choice candidates** for such an honor. But after reviewing the year, I've narrowed the list to ten.

There weren't any really **bad taste station promotions** this year . . . nothing on the level of the breast implant contest of last year. The closest one was the DJ who **covered himself in chocolate** for Valentine's Day, but it would be contradictory for me to say anything involving chocolate was "in bad taste."

So, sorry, no award.

I also considered the whole fiasco with a particular California **high power FM booster.** The station not only obscured part of its own regular coverage but that of several other adjacent FMs with the booster, prompting **a loud outcry** to the Commission.

WBMW switches calls to WJFK and wins a dubious honor.

But the case got resolved when one of the protesting FMs filed a **license challenge** at renewal time for the boosting station's license. A "settlement" was made, the station kept its license, **the booster went,** and that was the end of that.

Tempting as it is to reward such creativity on both station's parts, there are **more deserving nominees.**

So, on to the awards.

First on the list has to be the much hyped and ballyhooed **Sequerra or "ultimate" radio,** unveiled amid much fanfare by the NAB at Radio '88.

Morsels of public relations leading up to the unveiling touted it as the new hope of AM and the latest in high tech wizardry.

But when the gold lamé was pulled off the receiver at a **well-attended press conference,** the AM portion wasn't working and neither was the continuous tuning feature. Plus, it was a tabletop, not a car model. Whoops.


The "ultimate radio" fell short of its hype.

Next on the list has to be the **CBS Copycode**—the anti-copying device the Recording Industries Association of America hoped would stop big, bad **DAT** from making its way into consumers' grubby hands.

The notch, which was supposed to be inaudible, was **readily identified in listening tests.** Plus, the National Bureau of Standards decided it would be a piece of cake to defeat the device with only minor technical skills.

The death of the Copycode has not meant the death of the controversy, however. **Japanese electronics manufacturers** have still been wary of bringing to market a product that was slated for the Christmas season over one year ago.

Third on the list is an award to **Inifinity Broadcasting,** for its continued promotion of the off-color radio wit(?) of shock-jock **Howard Stern.**

Not content to let radio's bad boy (whose mother apparently never heard of washing out mouths with soap) foul up the Big Apple's airwaves, the company now **simulcasts his New York morning drive show** into Philadelphia and Washington, DC.

To further add insult to injury, Infinity changed its DC's station call letters from the yuppified **WBMW to WJFK.** And this, in a year which marked the 25th anniversary of that President's assassination. 'Nough said.

Moving along with the rest of the dubious awards, there was the **SBE National Convention's move to Denver,** which brought quality attendees, but not much quantity. What was wrong with St. Louis?

There was also the FCC's **non-decision on an AM stereo standard.** With the numbers overwhelmingly in favor of one system, but with the whole mess stalled at only 10% acceptance, the Commission still thinks its **marketplace approach** was the answer all along. Right.

Another action by the Commission—its **settlement of the RKO case**—also deserves a dubious award. After decades of haggling in the courts, the Commission settled by allowing RKO to divest itself of stations . . . at hefty price tags.

Dissenting **Commissioner Dennis** wondered why the owner, who was being punished for the past wrongdoings of its parent company by not being allowed to hold broadcast licenses, should be allowed to **profit from the process.**

The **US Congress** also deserves an award, for failing to act on **President Reagan's appointments** of Bradley Holmes and Susan Wing to the FCC.

The lawmakers apparently wanted to leave such appointments to the discretion of a new administration. But the non-action left a **three-member Commission** to make some important decisions on radio's future.

One other unfortunately dubious achievement involved comments filed in ➤

the **FCC's docket 87-267**—the technical review of AM's technical allotment criteria.

Here was the opportunity for some comprehensive input from the industry on AM's problems and **strong, cohesive leadership** was called for.

Instead, studies which were to help formulate comments were held up and many filings took a "wait-and-see-what-the-Commission-proposes" approach—further evidence that there is **no unified solution** to AM's problems.

I was going to give a real award to **Finial Technology**, for finally making its **laser turntable** a reality.

But during the **Winter CES** word surfaced that the **cost factor** had simply proven too much for Finial.

So, it's **no laser turntable** for those of you with old vinyl libraries. And a **dubious achievement** award to Finial.

And finally, without comment, a dubious achievement award to the NAB for its progress (?) on the **AM antenna project** during 1988.

☆☆☆

Now on to some **real** achievements. Many of them fall into the **product category**. For the top of the list let's give kudos to **Harris** for its continued development of **digital transmitters** for AM. The company started in 1987 with a 10 kW model and this year sold its first 50 kW, with good reports from the users.

Another achievement has been the development of **portable DAT** for production. Public stations have pioneered the effort, but commercial use in the field can't be far behind.

Also on the list of real achievements is the **completed NRSC standard**, from audio to transmission, and the effort to make it mandatory.

Stations using the standard report a **decrease in second adjacent interference** and it was a long, diligent effort with many compromises and lots of cooperation along the way to bring it to fruition.

The **NRSC** gets a **second award** for establishing a technical subgroup to **tackle FM's problems**. By starting now, the group may be able to avoid letting the band fall prey to AM's woes and it brings the work on FM technical issues, which has been addressed in a closed NAB committee, into an **open forum**.

Broadcast Technology Partners also gets a real achievement award for progresss on **FMX**. The stereo extension system seems to have gotten the bugs out of it, one manufacturer is selling generators to stations and several receiver manufacturers are ready to market receivers.

Plus, the group managed to get the **Car Audio Specialists Association** to endorse the system and I like the nifty new FMX logo.

A few other products which deserve mention this year are the **Denon CD cart player**, which apparently has the bugs out of it as well; **Delta's splatter monitor**, which offers a way to test for NRSC compliance; and **Radio Design Labs' AM noise monitor**, which addresses the AM synchronous noise problem FM stations are increasingly concerned about.

And finally, a real achievement award to **Target Tuning**, which has continued to support development of receivers for **AM stereo** with its personal single frequency sets. The company has also managed to stay out of the AM stereo fray.

And besides, it's located in Moonachie, NJ.

1988 CONVENTION REVIEW

Record Crowd Flocks to NAB '88

If "largest evers" make for a success, then the 66th annual National Association of Broadcasters Convention and International Exhibition could take such an honor.

Held in Las Vegas 8-12 April, the NAB convention had a reported attendance of 461,871, up from 40,388 for the 1987 Dallas conclave. Exhibitors totalled 723, compared to 696 a year earlier. Exhibit space was 383,400 square feet, compared to 313,000 square feet in 1987.

A difference in this year's exhibit area was the separation of radio and audio ex- ➤

Radio '88: Ups and Downs

It wasn't the worst of times, but it wasn't the best of times for the radio industry at Radio '88, as a record 6529 broadcasters came to the nation's capital 14-17 September for the NAB's annual fall radio convention.

Sessions focused on AM and FM technical improvements, new listenership surveys and regulatory issues for management, programming, sales and engineering. Over 180 exhibitors, of which about 40 were manufacturers and distributors of equipment, set up shop in 37,000 square feet of floor space.

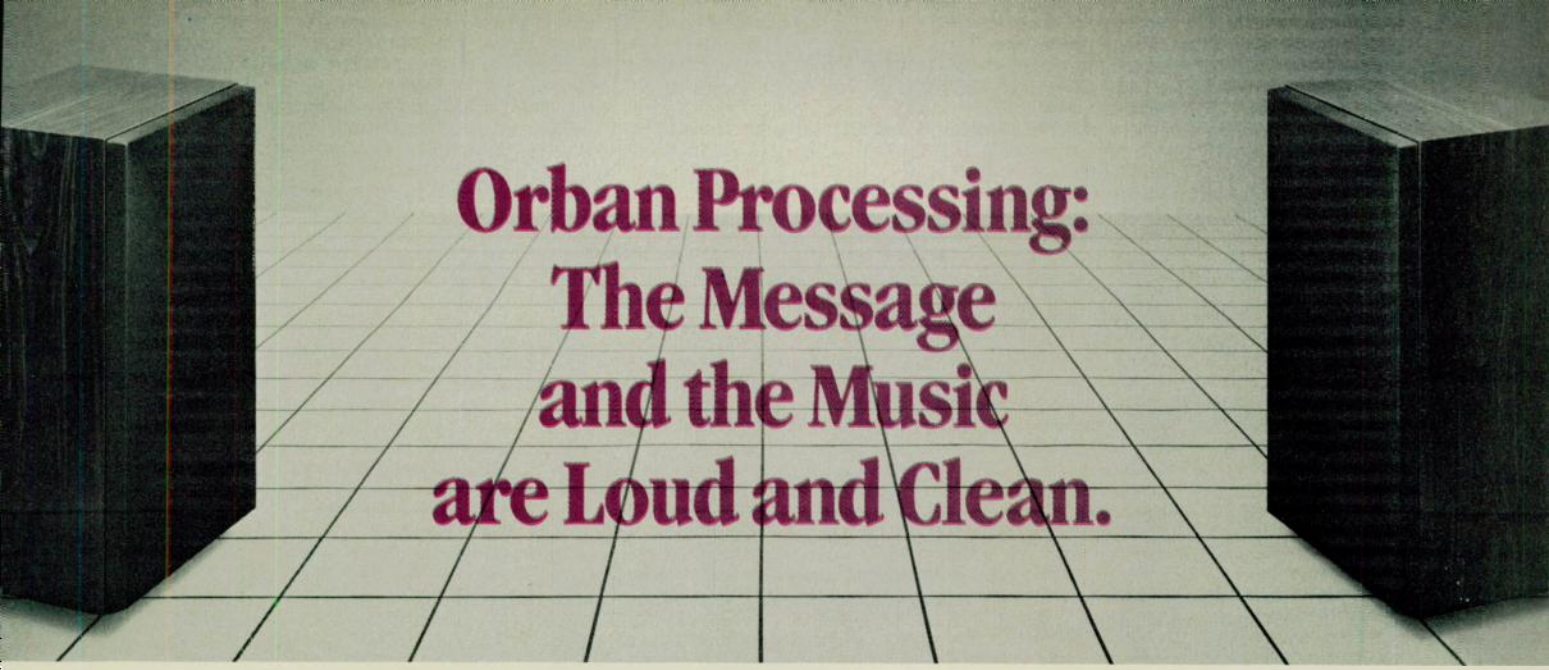
While there were ups, however, there ➤

SBE Traffic Sparse, Quality High

"Quality, not quantity" seemed to be the general appraisal of attendance at the third annual Society of Broadcast Engineers (SBE) national convention, as exhibitors reported light floor traffic while still making good sales contacts.

Attendance at the 22-25 September event totaled 1874, according to SBE figures. Of that number, 646 were admitted with guest passes. Exhibitor registration was 503 for the more than 400 companies represented in the show. (The Rocky Mountain Film and Video Expo held jointly with the SBE show reported registering 920 people for the exhibits.)

Comparing SBE registration this year ➤



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hibits from the television displays.

While the spotlight may have shone more on television, radio broadcasters found plenty to feast their eyes on in the Radio & Audio exhibit hall in the Las Vegas Convention Center, particularly in digital developments.

A wide range of broadcast products was on display not only in the Convention Center but in the Las Vegas Hilton next door and an outdoor display area connecting the two facilities.

NAB President Eddie Fritts opened the convention with a state of the industry address, in which he ranked technological advances, legislative and regulatory issues, and taxation and advertising restrictions as broadcasters' concerns in the coming years.

Other highlights of the NAB gathering included a speech by President Ronald Reagan to approximately 4,000 at the Hilton Pavilion. Reagan addressed the convention's "Broadcasting and Democracy" theme, urging Soviet leader Mikhail Gorbachev to allow freer information flow between East and West.

The speech was transmitted by fiber optics to an advanced television theater and presented on HDTV.

The NAB also presented Reagan with "The Ronald Reagan Broadcasting Award" for a "lifetime of achievement and leadership through the effective use of the broadcast media."

Jules Cohen of Washington, DC was the recipient of the NAB's Engineering Achievement Award. Former FCC Chairman Mark Fowler was presented the Distinguished Service Award.

As for the exhibit area, NAB Exhibits Director Rick Dobson was jubilant.

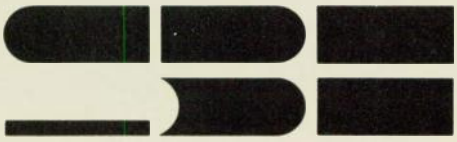
"This was without question the most successful NAB in history," he said. "Every exhibitor I talked to reported record sales . . . "

The 1988 NAB convention was Dobson's first year at the helm of the operation, and he brought with him some procedural changes, particularly in the area of traffic flow.

Dobson noted that concerns about use of the Hilton Center in past conventions were not a problem in the 1988 gathering. The Hilton was used as overflow in 1985, the last time Las Vegas hosted the NAB, and traffic was slow.

For 1988, Dobson said the Hilton was "part of the plan" from the beginning. Exhibit guest registration was moved there, and that section of the display area, as well as the outdoor exhibits, opened a half hour before the main show in the Las Vegas Convention Center.

With the record size of the exhibit, the NAB show now ranks among the top 20 in the US, according to Dobson.



with that of 1987, attendance dropped by a little more than 300 from the previous year's 2200.

The SBE convention included 31 technical sessions tackling issues such as AM improvement and digital technology, the expanded AM band, and audio processing and the NRSC standard.

SBE President Jack McKain said during the convention that he was pleased with the evolution of the national show.

Registration figures indicated "heavy" local traffic and attendees from all states except the Northeast, McKain noted. He attributed the lack of people from the Northeast to the concurrent IEEE conference in Washington, DC and Radio '88, which was held the previous week in the nation's capital.

This was the first show SBE organized under the direction of a show management firm, Eddie Barker and Associates, which also manages the annual RTNDA convention and exhibit. McKain said SBE will continue to use professional management and may hire a publicist for 1989's show, slated for Kansas City.

Response from exhibitors was varied. Gary Crowder of Gentner Electronics said the company made "good quality contacts" but called them "sparse." Looking to next year's convention, Crowder expected better attendance, adding that Denver may not have been a good location to draw people.

Bill Ammons of CRL also did not think Denver was a good location and expected Kansas City to draw more people. Even though he thought attendance was not sufficient, Ammons said he made "some good quality leads."

Jack Williams of Pacific Recorders & Engineering was another who said the number of attendees was down but the people there were talking seriously with his company's representatives. He praised SBE for scheduling less conflict between exhibit floor hours and engineering sessions.

Williams said the two-hour opening reception needs to be organized to attract more people, and if attendance overall does not increase, SBE needs to reconsider keeping the exhibit hall open for three hours on the last day.

Eric Small of Modulation Sciences said he was disappointed in the lack of turnout from California. Based on the attendance in Denver, after being in St. Louis for the previous two years, Small characterized the convention as a "super regional show."

were also downs.

The much touted and awaited "ultimate radio" promised for the show was not finished. The design by New York consulting engineer Richard Sequerra was minus a working AM band and continuous tuning feature.

Radio broadcasters also used the convention to rally forces for challenges both AMers and FMers face in the coming months.

A large contingent went to Congress lobbying for radio-only legislation, an idea to separate radio and TV issues in regulatory moves.

FCC Chairman Dennis Patrick and NAB President and CEO Eddie Fritts, in a one-on-one session, addressed ownership rules and the renewal process. Patrick also asked for help from broadcasters in the Commission's push to clean up the comparative renewal process and remove application abuses.

In the area of listenership, a national survey conducted by Bill Moyes of The Research Group found that AM has a tough battle to overcome listeners' perception that FM has better sound and programming than AM.

And according to the study, "AM Ste-

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RADIO '88
WASHINGTON, D.C.
SEPTEMBER 14-17

reo" may be the wrong terminology to use on the air. Apparently listeners do not believe AM can be in stereo, the study reported. To the average listener, AM and stereo are a contradiction in terms.

Turning to the show floor, exhibitors reported light traffic, although many said those that were there were talking business.

Radio Systems Sales Engineer Paul McLane said he found people at the show were there "to make decisions to buy." Dan Braverman, the company's president, added that because many of the broadcasters present were programmers and managers, he found it a good opportunity to promote his DAT products.

Although many exhibitors highlighted the positive aspects of the show, some expressed their discontent.

"They've got to get the smaller market guys in here," said CRL's Bill Ammon. He said the "fluff and frills" door prize giveaways offered by NAB were not enough to draw people onto the convention floor.

Other comments from the convention included some disappointment with the way NAB handled guest passes to the 1988 convention. At first NAB was not going to issue guest passes at Radio '88, but changed its position when some exhibitors complained. In the place of guest passes, NAB issued $50 discounts exhibitors could distribute.

But Pacific Recorders & Engineering President Jack Williams said NAB came up with "too little, too late."

Without a guest pass or a discount, it cost $100 to get on the Radio '88 exhibit floor only.

Federal Communications Commission

Broadcast Related Phone Listing

**Unless noted, all numbers are in Area Code 202, Washington, D.C. Area Code 717 refers to the Gettysburg, PA office, Area Code 301 refers to the laboratory in Laurel, MD.*

Subject	Telephone Number
Access Charge (CCB)	
• Rules and Policies	632-9342
• Tariff	632-6387
Accounting systems (CC)	634-1861
Advisory Committees	
• Radio Broadcasting	632-6485
• Emergency Broadcast System	632-3906
• National Public Safety	632-7060
Alien Restricted Permits (FOB)	632-7240
Allocation	
• Broadcast	634-6530
• Call Signs	634-1923
• Call Sign Block	653-8126
• Call Sign Policy	653-8126
Charts and Tables (OET)	653-8108
• Government (OET)	653-8141
• Non-Government (OET)	653-8108
• International (OET)	632-8126
Amateur Licenses (PRB)	(717) 337-1212
Annual Report Form (CC)	632-7084
Annual Employment Report (CCB)	632-0745
Antennas & Towers (FOB)	632-7521
Application Status	
• Amateur (PRB)	(717) 337-1212
• Aviation (PRB)	
• Aircraft	(717) 337-1212
• Aviation Ground	(717) 337-1511
• Business (PRB)	(717) 337-1511
• Cellular	632-6400
• Commercial Operator (FOB)	632-7240
• Common Carrier	634-1800
• Domestic Satellite	634-1624
• Mobile Services (CCB)	254-6810
• Microwave (CCB)	634-1706
• Multichannel Service (CCB)	634-1706
• International (CCB)	632-7265
• Experiment (OET)	653-8146
• General Mobile (PRB)	(717) 337-1511
• Industrial (PRB)	(717) 337-1511
• Land Transportation (PRB)	(717) 337-1511
• Equipment Authorization RF Devices only:	
• 24 Hour computer access	(301) 725-1072
• Non-computer access	(301) 725-1585
• Offshore Radio Service (CCB)	653-5560
• Rural Radio Service (CCB)	653-5560
• Microwave (Industrial) (PRB)	(717) 337-1421
• Public Safety (PRB)	(717) 337-1511
• Radio, TV, & Aux. Serv. (MM)	634-6307
Assignment of Microwave Common Carrier Licenses (CCB)	634-1706
Auctions (OPP)	653-5940
Automobile Emergency (PRB)	(717) 337-1212
Bills (Legislative) (OLA)	632-6405
Broadcast, Inspection of Stations (FOB)	632-7014
Broadcast Services—(MMB)	
• *AM Service*	
• Engineering Rules:	
• Existing Stations	632-7010
• Minor Changes Applications	254-9570
• New stations and major changes Applications	254-9570
• STLs; RPUs, Intercity Relays	634-6307
• Non-Engineering Rules:	
• Advertising Questions/Comments	632-7551
• Application Forms	632-7272
• Assignment/Transfer Applications	254-9470
• Construction Permit Applications	254-9570
• Emergency Broadcast System	632-3906
• Political Broadcasting	632-7586
• Programming Questions	632-7048
• Renewal Applications	254-9572
• Equal Employment Opportunity	632-7069
• Reports	
• Employment (Form 395B)	632-7069
• Ownership (Form 323)	632-7258
• *FM Services*	
• Engineering Rules	
• Existing Stations	632-6908
• Minor Changes Applications	632-6908
• New Stations/Major Changes	632-6908
• SCA	632-7166
• STLs; RPUs; Intercity Relays	634-6307
• Translators/Boosters	634-6307
• Advertising Questions	632-7551
• Application Forms	632-7272
• Construction Permits	632-6908
• Educational FM	632-6908
• Emergency Broadcast System	632-3906
• Political Broadcasting	632-7586
• Programming Questions	632-7551/632-7048
• Renewal Applications	632-3954
• Equal Employment Opportunity	632-7069
• Employment (Form 395B)	632-7069
• Ownership (Form 323)	632-7258
• SCA's Stereo-Multiplex	632-7166
Bulletins, Request for (OPA)	632-7000
Business Radio (PRB)	(717) 337-1212
Registration (MMB)	632-7076
• Complaints (Subscribers)	632-7048
• Franchising	632-7076
• General Radio and TV	632-7048
• Microwave	
• Legal	632-7480
• Engineering	254-3420
• Pole Attachments (CCB)	632-4890
• Policy	
• Access	632-7480
• Public Reference Room	632-7076
• Special Relief	632-7480
• Technical Standards & Rules	254-3420
Cablegrams (CCB)	632-7265
Call Letters (Signs—)	
• Private Radio Services	(717) 337-1212
• Broadcast	634-1923
Campus Radio Stations (OET)	653-6288
Carrier Equipment (CCB)	634-1800
Cases in Court (OGC)	632-7112
Cellular Mobile Radio	632-6400
Cellular (Recorded Message)	653-5858
Certification of RF Gear (OET)	653-6288
Civil Air Patrol (PRB)	
• Applications/Licenses	(717) 337-1212
• Rules	632-7175
Coast Stations (PRB)	
• Applications/Licenses	(717) 337-1212
• Rules/Hearings	632-7175
Commercial Operators—(FOB)	
• Examinations (D.C. Area)	(301) 962-2729
• Examinations (Other Areas)	632-7240
• All other matters	632-7240
Commission Proceedings	632-7000
Common Carrier Radio (CCB)	
• International & Satellite	632-7265
• Mobile Services	632-6400
• Microwave Services	634-1706
Complaints—	
• Broadcast (TV & Radio)	632-7048
• Advertising Questions	632-7551
• Political Broadcasting	632-7586
• Programming Questions/Religious	
• Common Carrier—	
• Informal Complaints & Inquiries	632-7553
• Telephone	632-7553
• Telegraph/Telegram	632-7553
• Pole Attachments (CCB)	632-4887
• Rates	632-7553
• Interference to Radio & TV	
• Washington, DC Area	(301) 962-2727
• All Other Areas—Refer to local field installations	
Compliance—	
• Registration (MMB)	254-3407
• Common Carrier Accounting (CCB)	634-1861
• Experimental (OET)	653-8141
• Incidental Radiation (OET)	653-6288
• Land Mobile (PRB)	632-7125
• Aviation & Marine (PRB)	632-7197
• Personal & Amateur (PRB)	632-7197
Conferences	
International—CCIR, WARC (OET)	653-8126
CCITT (CCB)	632-3214
Conflict of Interest (OGC)	632-6990
Congressional Liaison (OLA)	632-6366
Consumer Assistance/Small Business	632-7000
Control Devices (non-licensed) (OET)	653-6288
Copy Contractor	857-3800
Cordless Telephone (Pt. 15) (OET)	653-6288
Court Cases (OGC)	632-7112
Customer Owned Equipment—	
• Attach to Telephone (CCB)	634-1833
Customer Toll Dialing (CCB)	632-7553
Depreciation Rules (CCB)	632-7500
Development Stations	
• Aviation or Marine (PRB)	(717) 337-1431
• Common Carrier (CCB)	634-1706
• Experimental (OET)	653-6288
• Dial-a-Porn Complaints	632-7553
Diathermy Approval (OET)	(301) 725-1585
Digital Terminations Systems (DTS)	634-1706
Digital Electronic Message Svc	634-1706
Direct Broadcasting Satellites	632-9356
Direct Distance Dialing (CCB)	632-5550
Domestic Public (CCB)	
• Auxiliary Test and Repeater Stations	653-5560
• Cellular Radio	632-6400
• Land Mobile Radio Service	653-5560
• Microwave	634-1706
• Rural Radio	653-5560
Duplication Contractor (ITS)—	
• Washington, DC	9-857-3800

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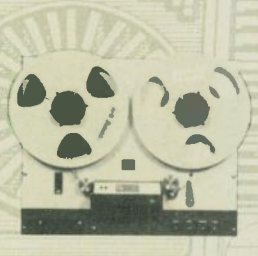

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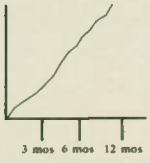

Simulated number of on-air embarrassments without CD cartridge protection against contaminants

Simulated number of on-air embarrassments WITH DENON CD Cart Player CD protection against contaminants

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CONVERSION CHART

Dec	Oct	Hex	Binary	B C D
1	1	1	00000001	0000 0001
2	2	2	00000010	0000 0010
3	3	3	00000011	0000 0011
4	4	4	00000100	0000 0100
5	5	5	00000101	0000 0101
6	6	6	00000110	0000 0110
7	7	7	00000111	0000 0111
8	10	8	00001000	0000 1000
9	11	9	00001001	0000 1001
10	12	A	00001010	0001 0000
11	13	B	00001011	0001 0001
12	14	C	00001100	0001 0010
13	15	D	00001101	0001 0011
14	16	E	00001110	0001 0100
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21	25	15	00010101	0010 0001
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23	27	17	00010111	0010 0011
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27	33	1B	00011011	0010 0111
28	34	1C	00011100	0010 1000
29	35	1D	00011101	0010 1001
30	36	1E	00011110	0011 0000
31	37	1F	00011111	0011 0001
32	40	20	00100000	0011 0010
33	41	21	00100001	0011 0011
34	42	22	00100010	0011 0100
35	43	23	00100011	0011 0101
36	44	24	00100100	0011 0110
37	45	25	00100101	0011 0111
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39	47	27	00100111	0011 1001
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41	51	29	00101001	0100 0001
42	52	2A	00101010	0100 0010
43	53	2B	00101011	0100 0011
44	54	2C	00101100	0100 0100
45	55	2D	00101101	0100 0101
46	56	2E	00101110	0100 0110
47	57	2F	00101111	0100 0111
48	60	30	00110000	0100 1000
49	61	31	00110001	0100 1001
50	62	32	00110010	0101 0000
51	63	33	00110011	0101 0001
52	64	34	00110100	0101 0010
53	65	35	00110101	0101 0011
54	66	36	00110110	0101 0100
55	67	37	00110111	0101 0101
56	70	38	00111000	0101 0110
57	71	39	00111001	0101 0111
58	72	3A	00111010	0101 1000
59	73	3B	00111011	0101 1001
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62	76	E	00111110	0110 0010
63	77	3F	00111111	0110 0011
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65	101	41	01000001	0110 0101
66	102	42	01000010	0110 0111
67	103	43	01000011	0110 0111
68	104	44	01000100	0110 1000
69	105	45	01000101	0110 1001
70	106	46	01000110	0111 0000
71	107	47	01000111	0111 0001
72	110	48	01001000	0111 0010
73	111	49	01001001	0111 0011
74	112	4A	01001010	0111 0100
75	113	4B	01001011	0111 0101
76	114	4C	01001100	0111 0110
77	115	4D	01001101	0111 0111
78	116	4E	01001110	0111 1000
79	117	4F	01001111	0111 1001
80	120	50	01010000	1000 0000
81	121	51	01010001	1000 0001
82	122	52	01010010	1000 0010
83	123	53	01010011	1000 0011
84	124	54	01010100	1000 0100
85	125	55	01010101	1000 0101
86	126	56	01010110	1000 0110
87	127	57	01010111	1000 0111
88	130	58	01011000	1000 1000
89	131	59	01011001	1000 1001
90	132	5A	01011010	1001 0000
91	133	5B	01011011	1001 0001
92	134	5C	01011100	1001 0010
93	135	5D	01011101	1001 0011
94	136	5E	01011110	1001 0100
95	137	5F	01011111	1001 0101
96	140	60	01100000	1001 0110
97	141	61	01100001	1001 0111
98	142	62	01100010	1001 1000
99	143	63	01100011	1001 1001
100	144	64	01100100	000 0000

courtesy of Modulation Sciences

National Association of Broadcasters

1771 N Street, NW, Washington, DC 20036

Unless otherwise indicated all numbers should be preceeded by 202-429

(202) 429-5300

Advanced Television Systems Committee (ATSC)	5345
Broadcast Capital Fund (BROADCAP)	5393
Broadcast Ind. Council. to Improve American Productivity (BICIAP)	5330
Broadcast Education Association (BEA)	5355
Broadcast Pioneers Library Catherine Heinz	223-0088
NAB Department Listings	
Accounting	5432
Administration	5440
Billing	(800) 626-5542
Building Maintenance	5331
Data Processing	5349
Conventions and Meetings	5356
Employment Clearinghouse	5497
Exhibit Office	5335
Government Relations	5301
GR Hot Line	(800) 424-8806
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International Consultant	5451
Legal	5430
Library & Information Ctr.	5490
Lobby	5333
Minority & Special Services	5498
Personnel	5438
Public Affairs & Comm.	5350
Publications	5376
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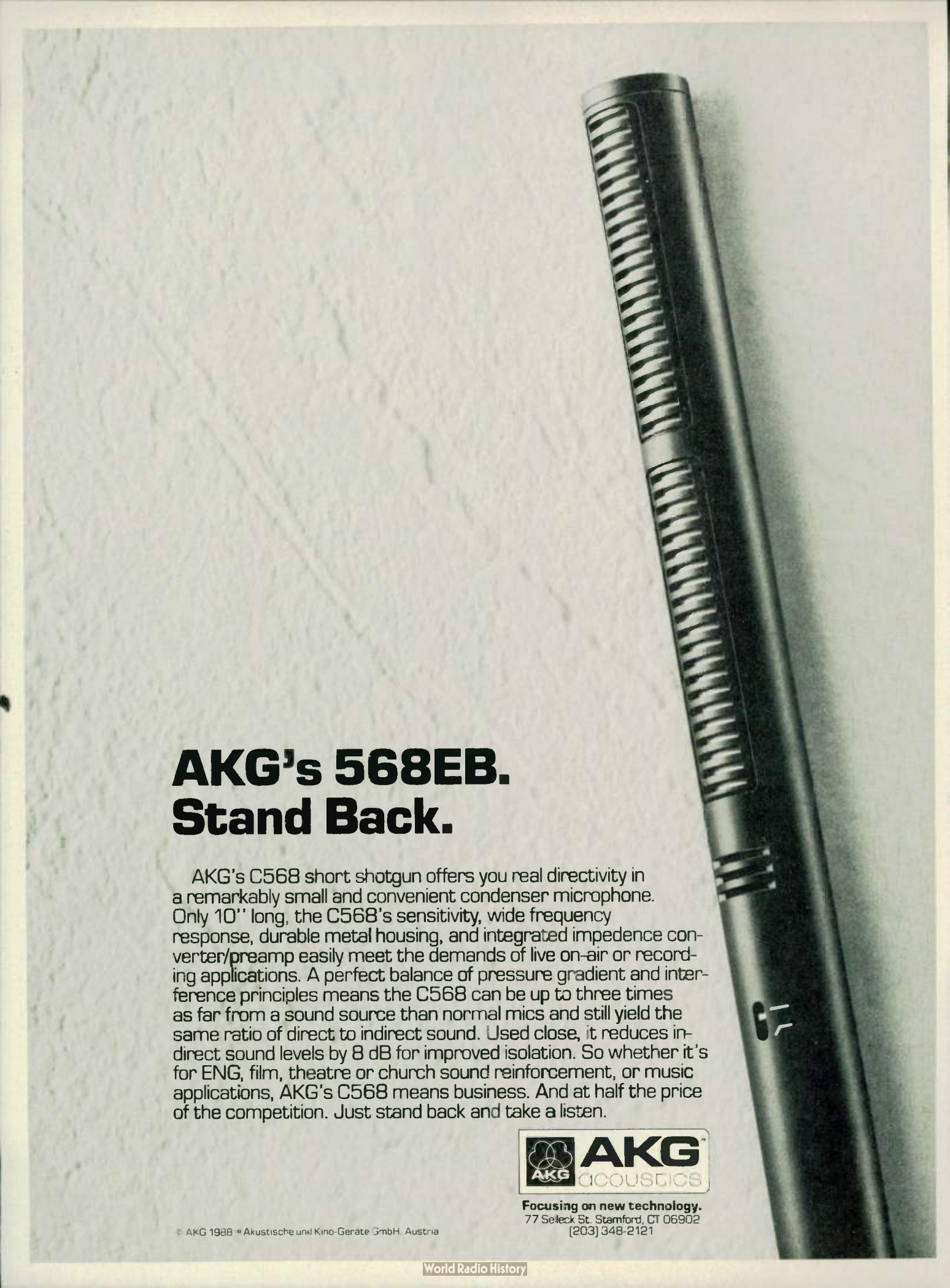
Radio	5420
Radio Membership	5400
Research & Planning	5380
Science & Technology	5346
Station Services	5373
Television	5362
Television Membership	5363
Tarpac	5318



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A LOOK BACK/A LOOK AHEAD

Industry Perspectives on the Year That Was and Predictions of What's to Come

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With more than 40,000 sites in 100 nations, Scientific-Atlanta is the number one provider of satellite-based communications networks in the world.

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- Our data communications networks are helping Thrifty Corporation, The Home Depot, CADP, Curry Communications, the New York Times, Shell and Metropolitan Life communicate data direct;
- At over 20,000 locations, our high-security B-MAC video encryption systems are at work in business TV networks...adding value while saving time and money for AT&T, Federal Express, Kodak, J.C. Penney, even the Mayo Clinic;
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To add maximum value to our networks, we add the most comprehensive support in the business.

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- Model 6301 Ku/L-Band Low Noise Block Converter—highly stable Ku-Band downconverter. Converts 11700-12180 MHz to 905-1450 MHz.
- Model 7007 L/70 MHz Agile Downconverter—A synthesized agile L-Band converter. Converts 950-1450 to 52-88 MHz. Frequency control via front-panel thumbwheel switches in 10 MHz steps.
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Circle 29 On Reader Service Card

Radio's Crystal Ball

Prognostications for the Coming Year

by Michael Rau

Radio, of course, has been evolving since the earliest broadcasts of KDKA in the 1920s, and will keep evolving through the digital revolutions of the '80s and beyond. Let's peer into our industry's collective crystal sphere and attempt to perceive what's murky and what's clear.

The forecast for AM

AM improvement matters will continue to be first on the industry's agenda. In 1989, at least five FCC AM rule makings will conclude: NRSC regulation, revision of the AM groundwave and skywave curves, revising the 50% RSS calculations, and permitting daytimers to more effectively use low-power authorizations.

Additional potential rule makings would consider revisions in the FCC's protected contours and adjacent channel protection ratios, as well as continued planning for the expanded AM band. NAB will construct our reduced skywave experimental AM antenna project, and begin efforts to standardize a so-called "low-profile" local area AM antenna.

Through our AM Improvement Committee, NAB will continue to develop and implement new AM improvement policies and programs.

Whither AM Stereo? 1989 is not going to bring a "solution" to the industry's AM Stereo conundrum. Perhaps the economics of many AM stations better explains the slow growth of AM Stereo implementation than the lack of an AM stereo standard for broadcasting. I think most would agree there certainly is an AM Stereo standard for receiver manufacturers.

But will AM "turn around" in 1989? I do not believe this will be the case. It took 15 years to get AM where we are today; probably one year is not going to do it.

The best that can be done, in my opinion, is to rebuild the technical and policy foundations of the industry and hope we're doing the right thing. The best results from these efforts would be to realize a new commitment to investing in and operating AM stations, leading to a rise, or at least not further decline, in the trading prices of standalone AM stations.

And what about FM? Is there a murky cloud inside FM's silver lining?

In 1989, we may discover the true extent of FM's success—will the more "marginal" Docket 80-90 stations survive? And the industry, I think, will continue to run a sizeable risk that poorly crafted technical and allocations standards will cause instances of objectionable interference to increase as the FM band becomes more congested.

Unchecked, poor allocations planning could lead to a general degradation of the band as a whole and render FM broadcasting technically less competitive with increasingly prevalent CD and DAT players in cars.

But it may be too late to prevent an FM technical decline: the future status of the FM band has already been determined—there are hundreds of yet-to-be processed FCC applications now on file at the FCC. What is the FM band going to sound like when these applications are granted?

Of course, city grade signals (70 dBu) will continue to offer listeners high quality and low noise. We may also see an increasing use of FM subcarriers, and perhaps some standards activity in a subgroup of the NRSC.

FMX™ technology will make further gains in 1989. At last count, the FMX people had 53 stations on air or about to go on the air with FMX.

But the real rub, as always, is with the receiver manufacturers and the suppliers of IC chips. In this respect I believe that 1989 will be a critical year in the implementation of FMX. We shall have a clearer view on the intentions of FMX receiver manufacturers.

A prediction for engineering

What is the future of the radio engineering profession? It is an unfortunate consequence of technical deregulation that many radio station owners and operators find it economical to cut back on technical staffs, maintenance, and purchases of new equipment.

I believe, however, that the "worst" is over. I cannot imagine the radio industry cutting back much further on its technical resources. And, even for radio engineers that become exposed to the harsh realities of the "marketplace," the dedicated radio engineer will always have a job: technical talent remains in short supply in the broadcast industry. Radio engineers must simply go where the work is.

Engineering is one skill among many that are needed to organize a successful radio station. Like other skills in radio—sales, news, talent, production, and management—it is the station management that assigns value to each skill.

In 1989, I believe that station management increasingly will recognize the value of sound engineering. (Today, many managers feel this way already—as the pool of qualified engineers diminishes, engineers become more valuable.)

The future of digital technology is murky, at least in 1989. Even though the dream of "tapeless" and cost-effective production studios will come closer to reality, there remains a hodgepodge of competing digital technologies none of which can digitally interface with the others.

In 1989, perhaps we shall see some standards emerge that may help guide the digital future. NAB plans to do some work in this area. Digital is here to stay.

In America, where industry futures are often uncertain, and where foreign competition threatens many industries' ability to control their own destinies, radio seems to be in a strong position. Absent some big change in American society, there will always be a strong demand for local news, weather, traffic and sports delivered by radio—in 1989, and beyond.

Michael Rau is vice president of Science and Technology for the National Association of Broadcasters. He may be contacted at 202-429-5346. The opinions expressed here do not necessarily reflect those of **RW.**

The Fidelipac Perspective—Past, Present and Future

by Jack Ducart

There was a time when everything you heard on the radio was live. Talent. Music. Commercials. Everything. Some say that radio was better then. What you heard was really happening, somewhere.

Those were the days when "what was on" was the only thing that mattered. We accepted the missed cues, wrong notes and occasional absences of familiar players knowing that, after all, what we were hearing was live.

But the huge cost of assembling and maintaining "talent," studio orchestras, singers and sound effects made live radio production impractical for the hundreds of new stations signing on in the US. The advent of television siphoned advertising revenue, forcing radio stations to find inexpensive ways to create quality programming.

By the early '50s, disc jockeys, news and talk shows were the mainstay of commercial radio programming, with "commercial" the key word. Whether DJ, news announcer or talk show host, the two things that counted most in your job were hitting those SIs straight up and keeping up with the commercial log.

Until the tape cartridge entered the picture in the late '50s, commercials were presented in three ways: they were typed in the log for the announcer to read live, they were played from discs called ETs (electrical transcriptions) and they were recorded on reel-to-reel tape. If you weren't there yourself to witness them, you can imagine the problems that arose, problems much the same as those we have today.

Announcers, ETs and reel-to-reel tape

Ask an announcer to read commercial copy live and what do you get?

The performance varies with the announcer. Mistakes, mispronunciations and flubs become an immediate part of the commercial message. If sound effects, musical beds or theme songs are required, live production increases the risk of error.

ETs solved the problems of inconsistent voicing and the need for live production, but were subject to skipping, scratching and that denizen of all phono discs, cue burn. Reel-to-reel tape containing the day's commercials solved the ET's problems, but had problems of its own.

Locating the right spot was tough in a pinch. Threading and unthreading tapes was a bother. And those Ampex 350s were the size of living room furniture.

. . . the first tape cartridge wasn't used in broadcasting at all, but as an alternative to it.

Then tape cartridges stepped in and changed radio.

Make a positive statement about when the first tape cartridge was used in broadcasting and you're sure to get an argument. But one thing is certain: the first tape cartridge wasn't used in broadcasting at all, but as an alternative to it.

Old lab notebooks from the dustiest corner of Fidelipac archives reveal that in the very early '50s, George Eash set about to create a reliable method of storing and reproducing music for playback in automobiles.

The first endless-loop cartridges were known as *four-tracks*. The cartridges and the players that played them produced the first prerecorded stereophonic sound ever heard in autos. With a tape speed of 3¾ ips, the four parallel tracks yielded up to 40 minutes of stereo or 80 minutes of mono.

Although first produced in the familiar "A" size, "B" and "C" size cartridges quickly followed and became the preferred format for syndicated background music.

In the late '50s, Fidelipac consumer tape cartridges were adapted for broadcasting. The molded-in plastic center and front corner posts were replaced with brass and nylon, respectively, to yield longer life. Opaque covers gave way to crystal styrene, so that the splice could be easily viewed. A cueing system was worked out.

The tape speed and track configuration first used in 1957 survive very well to this day.

The system today . . .

Standardized by the NAB in 1964 and updated in 1975, the NAB tape cartridge system can be found in most of the world's commercial radio stations, delivering more than just commercials. Many, if not most, locally originated stations air all of their prerecorded programming directly from tape cartridges.

Why, you may ask, is the cartridge still around? And why, even with digital audio a reality, do cartridge and cartridge machines continue selling steadily? The announcers, DJs and newscasters know.

They're the ones in the hot seat. They're the ones who have to deliver continuous, reliable audio programming. And they're the ones who know that when they're reading the last line of live copy and nothing is cued up, a cartridge—*any* cartridge—can be played in an instant. Blindfolded.

. . . and tomorrow

People are constantly working on improvements to the cartridge machine. We've already seen some extreme examples, resulting in cartridge players far too complicated for the weekend DJ to operate.

We've seen digital storage systems using hard disk, DAT, and erasable, recordable CD. I've heard rumors of a new interface involving mental telepathy.

Someday, someone may hit on the right combination of random accessibility, reliability, simplicity and cost effectiveness. Watch this space for the latest!

Jack Ducart is director of sales at Fidelipac. He can be contacted at 609-235-3900.

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RF IDEAS

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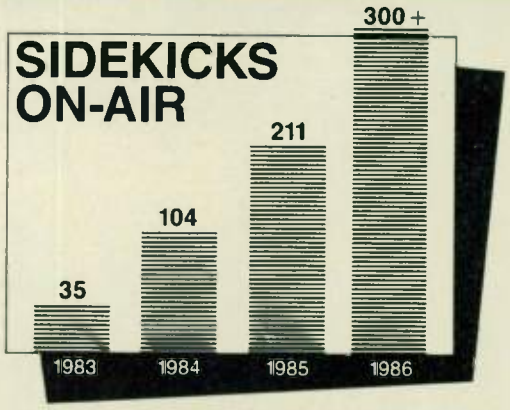

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Circle 34 On Reader Service Card

Reflections on RF Compliance

by Richard A. Tell

Broadcasters in 1988 began to give more serious consideration to the subject of RF radiation matters at their stations as license renewals for FM stations began in earnest.

Due to the characteristics of many FM antennas which exhibit pronounced radiated signals at steep depression angles, many broadcasters found themselves embroiled in applying the Federal Communications Commission's Bulletin OST-65 for evaluating whether their stations complied with the FCC's environmental rules.

In some cases, broadcasters forgot that the FCC rules, which specify that RF fields shall not cause exposure of individuals at levels greater than the American National Standards Institute (ANSI) RF radiation protection guide, apply not only to the public living in the vicinity of their transmitter sites, but also to their own employees and subcontractors.

More station engineers are realizing the benefit of attending the annual RF compliance seminar held by the the National Association of Broadcasters (NAB) at its yearly fall radio show.

An interesting observation made this year was that of older, multiple use broadcast sites at which a station has decided to change its old antenna for something new. The problem, in this writer's mind, is something akin to the old story of the painter painting himself into a corner, except in this case, the paint simply does not dry.

In complex and large multi-user facilities, it is downright difficult to do extensive antenna work and keep personnel exposures to RF fields within the limits without power reductions, use of auxiliary antennas, and the possible installation of shielding. In the context of complex mountaintop or tall building transmitter sites, all of these things make for some mighty difficult times—not necessarily impossible, but mighty difficult. ➤

Richard Tell is president of Richard Tell Associates, an RF radiation consulting firm, and was formerly the EPA's expert on RF issues. He can be contacted at 6141 W. Racel St., Las Vegas, NV, 89131-1912, or by phone at 702-645-3338.

Maybe it's time for those developing major new broadcast sites, and this still happens from time to time, to give thought to what may happen down the road in twenty years or so when tenants decide to change antennas after the site is loaded up.

Simmering standards

The whole issue of standards continues to simmer. Worst of all bad dreams, the Environmental Protection Agency decided to bail out of the guidance role in which it had played a leadership role for a long time.

Crazy as it seems, despite urging from the broadcast industry to develop a federal standard for controlling RF exposures of the public, EPA decided to phase out its RF program and forget about issuing the federal guidance it had planned. Instead, the agency opted to put the miniscule resources it had been using to keep the RF program alive into other more critical areas.

This continued inaction on the part of the federal government will only add to the present confusion and problems generated by the proliferation of RF standards at the local level.

For example, Seattle finally issued its draft Telecommunication Policy and Regulations on RF fields. This document proposes a limit for RF fields in the VHF band of only 100 $\mu W/cm^2$. A number of outstanding issues remain on exactly how RF fields are to be measured.

Back to ANSI

The decision by EPA to drop its RF guidance program tends to emphasize the observation of some that ANSI is just about the only show in town. Irrespective of EPA's decision, ANSI continued to reevaluate its position on an acceptable level of exposure and introduced the ccncept of possibly revising its guide to differentiate in some fashion between occupational exposure and that of the general public.

EPA decided to phase out its RF program and forget about issuing the federal guidance it had planned.

How this will all come out is still uncertain, but ANSI will be meeting in January to further discuss the possibility along with new provisions for preventing excessive currents from being induced in the body from medium wave fields, such as those at AM radio stations.

With more FM stations finding themselves in trouble because of high level RF fields, more and more new antennas with altered element spacing were being installed at sites where, due to low tower heights, use of traditional types of antennas with one wavelength spacing simply wouldn't cut it. Here is a case where industry has responded to the problem with a cure.

Even though RF radiation measurements for evaluating broadcast station compliance with the FCC rules are becoming more widespread, 1988 brought no major breakthroughs in instrumentation. Despite this, the year saw increased use of more sophisticated measurement techniques to determine compliance, with special emphasis on invoking the time averaging provision of the ANSI radiation protection guide.

Commission action

Finally, 1988 found the FCC responding to two sensitive issues in the RF radiation area. On 7 October 1989 the FCC released a Notice of Proposed Rule Making which sought comments on how to define a transmitter site and how to deal with the problem of so-called hot spots.

The Commission has maintained that a new station at a multi-user site, or a station desiring to modify its facilites, must work with other site tenants to mitigate RF levels if those levels, in the aggregate sum, exceed the ANSI guides. The rule making suggests that if the contribution of any given station is less than one percent of the applicable guide level, then it may consider itself as a separate site and be categorically excluded from further evaluation.

Hot spots, those areas of concentrated field strength caused by reradiating objects, was another area of discussion in the notice. The FCC sought comments on a suggested minimum measurement distance of 20 cm, and whether such a change from the present 5 cm distance would provide any less protection from exposure to these near field type situations.

The Notice of Proposed Rule Making was a major step in the right direction to help broadcasters out of two rather complex problems which are very frequently encountered in site surveys.

What about 1989? I see a new ANSI standard which will address a whole variety of new considerations. However, I see continued regulatory activity at the local level.

I am hopeful that, between ANSI and the FCC, we will have new and more specific guidance on assessing RF fields due to hot spots and RF fields at multi-user sites. Relative to the government setting a national guide for RF field limits, we can only wait and see. But I wouldn't hold my breath.

Radio Gets Comfortable with Advanced Technology

by David Burns

When Radio World asked me to participate in a review of the year 1988 (and a look ahead), I had to pause for a moment. It will soon be eleven years for me at Allied and I am still having fun.

After selling for 10 years, I assumed the marketing position I now fill would be life in a somewhat slower lane. Not so!

Discovering new products, providing training to our sales troops and advertising to our market is more exciting and romantic than I could ever have imagined.

The technology cycle

Product voids are filled by aggressive entrepreneurs as soon as they develop. New technology replaces old. Unique technology is born.

Ideas change. For example, a get-serious attitude in FM loudness took place in 1988. It was not cool to be just loud—*loud and clear* was the attitude, and a mandate. Programmers were finally admitting that a listener can listen to only one station at a time.

Transmitter manufacturers continue to stretch and reach toward the theoretical limits of FM transmission standards. Processing has entered the digital domain.

AM noise and its effects on FM signal has become the latest villain in the engineering community's quest for quality. Yes, there is even an automatic monitor for this malady.

Although turnkeys have been a part of our industry for a long time, recent relaxations by the FCC have created more turnkey opportunities than ever before. From the prewired patch panel to a complete station installation, those engineers left in our industry need all the help they can get.

Fifteen years ago, an AM/FM operation I knew of employed 17 staff engineers. They now have two engineers. They and more and more of their associates are forced to seek more and more prefabrication.

Buying trends of the future

From our vantage point, we observe a solid stream of spot equipment buying. Coupled with this, however, are more clients who seek a supplier which can do everything.

The need for turnkey ability has been encouraged by a diminishing number of engineering positions. To pursue this growing need, Allied and several other suppliers have established systems departments able to supply "everything from the microphone to the antenna."

On the other hand, there is the trend towards trading in stations. Without the three-year ownership rule, our customers have become the product. Fast turnarounds have quickly made and lost fortunes. Financers sometimes forget new equipment.

Systems, used equipment trade-ins, satellite downlinks of every broadcast radio description—all this does tend to keep one on his toes!

But now, even the building in which to house all of the 250 lines of studio equipment we carry can be part of a system package.

We recently agreed with a supplier to promote and market a complete studio facility. Our builder only needs a piece of land and he will take it from there, working with everyone from the planning commission to the plumber.

Nasty zoning boards not withstanding, average lead time is ten weeks from signature to sign-on. We at Allied are very excited about this and the systems concept.

Progress and change

Compact discs are almost as standard as black vinyl. Several pro manufacturers have responded to broadcast needs and even the smallest markets have become proficient with this accepted medium.

DAT has become more of a reality with the advent of several professional machines. Now, if the Recording Industry Association of America will compromise with consumer manufacturers, DAT can catch fire just as CD did a few years ago.

Synclavier, DAR and other exotic names have slipped into our lexicon and into the facilities of Gannett who experiments with the tapeless studio.

Is anybody just a one-network affiliate any more? When networks abandoned land lines, satellite technology allowed the affiliate and the network to be flexible. Not at all unusual is the station which may "cherry-pick" actualities, sports and special programming from four or five major networks in one broadcast day.

Watching the horizon

In Allied's view of the future of radio, tomorrow's operator will sit in front of some type of human-responsive device. Instead of responding to the operator's mechnical know-how and manual dexterity, this interface will be touch- or voice-sensitive.

A video display terminal will replace pen and paper. The display will prompt, inform, reveal and guide the operator through his shift.

When we consider cartridge tape machines, we have no doubt they will be needed for several years to come.

My first employer installed the devices in 1962; I went from a record-holding Ampex 601 threader/cuer to pushing buttons. The Cart machine is a miracle that still has not been made obsolete with existing technology.

This industry is ready for another miracle; we believe it will happen before the century's turn. Still, cart machines will be with us for a long time even after that happens, although on a smaller scale.

Be ready for more computer-driven broadcast facilities. Tandy-THOR say they will license a recordable CD system for production within the next 18 months. This will be part of the miracle if they are able to deliver at affordable pricing.

Remember, though, if you can buy one, it will take computer interfacing and operational knowledge to make it work. For a CD to play compatibly on common CD players, it must have developed subcodes and several other bits of computer-generated information.

Technology is never static. The last 27 radio years have been a lot of fun. I think I will stick around to see what the next 27 hold.

Dave Burns is National Marketing Director for Allied Broadcast Equipment. He can be reached at 317-962-8596.

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Circle 46 On Reader Service Card

Radio Systems Talks Turnkey

by William A. Wohl, Sr.

In a year of mergers, legal issues and new product announcements, those of us who view the industry from the vendor side of the fence have noticed a longer-term trend that, in the last year, has shaped the very course of business for manufacturers and distributors.

The matter of "dwindling" station engineers has been well documented in trade publications and at countless local, regional and national meetings. Consider for a moment the kind of impact this trend is having on both radio stations and their vendors.

All of us, including the remaining engineers who thrive, now speak the language of the industry's newest players—the nonbroadcast business professionals who are buying and managing today's radio stations. In increasing numbers, these people are making important decisions about station equipment and operations without the advice of local, experienced technical personnel.

The changing face of radio

A revolution is taking place—the birth of the vendor-engineered radio station.

Many of us fondly remember doing business with station managers who got all their advice on equipment from the station engineer, who had grown up at the station and knew the operation from the ground up. Or, as at many smaller stations, the manager *was* the technical expert, because he had moved up from engineer or announcer.

For many years, our firm has been a turnkey builder of radio stations. The vast majority of this work had been specified, directed or, at least, planned by the local engineer. Now the approach is different.

More and more stations and corporations are making operations, equipment and engineering decisions from a strictly business dollars-and-cents viewpoint, without local engineering advice. A typical caller to our company now may begin by saying, for example, "Tell us what we need to get a Class A on the air . . . "

For the few firms that have turnkey experience, the transition has been easy. We already know the equipment and resources that are necessary to get the job done based on field experience—and how to effectively communicate that to the new breed of owners and managers.

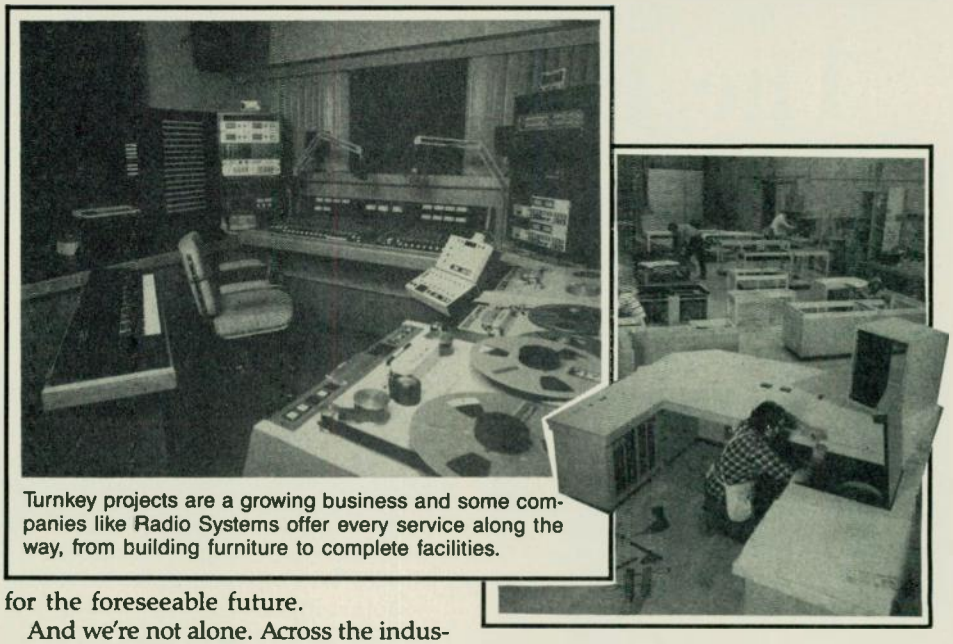
But in the vast majority of transactions,

➤

William A. Wohl, Sr. is custom projects manager for Radio Systems, a turnkey supplier to the industry, based in Edgemont, PA. He can be reached at 215-356-4700.

entire studio and RF projects are being designed by people who don't have the experience in making the pieces work in the field. The result is too often disappointing—not all the pieces are specified, the parts don't fit together and the project is just plain unsatisfactory.

In these cases—when vendor-engineering is done by those without turnkey experience or resources (for example, without field experience)—the lack of local engineering talent is sorely missed. And for stations which have a real turnkey company provide the installation, very often the result of the "dwindling engineer" is a facility that is left to deteriorate over the years.



Turnkey projects are a growing business and some companies like Radio Systems offer every service along the way, from building furniture to complete facilities.

The role of the supplier

More and more, without the local engineer on site, station owners and managers are turning to firms like ours to specify, purchase and install radio stations. In short, our role has changed from a supplier and installer to a designer, a kind of engineer "in absentia."

At Radio Systems, this trend has reemphasized a portion of our business—our turnkey services. While we've been doing this for years, 1988 has brought a real surge in this portion of our business—a growth pattern that we see continuing for the foreseeable future.

And we're not alone. Across the industry, many other firms are now entering the turnkey business, hoping to capture a growing portion of the market that doesn't have local engineering support to install radio equipment. Expect more companies to follow suit.

Still, there are two sides to the concept of the vendor-engineered radio station. Yes, it has increased business for our turnkey division. But overall, we are concerned about the loss of local engineering support.

Already we are seeing a general decline in the quality of local station operations, and there is no doubt, as this trend continues into the 1990s, conditions locally will continue to decline. It is our hope that station owners will continue to examine their investment in engineering staff and, in lieu of on-site personnel, consider the use of an experienced turnkey company to spec, design and install broadcast equipment.

SOS From RSD

by Dan Braverman

This one's really insidious. It's invading our stations, infecting our organzations and polluting our airwaves. Like a computer virus, it multiplies via its own indecipherable code. We all speak its language and unwittingly spread the plague.

No, our industry is not suffering from any growing technical problems—scratchy LPs have long ago been replaced by CDs and now even R-DAT has arrived. STLs, TSLs and RPUs proliferate where the BOCs have failed. And FMX and the NRSC standard are improving transmission until DBS is a reality.

And no, you can't blame FCC deregulation for this one. Today you can increase your ERP just by requesting more HAAT, with no more TPO, and really push your 1 mV contour—even with two SCAs. And TV has SAP and PRO—thanks in part to dbx.

If ABC, CBS or NBC don't see the danger, then let powerhouse stations like KIIS, WLW or WHTZ spread the word. We need a PBS or NPR documentary—or maybe VOA or the BBC could go international with this problem. How about an MTV rock video!

My fellow manufacturers—wake up! Eastern—LPB, ATI, QEI and CCA should march on Washington, DC. Midwest—BE/QRK, ADC and ITC could rally the heartland. And TFT, PR&E and ESE should cover the West Coast. Dealers heed the call—ABG and ABE could join BSW with a special 800 number warning!

I say, petition the NAB to get an NTIA grant to fund a one-time collaboration with the SBE, NRB and RTNDA to get the SBE to certify some SMPTE or RIAA standard to measure the problem. I know that SAG won't sit still for this one!

No, this trend has got to be stopped. PLEASE—NO MORE DAMNED INITIALS!

DB is CEO of RSD, Inc., a PA , OEM. Contact Dan Braverman at 215-356-4700.

The Future of Broadcasting: A Regulatory Perspective

by Barry Umansky

Washington DC ... As the new year begins, it's time for a brief retrospective on the radio-related decisions of the FCC, other agencies, the courts and Congress, and how these events may affect us today and in the future.

In many cases, these actions of government are not "final actions." Instead, they merely lay the foundation—or set the direction—for decisions in 1989. And based upon the events and the processes that developed this year, it's possible to make a few well-founded predictions on the future of broadcast regulation and the steps that government should—or likely will take next year.

An important time

From several perspectives, 1989 promises to be one of the most important years for broadcasting, in terms of its relationship with government and its capacity for continued competitive strength vis-a-vis other electronic media.

The philosophical driving forces behind broadcast regulation and allocations issues—such as "more is always better" and "the marketplace always is more efficient than government regulation"—will have to change markedly. If not, broadcasters will find that their vitality—individually and in the industry aggregate—will be diminished. And in the end, broadcasters and the public will be the losers.

As mandated by Congress, the 1989 FCC must ensure that the radio medium is not subjected to increasing levels of intra-industry interference. Simply jamming in more stations will not achieve any public policy goal.

The AM band is saturated; FM is not far behind. We have reached the point of diminished, if not negative, returns from adding scores of new stations to the radio marketplace.

With consumers now confronted with myriad audio alternatives—ranging from audio cassettes to CDs to DAT to the prospect of satellite audio, etc.—it is critical that broadcasters transmit the highest quality sound. Both government and broadcasters share this goal and the responsibility to achieve it.

Looking at competition

Surely there are those in government and elsewhere who will argue that steps to reduce frequency congestion in radio actually are efforts to limit "competition." But, let's look at competition.

As found in NAB's recently-completed National Radio Listening Study based on Arbitron Total Audience Listening Output data, the average radio listener has over 25 radio station options from which to choose. Even in the smallest radio "markets" at least 10 stations are available to the listener. When larger markets are considered, the number of stations mentioned in ratings diaries swells to over one hundred.

In light of this overwhelming number of choices—depicting a radio market chocked full of competing stations—now is the time for the FCC to abandon its endless quest for more and more stations. The FCC should focus, instead, on its first missions from Congress—the limiting of interference among stations and the promulgation and enforcement of effective technical standards.

At the top of the industry's agenda is the FCC's transformation of the existing license renewal process into a system where broadcasters will be given greater incentives—based upon notions of renewal expectancy—to invest more in their programming efforts and in their service to the local community.

Based upon recent ownership rule changes, radio broadcasters also should be able to use cost efficiencies to enhance their competitive potential and better serve local audiences.

In many regulatory and competitive areas, broadcasters can enjoy significant advances in 1989 and the years to come. Below are some "prognostications," grouped in several categories.

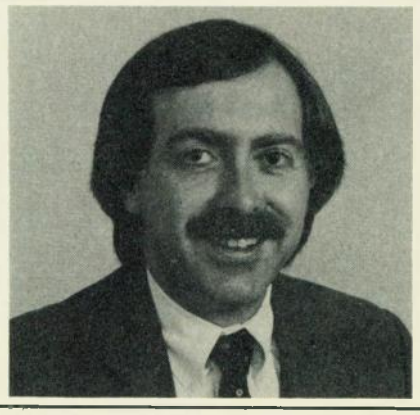
AM allocations

In 1989 the Commission will take action on a number of rule makings initiated as part of the "AM improvement process." In each of these rule makings, the Commission has the capacity to make things better—or far worse.

With continued pressure from the industry, we hope the Commission will make the right choices and adopt AM allocations policies that will bring an end to the continued "engineering in" of new stations on an already saturated band.

Adopting more realistic and effective interference protection standards will be but one part of the process. To achieve significant, positive change, the Commission also should take advantage of a unique opportunity—an opportunity hinged on AM band expansion.

With the expansion of the AM band a certainty, as a result of international agreements in 1979 and last year as well, by 1990 the Commission will be licensing new band expansion stations. Also, manufacturers will be building radio receivers capable of picking up an addi- ➤



Barry D. Umansky is deputy general Counsel of the National Association of Broadcasters. He may be contacted at 202-429-5430. The views expressed are those of the author and do not necessarily reflect those of **RW** *or the NAB.*

tional ten channels, extending the top part of the band.

Public and AM improvement benefits can be maximized if the Commission takes several important steps.

First, the FCC should adopt a "daytimer homesteading" approach for licensing much of the expanded band. Under this scenario, many existing AM daytime-only stations would be granted fulltime opportunities on the expanded AM band.

On condition that these licensees "turn off" the existing AM daytimer (at a time when band expansion receivers generally have penetrated the marketplace), other classes of AM stations on the existing band, and the public, will enjoy more interference-free radio service.

By eliminating many "daytimers" who, in recent years, have been granted presunrise, postsunset and even nighttime authority, the existing band will be less congested and the technical quality and reliability of AM service will be improved.

Second, band expansion operations should be governed by more responsible technical standards and allocations policies than those which led to the interference morass on the existing AM band. Expanded band operations should be at maximum 10 kW power, largely omnidirectional (with directional antenna "engineering in" banned) and governed by a policy against creation of *any* new daytime-only stations.

The radical concept of "national licensing" should be rejected outright—as both ill-conceived and at odds with the fundamental principles of the Communications Act.

Third, the FCC should mandate the NRSC-1 standard for AM radio (and also adopt a policy whereby meeting the NRSC-1 standard would be considered as compliance with the NRSC-2 or "RF mask" standard). By mandating NRSC compliance, the FCC will be sending a signal to broadcasters and to receiver manufacturers as well.

NAB has asked the Commission to require NRSC-1 compliance by 1 January 1990. Were this to be the case, radio receiver manufacturers would have incentive to "retool" and meet not only AM band expansion but NRSC conversion as well. What's more, radio receiver manufacturers choosing to retool for NRSC and AM band expansion likely would include AM stereo as part of the process.

The end result, of course, would be a new generation of "super AM" receivers, a revitalization of AM broadcasting and the provision of higher quality sound to the American consumer. These goals need not be achieved through significant government intervention. All that is needed is a government "catalyst" to set in motion a series of AM improvement steps by broadcasters and radio manufacturers.

The future for daytimers

What about AM daytimers? Well, using today's technology, additional power and increased hours of operation would seem to run counter to the concepts of reduced technical interference.

But there are several ways that AM daytimers could obtain future benefits. Aside from the concept of daytimers homesteading a good portion of the expanded AM band, the Commission could encourage even more daytimers to leave the existing AM band if the current "daytimers' preference" for FM allocations were modified.

By changing the "same city" requirement to one which would grant daytimers a preference if the proposed FM station were to be within the daytimer's principle community contour, daytimers, fulltimers and the public would benefit.

For daytimers with relatively low PSSA and/or nighttime power, the NAB-supported FCC rule making on "low profile" antennas should offer some relief—perhaps as early as mid-1989. Here daytimers would be able to use an ➤

alternate transmitter during evening and nighttime hours—at sites geographically closer to the potential audience.

Also, with the use of new skywave-reducing antenna designs (based on NAB's forthcoming antenna experiments in the Washington area) some daytimers may actually be able to increase hours and/or power and meet not only today's technical standards, but also the more stringent ones which must be imposed soon to ensure reduced technical interference.

FM allocations

So that FM does not suffer the same technical degradation and band congestion which have plagued AM, the NAB must insist that all future Commission FM allocations actions be based on notions of reasoned decision making and spectrum integrity.

For example, while NAB strongly supports the concept of Class A FM station upgrades, it is critical that such upgrades are only undertaken where they can be accomplished with minimal additional interference to the band. Class A upgrades must meet a reasonable set of mileage separations, based on sound technical standards.

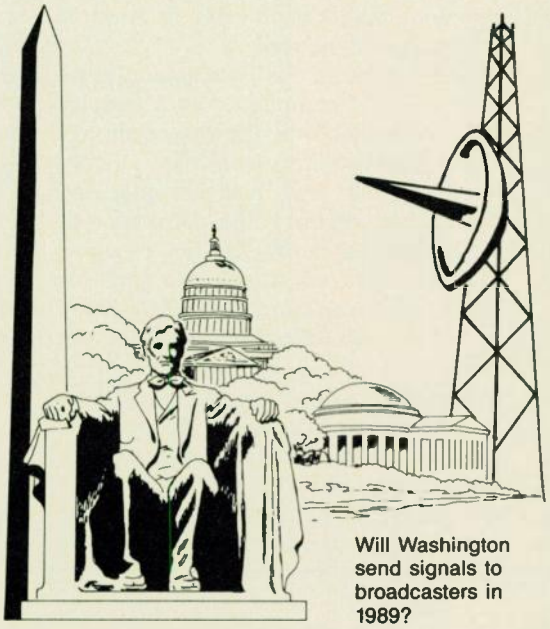
Those who advance a policy of simply increasing all Class A stations must consider the consequences of such a policy, especially as it might be applied elsewhere. The result, NAB believes, would be interference chaos and a repeat of the AM pattern.

Another factor which led to the diminished technical quality of AM radio was the rampant use of directional antennas. Now, incredibly, the Commission is taking steps to use these same techniques in FM. While 1989 may see some FCC-approved use of FM DAs to modify antenna sites, etc., the industry must take a unified stand against the use of directional antennas as station allocation tools.

In NAB's view, perhaps the most significant near-term threat to FM, indeed to all radio broadcasting, is the virtually unrestrained growth of FM translators and the current FCC proposals to create what, in effect, would be a new "low power FM" service.

While the Commission has started a proceeding based upon NAB's call for an end of translator abuses and a return of this service to its original purposes, make no mistake—the FCC also has plans to legitimize these translator misuses and to establish a new radio service based on translator technology.

Though subject to petitions for reconsideration, filed by NAB, NPR and others, the FCC already has changed its rules to allow noncommercial FM translators to use space satellite and microwave feeds. The same—even more—is now proposed for all FM translators and their progeny.



Will Washington send signals to broadcasters in 1989?

The 1989 FCC cannot be allowed to abandon all notions of technical integrity, reasoned allocations policy and local service when it comes to FM translators. It must not authorize low power FM, but instead must shore up its translator rules and put an end to the misuse of a secondary, supplementary radio service.

Other prospects—good and bad

As we move into the new year, there are several other opportunities and challenges facing broadcasters. In most of these areas, broadcasters ultimately will be the winners.

One area where broadcasters already are winners resulted from an act of Congress allowing the broadcast advertising of most gaming activities on Indian reservations—a multimillion dollar industry. Even more importantly, broadcasters can anticipate taking advantage of a related Congressional act, effective May, 1990, whereby stations can advertise most other lawful lotteries, including sweepstakes, raffles, church bingo, etc.

Absent state restrictions (which are not preempted by the federal law change), broadcasters should see new revenue options, opportunities for new station promotions and greater cooperation with civic groups and others who use "lotteries" for fund raising.

Environmental impact on radio

In 1989, the Environmental Protection Agency will be a critical battleground for radio broadcasters and all other users of the electromagnetic spectrum.

For years communications industries have sought a federal standard—issued by the "expert" agency—for human exposure to nonionizing, radiofrequency (RF) energy. We are now faced with a myriad of varying and often irrationally restrictive non-federal standards (e.g., construction moratoria, zoning restrictions and health standards).

A uniform and, ideally, preemptive federal standard is essential to continued provision and orderly expansion of public service by broadcasters and others who use the airwaves.

Despite the fact that it is now in the position to adopt such a standard following years of study, public hearings, the gathering of a complete and scientifically-based record and the expenditure of untold federal resources, the EPA has proposed to shut down its nonionizing radiation program without the adoption of a standard.

The coming year must see a reversal of this EPA decision and a recognition by the EPA, the Administration and Congress that EPA standard-setting will result in a net reduction in regulation and a greater degree of scientific certainty and safety for communications companies and the public.

Without a doubt, 1989 will require some hard choices by both broadcasters and the government. But with responsible governmental decision making that supports the fundamental tenets of spectrum integrity and local service, radio broadcasters can look forward to new successes next year and in the years to follow.

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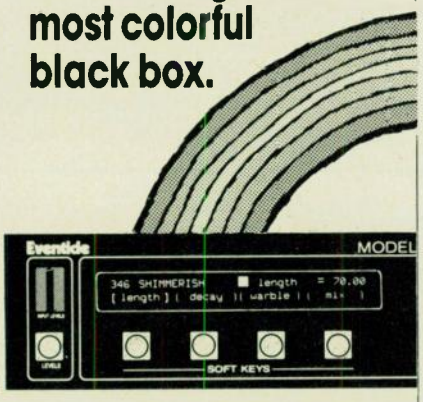

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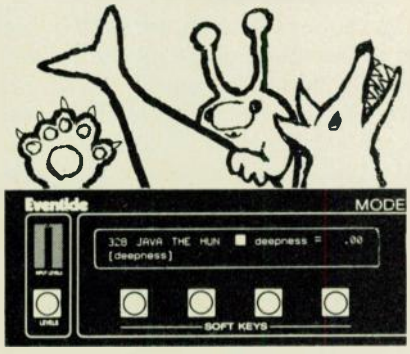

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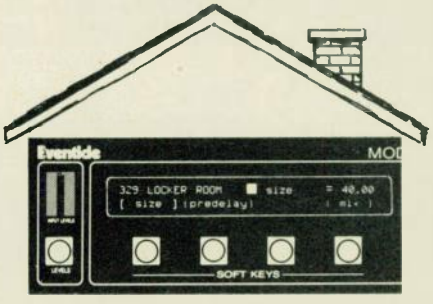

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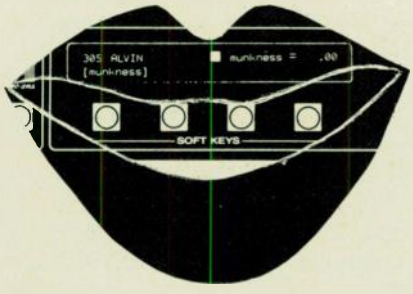

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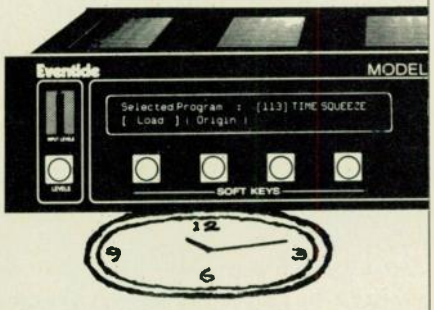

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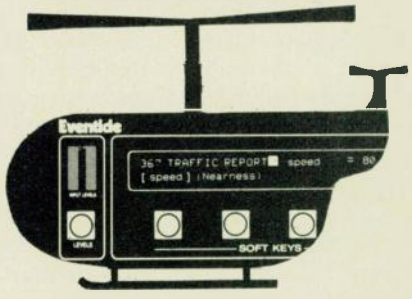

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Circle 56 On Reader Service Card

Station Buying Trends Establish New Equipment Priorities

by Geoffrey Mendenhall

I believe the majority of today's radio broadcasters/owners have a new set of priorities for their equipment needs.

What was once a highly technical, innovative and sometimes even experimental era of radio broadcast engineering has evolved into today's less technical, simplified lower risk engineering function.

I have seen changes in equipment selection priorities that reflect a deemphasis in the engineering aspects of the operation and new emphasis on lower cost, highly reliable equipment. Here is how I see the new priorities.

Reliability, quality and price

Reliability has always been important to broadcasters, because when you're off the air, you're effectively out of business. But today reliability is even more important, because many broadcasters no longer have a technically qualified, full-time chief engineer to do preventative maintenance.

Today's broadcaster expects broadcast equipment to perform like an appliance—plug it in, turn it on, and it should run reliably without attention for years. We equipment manufacturers must strive to design and create products with this kind of reliability and durability.

Of course, product quality is reflected in reliability, but there are other aspects of quality not related to reliability. Quality also relates to the seviceability, durability and whether the equipment consistently meets all of its performance specifications.

In addition, a lower price with greater value has become more important to today's "bottom line" oriented radio broadcaster. I believe price is now more important than the technical performance specifications and features are to most medium to small market broadcasters.

As long as the performance of the equipment is "good enough," most broadcasters are unwilling to pay for a few extra decibels in performance or a few extra nice but nonessential features.

Operational features

Operational features are very important to the ability of the product to conveniently fulfill the customer's needs, but there is a critical tradeoff between price, reliability and the number of operational features incorporated into the product.

Often reliability is compromised by adding too many features which increase the complexity of the product.

As for technical performance, networks, large group owners and some major market stations are still interested in, and are willing to pay for, the latest high performance equipment. The majority of broadcasters, however, are not as interested as they once were in paying a premium for better signal-to-noise ratio or less distortion.

Of course, everyone wants the best possible performance specifications—*if* the cost is the same or less than the competitive products.

Fortunately, the cost of many electronic functions has been coming down due to large scale integration and other new technologies. Clever and innovative circuit designs that take advantage of the latest technologies will often allow improved performance at lower cost.

New product areas

In the realm of new products, FM boosters promise great benefits for some broadcasters, but broadcasters and consultants alike must be careful about misapplication and overselling of booster technology.

Broadcast Electronics' extensive research in the laboratory as well as in the field has highlighted several important considerations about the application of FM boosters.

For example, the addition of a booster is not a cure for multipath. It will only move the problem somewhere else, and may create more interference than it will fix.

Every booster installation will create interference zones where the signal strength is nearly equal to the main signal. Frequency and phase locking does not eliminate these interference zones for mobile receivers, because as the vehicle moves through these interference zones, the equal level signals alternately go through constructive and destructive interference.

... the trend in future audio mixing and switching requirements will be met by computer assisted systems.

The width of interference zones is difficult to accurately predict, but in general, the better the degree of natural shielding—such as a mountain—the smaller will be the area of interference.

Digital replacement for cart machines

The digital replacement for the analog tape cartridge machine has not yet arrived. I believe that ultimately, broadcasters want a mass storage system for all their audio source needs. Such a system must be affordable, ultra-reliable and random access, with no moving parts.

The transition from analog tape to mass storage will evolve in several steps. The first step utilizes conventional hard disk computer hardware and is already available in several products. Hard disk systems do, however, suffer from high cost and limited storage capacity.

Simultaneously, the first products utilizing more desirable solid state RAM ➤

Geoffrey Mendenhall is vice president of engineering for Broadcast Electronics, Inc. He can be reached at 217-224-9600.

storage have appeared on the market, but are limited in bandwidth and recording time by their limited storage capability. Advances in higher density solid state storage devices will make these products more competitive in performance.

I have not mentioned R-DAT or S-DAT digital tape systems as part of the transition to digital storage, because digital tape systems fail to meet broadcasters' needs in several key areas.

Tape systems can be random selection, but are not capable of random access because they use longitudinal tape rather than disk media. Rotary head systems were designed for light duty consumer use and do not hold up under continuous broadcast use.

Both rotary and stationary digital tape systems suffer from high speed tape to head physical contact which causes accelerated wear and relatively short operating life of the heads and media.

Optical disc record/play systems are much more attractive for broadcast audio applications, because they are random access, higher density and eliminate physical contact with the media. Optical record/play systems similar to the presently available CD playback-only systems will begin to replace tape cartridge systems within a few years.

Meanwhile, the latest analog tape cartridge technology will continue to offer the broadcaster the biggest bang for the buck. Their level of performance is quite adequate for spots, jingles, promos, news and even music in most situations.

Computerized audio

I believe the trend in future audio mixing and switching requirements will be met by computer assisted systems. There is no longer any need for audio to pass throught the switches and faders or an audio console that the operator manipulates.

The audio console as we know it today will be replaced by computer controlled analog audio and, eventually, full digital audio switching systems.

Already there are several PC-based systems on the market that are moving in this direction, but the operator interface is far from being optimized. A computer assisted replacement for the conventional audio console meshes well with the concept of digital mass storage of all the audio source requirements.

The successful introduction and acceptance of the compact disc (CD) as today's major music source will stimulate higher technical standards for the delivery of this quality to the listener.

Analog transmission systems and receivers currently available are not fully capable of delivering the CD quality to the listener. Although the best analog FM modulation schemes can match CD performance with S/N ratios greater than 90 dB and distortion less than 0.01%, the currently available STLs and consumer receivers are about 20 dB below this standard.

The first meaningful step in digital FM transmission will be digital encoding at the source and transmission of programming from the studio to the transmitter in the digital domain with direct conversion from the digital domain to RF at the transmitters.

Such a system would still be compatible with the current FM transmission standards and could provide a signal with CD quality to the receiver, but much of this quality will be lost in the narrow IF bandwidth used in most consumer receivers.

True "digital quality" will have to wait for a new FM band with new transmission standards that permit transmission of a digital bit stream to the receiver where D-to-A conversion will occur.

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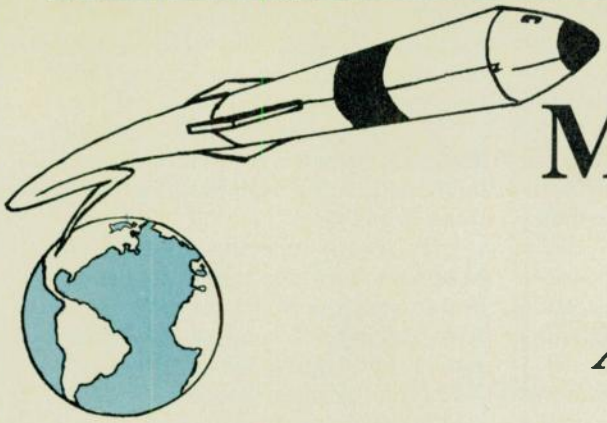

Martian Chronicles Revisited:

A Science Fiction Parable

by Barry Mishkind

It was one of those clear, crisp, fall evenings that makes life special on the Arizona desert. Mars was making its closest approach towards the Earth in many years and was easily visible as a huge red orb in the sky.

So it was that, after dinner, we sat on the patio staring out at the stars.

Our topic of conversation centered on our profession as radio engineers: the state of the industry, where things stand, where the new engineers might come from, and what we can expect in the future.

Staring at the stars, I drifted off into my thoughts, wondering how the radio industry might exist on an inhabited Mars.

And then, as I watched, Mars seemed to be getting larger and larger, and I suddenly realized that some unknown force was pulling me across the void. Presently, I found myself deposited on the surface of that red world, looking back at the Earth, many millions of miles distant.

The first encounter

Looking around, I found myself near one of the canals. At first, that seemed fortunate, for the deserts of Mars were just as arid as in Arizona. Water might be handy.

But then, I noticed something about the "canals"—they seemed to have a magnetic effect, and weren't water conduits at all.

Approaching a large round building near the intersection of two "canals," I knocked on the ancient door. With little delay, the door opened, revealing a short, copper skinned man.

Although I couldn't understand him at first, he switched languages and began speaking to me in English, for somehow he recognized me as an Earthman.

Then I noticed the little screwdriver in his plastic pocket protector. He explained that he was, in fact, an apprentice radio engineer, working for a Martian radio station.

We spent the next day and a half talking about radio on Mars and on Earth, for it developed that the Martian had gotten his language skills from monitoring our transmissions. We each had questions for the other, the "whys" of how our worlds used radio.

The canals that weren't

The first surprise came when I found out why this fellow was alone out on the Martian desert. Evets Anad, as he introduced himself, was in charge of a regional broadcast station.

Quickly, he followed up with information that left me reeling. The "canals" were never designed for water, they were in reality cunningly designed directional antennas, the results of an attempt to reach the thinly spread population of Mars.

Evets then explained that on Mars, there were two services, MA and MF radio, regulated by the Martian Communications Commission.

The MCC, though, had followed the lead of the Chairman, Yar Notslaw, and over the years deregulated the industry and allowed the Martian Association of Broadcasters to police themselves.

Thus, it came about that when Evets Anad wanted to enter the broadcasting business, he was required to spend ten years as an apprentice out at the desert transmission site.

According to the station policy, Evets was paid no money, but was given a furnished trailer and meals traded out at the local Pizza Hill franchise. (There are no Huts on Mars except Jabba the . . .)

Training is rigorous, as the MCC enforces its few laws vigorously: Martian radio inspectors are told to check station operating logs, and kill any unlicensed operators. Those failing to accurately log power readings and tower light observations are merely maimed.

After ten years, Evets could expect to be certified, and be permitted to work for any station on Mars.

However, the MAB had convinced the MCC that fulltime engineers were merely a financial drain. So, Evets said that the best he could hope for was a barter business as a contract engineer, getting paid a rate fixed by the MAB as the equivalent of 75 US dollars per month. But he could now expect fried chicken in addition to the pizza.

Technology update

The reasons we Earthlings have not picked up the Martian broadcasts was explained by their mode of transmission. All RF is broadcast on triple sideband, suppressed carriers, coupled to the antenna by nuclear technology.

All MA stations are permitted 30 Krads of power, roughly equivalent to 100 kW. MF stations are restricted to .074 Krad, or 246.67 watts. As far as I could determine, that was the MCC's method of equalizing audience shares for the two services.

Evets told me there had been a long steady erosion of listeners from MA to MF radio, leaving just old people listening to MA radio stations playing "Music Of Your Canals" and Martian talk ➤

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shows, such as Ekim Noskcaj, Hsur Hguabmil, and Yrral Gnik.

At first, the MAB tried a more direct approach to audience erosion control. Appropriate for a world ruled by the God of War, after the Martian ratings services put out the ratings, the MAers hired hit gangs to assassinate 10% of the MFers listeners. (Quiet! This is a no smirking section!)

As this led to reprisals, with MFer hit teams and old age taking out even more MA listeners, the MF power reduction compromise was made, to the advantage of MAers.

Standards?

Due to a secretary's transcription error of an earthly broadcast, all records on Mars play at a speed of 39.3 RPM. However, this allows the operation of a special copy code notch on its center frequency of 2.5 kHz. (Tape recorders, if not sensing the special tone, replace notched material with a special version of Danke Schoen by Wayne Newton, stored in ROM.)

Meanwhile, the MAB lobbied for a special tax of M$7.50 on each radio receiver. This would fund an industry committee which would research ways to improve MA reception.

Apparently it also pays for a lot of MAB luncheons, not to mention the semi-annual trip to the Valley D'Or, the last remaining body of water on Mars. The resort atmosphere doesn't contribute much to improving the radio industry, but it does wonders for the board members' tans.

The committee has been meeting regularly for 35 years. It releases its latest study each autumn, and then starts another. Some committee members haven't even been in a radio station for over 10 years.

One of the committee's proposals, a preemphasis curve, was designed to provide a boost of 22.4 dB at 2.5 kHz. This was said to provide better clarity for shower radios, and as a side effect defeated the copy notch.

Unfortunately, the MRSC-2,3F4,000,000 curve was rejected by broadcasters who were unwilling to use the specified decoder, a digitized version of a stereo ice tea recipe developed by Trebor Senoj and Nor Nabro.

Instead, the marketplace favored Eoj Sdnas' variation of a phase amplified poly polar dissipator. However, this resulted in such extreme audio clipping that the alleyways behind the stations began to be filled with leftover peaks.

The favorite audio processor, designed by a program director with some engineering experience, used frequency shifting and shaping to put all audio in the form of quasi square waves between 2 and 3 kHz. Harmonic distortion reached 42% as time spent listening dipped to 12 seconds.

Overall, Evets explained that there was too little cooperation among those in the industry. MA Radio was slowly dying. Many ideas had been advanced as to what could be done. But no one wanted to give up a single percent of modulation or a Martian penny to get things rolling.

I asked why, if he felt so strongly, didn't he file an application with the MCC, start his own station, and lead by example?

He replied sadly that MCC policies made it very difficult for the copper man to get a construction permit. In fact, he said, the entire application process was dangerous to the unwary.

According to the Rules and Regulations of the MCC, the racial minorities of green, purple, and orange people were given high preferences for any new stations.

What then happened, Evets explained, was that these minority applicants always seemed to sell their new stations within a few months, becoming instant Martian millionaires.

Meanwhile the MCC, frustrated by pressure from lobbyists stating that the number of minority owned stations was not increasing, decided to try again to find a way to implement their policy.

Now, whenever there are two or more applicants, the competing applications are resolved by utilizing poison dart guns at 50 paces. (While this has cut down on the number of speculative applications, it has also put Evets off any idea of applying himself.)

The MAB show

Every autumn there is a huge trade show for the Martian broadcasters. The MAB conventions are held in the city of Mas Vegas. The radio hotel is the Marsmark.

However, hospitality suites have become too expensive for many manufacturers. Instead, delegates go to the ballroom on sub-level 42 and talk while dancing. Except those in the no smirking zone.

The MAB lobbies the MCC to deregulate the industry on the model of the Italian Broadcasting system—that is, anything goes.

The current lobbying effort among MAB members is to have a new regulation to start the Martian broadcast day with the school song of the nearest school, and the Pledge of Alliance.

Another proposal is to lobby the MCC for the right to self regulate program content, as a survey of 364 program directors found 93.5% considered news or public affairs programs a waste of time that prevented more cash giveaway contests between the top 5.2 records.

Acting as a watchdog on the MAB activities is the premier publication on Mars, Radio Globe Newspaper. Its editor, Htiduj Ssorg (you have gotten the hang of this by now, haven't you?), zealously makes suggestions to the industry, trying to fill in all the space between the ads with the names of strange cities.

Could it have all been a dream? Or, was broadcasting, Martian style, a nightmare?

Evets told me he wanted to write to Radio Globe, and have his ideas to improve broadcasting published. However, the editor demanded he supply airplane tickets to the capitol of Ecnarf as compensation. Since all Evets had were pizza coupons, he is still an unpublished author.

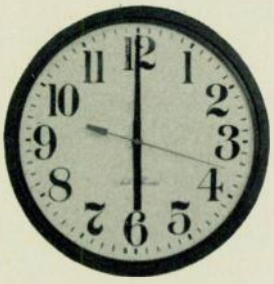
He started to read to me some of the Radio Globe editorials. But since they were in Martian, I couldn't understand a word, and found myself drifting off to sleep.

Upon awakening, I found myself back on my patio, still staring at Mars, as it fell towards the horizon. Could it have all been a dream? Or, was broadcasting, Martian style, a nightmare? I couldn't be sure for a long time. But then, I found a small bumper sticker in my pocket.

It was for Hit Rokken, Star Radio FA9C.

Shivers went down my spine . . .

America's Full-Time Broadcast Supplier



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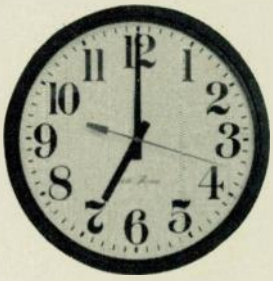
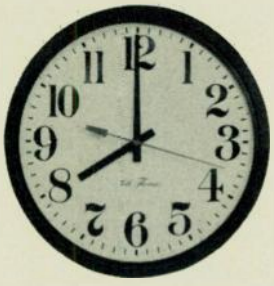
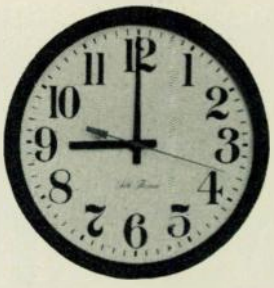
Pacific



7:00-7:00
Mountain



8:00-8:00
Central



9:00-9:00
Eastern

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So we decided to work overtime every day of the week. 12 hours a day, there is a qualified sales engineer on duty who knows your business and your needs. And there's only one number you need to know — toll free across America. BSW's commitment to service is why we're America's full-time broadcast supplier.

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Circle 13 On Reader Service Card

Welcome, Students

by Richard Rudman

The History of Broadcasting class was held in one of UCLA's Post Great Quake buildings, Huntz Hall. While many college classes in the year 2020 are taught via two-way cable, colleges still feel the need to get students in classroom settings for a few courses. Call it tradition.

Broadcasting was one of the key social institutions used by social researchers to measure culture in 2020. It was both a mirror and thermometer. *Introduction to Broadcasting* was a *very* required course for anyone entering the social sciences.

In the fall of 2020, 30 years after the Great Los Angeles Quake, Los Angeles had been redesigned and rebuilt literally from the ground up. The first six months after the Quake were total chaos. Sixty percent of all businesses, including radio and TV broadcasting, went under in those dark months.

Like the South after the Civil War of the 19th century, outsiders poured in with money and advice on how to rebuild. After the injured and fearful sold out at a loss and left, those who remained were on the ground floor of a genuine boom.

"Class," began the Professor, "While I have never actually worked in a broadcast station, I have studied this art all my academic life."

"Some things never change," muttered a blonde surfer type in the 25th row. Her friend nodded in agreement.

Remembering the 1980s

"Things were just starting to really change in radio in Los Angeles in the '80s. That process continued. The Reagan Adminis- ➤

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tration FCC had instituted deregulation. Modern political analysts view that process as a misinterpretation of a widely held economic theory of the Chicago School of Economics marketplace model.

"The so-called marketplace model, applied to broadcasting, helped lead to the Dark Age of AM Radio. As history has shown, the economists of the Chicago School never meant their theory to apply to a model of a scarce natural resource like the broadcast spectrum.

"But by the time everyone realized what was happening, it was too late," the Professor said. "The damage had been done."

"I am getting ahead of myself. Economic forces had already led to marked decreases in the size of technical departments in most radio stations by 1985. Technology fueled the process.

"Some stations and owners used technology to cut costs. Others, a small number, put some of their savings back into their facilities and programming. Still others, victims of what I call the "Crazy Years," were too busy paying debt service on inflated station prices to do much of anything except tread water to postpone inevitable financial drowning.

The spread of the plague

The Professor continued. "By 1993, there were ten major group radio station operators in the US. Of these, General Westinghouse was the largest, followed by Emmis, The Church of the Latter Day Dial, MTV and Radio Bingo.

"Two giant corporations, GE and Westinghouse, launched their successful merger in 1991 with a new advertising slogan, 'Progress is our most important byproduct.' If you want more information on what led to that merger and why the Federal Government let it go through, you should take my *Intro to Cartels: The Visible Hand in the Marketplace* class next spring.

"At any rate," he said, "MTV saw an opportunity to win the driving public. They began to buy bankrupt FM stations in the Southwest after the Great Quake in 1990. They added to their chain over the years by buying up stations all over the country about to go dark.

"Many entrepreneurs in other parts of the country stepped in to purchase failing businesses of all types in the Southwest right after the Quake."

"Other factors were at work that hurt broadcasting. The FCC adopted a plan by 1990 that allowed stations wanting greater interference protection to purchase it from other stations on co- and adjacent channels. Though the FCC said they would remain the final arbiter of the public interest, that did not stop several large broadcasters from, as commented a consumer advocate of the time, Ralph Nader, 'strip mining the AM band.'

"The broadcasting industry's voluntary NRSC standard that was supposed to clean up the AM band was too little and too late. Most conscientious operators complied with the standard. Its promise to dramatically decrease second adjacent channel interference was kept in many instances. Unfortunately, other forms of serious interference were not addressed until much later; too late in the minds of many AM broadcasters of the era.

"Most significant of these were the steps that finally had to be taken to deal with interference from co-channel to the sixth adjacent channel. These harsh but necessary steps involved banning the import of foreign car and home AM radios that did not meet the 'Five Volt Test.'

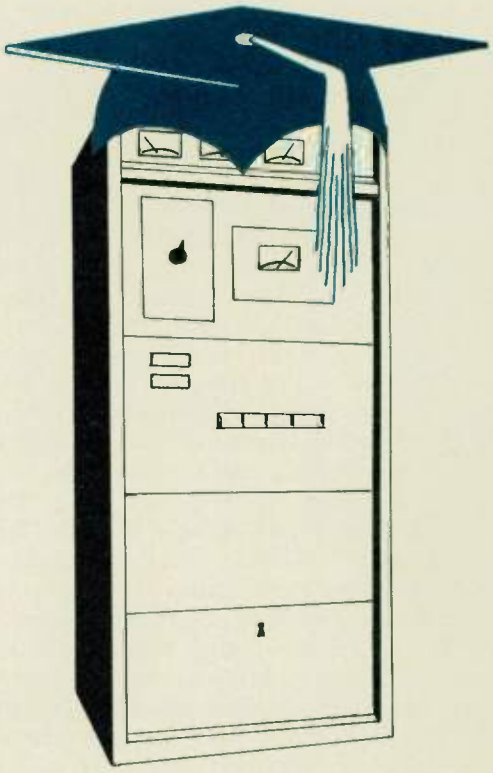
"As some of you technically-minded students know, this test involves coupling a test generator with a five volt signal tuned to a fifth adjacent channel to a car antenna. If a radio could not pass this test, it could not be sold legally in this country.

"Unfortunately," the Professor noted, "millions of cars on the road since the early '80s—many luxury class—were equipped with car radios that could never come close to passing that test. Los Angeles stations regularly received reports from irate listeners who lost their favorite stations ten miles and five channels away from high power AMs. Documented reports from Philadelphia and New York support this phenomenon.

"Motorola had a receiver chip on the market by 1988 that solved the problem technically. It came too late for many broadcasters. The arrival of the NRSC-approved Splatter Monitor in 1989 only raised the frustration and blood pressure of broadcasters who dutifully took measurements and were made ill by the results."

"A number of very poorly engineered stations were identified. Some were cleaned up when broadcasters suffering at their hands put up the cash. Others did nothing to clean up their signals, and were allowed to get away with it because NRSC standards were voluntary.

"Some creative engineers had ideas for so-called 'noise-free AM,'" he said.



"Since all of them required cooperation from uncooperative off-shore receiver manufacturers, they were doomed to failure. One attempt to form a cooperative research and development entity to look at this and other plans almost got off the ground. The Great Quake leveled the building in San Diego where the laboratory was housed.

"FM stations came into their own in the '80s, and benefitted from the public's increased awareness and demand for high quality audio. This demand, fueled by stereo TV, CDs and inexpensive optical magnetic read/write storage of sound (OPMAG), pictures and computer data, left AM ultimately to All News, some sports and talk shows, religion and Radio Bingo.

"Bingo and lotteries were legalized for ➤

broadcasting in 1994; the very last paragraphs in the FCC's Part 73 had to be totally eliminated.

"National EBS had been taken off the books in 1993. The SALT XXXV talks barred all nuclear weapons and dictated that all wars were to be fought by politicians, not soldiers.

"Always looking for technology to help cut costs, All News stations survived the Dark Days with real-time computer voice synthesis. The IBM/Harris Cronkite II Broadcast Synthesizer could do 1400 different voices, each tailored to day part and story type. The estates of the great voices of the first half century of radio cashed in on a licensing bonanza."

Homogenization

"Music stations changed, but true to trends firmly established in the 1960s, they changed by becoming more alike. At last count there were 1932 stations using a voice license of Gary Owens as their 24 hour DJ, followed closely by 1545 stations using Cousin Bruce Morrow.

"Satellite-distributed formats fell by the wayside when it became less expensive to distribute a 10,000 song music library on five OPMAG disks or a single high density GASFET digital information chip. Any station could have the music for any format in-house at all times.

"All a format change required was filling out an on-line copyright agreement and reprogramming the OPMAG computer. Some stations changed formats monthly until they went broke.

"DJ not right for the new format? Firing became a thing of the past when DJs lived only in silicon and on disks. The job vocation of Program Director disappeared. In their place rose a small cadre of research people using CRAY 5 computers.

"Inside stations, things changed too. Audio consoles disappeared. They were replaced with varying sizes of crosspoint switchers with active VCAs. These switchers were hooked to all types of control panels and computer terminals. Someone even wired one to the shell of an old RCA rotary pot board to humor an aging LA disc jockey who never quite adapted to slide faders."

The vanishing profession

The Professor paused, then added, "This and other technical events marked the end of the broadcast engineer. Computer controlled equipment made it possible to build double and triple redundant studio equipment that diagnosed itself, switching in spare parts automatically.

"Borrowed from computer-controlled telephone switches that became popular in the late '70s and early '80s, this technology spelled the end of the traditional broadcast engineer. Those that survive in that venerable profession today are usually members of large service companies or consulting firms, some owned by giants like General Westinghouse.

"Where staff engineers are still employed, they spend most of their time as computer specialists. Their skills still have to include RF, but not as much as everyone thought. As one former Society of Broadcast Engineers President said in 1987, 'It will be quite some time, if ever, until they can microminiaturize a two tower DA.'

"It took until 2025 to happen, but technology ultimately proved him wrong.

"When telephone companies were allowed to run fiber optics into America's homes, this marked the end for on-air television and many cable operations which really couldn't deliver clean, ghost-free pictures, anyway. The spectrum for channels 2-83 was eventually given to land mobile, police dapartments and the computer industry for wireless local area networks.

Music stations changed, but true to trends firmly established in the 1960s, they changed by becoming more alike.

"Broadcasting retained some spectrum for high quality video and aural remote pickup to feed the hungry appetite of the fiber optic cable; FM, which survived because it was still not possible to run fiber to moving individual automobiles; certain outlying communities and the growing space colony in orbit at the L5 point between the Earth and the Moon."

Heroes and survivors

"The National Association of Broadcasters ultimately merged with the NCTA and several of the telephone industry groups to form the National Association of Telecommunications Utilization and Resources. The acronym for this group, NATURE, is a household word today.

"A footnote to broadcast advertising history is the name of the consumer telecommunications watchdog group SERUTAN (Salvage Every Resource Until Telecommunications Attains Normalcy). Their leaders vow a return to the 'Good Old Days,' saying, and I quote, 'Big Business has digested broadcasting until all that is left are gas pains. We want to administer a good dose of medicine and make the industry feel good again.'

"The SBE survived, but only after an attempt by the IEEE to absorb it, much as the IEEE did indeed absorb the old Institute of Radio Engineers (IRE) in the early '60s.

"Car radio survived, but not without some anxious moments, and not in its 20th Century form. The growing number of cities choking in their own traffic volume continued to help radio, especially FM. They provided a captive audience with little else to do but sit in traffic jams.

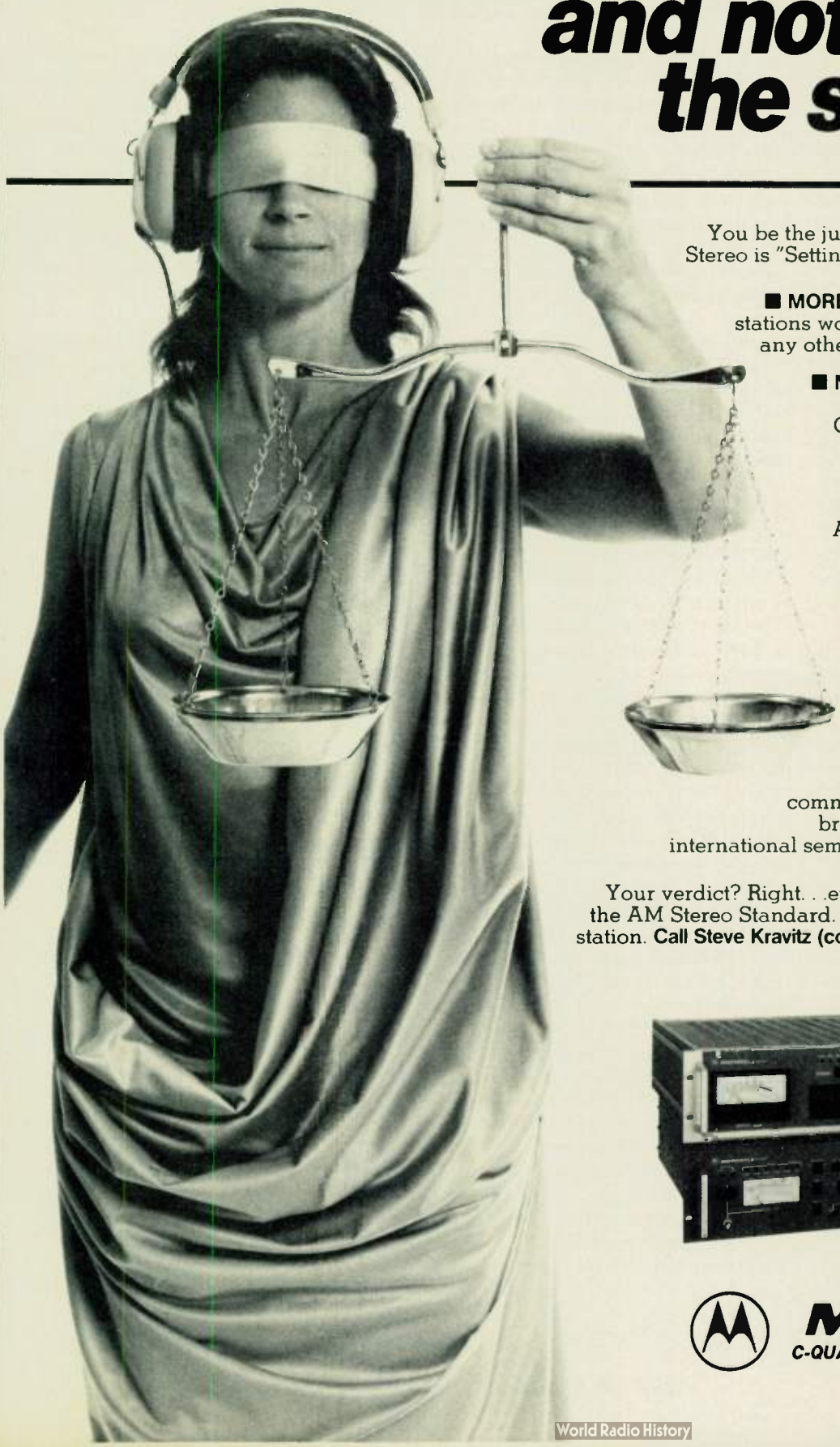
"When Los Angeles was rebuilt after the Great Quake, with legislatively mandated public transportation, the radio broadcast lobby was able to make sure that every seat in the Magnetic Busses had a minijack and selector switch for stations in the market—the so-called All Channel Seat.

"Since the Radio Bailout Bill passed in 1996, basing the number of stations any market could have on a complex GNP formula, a guaranteed captive audience could plug their personal sound systems into the minijacks on public transport vehicles and choose their entertainment based on programming, not signal strength. Wideband RF distribution coax, buried deep inside the magnetic levitation tracks that criss-crossed Los Angeles, made sure of that."

The Professor ended the lecture scant seconds before the chime announced the conclusion of the class. As the students filed out of the room, the blonde surfer girl stopped at the lectern and looked at the Professor with new found respect.

The janitor entered the room. He walked quickly to the lectern. Reaching past the girl, he turned off the small switch under the Professor's 36-inch high definition screen.

C-QUAM® AM Stereo . . . setting the whole standard and nothing but the standard.



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Model 1400 Exciter

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The Challenge of a New Age in Radio

A Fanciful Trip Through An Ambitious Radio Station of the Not-So-Distant Future

by John Shepler

Bill Collins was somewhat apprehensive as he approached the front door of the station. It had been 10 years since he retired as chief engineer and handed the shop keys over to his son. Why, it had been nearly that long since he had last seen Todd. "I wonder if he'll even recognize his old man," he mused.

Bill soon found that his fears were unwarranted.

"Dad, I'm so glad you made it." The younger man nearly flew out the doorway and flung his arms around his father. "Come on in and see what you think of the station."

Bill had two things in mind for this trip. His official reason was to attend the NAB convention the next day and catch up on the industry. That was exciting, but not nearly as much as seeing how his boy was making out.

"Still got the Gates *Yard*?"

"Ah, well, Dad ... you're going to see a few changes here." Todd had a bit of a twinkle in his eye.

A peek into production

Their first stop appeared to be a rather small production studio. As Bill poked his head in, he could see a couple of mics, but not the big Ampex reel recorders he had installed long ago.

In fact, the room looked pretty sparse—just an "L"-shaped desk with a computer screen, some other computer equipment on the floor and a compact disc player on a shelf to the side. Something besides recorders also seemed to be missing.

"No board?"

"It's in the computer."

Bill shook his head. "You'll have to explain that one, son."

Todd was only too happy to show off for his father. He tapped the space bar on the keyboard and the CRT lit up with pictures. "Let's make a commercial!"

Todd worked the mouse and brought up a picture of a control board. He passed some copy to Bill, then pointed at the microphone. Bill wasn't too sure what was going on, but figured he'd have to play along if he was going to find out.

Todd tapped the mouse again and motioned to Bill, who took a breath and read the copy, cold. It wasn't a very smooth job. Bill was out of practice, and the pictures of the scope waveform and animated VU meter on the screen were just too intriguing. He caught himself pausing a number of times to eyeball the system.

Finished with the read, Bill watched as Todd worked the computer.

Commercials by computer

"OK, Dad, your voice track was just recorded onto hard disk," Todd said. "The mic is plugged directly into a DSP or digital processing board which is a preamp and an A-to-D converter, along with some other digital chips.

"This picture of the control board works just like the real thing. I can adjust the level by pointing at the pots and moving the knobs up and down on the screen like this."

Todd clicked to the next picture which had the waveform scope, a VU meter and a scale that looked like a piece of recording tape laid flat across the screen. It had numbers underneath, like a ruler. At the bottom of the screen were buttons with familiar legends such as Play, Fast Forward, Rewind, Stop, as well as two labeled Cut and Splice.

When he activated the play button, the voice track replayed, just like a recording. The VU meter wagged back and forth, the scope showed a voice waveform and a pattern moved across the tape as it played back.

"Sounds pretty good, Todd. Is this, then, the long awaited replacement for tape and cartridge recorders?"

"Oh, much, much more. Watch what I can do."

Todd worked the keyboard and mouse like a musician. He sped up the voice track and slowed it down. He kept the timing constant while varying the pitch from a low growl to a high falsetto. Bill chuckled at that, becoming less intimidated with this strange equipment as it entertained him.

Next, Todd called up a screen full of small pictures. There was a river, a car, a group of people, various animals and so on. He selected the river and moved it over the second pot on the board. Instantly, the sound of a babbling brook was mixed in as a background.

"I've got several hundred sound effects and even more musical beds," Todd said.

"Sounds very lifelike, considering it's a computer."

"Oh, these are digital samples, Dad. They will sound exactly like the original because they are real recordings. Stereo, too. In fact, we're talking CD quality on the entire system."

"Oh, I see. You record your spots and music on CDs and use them instead of carts in the control room. Pretty fancy, Son."

"Uh ... well, almost, Dad. Actually the control room is a bit different than you think. For instance ... oh, let's go over and I'll show you."

Next stop, control room

Across the hall were two small rooms with a double-pane window between them. The one that was dark had a couple of mic stands, a table with two chairs and acoustic foam on the walls.

They walked into the other, which was the control room. Bill guessed it was about eight feet square. Inside there was a computer setup like the one in the production studio and a short rack with some equipment that he didn't recognize. Once again, there was no board, meters, tape decks or anything that would indicate this was radio station equipment.

Todd reached over for the keyboard and tapped on a key that had a schematic symbol of a loudspeaker. The monitor volume came up to a comforta- ➤

John Shepler is an engineering manager, broadcast consultant, writer and regular **RW** *columnist. He can be reached at 815-654-0145.*

ble level. The fidelity and separation sounded fantastic to the retired engineer, who hadn't listened closely to a studio monitor since he had installed a pair of Altec *Voice of the Theater* speakers over 10 years ago.

The music wasn't quite to Bill's taste, but it sure sounded good. The flutes had a strong presence and the ocean in the background sounded as if it was lapping up on the parking lot.

"Is this one of those New Wave formats?"

"New *Age*," Todd corrected. "Relaxing, don't you think?"

"Hmmm. So where is the announcer?" Bill felt a little uncomfortable with no control operator in sight. Then it occurred to him.

"Oh, is this coming in on satellite?"

"Going out, actually."

"How's that?"

"We're a superstation, Dad. We're sending this format to over 100 subscribers right now."

Now Bill was really puzzled. They were the only ones in the control room and yet he had just been told the sound on the monitor was their audio feed. Not just to their own transmitter, mind you, but to over 100 other stations via satellite! This was getting more incredible by the moment.

Point of origin

Not to appear totally out of it, Bill took another quick look around. He must have missed another studio or maybe even a big automation system. No, all he could see were the business offices out front, the production studio across the hall, the dark announce studio and the control room they were standing in.

"So, where is it originating?"

"Right here," Todd said, grinning as he patted the top of the rack.

"I guess I better explain this stuff. You remember, I told you we did all of our production to computer disk storage. Those disks are networked among the PCs you see in these different rooms.

"The setup in the other studio is an audio production workstation. Now, this machine is programmed as a program controller, much like the brain of the older automation systems. It will also work as a live board when we do interviews or live shows. Other computers in the station are less sophisticated. They are used for word processing, billing, transmitter monitoring, FAX and whatever."

Bill nodded. "OK, I'm with you so far. Harris or Schafer systems of my day. But where's the rest of the automation?"

"I'm getting to that. Now, all of the spots, news, and other announcements are stored digitally in files on the optical memory. In fact, everything that's programmed to run today is in this unit."

Todd pointed to a 12" rack panel that had a couple of status LEDs on the front and ventilation grooves.

"Music, too?"

"Very little, Dad. We can dub a lot of material from CD, DAT, or even PCM from video cassettes, when we want to. Some stations are doing that—using tape and CD for long term storage and downloading to disk for on-line access. However, our format is pretty unique. I guess you could say we make it as we go."

Todd turned a sheepish look toward his father, waiting for the obvious reply.

"You do what?"

"We roll our own. Right here, in fact." Todd lightly tapped the front panel of another piece of equipment on the rack.

A new take on programming

"This is a new type of music synthesizer," Todd said. "It's a combination computer, synthesizer and expert software system. Say you hooked up a Macintosh to one of those keyboards with the MIDI inputs. Then you could compose a whole song and play it back, right?"

Bill nodded, not sure where this was going.

"Well, carry that idea a little further. Instead of writing the score, what if you had a program that composes music on the fly, and it commands a high quality music synthesizer to play the instruments and sound effects so it sounds real. The software contains the rules for an acceptable range of sound and melodies. Turn it on and it just goes and goes."

"Now wait a minute, Todd. Do you mean that the computer is actually composing your entire format at random as we speak? Oh . . . that's nonsense. I've heard synthesizer programs and they never sound like human music—not unless somebody programmed it ahead of time, like a player piano. Is that what this is?"

"The next step beyond that idea. You know we call our format 'Classics for a New Age.' Well, the computer uses the music of the classical composers as its template. Mozart, Brahms, Beethoven. They're all in there.

"The knowledge program takes those patterns and translates then into something modern. It doesn't sound like classical music; yet, you get the feeling of something familiar."

Bill gulped. Then he reached over to the key with the speaker symbol and pushed it to raise the monitor volume. A piano piece ended, followed by an announcer who gave a station ID and read the weather.

Bill gave Todd an evil eye. "Is this guy a computer voice, too?"

"No, we don't know how to do that yet. Although, it's easy to change voice qualities so that one announcer can play the role of three or four. My partner, Tom, does most of the announcing."

"What did you say—partner? Do you mean that you're a part owner in this station?"

"Yup. Tom, me and the bank."

"But . . . this equipment . . . it must cost a fortune. How did you ever . . . ? Where do you even buy this stuff? . . . and the programming costs . . . ?"

"It's mostly personal computers, Dad. The music base is public domain. Now, the synthesizer . . . well, the patent will take another six months or so to be awarded, but I'm not sure whether to license the technology or just provide programming services."

Todd smiled as he put his arm around his father who was obviously still in shock.

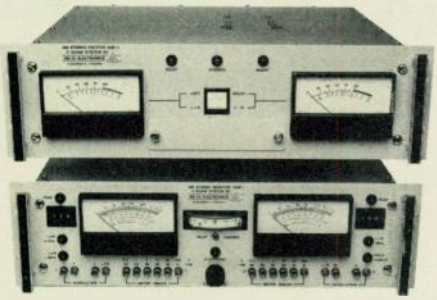
"You will come to our booth at the NAB tomorrow, won't you, Dad?"

"Come? I'll be there when it opens. I expect to sign up three or four stations myself. Pretty healthy commission, I suppose. You can explain the details as you drive me to the hotel!"

Adhere to Broadcast Standards.

Every day, all over the world, Delta's full line of products make sure the most important broadcasting standard of all is met—your total satisfaction.

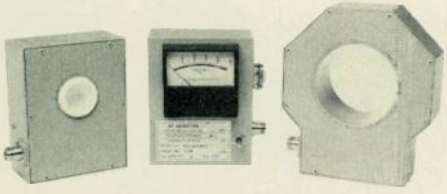
AM Splatter Monitor—Spectrum analyzer performance at a significantly reduced price! An inexpensive means of verifying FCC and NRSC spectral compliance. This frequency agile instrument tunes from 1700 kHz down to 450 kHz, with 9 or 10 kHz channel spacing. The monitor also measures incidental phase modulation (IPM). Designed to be rack-mounted or operated from a vehicle's 12 volt supply using an optional antenna.



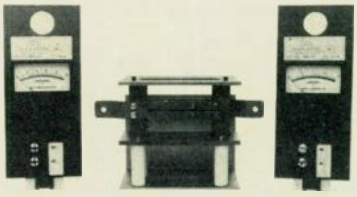
C-QUAM® AM Stereo—The Above Standard Industry Standard is easy to install and maintain with its modular design and construction. Offers standard features other manufacturers charge as options. A sound value, built to last.

High Power Pulse Reflectometer—Strong interfering fields that would destroy time domain reflectometers are virtually ignored by the PRH-1. This instrument can handle up to 1,000 watts of induced power on an intermittent basis as it locates faults on transmission lines. Provides a visual representation of the transmission or sample line, STL coax, or antenna, using your oscilloscope.

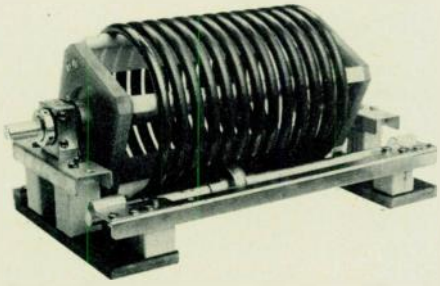
Coaxial Transfer Switches—These 1⅜" and 3⅛" motorized four port switches are designed to switch between antennas, transmitters, or dummy loads both quickly and efficiently. The switches can also be operated manually and are fully interlocked.



RF Ammeters and Sampling Toroids—Precision toroidal current transformers (TCTs) provide stable antenna monitor sampling while eliminating the problems associated with loops. TCTs also work well in supplying additional modulation monitor or test sample RF outputs. The transformer coupled ammeter (TCA) offers stable base or common point current readings, independent of modulation. The dual and single scale meters also provide remote DC outputs.

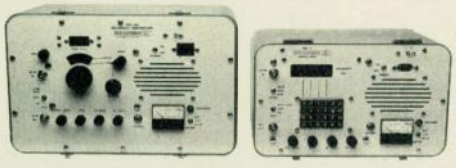


Low Power RF Ammeters—When every milliamp of current counts, depend on the accuracy of the TCA-Jr. This portable RF ammeter is designed to plug into either a Delta MJ-50 Meter Jack (pictured above), or a standard J-plug jack. Two current ranges are available: 0.2 to 1.0 Ampere, or 0.4 to 2.0 Amperes.

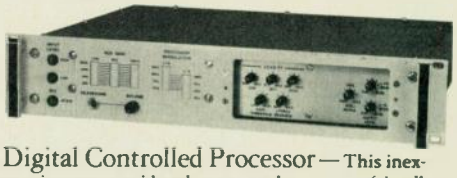


Rotary Variable Inductor—Where long life and high reliability are required, specify the RVI. Designed to provide long life, even under continuous rotation, the RVI is available in either 12 μH or 10 μH versions (maximum inductance). Other values by special order.

Transmitter Power Controller—Your insurance against over- and under-power citations. Continuously monitors transmitter power levels, compensating for AC power line sag by adjusting the transmitter to 100% power.



RF Receiver/Generator—A rugged, high output (2 watts) generator and correlation detector receiver virtually eliminate false nulls caused by interfering signals. The RG-3A operates from 0.5 to 1.65 MHz, and the expanded range of the RG-4 generates signals from 100 kHz to 30 MHz.



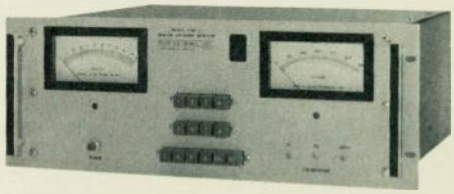
Digital Controlled Processor—This inexpensive, stereo tri-band processor boasts user-friendly controls and an aggressive sound. Mono stations can take a step toward AM Stereo, at a price that won't break the budget.

Impedance Bridges—At last, a means of measuring your impedance under full power. Both portable and in-line bridges are available, with a variety of features, for both AM broadcast and HF applications. The in-line Common Point Bridge can be supplied with a TCA RF Ammeter to permit precise current and impedance measurements.

The Above Standard Industry Standards.

DELTA ELECTRONICS

Delta Electronics, Inc. • 5730 General Washington Dr.
P.O. Box 11268 • Alexandria, VA 22312 • U.S.A.
Telephone: 703-354-3350
FAX: 703-354-0216 • Telex: 90-1963



AM Antenna Monitors—These are true ratio monitors which deliver a ratio reading without the need to continually reset the reference tower to 1.000. This simple operation reduces errors by non-technical personnel and makes tuning an array easier.

Circle 6 On Reader Service Card

Computers and Radio Engineering: A Perfect Match

We've Come a Long Way Since the Slide Rule . . .

by Michael Callaghan

Remember how long it took to figure out anything when you were using a slide rule? Do you remember the vague answer, the squinting and your lack of confidence in the result? Had you used the right scale to take the square root? Was the index out of calibration? All these concerns disappeared the minute you picked up your first scientific calculator.

The slide rule wasn't something we used a lot. In those days we didn't use flowcharts, personal organizers or spreadsheets, either. They were cumbersome and more trouble than they were worth. But in the same way that the calculator gave us better and more believable answers, the personal computer is revolutionizing the way we use these management techniques.

We're used to thinking of television as the birthplace of computers in broadcast engineering. TV stations were using punched tape and computers as automatic program switchers when we in radio were still discovering automation. Even today, digital effects and video are at the cutting edge of TV production.

Broadcast audio has been slower to adapt to digital storage and manipulation. Just now we're seeing the first rays of digital audio on the horizon. But the slower startup of digitized sound doesn't mean we can't take advantage of current digital technology.

The current crop of personal computers provides some invaluable tools for the radio engineer. It's just a matter of overcoming the inertia of unfamiliarity and starting to explore the systems and programs available.

The big two

There are two dominant computers in use: the IBM/MS-DOS series and the ➤

Michael Callaghan has been CE for KIIS-AM/FM for 14 years. He is an SBE senior certified AM/FM broadcast engineer, a teacher and a writer. Contact him at 213-466-8381.

Apple Macintosh. Each has its strong points.

The IBM was the first out, starting in 1980 with a simple 64K floppy system with a slow 4.77 MHz system clock. It was a very basic system using an 8088 Intel processor, and even offered a laughable cassette port for program storage.

From this unpretentious start, the IBM has evolved into some incredibly powerful configurations. While the basic system is still available (without the cassette port), the newer versions run advanced 386 processor chips at 25 MHz clock speeds, and use 100+ megabyte hard drives for data storage.

Any number of systems are available between these power extremes. The amount of money to be spent will largely determine how fast and powerful a system you'll buy. Also, any number of vendors offer accessories to "supercharge" the performance of IBM-type systems.

IBM compatible computers can be bought from a number of sources. Competition is intense, and excellent values can be found by careful shopping. While the early IBM "clones" had some compatibility problems, the recent ones run everything.

Innovative programmers have found ways to get the IBM architecture into many different sized packages and still keep program compatibility. This "open architecture" has contributed greatly to the advances brought on by Compaq, Dell Computers and other clone developers.

Along with the cassette port, the original IBM graphics were pretty sad, too. Users that wanted high quality images had to look beyond the IBM foundation. Over the years a number of enhanced video displays have been introduced and although they cost dearly, they produce both color and fine detail.

The advent of the Apple

The Apple Macintosh, by contrast, has always had excellent graphics. (Some of the X-rated programs are a little too graphic.)

The Macintosh must be bought from an Apple dealer. There are no Apple-clone manufacturers, little competition and very little in terms of bargains. Considering what goes into a Macintosh, it's no wonder Apple Computer produces such a profit.

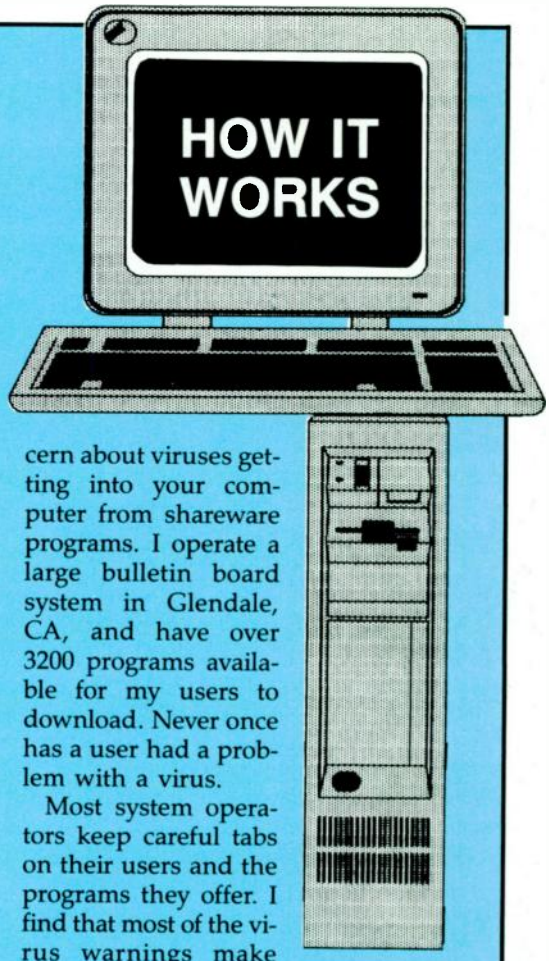
Largely because of the small monitor screen and the lack of colors, the Macintosh got off to a slow start. Both of those shortcomings have been overcome in the new Mac line, with high resolution color monitors in almost any size you want.

The Macintosh is "mouse-driven," meaning that you move around the screen and pick menus to tell the system what you want it to do. Word processing, of course, still involves the keyboard, although the mouse makes moving pages and paragraphs around easy.

Putting the computer to work

One of the most common questions asked when someone buys a new computer is, "What can it do?" The commonly frustrating answer is, "What do ➤

SHAREWARE



Most computer programs on the commercial market are published just like a book would be. It's extremely expensive to publish software; a fledgling programmer who's written a neat program and wants to make some money with it often doesn't want to accept the 5% or so he might get from a regular publisher.

Many times he'll simply release the program to the public. This can be as simple as sending it to a local Computer Bulletin Board for other users to try out. If you get the program this way, try it and like it well enough to keep using it, you are expected to send some money directly to the author.

In exchange for this, he'll keep you notified of any changes and will support the program if you have any questions about its use. The amount the author expects is specified in the documentation that comes with the program.

Getting hold of a program is simple. All you need is a modem to connect your computer to the telephone line, and a communication program. Any number of bulletin boards across the country will let you download shareware programs. Often some of the other users on a bulletin board will have used a program and can answer questions about it.

Most bulletin boards cost nothing to use. Just signing on and answering some questions about who you are will earn you a high enough level of access to become a regular user.

You can learn a lot from these bulletin boards just by reading the messages various users post to each other. Your local users group or computer store can help you find a board to use and the communication program if you need it.

If you don't have a modem or a bulletin board you can use, shareware is also available by mail from a number of user groups. They regularly publish catalogs and send them for the asking.

Remember that the program is given to you on the honor system; if you keep using it without paying for it, you're violating a trust.

There has recently been some concern about viruses getting into your computer from shareware programs. I operate a large bulletin board system in Glendale, CA, and have over 3200 programs available for my users to download. Never once has a user had a problem with a virus.

Most system operators keep careful tabs on their users and the programs they offer. I find that most of the virus warnings make good press and little else.

—Michael Callaghan

you want it to do?"

It's like asking what a screwdriver is used for. For driving screws. A computer is for computing; the use depends on the application. And radio engineers have a lot more applications than many users.

Follow this scenario: You arrive at work, walk into your office, flip on a switch, and go get that first cup of coffee. When you return, coffee in hand, your printer has a list of all the projects, appointments and assignments you want to tackle today.

You start by sitting down to follow up a cart shipment that's running a couple of days late. You hit a key on the computer and type in the first three letters of the vendor's name.

The screen flashes, and all the information about the order is in front of you, including the phone number and the contact name. You dial the number and type in the details of the call and the new date the vendor offers.

Then it's time to write your monthly report. You ask the system to make a list of all the completed tasks for the last month. You sip coffee and read the morning mail while it dutifully prints out all the meetings, projects and tasks you undertook and even those which you let slide during the last 30 days.

Using this list, you decide which tasks to include in the report and which to leave out. You call up the monthly report heading in your word processor and spend 15 minutes filling in the noteworthy achievements. After that, you hit a couple of keys to pop up a list of future plans and deadlines to include, and drop back to the report without ever leaving the word processor.

Finally, you print out the report and sign it.

But wait, there's more ...

Moving on, you call up a Map program that draws a street map on the screen. You tell it the street address of the upcoming Saturday remote, and it starts figuring the best route for your staff to follow to get there.

While it looks at all the possibilities, you walk the monthly report up to the GM's office and leave it with his secretary. When you return, your route has been overlaid on the map, and you hit a key to print it out.

The program produces precise directions, starting at the station and telling you how far to go and where to turn on each street to make the best time on Saturday. The same program also provides the line-of-sight distance from the remote to your transmitter, so you can be sure the remote pickup link will work.

If you use steerable dishes, the same program also gives the azimuths.

So, you gather up all this information, print out a copy of the names, contacts and circuit numbers for the remote, and assemble a care package for the engineer running the remote. You make a copy for the program director and include a simple spreadsheet showing what the overtime costs will be.

Performing multiple tasks

The production director walks in while you're putting the hours into the spreadsheet. He wants to know if you have the combination to his new locker. You tap three keys and read him the numbers he need. Another tap and you're back to the spreadsheet.

Finally, you use a program called TASKSTAR to run off a task list for each member of your staff, reminding them of the projects to which they're assigned. They make comments on the sheets and return them to you for updating into the system. As each of the projects is completed, it's moved into a Report file, where it will pop up at month's end to be included in next month's report.

Just as you're saving the project files, you remember some confusion about playing a videotape in the conference room, so you pump out an easy-to-use flow chart giving the necessary details.

It's just an hour after you walked in the door, and you've already finished work that would have taken a half day before you started using the computer. Everything you've done is not just printed out and distributed, it's stored on your hard drive if you need it again.

During the afternoon you use a Computer Aided Design program to lay out the floor plan for a new studio, a spreadsheet to figure the costs, and a database to start assigning the new cable pairs.

We know this is all possible, but how much will it cost?

Hardware and software

All of the accomplishments in our scenario are easily covered with a system that costs under $1500—a good, reliable and simple IBM-XT clone with a 30 Mb hard drive and an EGA monitor and printer.

The software cost depends on what you use. While I use the commercial versions of most of them, they are also available in "shareware" versions, and none of those will cost over $65.

Figure 1. Computer list responding to "Telco"

```
10/87 Telco Phone Circuits:
7 AFLA 777160-PT AM ST. Left
7 AFLA 777152-PT AM ST. Rght
7 XB 3500        AM 15 k B/U
30 XC 7426       AM Comp R/C
30 XC 877        AM Anal R/C
30 XC 7427     KFSG Comp R/C
7 AFLA 777136-PT FM St. Left
7 AFLA 777137-PT FM St. Rght
7 VMNA 700388   Moseley FM RC
30 VMNA 796257 Hallik. FM RC
7 AFLA 774323  AOC Util Loop
7 AFLA 703161  KABC Promo Ln
20 PFGP 746946  Chopper 450
7 AFLA 744815 KABC # 2
30 PKGP 747325 Wilson->VAM-L
30 PKGP 747326 Wilson->VAM R
11 PKGP 747435-1 AOC St Left Eq # 10
11 PKGP 747435-2 AOC St Rght Eq # 15
30 PQGP 747583  KMX Weather Wire

TELCO BUSINESS LINES
Dave Kaswan
(213) 975-7183
John Barron
(213) 975-3743

Telco Leased Lines
Gloria Simon
Mike Dimichina
811-6990
Studio Moves/Big Projects
Terri Spatola
(818) 576-6592

Telco Priority Repair
811-8881
Business Lines

SEARCH MENU  NOTE FILE  0e 140t 47p 49s  11-8-88  9:45a  26423
```

Word processing is probably the single most advocated use of personal computers. Once you've shuffled paragraphs around, checked for misspellings and used a built-in thesaurus, you'll be hard pressed to go back to a typewriter.

An early word processor, WordStar, was responsible for selling a lot of computer systems ten years ago. And the WordStar enthusiasts are still loyal to the program, even though it's been through a lot of changes and uses some strange Control Key codes that totally defy logic.

Today's leading word processor is Wordperfect 5.0. It's a little tricky to learn, but like a lot of new experiences, once you've used it, you'll be angry you didn't start earlier.

Charts and graphs are important to any engineer. They can show equipment performance, the steps in a process, or even the organization of your station. An example is a flowchart that tells a board operator how to get the station back on the air after a failure.

Such a chart can be produced with ➤

FLOWCHART II+, from Patton and Patton. It's an easy program to use, and the line drawing and text features make high-quality forms for everything from remotes to technical discrepancies.

Spreadsheets are an incredible help in all sorts of money matters. Laying out operating budgets, deciding how many of each length cartridge you can afford, and producing prefigured purchase orders are all easy with Lotus 1-2-3 or a comparable program.

Making up a different template for each vendor and then just recalling it and typing in the material you want to buy makes routine purchases easy.

Data management

Databases form the other main use of computers. Radio stations can use them for everything from tracking contest winners to laying out the wire and cable numbers in studios.

Most of the time database programs are supplied as basic "engines" and you put together the input screens, the information you want to store and the ways you'd like it presented. My station, KIIS, uses a shareware database called File Express to itemize such varied things as door keys, wire numbers and contest winners.

A new breed of program, called a personal information manager (PIM), is becoming indispensable to department managers and salespeople. This takes the place of a desktop organizer.

Appointments are entered as they're made, and as the computer is turned on each day it checks the calendar to remind you of meetings, deadlines and other commitments.

The different stages of a project can be entered, and the program reminds you of when you or the project is falling behind. Ticklex, the PIM I use, can handle appointments, vacations, business trips and the scheduling of remotes for the entire department. It allows any number of reminders to be set up for each event, and offers a daily printout of important things to know.

Computer aided design programs can do everything from laying out a floor plan to a printed circuit board. They automatically print the dimensions on drawings, and dedicated PC board programs check for crossed traces and automatically number and label the device types.

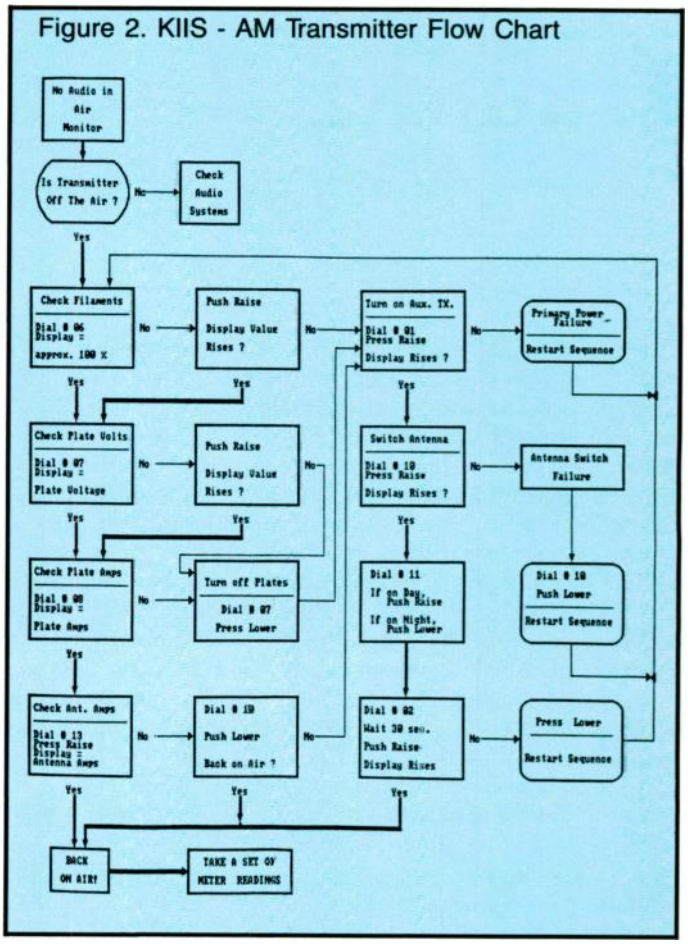
I've included some sample screens from our scenario to show how some of these programs work:

The "Tornado Notes" screen (Figure 1) is the result of simply asking for references to "Telco." Every note with "telco" anywhere in it is on the screen. I can find any circuit number, the business office, or who to call for leased lines. And it works even if I'm using another program—the screen just switches over long enough to recover what I need.

The flowchart (Figure 2) comes from Patton & Patton. It draws everything from the "Transmitter Failure" chart to monthly activity schedules.

These tools can benefit almost any manager, but one area will save a broadcast engineer more time than any other: the automated testing of audio equipment.

Figure 2. KIIS - AM Transmitter Flow Chart



Automation put to the test

The Audio Precision System One is the system KIIS uses. We've developed a system whereby we test the cart and tape decks without taking them out of the studio. Test busses run from the studio to the maintenance shop.

We usually make phone calls and handle other chores while the System One sits quietly in the corner, running weekly checks on all the cart machines we use on the air. It checks frequency response and phase and prints out the results. If anything's wrong, it beeps to let us know we have something deserving attention.

The result? Easier maintenance and better maintained equipment. Better maintained equipment sounds better and works longer. With fewer "fires" to put out, broadcast engineers will have more time for engineering.

They'll be able to spend more time working on processing details and better air sound. The same test system that checks the tape machines can be of invaluable help in designing filters and amplifiers.

What does the future for dedicated engineering computers look like? As more powerful systems come to market, the low-end systems will continue to drop in price. The hardware is ready and getting better.

The cost/performance ratio is at the point where it's senseless to work without a computer system. And once you start using one, you'll find a tremendous variety of programs to help with almost everything you do.

Training Broadcast Engineers:

Where's the Next Generation Coming From?

by Thomas Vernon

There's a growing number of voices in our industry expressing concern over the lack of capable personnel to maintain and repair broadcast facilities. Stories of butchered equipment and incompetent engineers are no longer confined to small market stations.

In this article, we will examine the problem of finding qualified engineers, how we got into this dilemma and some possible solutions. First, a brief history lesson to put things in perspective.

The good old days

It used to be much easier to get an education in broadcast engineering than it is now. If you were interested in radio, you started out by hanging around one of the local stations.

Eventually you got a job as a "gofer." Your responsibilities included emptying waste paper baskets, clearing the teletype and cleaning an infinite number of tape heads and pinch rollers.

In exchange for the performance of these menial tasks, you got to work with the Chief Engineer.

You studied and pestered the Chief Engineer with questions. Finally, the day came when you passed your exam for elements I, II, III and IV, and received your coveted First Class license, signed by Ben F. Waple.

If you went on to college, there was a chance to work for the campus radio station. Usually the station didn't have much money, but if you made friends in the Physics Department, you could get electronic parts to build remote mixers, consoles, limiters, etc. Over the summer there were lots of carrier current transmitters to be cleaned up and checked out.

That was then, this is now

A lot has changed in the last 10 years. Equipment became more reliable, and didn't need frequent maintenance. The winds of deregulation blew through the Commission offices, resulting in the elimination of the three-year ownership rule, as well as the requirment for First Class operators. Finally, despite industry protests, the First Class license itself went away.

In its place was the mandate that it was up to the station's owners to determine acceptable standards for engineers. Some said that this was like expecting the fox to guard the chickens.

This series of events gave rise to contract engineering, where one engineer takes care of several stations on a contract basis, usually for an hourly or monthly fee.

How can the next generation of radio engineers be expected to learn in this type of environment? The answer is, they can't. Unfortunately, many of the traditional means of education just discussed are not available, or not applicable to youngsters entering our profession today.

A two- or four-year degree in electrical engineering, while useful for learning some electronics theory, often leaves one ill prepared to enter radio broadcasting. Most engineering programs exist to prepare graduates to enter the digital design and servicing realm, because that's where the money is these days.

Analog electronics is given only brief mention, usually in the context of analog to digital converters. Even topics such as audio are neglected. Many graduates don't know the difference between balanced and unbalanced audio lines, and why one is better.

What about those programs in community colleges offering specialized courses in radio engineering? They're gone; most were victims of falling enrollment, as electronics students went off in search or more lucrative pastures.

What's left?

Currently, the only broadcast equipment manufacturer offering in-house training to radio engineers is Harris Corporation. Here too, the gradual loss of skilled personnel has been observed.

In the early years of the high power transmitter seminars, most attendees had a thorough understanding of RF, antennas and transmitter operations. The training concentrated on fundamentals of PDM and other product-specific information.

As older engineers retired over the years, stations moved their studio technicians into transmitter operations. Many were only experienced with audio, and needed a crash course in RF fundamentals.

To answer this need, Harris has begun offering three four-day workshops, covering AM, FM and TV topics. These courses take the student from studio operations to RF systems.

At a more advanced level, Harris offers two week-long courses—Circuits 1 and Circuits 2. Among the topics presented are power measurement, impedance matching networks, neutralization and antenna basics.

Additionally, company employees teach broadcast engineering courses at the local community college, which offers a specialized concentration in this area. The program is in its tenth year, and is probably the only one of its kind left in the country.

Training from the government

Without a doubt, the most extensive program for educating broadcast engineers in the US is operated by the Voice of America. Noting the decrease of skilled applicants for positions in its worldwide network of relay stations, ➤

Acknowledgements: Special thanks to the following people for sharing information used in the preparation of this article:

Margaret Bryant, WMAQ, Chicago; Dell Carson, Voice of America; Dave May, Harris Corporation; and Ed Montgomery.

Thomas Vernon, a regular **RW** *columnist, divides his time among broadcast consulting, computers and instructional technology. He can be reached at 717-249-1230.*

VOA embarked on an educational program to coincide with its overall facilities upgrade.

The 12-month training program takes place at the Greenville, NC transmitting station. Six months of classroom instruction include 670 hours of instruction on many electronics topics, including propagation and monitoring, modulation, antennas, transmitters, microwave links and power distribution. The material presented is both generic and specific to the types of transmitters and other equipment in use at VOA.

Soon to be added are modules on first aid/CPR, firefighting in antenna fields, and living abroad.

Following the six months of classroom instruction, there is a six-month work period where the new personnel gain experience in the many duties necessary to operate a high power relay station.

The non-technical angle

Our discussion of qualifications for engineers wouldn't be complete without mention of the non-technical skills necessary for success.

On the top of everyone's list is the need for strong interpersonal skills. Today the job demands good oral and writing skills, as well as an understanding of budget and administrative duties.

The ability to function as part of a team is also essential. Many of those who complain about being excluded brom the decision-making process are the same ones who fit the old stereotype of what a broadcast engineer is.

Many engineers have an introverted personality, and this is part of what makes them good at what they do, but more effort needs to be made in developing an awareness of how we're perceived by others at the station.

It should be pointed out that this problem is not unique to broadcast engineers, but is shared by technical people in other disciplines as well.

Broadcast management must be more aware of the need for continuing education on the part of the technical staff. Sufficient time and money should be allocated for purchase of educational materials, attendance of seminars, classes, etc.

Getting the next generation involved

Another thing that has changed over the years is the number of young people interested in entering the broadcast field. Perhaps the "magic of broadcasting" that many remember has been replaced by the "magic of computers."

Whatever the reason, an aggressive recruitment program needs to take place at both the high school and college level. Perhaps this will involve SBE members setting up booths at high school job fairs and career nights.

Contacts should be made with colleges offering two- and four- year electronics programs so that graduates are aware of opportunities in the broadcast profession. Some SBE groups, notably the Chicago area chapter, have set up courses to educate newcomers and prepare them to take the SBE certification exams.

Some of the newer technologies for instructional development may also be available to help train and retrain engineers in the future. Most notable among these are hypermedia and interactive videodisc.

The cost of curriculum development in these media used to be prohibitive; however, recent advances are reversing this trend. HyperCard for the Macintosh, for example, places a very powerful development tool in the hands of the average personal computer user. Recently, an affordable videodisc record unit has also been introduced.

These developments will encourage the creation of specialized educational materials for groups too small to be addressed in a cost-effective manner by large educational institutions. Manufacturers will be able to produce hypermedia instruction manuals which integrate the conventional manual functions with product specific training through animation, graphics, color and sound.

The broadcast engineer of the future may have to work harder than his predecessors to get the kind of education he needs. With very few exceptions, there won't be a clear academic curriculum laid out for him, nor will there be an experienced mentor to show the way.

A two- or four-year EE degree may provide an understanding of the fundamentals, and much-needed background in digital, but the rest will have to be gleaned through self-study programs, manufacturers' seminars and, hopefully, training materials developed with emerging technologies.

Staying Fresh in Production

Technology from a Variety of Fields Will Keep Your Spots Sounding Up to Date

by Ty Ford

Welcome to the future of audio production! You will notice that it doesn't look that much different than the past (which was the present only moments ago).

Sure the big boxes are smaller, but they have been replaced by more big boxes that do things pretty much like the old boxes. Reports of their ability to save us time are largely a myth. Any time that might have been saved has been offset, because as humans we tend to fill any available time by haggling over lesser decisions and experimentation.

Over what horizon should we expect the future to rise? First will be the marketplace and the manufacturers who make a living by producing new equipment based on what they perceive is our need.

Sure there are those whose specialty is the "exotic," but let's not kid ourselves—tight budgets make for conservative buying. Besides, nobody wants to get caught with deadend technology (apologies to RPG).

Progress in the near term

If you're itchy for the immediate future, the places to look are the markets adjacent to our own. For audio this means the MI (music industry), video and computer markets. Finding new applications for existing technology is one of the things that made this country what it is today.

Here's how it works. The new MI gear which makes things sound different works its way into the culture through-commercial music. We have the musicians and muso-technicians to thank for these changes, as they are in constant search for the next new sound.

The creative circuitry then makes its way to the "pro" department where they slap on the appropriate −10, 0, or +4 balanced or unbalanced interfaces.

Recognition and a gold star should be awarded to the companies who spend the extra nickel on these multiple interfaces. I realize it flies in the face of some of the crustier hard-line engineers who believe that +8 is the only way to go, but denying change is a hopeless pursuit.

Perhaps because the music people are more open to change, they have been consorting with the computer people, who have been consorting with the video people since the dawn of SMPTE time code.

There are a number of controlling systems (SMPTE, FSK, MIDI, CTL) each with its own differences. The more you ➤

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know about these systems the better off you will be. The more you know about computers and how they interface with the new electronics the longer you will remain competitive.

Stop now and you're on the way to the surplus store for white socks and a pocket protector.

Our own worst enemy

One of the biggest obstructions between us and the future is ourselves. The tendency to become creatures of habit pulls at our creative abilities as surely as gravity pulls us to earth.

Too many of us have used the "tried and true" methods for so long that we have become the "true but tired." Nowhere is this more apparent than in radio station and commercial production.

Too few people realize that great production begins with a great concept. Without a great concept, great copy and great delivery, and all the effects boxes in the world won't drive the message home.

Positioning and marketing have replaced selling. Together they demand that we broaden our awareness. First by being aware of where we are in relation to our competition, second by being more aware of the needs of the market.

Radio people in search of a clue have looked for concepts they could translate to their non-video medium. The result has been the evolution of the "Theater of the Mind" concept where spoken words are so strong that they create images in the mind of the listener. TV people search for similar clues in cinematic production.

We must continue to push at these boundaries with stronger concepts and writing skills. To survive and prosper you must be a great wordsmith and a ruthless editor.

Simply knowing that there is a difference between the written and spoken word is not enough. In this highly pressurized environment the laws of grammar can become extremely warped, even destroyed.

Improving communication

Consider that the volume of words used is not always the benchmark of great production. Using the "Less is More" philosophy demands that we understand which words are the important ones.

We live in a world with too much information in it already. Our minds have developed a hair-trigger defense system which protects us from overload.

Full communication via the media is impossible. Communication has become a mental linguistic game of darts. The best we can hope for is to hurl carefully honed messages into the minds of the audience, hoping that they will not be dislodged by the barrage of other incoming messages.

Because mental tune-out happens so quickly, wasting words is a luxury we cannot afford. We have therefore created a "new language" to guard against it.

This new language is called "MediaSpeak." It is a chopped and channeled version of American English. Those who excel in its use will do well.

Turning to technology

As for emerging technology, most can be put into one of three categories: new gear that makes things sound different, new gear that controls those sounds and new gear in which to store those sounds. Most of of this processing will be done digitally.

Technology is already available (in the MI) which allows sampled sounds to be altered by digital filtering and algorithms. Some devices allow you not only to see the waveform on a screen, but to change any part of that waveform.

Marvin Caesar, president and chief engineer of Aphex Systems Ltd., feels strongly enough about MIDI to have recently brought aboard Michael Stewart, who has developed the Studio CI. Instead of having MIDI equipment sync to the relentless perfection of a click track, the gear will sync to the playing of a human drummer. This breakthrough should reduce the sterility of the performed piece.

For broadcast, Caesar believes there will always be a need for competitive loudness. He believes that Aphex's success in the marketplace is the result of providing high quality transparent circuitry that makes other less transparent pieces work less, therefore imparting fewer of their objectionable byproducts.

New England Digital's Synclavier integrates a piano-type keyboard into its workstation design.

MIDI controls, computer controls and automated consoles are becoming increasingly common in broadcasting, as well.

Having six cart machines synchronized to fire by time code would give you more flexibility than if you used a multitrack tape machine, because you could slip each audio source around to get it in exactly the right place.

Your work wouldn't necessarily be faster, but you would have more choices, and more control. The new breed of digital work stations—Waveframe, Synclavier, Dyaxis, CompuSonics, Opus and others—currently have this capability.

New entrants

Doug Shauer, marketing director for Symetrix, says look for their entry in the market sometime within the next 12 months. Currently called the DPR 100 (in prototype), it uses a 16-bit processor, runs at 44 kHz, 48 kHz or 32 kHz, does real time processing, time compression and expansion.

The Symetrix unit will operate as a ➤

four-track with one disk or an eight-track with two. With SMPTE, MIDI code and MIDI to SMPTE conversion, this system will replace the multitrack recorder, the console and an effects rack.

While it currently uses a stack of hard drive disks for memory, the DPR 100 is designed to be able to use whatever digital storage medium is developed via a SCSI port.

With rewritable optical discs virtually at our doorstep, we will soon break the storage barrier that has kept random access audio on standby.

The future, however, goes on. Gil Griffith of Eventide sees a time when data, including audio, will be stored via laser on the surface of precious jewels in a spectrum of light.

Digital equipment like the CompuSonics DSP 1500 is bringing technology's cutting edge to production.

The advantages of this system, it is believed, would be incredibly increased storage space and immunity from electromagnetic erasure.

So, in case of nuclear attack, the explosion wouldn't bulk erase your data base. The diamond might melt if the blast was close enough, but if you were nearby you'd be history anyway.

As for me, I've always wanted a device that, when "turned up," increased the silence. To some degree the makers of noise reduction gear have come to this, but they haven't gone far enough. In my mind the circuit should be able to be "turned up" until the silence is excruciating.

It's sort of a Zen idea.

A more practical device would be a computer-based segueing system. The prototype version would require you to play each song once through a sampling filter before you put it into rotation.

The computer would then store enough data and sound so that when you segued to another record or jingle, the computer would create a musical bridge between the two.

Time signatures, musical keys, textures and actual samples of each piece would be combined to create the bridge. You could choose how long the bridge would be, say two seconds to 10 seconds. It would be merely a matter of storage and software.

Once the bugs were worked out of the prototype, additional updates would not require pre-sampling. Instead the computer would monitor the program line and, during the bridge, would work out where it had to end up to start the next piece.

This would be a bit tough if you used CDs, carts or records, but since the studio of the future has all elements in digital random access storage, there would be no need for delay at all. Remember you read it here first!

The success profile

Meanwhile, there's a gentleman in Savannah, GA who has spent quite a bit of time working on voice stress analysis. When I talked to him late last year, he was still working on the software.

He had found that, when distressed, we tighten our diaphragms, thus reducing or eliminating a range of frequencies between 4 Hz and 8 Hz.

The analysis I envision would go further. If the voices of successful air personalities and newspeople were analyzed and compared to unsuccessful ones, could a "success profile" be derived from the voice prints?

If it could, could bio-feedback devices be used to train the unsuccessful ones to attain the success profile? Could a "prosthetic enhancement modulator" be designed which would add the right stuff to make unsuccessful voices meet the success profile?

At the time, I was told, the software had not been sufficiently developed.

Progress in other areas is also moving along. Ivan Schwartz, broadcast and production marketing manager for ElectroVoice, believes the day of optical or direct digital microphones is not that far away.

According to him, some of the people who are now working with digital consoles and tape machines are finding out how noisy condenser "tube" microphones really are. Until optical or digital microphones are practical and affordable, however, he believes the new improvements in their dynamic microphone line (N/DYM) will yield the "CD quality sound" today's broadcasters are looking for.

One major dilemma which faces the microphone industry is whether to make a microphone that sounds great on its own, or that sounds great with the heavy processing used by radio stations today.

Make your bed and talk over it

Getting back to the MI market mentioned earlier, I think (and hope) more production people will be checking in with their local music stores. When people find out how easy it is to make music with MIDI'd drum machines, synthesizers, samplers and multitimbral boxes you won't be able to drag them out of the studio.

With the three boxes I'm using right now, I can create an eight piece arrangement with rhythm section in stereo which is always first generation. Sure, there's alot of time spent getting up to speed with the technology, but you're really wimpy if that's your only excuse.

If you can't afford the toys yourself, have the station trade out for the gear you need. Take some time and find out what can be done with this stuff. It's important to get the right pieces.

If there isn't a keyboard room in your local music store, give me a call.

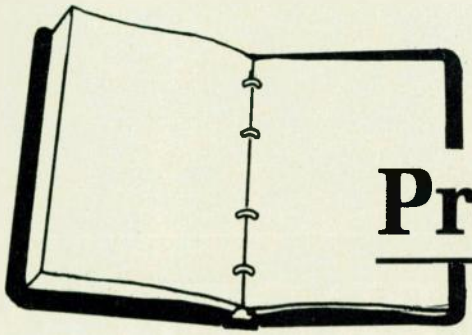
DIRECTORIES & PROFILES

In the following pages, you will find three tools for keeping track of vendors and their products.

The Product Source Book is an index which lists companies according to the type of equipment they make or distribute. The product information was provided by the vendors themselves, in response to a questionnaire sent by *Radio World* late in 1988.

In the next section, our Supplier Source Book lists the names and addresses of the companies found in the Product Source Book. Finally, those of you looking for more information on the companies listed can turn to the Company Profiles, in which firms have provided details about their businesses and products.

We hope these listings will save you time and help you find the products you want to buy.



Product Source Book

a ACOUSTIC MATERIALS

Acoustic Systems
Allied Broadcast Equipment
Alpha Audio
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Services Co
Crouse-Kimzey
IER
La Salle Audio Systems
Martin Audio Video Corp
McMartin Inc
PAS (Professional Audio Supply)
RPG Diffusor Systems Inc
Ram Broadcast Systems Inc
S C M S Inc
Vaughn Communications

a AMPLIFIERS

AUDIO

ADM Technology Inc
ATI (Audio Technologies Inc)
AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Atlas/Soundolier
Audio Broadcast Group Inc
Audisar Inc
Auditronics Inc
BGW Systems Inc
BSM Systems Inc
BSW (Broadcast Supply West)
Benchmark Media Systems Inc
Boynton Studio Inc
Broadcast Audio Corp
Broadcast Electronics Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
Dayton Industrial Corp/Fox
Delta Electronics Inc
H M Dyer Electronics Inc
Electrex Co
Erko Technologies
Full Compass Systems
Guarantee Radio Supply
H & E Micro-Trak
Hall Electronics
Henry Engineering
Holzberg Inc
IBSS Canada
IER
JBL Professional
Jensen Transformers Inc
Johnson Electronics
La Salle Audio Systems
Learning Industries
Logitek
Martin Audio Video Corp
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
Opamp Labs Inc
Ortofon Inc
PAS (Professional Audio Supply)
Panasonic - Ramsa Div
Phase Linear
QSC Audio Products
Radio Design Labs
Ram Broadcast Systems Inc
Research Associates Inc
Riggins Electronic Sales
Russco Electronics Mfg
S C M S Inc
Schafer World Communications Corp
Sequoia Electronics
Sescom Inc
Shure Brothers Inc
Sound Com Corp
Sound Workshop
Spectra Sonics
Studer Revox America Inc
Studio-Sonics Corp
Symetrix Inc
TOA Electronics Inc
Titus Technological Laboratories
Transcom Corp
United Audio Recording
UREI
Vaughn Communications
Zercom Corp

DISTRIBUTION

ADM Technology Inc
ATI (Audio Technologies Inc)
AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Audio Broadcast Group Inc
Audisar Inc
BGW Systems Inc
BJM Electronics Ltd
BSM Systems Inc
BSW (Broadcast Supply West)
Benchmark Media Systems Inc
Boynton Studio Inc
Broadcast Audio Corp
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
Di-Tech Inc
H M Dyer Electronics Inc
Electrex Co
Full Compass Systems
Guarantee Radio Supply
H & E Micro-Trak
Hall Electronics
Henry Engineering
Hirschmann Co
Holzberg Inc
IER
La Salle Audio Systems
Logitek
Martin Audio Video Corp
McCurdy Radio Industries
Milam Audio Co
McMartin Inc
Modulation Sciences Inc
New World Audio Express
Northeast Broadcast Lab Inc
Omega International
Opamp Labs Inc
PAS (Professional Audio Supply)
Radio Design Labs
Ram Broadcast Systems Inc
Research Associates Inc
Riggins Electronic Sales
Russco Electronics Mfg
S C M S Inc
Schafer World Communications Corp
Sequoia Electronics
Sescom Inc
Shure Brothers Inc
Sound Com Corp
Spectra Sonics
United Audio Recording
Vaughn Communications

RF

AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Belar Electronics Laboratory Inc
Bext Inc
Beyer Dynamic Inc
Broadcast Electronics Inc
Broadcast Services Co
CCA Electronics Inc
Control Technology Inc
Crouse-Kimzey
Delta Electronics Inc
H M Dyer Electronics Inc
Electrex Co
Energy-Onix Broadcast Equip Co
Full Compass Systems
Guarantee Radio Supply
Hirschmann Co
Holzberg Inc
IBSS Canada
McMartin Inc
Micro Controls Inc
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Research Associates Inc
S C M S Inc
Schafer World Communications Corp
Tepco Corp
Vaughn Communications

SATELLITE

Allied Broadcast Equipment
BJM Electronics Ltd
Broadcast Services Co
H M Dyer Electronics Inc
Hirschmann Co
Holzberg Inc
IER
Ram Broadcast Systems Inc
S C M S Inc
Schafer World Communications Corp
Scientific Atlanta Inc
Vaughn Communications

STL

Allied Broadcast Equipment
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Bext Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
H M Dyer Electronics Inc
Electrex Co
Guarantee Radio Supply
Hall Electronics
Holzberg Inc
IBSS Canada
IER
Marti Electronics
Micro Controls Inc
Modulation Sciences Inc
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
S C M S Inc
Schafer World Communications Corp
TFT Inc
Vaughn Communications

☞

a ANTENNAS

FM

AEG Bayly Inc
Allied Broadcast Equipment
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Bogner Broadcast Equipment
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Comad Communications Ltd
Control Technology Inc
Crouse-Kimzey
Dayton Industrial Corp/Fox
Dielectric Communications
H M Dyer Electronics Inc
Electrex Co
Bernard Gelman Associates
Guarantee Radio Supply
Hall Electronics
Harris Corp, Broadcast Div
Hirschmann Co
Holzberg Inc
IER
Jampro Antennas Inc
Kidd Communications
LDL Communications Inc
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Research Associates Inc
S C M S Inc
Scala Electronic Corp
Schafer World Communications Corp
Shively Labs
Television Technology Corp
Tennaplex Systems Ltd
Transcom Corp
Varian Continental Electronics
Vaughn Communications

a AUTOMATION

STATION BUSINESS

Control Technology Inc
Full Compass Systems
Holzberg Inc
The Management
Media Touch Systems Inc
S C M S Inc
Tapscan

NEWSROOM

Comprompter Inc
Full Compass Systems
IBSS Canada
Media Computing Inc
Media Touch Systems Inc
S C M S Inc

RADIO PROGRAM

Allied Broadcast Equipment
Audio Broadcast Group Inc
Broadcast Automation Inc
Broadcast Electronics Inc
Broadcast Services Co
Century 21 Programming Inc
Concept Productions
Hall Electronics
Holzberg Inc
IBSS Canada
IGM Comm
Innovative Automation
La Salle Audio Systems
The Management
Media Touch Systems Inc
Northeast Broadcast Lab Inc
Ram Broadcast Systems Inc
Research Associates Inc
S C M S Inc
Schafer World Communications Corp
Sono-Mag Corp
Studer Revox America Inc
Tennaplex Systems Ltd
Titus Technological Laboratories

b BATTERIES

AVC Systems Division of Vaughn Communications
BJM Electronics Ltd
Beyer Dynamic Inc
Broadcast Services Co
Erko Technologies
Fort Worth Tower Co Inc
Full Compass Systems
Guarantee Radio Supply
Holzberg Inc
Marti Electronics
Martin Audio Video Corp
Schafer World Communications Corp
Vaughn Communications

b BUILDING PREFAB

Allied Broadcast Equipment
Andrew Corp
Holzberg Inc
Schafer World Communications Corp

c CABINETS Cases & Racks

AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Anvil Cases
Atlas/Soundolier
Audio Broadcast Group Inc
BJM Electronics Ltd
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
Emcor Products Crenlo Inc
The Express Group
Full Compass Systems
GKM Mfg Corp
Guarantee Radio Supply
H & E Micro-Trak
Harris Corp, Broadcast Div
Holzberg Inc
IER
Kintronic Laboratories Inc
La Salle Audio Systems
Martin Audio Video Corp
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
S C M S Inc
Schafer World Communications Corp
Sound Com Corp
Stantron Unit of Zero Corp
Vaughn Communications
Winsted Corp

c CART MACHINES

Ram Broadcast Systems Inc
Varian Continental Electronics

RECORD ONLY

AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Audio Broadcast Group Inc
Auditronics Inc
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Automation Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
Fidelipac Corp
Full Compass Systems
Bernard Gelman Associates
Guarantee Radio Supply
Hall Electronics
Holzberg Inc
IER
Kidd Communications
La Salle Audio Systems
Martin Audio Video Corp
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
Otari Corp
PAS (Professional Audio Supply)
Pacific Recorders & Eng
Riggins Electronic Sales
S C M S Inc
Schafer World Communications Corp
Sequoia Electronics
Television Technology Corp
Transcom Corp
Vaughn Communications

RECORD/PLAY

AMP Services
AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Audi-Cord Corp
Audio Broadcast Group Inc
Auditronics Inc
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Automation Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
Electrex Co
Fidelipac Corp
Full Compass Systems
Bernard Gelman Associates
Guarantee Radio Supply
Hall Electronics
Holzberg Inc
IER
International Tapetronics/3M Broadcasting & Related Products
Kidd Communications
La Salle Audio Systems
Martin Audio Video Corp
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
Otari Corp
PAS (Professional Audio Supply)
Pacific Recorders & Eng
Research Associates Inc
Riggins Electronic Sales
S C M S Inc
Schafer World Communications Corp
Sequoia Electronics
Sono-Mag Corp
Television Technology Corp
Transcom Corp
Vaughn Communications

MULTI-DECK

AMP Services
AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Automation Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
Electrex Co
Fidelipac Corp
Full Compass Systems
Bernard Gelman Associates
Guarantee Radio Supply
Hall Electronics
IER
International Tapetronics/3M Broadcasting & Related Products
Kidd Communications
Martin Audio Video Corp
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Research Associates Inc

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MULTI-DECK (contd)

Riggins Electronic Sales
S C M S Inc
Schafer World Communications Corp
Sequoia Electronics
Sono-Mag Corp
Television Technology Corp
Transcom Corp
Vaughn Communications

CASSETTE RECORDERS

AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
Electrex Co
Full Compass Systems
Bernard Gelman Associates
Guarantee Radio Supply
Hall Electronics
Holzberg Inc
IER
Kidd Communications
La Salle Audio Systems
Martin Audio Video Corp
Milam Audio Co
Nakamichi America Corp
New World Audio Express
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Research Associates Inc
Riggins Electronic Sales
S C M S Inc
Schafer World Communications Corp
Sound Com Corp
Studer Revox America Inc
Studio-Sonics Corp
TASCAM
Transcom Corp
United Audio Recording
Vaughn Communications

CD PLAYERS

AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Automation Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Century 21 Programming Inc
Control Technology Inc
Crouse-Kimzey
Denon America Inc
Electrex Co
Full Compass Systems
Bernard Gelman Associates
Gotham Audio Corp
Guarantee Radio Supply
Hall Electronics
Holzberg Inc
IER
Kidd Communications
La Salle Audio Systems
Martin Audio Video Corp
Media Touch Systems Inc
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
Ortofon Inc
PAS (Professional Audio Supply)
Panasonic - Ramsa Div
Ram Broadcast Systems Inc
Research Associates Inc
S C M S Inc
Schafer World Communications Corp
Sono-Mag Corp
Sound Com Corp
Studer Revox America Inc
Studio-Sonics Corp
TASCAM
Transcom Corp
United Audio Recording
Vaughn Communications

COMPONENTS

Broadcast Services Co

TRANSISTORS

AEG Bayly Inc
BJM Electronics Ltd
CCA Electronics Inc
D1 Products Inc
Full Compass Systems
Bernard Gelman Associates
Guarantee Radio Supply
IER
Martin Audio Video Corp
McMartin Inc
Richardson Electronics L&D
Riggins Electronic Sales
Schafer World Communications Corp

CAPACITORS

BJM Electronics Ltd
CCA Electronics Inc
D1 Products Inc
Full Compass Systems
Bernard Gelman Associates
Guarantee Radio Supply
ITT Jennings
IER
Martin Audio Video Corp
McMartin Inc
Plastic Capacitors Inc
Richardson Electronics L&D
Riggins Electronic Sales
Schafer World Communications Corp
Vector Technology Inc

RESISTORS

BJM Electronics Ltd
CCA Electronics Inc
D1 Products Inc
Full Compass Systems
Bernard Gelman Associates
Guarantee Radio Supply
IER
Martin Audio Video Corp
McMartin Inc
Schafer World Communications Corp

OTHER

BJM Electronics Ltd
Beyer Dynamic Inc
CCA Electronics Inc
Canare Cable Inc
Delta Electronics Inc
Bernard Gelman Associates
Hall Electronics
Jensen Transformers Inc
Martin Audio Video Corp
Microtran Co
Plastic Capacitors Inc
Research Associates Inc
Richardson Electronics L&D
Saki Magnetic
Vector Technology Inc

COMPUTERS

SOFTWARE & PERIPHERALS

Comprompter Inc
Data For Small Systems
Dataworld
Bernard Gelman Associates
IBSS Canada
Jensen Transformers Inc
La Salle Audio Systems
The Management
Martin Audio Video Corp
Media Computing Inc
Media Touch Systems Inc
Schafer World Communications Corp
Sound Workshop
Summit Software Systems Inc

CONSOLES

Comrex Corp
Stantron Unit of Zero Corp
Varian Continental Electronics

ON-AIR

ADM Technology Inc
ATI (Audio Technologies Inc)
AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Amek/Tac US Operations
Arrakis Systems
Audio Broadcast Group Inc
Auditronics Inc
Autogram Corp
BSW (Broadcast Supply West)
Broadcast Audio Corp
Broadcast Automation Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
D D A
DOD Electronics
H M Dyer Electronics Inc
Electrex Co
Full Compass Systems
Bernard Gelman Associates
Guarantee Radio Supply
H & E Micro-Trak
Hall Electronics
Hallikainen & Friends Inc
Harris Corp, Broadcast Div
Henry Engineering
Holzberg Inc
IBSS Canada
IER
LPB Inc
La Salle Audio Systems
Logitek
Martin Audio Video Corp
McCurdy Radio Industries
McMartin Inc
New World Audio Express
Northeast Broadcast Lab Inc
Douglas Ordon & Co Inc
PAS (Professional Audio Supply)
Pacific Recorders & Eng
Radio Design Labs
Radio Systems Design
Ram Broadcast Systems Inc
Research Associates Inc
S C M S Inc
Schafer World Communications
Sequoia Electronics
Sound Com Corp
Soundcraft
Studer Revox America Inc
Television Technology Corp
Transcom Corp
UREI
Vaughn Communications
Wheatstone Corp
Wheatstone Corp

PRODUCTION

ADM Technology Inc
AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Amek/Tac US Operations
Arrakis Systems
Audio Broadcast Group Inc
Audio Logic
Auditronics Inc
Autogram Corp
BSW (Broadcast Supply West)
Broadcast Audio Corp
Broadcast Automation Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
D D A
DOD Electronics
H M Dyer Electronics Inc
Electrex Co
Full Compass Systems
Bernard Gelman Associates

☞

PRODUCTION (Contd)

Gotham Audio Corp
Guarantee Radio Supply
H & E Micro-Trak
Hall Electronics
Harris Corp, Broadcast Div
Holzberg Inc
IER
LPB Inc
La Salle Audio Systems
Logitek
Martin Audio Video Corp
McCurdy Radio Industries
Milam Audio Co
Neotek Corp
Rupert Neve Inc
New World Audio Express
Northeast Broadcast Lab Inc
Opamp Labs Inc
Douglas Ordon & Co Inc
PAS (Professional Audio Supply)
Pacific Recorders & Eng
Radio Design Labs
Ram Broadcast Systems Inc
Research Associates Inc
Russco Electronics Mfg
S C M S Inc
Schafer World Communications
Sequoia Electronics
Sound Com Corp
Soundcraft
Studer Revox America Inc
TASCAM
Transcom Corp
United Audio Recording
Vaughn Communications
Wheatstone Corp
Zercom Corp

c CONSULTING

ENGINEERING & DESIGN SERVICES

AMP Services
AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Andrew Corp
Antenna Technology Corp
BSM Systems Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Comad Communications Ltd
Control Technology Inc
Cutting Edge Technologies
The Express Group
Full Compass Systems
R J Grandmaison, Pe
Holzberg Inc
IBSS Canada
IER
Kintronic Laboratories Inc
La Salle Audio Systems
Lawrence Behr Associates Inc
Lightning Eliminators & Consultants Inc
Milam Audio Co
Multiphase Consulting
Northeast Broadcast Lab Inc
Omega International
RPG Diffusor Systems Inc
Ram Broadcast Systems Inc
Research Associates Inc
S C M S Inc
Schafer World Communications
W Lee Simmons & Associates Inc
Sound Com Corp
Sound Workshop
Spencer Broadcast Inc
Television Technology Corp
Tennaplex Systems Ltd
Titus Technological Laboratories
United Audio Recording
Vaughn Communications
Vernier, Doug, Broadcast Cslt

c CONTRACT ENGINEERING

AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Broadcast Services Co
Comad Communications Ltd
Holzberg Inc
IBSS Canada
Intraplex Inc
LBA Technology Inc
La Salle Audio Systems
Multiphase Consulting
Northeast Broadcast Lab Inc
Research Associates Inc
Schafer World Communications
Spencer Broadcast Inc

d DAT MACHINES

AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Equipment Sales & Engineering Inc
Century 21 Programming Inc
Concept Productions
Control Technology Inc
Crouse-Kimzey
Full Compass Systems
Gotham Audio Corp
Guarantee Radio Supply
Harris Corp, Broadcast Div
IER
Kidd Communications
La Salle Audio Systems
Martin Audio Video Corp
Media Touch Systems Inc
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
Douglas Ordon & Co Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Ron Radio Communications
S C M S Inc
Schafer World Communications
Sound Com Corp
TASCAM
Transcom Corp
United Audio Recording
Vaughn Communications

d DIGITAL AUDIO WORK STATIONS

AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Audio/Digital Inc
Compusonics
Control Technology Inc
Fairlight Instruments
Full Compass Systems
Gotham Audio Corp
IBSS Canada
La Salle Audio Systems
Martin Audio Video Corp
McMartin Inc
Milam Audio Co
PAS (Professional Audio Supply)
Schafer World Communications
Studer Revox America Inc
Symetrix Inc
United Audio Recording
Vaughn Communications
Waveframe Corp

d DISTRIBUTORS

Broadcast Cartridge Service
Comex Corp
Sequoia Electronics

NATIONAL

Allied Broadcast Equipment
Amek/Tac US Operations
Audio Broadcast Group Inc
Audio Eng Assoc
Audiomedia Associates
BJM Electronics Ltd
Boynton Studio Inc
Bradley Broadcast Sales
Broadcast Equipment & Supply Co Inc
Broadcast Technology of Colorado
Broadcasters General Store
Control Technology Inc
Crouse-Kimzey
DYMA Engineering Inc
ESL Inc
Electrex Co
Electronic Industries
Funke & Assoc
Giesler Bdct Supply
Guarantee Radio Supply
Kidd Communications
LPB Inc
La Salle Audio Systems
Marathon Products
Marcom
Milam Audio Co
National Audio Co Inc
National TV Systems Co
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Parcom Inc
Ram Broadcast Systems Inc
Schafer World Communications
Spencer Broadcast Inc
United Audio Recording
VIF International

REGIONAL

AVC Systems Division of Vaughn Communications
Broadcast Equipment Sales & Engineering Inc
Control Technology Inc
Electrex Co
Guarantee Radio Supply
La Salle Audio Systems
RF Specialties of Washington Inc
S C M S Inc

d DUMMY LOADS

AEG Bayly Inc
Allied Broadcast Equipment
Altronic Research Inc
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Broadcast Electronics Inc
Broadcast Services Co
CCA Electronics Inc
Control Technology Inc
Crouse-Kimzey
Dielectric Communications
Electrex Co
Guarantee Radio Supply
Hall Electronics
Harris Corp, Broadcast Div
Holzberg Inc
Kintronic Laboratories Inc
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
S C M S Inc
Schafer World Communications
Transcom Corp
Varian Continental Electronics
Vector Technology Inc

e ENCODERS/ DECODERS

TONE & EBS EQUIPMENT

AEG Bayly Inc
Allied Broadcast Equipment
Audio Broadcast Group Inc
BSW (Broadcast Supply West)

☞

PRODUCTION (contd)

Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
H M Dyer Electronics Inc
Full Compass Systems
Gorman-Redlich Mfg Co
Guarantee Radio Supply
Hall Electronics
Holzberg Inc
Intraplex Inc
Kidd Communications
Modulation Sciences Inc
Monroe Electronics Inc
New World Audio Express
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
S C M S Inc
Schafer World Communications
TFT Inc
Vega, A Mark Iv Company

e EXCITERS

AVC Systems Division of Vaughn Communications
Full Compass Systems

AM

Allied Broadcast Equipment
Broadcast Services Co
CCA Electronics Inc
Control Technology Inc
Crouse-Kimzey
Energy-Onix Broadcast Equip Co
Guarantee Radio Supply
Hall Electronics
Harris Corp, Broadcast Div
Hirschmann Co
Holzberg Inc
Kidd Communications
McMartin Inc
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Research Associates Inc
Riggins Electronic Sales
S C M S Inc
Schafer World Communications
Transcom Corp
Vaughn Communications

AM STEREO

Allied Broadcast Equipment
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Broadcast Electronics Inc
Broadcast Services Co
CCA Electronics Inc
Control Technology Inc
Crouse-Kimzey
Delta Electronics Inc
Electrex Co
Energy-Onix Broadcast Equip Co
Guarantee Radio Supply
Hall Electronics
Hirschmann Co
Holzberg Inc
Kidd Communications
Motorola AM Stereo
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Research Associates Inc
Riggins Electronic Sales
S C M S Inc
Schafer World Communications
Sequoia Electronics
Transcom Corp
Varian Continental Electronics
Vaughn Communications

FM

AEG Bayly Inc
Allied Broadcast Equipment
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Bext Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
CCA Electronics Inc
Comad Communications Ltd
Control Technology Inc
Crouse-Kimzey
Dorrough Electronics
Elcom Bauer
Electrex Co
Energy-Onix Broadcast Equip Co
Bernard Gelman Associates
Guarantee Radio Supply
Hall Electronics
Harris Corp, Broadcast Div
Hirschmann Co
Holzberg Inc
IBSS Canada
Kidd Communications
LDL Communications Inc
McMartin Inc
Micro Controls Inc
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
QEI Corporation
Ram Broadcast Systems Inc
Research Associates Inc
Riggins Electronic Sales
S C M S Inc
Schafer World Communications
Sequoia Electronics
Television Technology Corp
Transcom Corp
Varian Continental Electronics
Vaughn Communications
Vector Technology Inc

f FIBER OPTIC PRODUCTS

Andrew Corp
Broadcast Services Co
Fort Worth Tower Co Inc
Hirschmann Co
Intraplex Inc
Vaughn Communications

h HEADPHONES HEADSETS

AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Audio-Technica U S, Inc
BJM Electronics Ltd
BSW (Broadcast Supply West)
Beyer Dynamic Inc
Boynton Studio Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
Electrex Co
Full Compass Systems
Bernard Gelman Associates
Guarantee Radio Supply
Holzberg Inc
IES
Kidd Communications
La Salle Audio Systems
Martin Audio Video Corp
Milam Audio Co
Nady Systems Inc
Nakamichi America Corp
New World Audio Express
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
R-Columbia Products Co Inc
Ram Broadcast Systems Inc
Research Associates Inc
Riggins Electronic Sales
S C M S Inc
Schafer World Communications
Sennheiser Electronic Corp
Shure Brothers Inc
Sound Com Corp
Stanton Magnetics Inc
Studio-Sonics Corp
Systems Wireless Ltd
TASCAM
Telex Communications Inc
Transcom Corp
United Audio Recording
Varian Continental Electronics
Vaughn Communications

h HEADS & REFURBISHING SERVICES

AMP Services
Audio Broadcast Group Inc
BJM Electronics Ltd
BSW (Broadcast Supply West)
Electrex Co
Guarantee Radio Supply
IES Inc
JRF Magnetic Sciences Inc
La Salle Audio Systems
Martin Audio Video Corp
Milam Audio Co
Nortronics Co Inc
Research Associates Inc
Riggins Electronic Sales
S C M S Inc
Sequoia Electronics
Sprague Magnetics Inc
United Audio Recording
Vaughn Communications

i INTERCOMS

Allied Broadcast Equipment
Atlas/Soundolier
BSW (Broadcast Supply West)
Clear-Com
Control Technology Inc
Full Compass Systems
Guarantee Radio Supply
H M Electronics Inc
Holzberg Inc
La Salle Audio Systems
Martin Audio Video Corp
McCurdy Radio Industries
New World Audio Express
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
R-Columbia Products Co Inc
Ram Broadcast Systems Inc
Sound Com Corp
Systems Wireless Ltd
Telex Communications Inc
United Audio Recording
Vega, A Mark IV Company

l LIGHTNING PROTECTION & POWER CONDITIONING

Allied Broadcast Equipment
BSW (Broadcast Supply West)
Broadcast Electronics Inc
Cortana Corp
Crouse-Kimzey
Peter W Dahl Co Inc
Electrex Co
Full Compass Systems
Guarantee Radio Supply
Holzberg Inc
Kintronic Laboratories Inc
Lightning Eliminators & Consultants Inc
PAS (Professional Audio Supply)
S C M S Inc
Schafer World Communications

m MACHINE SYNCHRONIZERS FOR ATRS

Audio Broadcast Group Inc
Control Technology Inc
Crouse-Kimzey
Full Compass Systems

☞

MACHINE (contd)

Gotham Audio Corp
Industrial Equipment Representative IER
La Salle Audio Systems
Martin Audio Video Corp
Milam Audio Co
New World Audio Express
Douglas Ordon & Co Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Research Asssociates Inc
United Audio Recording
Vaughn Communications

MICROPHONES (INCL WIRELESS) & ACCESSORIES

AKG Acoustics
AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Atlas/Soundolier
Audio Broadcast Group Inc
Audio-Technica U S, Inc
BJM Electronics Ltd
BSW (Broadcast Supply West)
Beyer Dynamic Inc
Broadcast Electronics Inc
Broadcast Services Co
Bruel & Kjaer Instruments
Control Technology Inc
Crouse-Kimzey
Electrex Co
Electro Voice Inc
Fostex Corp
Full Compass Systems
Bernard Gelman Associates
Gotham Audio Corp
Guarantee Radio Supply
H M Electronics Inc
Hall Electronics
Holzberg Inc
Industrial Equipment Representative IER
La Salle Audio Systems
Marti Electronics
Martin Audio Video Corp
Milab
Milam Audio Co
Nady Systems Inc
New World Audio Express
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Panasonic - Ramsa Div
R-Columbia Products Co Inc
Ram Broadcast Systems Inc
Research Asssociates Inc
Riggins Electronic Sales
S C M S Inc
Sennheiser Electronic Corp
Shure Brothers Inc
Sound Com Corp
Stanton Magnetics Inc
Studio-Sonics Corp
Swintek Enterprises
Systems Wireless Ltd
TASCAM
Telex Communications Inc
Transcom Corp
United Audio Recording
Varian Continental Electronics
Vaughn Communications
Vega, A Mark IV Company

MICROWAVE EQUIPMENT

Allied Broadcast Equipment
Andrew Corp
Audio Broadcast Group Inc
Broadcast Services Co
Cablewave Systems Inc
Control Technology Inc
Crouse-Kimzey
Electrex Co
Fort Worth Tower Co Inc
Bernard Gelman Associates
Guarantee Radio Supply
Hall Electronics
Hirschmann Co
Holzberg Inc
Industrial Equipment Representative IER
Kidd Communications
Marti Electronics
Micro Controls Inc
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
S C M S Inc
Schafer World Communications
Shively Labs
TFT Inc
Transcom Corp
Varian Continental Electronics

MISC

ADM Technology Inc
Dan Alexander Audio
Allied Broadcast Equipment
Antenna Technology Corp
Audico Inc
Audio Broadcast Group Inc
Audio Technologies Inc (ATI)
BJM Electronics Ltd
BSM Systems Inc
Benchmark Media Systems Inc
Broadcast Cartridge Service
Broadcast Electronics Inc
Broadcast Services Co
Broadcast Technology of Colorado
Cablewave Systems Inc
Carolina Maps
Compusonics
Comrex Corp
Connect Systems Inc
Cortana Corp
Cutting Edge Technologies
Data For Small Systems
Dataworld
Delta Electronics Inc
Dic Digital
Dolby Laboratories Inc
Dorrough Electronics
Energy-Onix Broadcast Equip Co
Eventide Inc
Fidelipac Corp
Fort Worth Tower Co Inc
Garner Industries
Gorman-Redlich Mfg Co
R J Grandmaison, Pe
Guarantee Radio Supply
Henry Engineering
Holzberg Inc
IBSS Canada
Inovonics Inc
Intraplex Inc
Jensen Transformers Inc
Kintronic Laboratories Inc
LBA Technology Inc
LDL Communications Inc
Leaming Industries
Logitek
Marti Electronics
Martin Audio Video Corp
Modulation Sciences Inc
Multiphase Consulting
Music Director Programming Service
Nady Systems Inc
Northwestern Inc
Omega International
Polyline Corp
Potomac Instruments
Radio Design Labs
Radio Systems Design
Richardson Electronics L&D
L J Scully Mfg Corp
Shively Labs
Shure Brothers Inc
Solar Signage Inc
Sound Com Corp
Sound Ideas Recording Studio
Spencer Broadcast Inc
Sprague Magnetics Inc
Stanton Magnetics Inc
Storeel Corp
Studio Technologies
Studio-Sonics Corp
Symetrix Inc
Tennaplex Systems Ltd
Tepco Corp
Titus Technological Laboratories
Vector Technology Inc
White Instruments Inc
Brian R White Co, Inc
Will-Burt/Tmd

MOBILE PROD VANS

Audio Broadcast Group Inc
Control Technology Inc
Holzberg Inc
Industrial Equipment Representative IER
La Salle Audio Systems
Ram Broadcast Systems Inc
S C M S Inc

MONITORS

Vaughn Communications

AM

Allied Broadcast Equipment
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Belar Electronics Laboratory Inc
Broadcast Electronics Inc
Broadcast Equipment Sales Engineering & Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
Delta Electronics Inc
H M Dyer Electronics Inc
Electrex Co
Full Compass Systems
Bernard Gelman Associates
Guarantee Radio Supply
Hall Electronics
Harris Corp, Broadcast Div
Holzberg Inc
Industrial Equipment Representative IER
Kidd Communications
McMartin Inc
Motorola Am Stereo
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Potomac Instruments
Ram Broadcast Systems Inc
Research Asssociates Inc
Richardson Electronics L&D
S C M S Inc
Schafer World Communications
TFT Inc
Transcom Corp
Varian Continental Electronics

FM

Allied Broadcast Equipment
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Belar Electronics Laboratory Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Inc
Broadcast Services Co
Comad Communications Ltd
Control Technology Inc
Crouse-Kimzey
Dayton Industrial Corp/Fox
H M Dyer Electronics Inc
Electrex Co
Full Compass Systems
Bernard Gelman Associates
Guarantee Radio Supply
Hall Electronics
Holzberg Inc
Industrial Equipment Representative IER
Kidd Communications
McMartin Industries
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
QEI Corporation
Radio Design Labs
Ram Broadcast Systems Inc
Research Associates Inc

FM (contd)

Richardson Electronics L&D
S C M S Inc
Schafer World Communications
TFT Inc
Transcom Corp
Varian Continental Electronics

MUSIC LIBRARIES

Century 21 Programming Inc
Creative Support Services
La Salle Audio Systems
Music Director Programming Service
Schafer World Communications
Sound Ideas Recording Studio
Vaughn Communications

NOISE REDUCTION EQUIPMENT

ANT Telecommunications Inc
AVC Systems Division of Vaughn Communications
Acoustic Systems
Allied Broadcast Equipment
Audio Broadcast Group Inc
Audio Logic
BSW (Broadcast Supply West)
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
dbx Inc
Dolby Laboratories Inc
Electrex Co
Full Compass Systems
Gotham Audio Corp
Guarantee Radio Supply
Hall Electronics
Holzberg Inc
Industrial Equipment Representative IER
La Salle Audio Systems
Marti Electronics
Martin Audio Video Corp
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
Douglas Ordon & Co Inc
PAS (Professional Audio Supply)
Pacific Recorders & Eng
Ram Broadcast Systems Inc
Research Asssociates Inc
S C M S Inc
Sound Com Corp
Symetrix Inc
Transcom Corp
United Audio Recording
Vaughn Communications

PATCH PANELS, JACKS, PLUGS, CONNECTORS

AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Audio Accessories Inc
BJM Electronics Ltd
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Electronics Inc
Broadcast Services Co
Canare Cable Inc
Connectronics Corp
Control Technology Inc
Crouse-Kimzey
Dielectric Communications
Electrex Co
Full Compass Systems
Bernard Gelman Associates
Guarantee Radio Supply
Hall Electronics
Holzberg Inc
Industrial Equipment Representative IER
Kidd Communications
Kintronic Laboratories Inc
La Salle Audio Systems
Martin Audio Video Corp
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Pacific Recorders & Eng
Ram Broadcast Systems Inc
Research Asssociates Inc
Riggins Electronic Sales
S C M S Inc
Shively Labs
Sound Com Corp
Studio-Sonics Corp
Switchcraft Inc
Symetrix Inc
United Audio Recording
Vaughn Communications
Zercom Corp

PHASORS

Allied Broadcast Equipment
BSW (Broadcast Supply West)
Energy-Onix Broadcast Equip Co
Guarantee Radio Supply
Harris Corp, Broadcast Div
Holzberg Inc
Industrial Equipment Representative IER
Kintronic Laboratories Inc
Martin Audio Video Corp
Milam Audio Co
Northeast Broadcast Lab Inc
Ram Broadcast Systems Inc
Varian Continental Electronics
Vector Technology Inc

PHONO CARTRIDGES

AKG Acoustics
AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Audio Broadcast Group Inc
Audio-Technica U S, Inc
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
Electrex Co
Full Compass Systems
Gotham Audio Corp
Guarantee Radio Supply
H & E Micro-Trak
Holzberg Inc
Industrial Equipment Representative IER
Kidd Communications
La Salle Audio Systems
Lyle Cartridges
Martin Audio Video Corp
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
Ortofon Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Research Asssociates Inc
Riggins Electronic Sales
S C M S Inc
Schafer World Communications
Shure Brothers Inc
Sound Com Corp
Stanton Magnetics Inc
Transcom Corp
United Audio Recording
Vaughn Communications

TURNTABLES & TONE ARMS

AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
Electrex Co
Full Compass Systems
Bernard Gelman Associates
Gotham Audio Corp
Guarantee Radio Supply
H & E Micro-Trak
Hall Electronics
Holzberg Inc
Industrial Equipment Representative IER
Kidd Communications
La Salle Audio Systems
Martin Audio Video Corp
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Research Asssociates Inc
Riggins Electronic Sales
Russco Electronics Mfg
S C M S Inc
Schafer World Communications
Sequoia Electronics
Sound Com Corp
Transcom Corp
United Audio Recording
Vaughn Communications

POWER SUPPLIES

Allied Broadcast Equipment
BSW (Broadcast Supply West)
Benchmark Media Systems Inc
Full Compass Systems
Guarantee Radio Supply
Holzberg Inc
Industrial Equipment Representative IER
Martin Audio Video Corp
McMartin Inc
Opamp Labs Inc
PAS (Professional Audio Supply)
Plastic Capacitors Inc
Ram Broadcast Systems Inc
Schafer World Communications
Solar Signage Inc
Spectra Sonics
Vaughn Communications

PROCESSING

S C M S Inc
Varian Continental Electronics

AUDIO EQ AND LIMITING

ADM Technology Inc
AKG Acoustics
ATI (Audio Technologies Inc)
AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Amek/Tac US Operations
Aphex Systems Ltd

☞

AUDIO EQ (contd)

Audio Broadcast Group Inc
Audio Logic
Audio/Digital Inc
BSW (Broadcast Supply West)
Beyer Dynamic Inc
Boynton Studio Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
CRL
Control Technology Inc
Crouse-Kimzey
Cutting Edge Technologies
DOD Electronics
Delta Electronics Inc
Dorrough Electronics
Elcom Bauer
Electrex Co
Full Compass Systems
Bernard Gelman Associates
Gotham Audio Corp
Guarantee Radio Supply
Hall Electronics
Hnat-Hindes
Holzberg Inc
IBSS Canada
Industrial Equipment Representative IER
Inovonics Inc
Intraplex Inc
Kidd Communications
Klark-Teknik Electronics
La Salle Audio Systems
Lexicon Inc
Martin Audio Video Corp
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
Opamp Labs Inc
Orban Associates Inc
PAS (Professional Audio Supply)
QSC Audio Products
Ram Broadcast Systems Inc
Research Asssociates Inc
Schafer World Communications
Sequoia Electronics
Sescom Inc
Shure Brothers Inc
Sound Com Corp
Sound Workshop
Spectra Sonics
Studio-Sonics Corp
Symetrix Inc
TASCAM
Transcom Corp
United Audio Recording
Vaughn Communications
Wheatstone Corp
White Instruments Inc

STUDIO EFFECTS

AKG Acoustics
AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Audio Broadcast Group Inc
Audio Logic
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
Digitech
Electrex Co
Eventide Inc
Full Compass Systems
Bernard Gelman Associates
Gotham Audio Corp
Guarantee Radio Supply
Hall Electronics
Hnat-Hindes
Holzberg Inc
Industrial Equipment Representative IER
Kidd Communications
Klark-Teknik Electronics
La Salle Audio Systems
Lexicon Inc
Martin Audio Video Corp
Milam Audio Co
Modulation Sciences Inc
New World Audio Express
Northeast Broadcast Lab Inc
Orban Associates Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Research Asssociates Inc
Schafer World Communications
Sound Com Corp
Spectra Sonics
Studio-Sonics Corp
Transcom Corp
United Audio Recording
Vaughn Communications
White Instruments Inc

PROGRAMMING

DISTRIBUTORS AND SERVICES

Century 21 Programming Inc
Concept Productions
Music Director Programming Service
Schafer World Communications

PROMOTION

MATERIALS AND SERVICES

Schafer World Communications

PA SYSTEMS AVC

Systems Division of Vaughn Communications
Atlas/Soundolier
Broadcast Equipment Sales & Engineering Inc
Control Technology Inc
Crouse-Kimzey Electrex Co
Guarantee Radio Supply
Hall Electronics
JBL Professional
La Salle Audio Systems
McMartin Inc
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Research Asssociates Inc
Schafer World Communications
Shure Brothers Inc
Sound Com Corp
Vaughn Communications

RF FILTERS

Beyer Dynamic Inc
Broadcast Electronics Inc
CCA Electronics Inc
Delta Electronics Inc
Dielectric Communications
Electrex Co
Energy-Onix
Broadcast Equip Co
Bernard Gelman Associates
Guarantee Radio Supply
Hall Electronics
Hirschmann Co
Industrial Equipment Representatives IER
Jampro Antennas Inc
Kidd Communications
Kintronic Laboratories Inc
Leaming Industries
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Schafer World Communications
Shively Labs
Tepco Corp
Varian Continental Electronics
Vector Technology Inc

RECEIVERS

RADIO

Allied Broadcast Equipment
Antenna Technology Corp
BSW (Broadcast Supply West)
Control Technology Inc
Crouse-Kimzey
D1 Products Inc
Dayton Industrial Corp/Fox
Erko Technologies
Guarantee Radio Supply
Holzberg Inc
Johnson Electronics
Kidd Communications
Marti Electronics
McMartin Inc
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Research Asssociates Inc
S C M S Inc
Sound Com Corp
Studer Revox America Inc

SATELLITE

Allied Broadcast Equipment
Andrew Corp Broadcast Services Co
Dayton Industrial Corp/Fox
Erko Technologies
Guarantee Radio Supply
Hirschmann Co
Holzberg Inc
Intraplex Inc
Ram Broadcast Systems Inc
Schafer World Communications
Scientific Atlanta Inc
Wegener Communications

SCA

Allied Broadcast Equipment
Applied Micro Technology
BSW (Broadcast Supply West)
Broadcast Equipment Sales & Engineering Inc
Broadcast Technology of Colorado
Control Technology Inc
Crouse-Kimzey
Dayton Industrial Corp/Fox
Electrex Co
Erko Technologies
Guarantee Radio Supply
Holzberg Inc
Industrial Equipment Representatives IER
Johnson Electronics
Marti Electronics
McMartin Inc
Micro Controls Inc
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Research Asssociates Inc
S C M S Inc
Sound Com Corp

REEL-TO-REEL RECORDERS

AEG Bayly Inc
AMP Services
AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Automation Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
Electrex Co
Fostex Corp
Full Compass Systems
Gotham Audio Corp

☞

RECORDERS (contd)

Guarantee Radio Supply
Hall Electronics
Holzberg Inc
Industrial Equipment Representatives IER
Inovonics Inc
Kidd Communications
La Salle Audio Systems
Martin Audio Video Corp
Milam Audio Co
Nagra Magnetic Recorders Inc
New World Audio Express
Northeast Broadcast Lab Inc
Otari Corp
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Research Asssociates Inc
Riggins Electronic Sales
S C M S Inc
Schafer World Communications
L J Scully Mfg Corp
Sequoia Electronics
Sound Com Corp
Studer Revox America Inc
Studio-Sonics Corp
TASCAM
Television Technology Corp
Transcom Corp
United Audio Recording
Vaughn Communications

REMOTE CONTROL & TELEMETRY

Advance Micro-Dynamics Inc
Allied Broadcast Equipment
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Broadcast Automation Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey Delta Electronics Inc
H M Dyer Electronics Inc
Electrex Co
Bernard Gelman Associates
Guarantee Radio Supply
Hall Electronics
Hallikainen & Friends Inc
Henry Engineering
Holzberg Inc
Industrial Equipment Representatives IER
Johnson Electronics
Marti Electronics
Micro Controls Inc
Monroe Electronics Inc
Moseley Associates Inc
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Potomac Instruments
QEI Corporation
Ram Broadcast Systems Inc
S C M S Inc
Schafer World Communications
Solar Signage Inc
TFT Inc
Transcom Corp
Varian Continental Electronics
Vega, A Mark IV Company

REMOTE PICKUP GEAR

Allied Broadcast Equipment
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Broadcast Automation Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey Electrex Co
Guarantee Radio Supply
H & E Micro-Trak
Holzberg Inc
Industrial Equipment Representatives IER
Moseley Associates Inc
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Riggins Electronic Sales
S C M S Inc
Schafer World Communications
Sound Com Corp
TFT Inc

SCA EQUIPMENT

AEG Bayly Inc
Advance Micro-Dynamics Inc
Allied Broadcast Equipment
Applied Micro Technology
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Broadcast Technology of Colorado
Control Technology Inc
Crouse-Kimzey
Dayton Industrial Corp/Fox
H M Dyer Electronics Inc
Electrex Co
Erko Technologies
Bernard Gelman Associates
Guarantee Radio Supply
Hall Electronics
Holzberg Inc
Industrial Equipment Representatives IER
Johnson Electronics
Micro Controls Inc
Modulation Sciences Inc
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Riggins Electronic Sales
S C M S Inc
Schafer World Communications
TFT Inc
Tennaplex Systems Ltd
Transcom Corp
Varian Continental Electronics

STL SYSTEMS

Advance Micro-Dynamics Inc
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Bext Inc
Broadcast Automation Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Cablewave Systems Inc
Comad Communications Ltd
Control Technology Inc
Crouse-Kimzey
H M Dyer Electronics Inc
Electrex Co
Bernard Gelman Associates
Guarantee Radio Supply
Hall Electronics
Holzberg Inc
Industrial Equipment Representatives IER
Intraplex Inc
Leaming Industries
Micro Controls Inc
Modulation Sciences Inc
Moseley Associates Inc
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
S C M S Inc
Schafer World Communications
Sound Com Corp
TFT Inc
Transcom Corp
Varian Continental Electronics
Wegener Communications

SATELLITE EQUIPMENT

Control Technology Inc

ANTENNAS

Allied Broadcast Equipment
Andrew Corp
Antenna Technology Corp
Broadcast Services Co
Guarantee Radio Supply
Hirschmann Co
Holzberg Inc
Industrial Equipment Representatives IER
Microtime Inc
Ram Broadcast Systems Inc
S C M S Inc
Schafer World Communications
Scientific Atlanta Inc
Wegener Communications

ELECTRONICS

Allied Broadcast Equipment
Andrew Corp Broadcast Equipment Sales & Inc
Engineering Broadcast Services Co
Broadcast Technology of Colorado
Dayton Industrial Corp/Fox
Guarantee Radio Supply
Hirschmann Co
Industrial Equipment Representatives IER
Intraplex Inc
Leaming Industries
Modulation Associates Inc
Ram Broadcast Systems Inc
S C M S Inc
Schafer World Communications
Scientific Atlanta Inc
Wegener Communications

SECURITY EQUIPMENT

Atlas/Soundolier
Guarantee Radio Supply
Holzberg Inc
Schafer World Communications
Sound Com Corp

SPEAKERS & ENCLOSURES

AVC Systems Division Of Vaughn Communications
Allied Broadcast Equipment
Atlas/Soundolier
Audio Broadcast Group Inc
Audisar Inc
Auratone Corp
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
D1 Products Inc
Electrex Co
Electro Voice Inc
Full Compass Systems
Gotham Audio Corp
Guarantee Radio Supply
Hall Electronics
Holzberg Inc
Industrial Equipment Representatives IER
JBL Professional
Kidd Communications
La Salle Audio Systems
Logitek
Martin Audio Video Corp
McCurdy Radio Industries
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
Douglas Ordon & Co Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc

SPEAKERS (contd)

Research Asssociates Inc
Riggins Electronic Sales
S C M S Inc
Schafer World Communications
Shure Brothers Inc
Sound Com Corp
Spectra Sonics
Studer Revox America Inc
Studio-Sonics Corp
Tannoy North America Inc
Transcom Corp
United Audio Recording
UREI
Varian Continental Electronics
Vaughn Communications

ADM Technology Inc
ATI (Audio Technologies Inc)
AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Audio Broadcast Group Inc
BSM Systems Inc
BSW (Broadcast Supply West)
Benchmark Media Systems Inc
Broadcast Electronics Inc
Broadcast Services Co
Comad Communications Ltd
Control Technology Inc
Crouse-Kimzey
Di-Tech Inc
H M Dyer Electronics Inc
Electrex Co
Full Compass Systems
Guarantee Radio Supply
Hall Electronics
Holzberg Inc
Industrial Equipment Representatives IER
International Tapetronics/3M Broadcasting & Related Products
La Salle Audio Systems
Logitek Martin
Audio Video Corp
Media Touch Systems Inc
Milam Audio Co
Moseley Associates Inc
New World Audio Express
Northeast Broadcast Lab Inc
Opamp Labs Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Ramko Research
Research Asssociates Inc
S C M S Inc
Sound Com Corp
Sound Workshop
Titus Technological Laboratories
United Audio Recording
Vaughn Communications
Wheatstone Corp

Dic Digital
Schafer World Communications

CARTS

AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Audio Broadcast Group Inc
Audiomedia Associates
Audiopak Inc
BJM Electronics Ltd
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Cartridge Service
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey Electrex Co
Fidelipac Corp
Full Compass Systems
Bernard Gelman Associates
Guarantee Radio Supply
Holzberg Inc
Industrial Equipment Representatives IER
International Tapetronics/3M Broadcasting & Related Products
Kidd Communications
La Salle Audio Systems
Marathon Products
Martin Audio Video Corp
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
Northwestern Inc
PAS (Professional Audio Supply)
Panasonic - Ramsa Div Ram Broadcast Systems Inc
Research Asssociates Inc
Riggins Electronic Sales
S C M S Inc
Sequoia Electronics
Stantron Unit of Zero Corp
United Audio Recording
Vaughn Communications

CLEANERS, ERASERS, & EVALUATORS

AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
BJM Electronics Ltd
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
Fidelipac Corp
Full Compass Systems
Guarantee Radio Supply
Holzberg Inc
Industrial Equipment Representatives IER
International Tapetronics/3M Broadcasting & Related Products
La Salle Audio Systems
Martin Audio Video Corp
Microtran Co
New World Audio Express
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Panasonic - Ramsa Div
Ram Broadcast Systems Inc
Research Asssociates Inc
Riggins Electronic Sales
S C M S Inc
Schafer World Communications
Sequoia Electronics
Sprague Magnetics Inc
Studio-Sonics Corp
United Audio Recording
Vaughn Communications

DUPLICATORS

AMP Services
AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Audio Broadcast Group Inc
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
Electrex Co
Full Compass Systems
Guarantee Radio Supply
Hall Electronics
Holzberg Inc
Inovonics Inc
La Salle Audio Systems
Martin Audio Video Corp
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
Otari Corp
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
S C M S Inc
Sound Com Corp
TASCAM
Telex Communications Inc
United Audio Recording
Vaughn Communications

REEL-TO-REEL

AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
Ampex Corp Magnetic Tape Div
Audio Broadcast Group Inc
BJM Electronics Ltd
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Cartridge Service
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
Electrex Co
Full Compass Systems
Guarantee Radio Supply
Holzberg Inc
Industrial Equipment Representatives IER
La Salle Audio Systems
Martin Audio Video Corp
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
Northwestern Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Research Asssociates Inc
Riggins Electronic Sales
S C M S Inc
TASCAM
United Audio Recording
Vaughn Communications

HYBRIDS

AEG Bayly Inc
Allied Broadcast Equipment
BSW (Broadcast Supply West)
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Comrex Corp
Control Technology Inc
Crouse-Kimzey
Electrex Co
Gentner Electronics Corp
Gotham Audio Corp
Hall Electronics
Henry Engineering
Holzberg Inc
Industrial Equipment Representatives IER
Kidd Communications
La Salle Audio Systems
Martin Audio Video Corp
Microtran Co
New World Audio Express
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Research Asssociates Inc
Russco Electronics Mfg
S C M S Inc
Sound Com Corp
Studer Revox America Inc
Symetrix Inc

BANDWIDTH EXTENDERS

Allied Broadcast Equipment
BSW (Broadcast Supply West)
Broadcast Services Co
Comrex Corp
Control Technology Inc
Crouse-Kimzey
Electrex Co
Holzberg Inc
Industrial Equipment Representatives IER
Martin Audio Video Corp
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
S C M S Inc
Zercom Corp

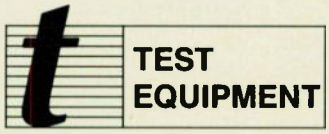
OTHER

Advance Micro-Dynamics Inc
Allied Broadcast Equipment
Benchmark Media Systems Inc
Broadcast Services Co
Comrex Corp

☞

OTHER (contd)

Gentner Electronics Corp
H & E Micro-Trak
Hall Electronics
Henry Engineering
Intraplex Inc
Nady Systems Inc
Russco Electronics Mfg
Stainless Inc
Zercom Corp



AVC Systems Division of Vaughn Communications

DISTORTION ANALYZERS

Allied Broadcast Equipment
Amber Electro Design
BJM Electronics Ltd
BSW (Broadcast Supply West)
Bruel & Kjaer Instruments
Crouse-Kimzey
Electrex Co
Full Compass Systems
Bernard Gelman Associates
Guarantee Radio Supply
Hall Electronics
Holzberg Inc
Industrial Equipment Representatives IER
Kidd Communications
Leader Instruments Corp
Northeast Broadcast Lab Inc
Douglas Ordon & Co Inc
Potomac Instruments
Ram Broadcast Systems Inc
S C M S Inc
Sound Technology
TFT Inc

OSCILLOSCOPES

Allied Broadcast Equipment
B & K Precision
BJM Electronics Ltd
BSW (Broadcast Supply West)
Electrex Co
Full Compass Systems
Bernard Gelman Associates
Guarantee Radio Supply
Hall Electronics
Holzberg Inc
Industrial Equipment Representatives IER
Leader Instruments Corp
Martin Audio Video Corp
Northeast Broadcast Lab Inc
Ram Broadcast Systems Inc
S C M S Inc

RF RADIATION TEST GEAR

Full Compass Systems
Guarantee Radio Supply
Hirschmann Co
Holaday Industries Inc
Holzberg Inc
Industrial Equipment Representatives IER
Leader Instruments Corp
Potomac Instruments
Ram Broadcast Systems Inc
S C M S Inc
Schafer World Communications

SPECTRUM ANALYZERS

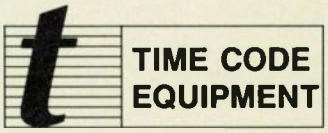
Amber Electro Design
BSW (Broadcast Supply West)
Bruel & Kjaer Instruments
Crouse-Kimzey
Full Compass Systems
Bernard Gelman Associates
Goldline
Guarantee Radio Supply
Holzberg Inc
Industrial Equipment Representatives IER
IVIE Electronics Inc
La Salle Audio Systems
Leader Instruments Corp
Martin Audio Video Corp
Ram Broadcast Systems Inc
S C M S Inc
Sound Technology

TEST SYSTEMS

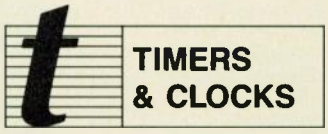
Amber Electro Design
BSW (Broadcast Supply West)
Bruel & Kjaer Instruments
Crouse-Kimzey
Dorrough Electronics
Full Compass Systems
Guarantee Radio Supply
Hirschmann Co
Holzberg Inc
Industrial Equipment Representatives IER
La Salle Audio Systems
Leader Instruments Corp
Modulation Sciences Inc
Northeast Broadcast Lab Inc
Douglas Ordon & Co Inc
Ram Broadcast Systems Inc
S C M S Inc
Sound Technology
TFT Inc

OTHER

Benchmark Media Systems Inc
Broadcast Electronics Inc
Broadcast Technology of Colorado
Burlington Audio/Video Tapes Inc
D1 Products Inc
Delta Electronics Inc
Denon America Inc
Fidelipac Corp
Full Compass Systems
Gotham Audio Corp
Johnson Electronics
Magnetic Reference Lab
McCurdy Radio Industries
Opamp Labs Inc
Potomac Instruments
Radio Design Labs
Sescom Inc
Spectra Sonics
Standard Tape Laboratory Inc
Tennaplex Systems Ltd
Tentel Corp
Titus Technological Laboratories
White Instruments Inc

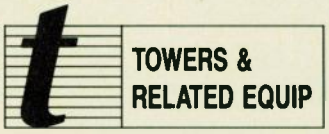


AVC Systems Division of Vaughn Communications
Aphex Systems Ltd
Audio Broadcast Group Inc
Boynton Studio Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
H M Dyer Electronics Inc
Full Compass Systems
Gotham Audio Corp
Holzberg Inc
La Salle Audio Systems
Martin Audio Video Corp
Milam Audio Co
New World Audio Express
Douglas Ordon & Co Inc
Otari Corp
Ram Broadcast Systems Inc
Research Asssociates Inc
Sequoia Electronics
Studer Revox America Inc
TASCAM
United Audio Recording
Vaughn Communications



Allied Broadcast Equipment
Audio Broadcast Group Inc
Autogram Corp
BSW (Broadcast Supply West)
Boynton Studio Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
Control Technology Inc
Crouse-Kimzey
H M Dyer Electronics Inc
ESE
Electrex Co
Guarantee Radio Supply
Hall Electronics
Holzberg Inc
Industrial Equipment Representatives IER
Martin Audio Video Corp
McCurdy Radio Industries
Monroe Electronics Inc
New World Audio Express
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
S C M S Inc
Schafer World Communications
Sequoia Electronics
Sound Com Corp
Vaughn Communications

BJM Electronics Ltd
BSW (Broadcast Supply West)
Industrial Equipment Representatives IER
Martin Audio Video Corp
Sequoia Electronics
Vertigo Recording
Brian R White Co Inc



Harris Corp, Broadcast Div
PAS (Professional Audio Supply)

GUYS

Andrew Corp
Electrex Co
Express Tower Co Inc
Fort Worth Tower Co Inc
Guarantee Radio Supply
Holzberg Inc
Industrial Equipment Representatives IER
LDL Communications Inc
Northeast Broadcast Lab Inc
Fred A Nudo Corp
Ram Broadcast Systems Inc
Research Associates Inc
Southern Tower Service Co

LIGHTS

Andrew Corp
BSW (Broadcast Supply West)
Electrex Co
Express Tower Co Inc
Flash Technology
Fort Worth Tower Co Inc
Guarantee Radio Supply
Holzberg Inc
Industrial Equipment Representatives IER
LDL Communications Inc
Northeast Broadcast Lab Inc
Fred A Nudo Corp
Ram Broadcast Systems Inc
Research Associates Inc
Southern Tower Service Co
Varian Continental Electronics

TOWERS

Andrew Corp
BSW (Broadcast Supply West)
Electrex Co
Express Tower Co Inc
Fort Worth Tower Co Inc
Guarantee Radio Supply
Holzberg Inc
Industrial Equipment Representatives IER
LDL Communications Inc
Northeast Broadcast Lab Inc
Fred A Nudo Corp
Ram Broadcast Systems Inc
Research Associates Inc

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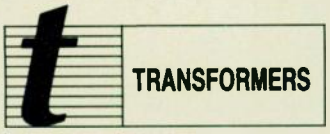
TOWERS (contd)

Schafer World Communications
Southern Tower Service Co
Telex Communications Inc
Varian Continental Electronics
Will-Burt/TMD

TOWER SERVICES

Andrew Corp
Express Tower Co Inc
Fort Worth Tower Co Inc
Holzberg Inc
Industrial Equipment Representatives IER
LDL Communications Inc
Multiphase Consulting
Fred A Nudo Corp
Southern Tower Service Co



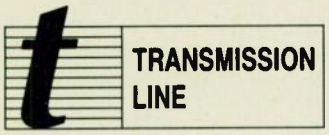
Peter W Dahl Co Inc
PAS (Professional Audio Supply)

AUDIO

Audisar Inc
BJM Electronics Ltd
Beyer Dynamic Inc
CCA Electronics Inc
D1 Products Inc
Electrex Co
Full Compass Systems
Guarantee Radio Supply
Hall Electronics
Industrial Equipment Representatives IER
Jensen Transformers Inc
Martin Audio Video Corp
Microtran Co
Opamp Labs Inc
Ram Broadcast Systems Inc
Research Associates Inc
Riggins Electronic Sales
Schafer World Communications
Sescom Inc
Shure Brothers Inc
Sound Com Corp
Spectra Sonics

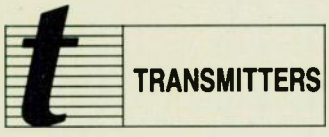
RF

BJM Electronics Ltd
CCA Electronics Inc
D1 Products Inc
Delta Electronics Inc
Dielectric Communications
Electrex Co
Full Compass Systems
Bernard Gelman Associates
Guarantee Radio Supply
Industrial Equipment Representatives IER
Ram Broadcast Systems Inc
Schafer World Communications
Vector Technology Inc



FLEXIBLE CABLE, WAVEGUIDE

Allied Broadcast Equipment
Andrew Corp
Audio Broadcast Group Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Cablewave Systems Inc
Celwave
Control Technology Inc
Crouse-Kimzey
Dielectric Communications
Electrex Co
Guarantee Radio Supply
Hall Electronics
Hirschmann Co
Holzberg Inc
Industrial Equipment Representatives IER
Jampro Antennas Inc
Kidd Communications
LDL Communications Inc
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
Ram Broadcast Systems Inc
Research Associates Inc
S C M S Inc
Scala Electronic Corp
Schafer World Communications
Shively Labs
Southern Tower Service Co
Tennaplex Systems Ltd
Transcom Corp
Varian Continental Electronics



AEG Corp
BSW (Broadcast Supply West)

AM

ALL POWER LEVELS
Allied Broadcast Equipment
Control Technology Inc
IBSS Canada
Industrial Equipment
Northeast Broadcast Lab Inc
S C M S Inc
Schafer World Communications
Spencer Broadcast Inc

UNDER 100 W
CCA Electronics Inc
Energy-Onix Broadcast Equip Co
Hirschmann Co
Holzberg Inc
Kidd Communications
LPB Inc
PAS
Ram Broadcast Systems Inc
Riggins Electronic Sales
Television Technology Corp
Transcom Corp
Vector Technology Inc

101 W - 1 kW
Audio Broadcast Group Inc
CCA Electronics Inc
Elcom Bauer
Electrex Co
Energy-Onix Broadcast Equip Co
Bernard Gelman Associates
Harris Corp, Broadcast Div
Hirschmann Co
Holzberg Inc
Kidd Communications
LPB Inc
PAS
Ram Broadcast Systems Inc
Riggins Electronic Sales
Television Technology Corp
Transcom Corp
Varian Continental Electronics
Vector Technology Inc

1.01 kW - 10 kW
Audio Broadcast Group Inc
CCA Electronics Inc
Elcom Bauer
Electrex Co
Energy-Onix Broadcast Equip Co
Bernard Gelman Associates
Harris Corp, Broadcast Div
Hirschmann Co
Holzberg Inc
Kidd Communications
PAS
Ram Broadcast Systems Inc
Riggins Electronic Sales
Television Technology Corp
Transcom Corp
Varian Continental Electronics
Vector Technology Inc

10.1 kW - 50 kW
Audio Broadcast Group Inc
CCA Electronics Inc
Elcom Bauer
Electrex Co
Energy-Onix Broadcast Equip Co
Bernard Gelman Associates
Guarantee Radio Supply
Harris Corp, Broadcast Div
Holzberg Inc
Kidd Communications
PAS
Ram Broadcast Systems Inc
Research Associates Inc
Television Technology Corp
Transcom Corp
Varian Continental Electronics
Vector Technology Inc

50.01 kW - 100 kW
CCA Electronics Inc
Energy-Onix Broadcast Equip Co
Harris Corp, Broadcast Div
Kidd Communications
PAS
Transcom Corp
Varian Continental Electronics

100 kW+)
Kidd Communications
PAS
Transcom Corp
Varian Continental Electronics

FM

UNDER 100 W
Audio Broadcast Group Inc
Bext Inc
CCA Electronics Inc
Comad Communications Ltd
Crouse-Kimzey
Elcom Bauer
Energy-Onix Broadcast Equip Co
Bernard Gelman Associates
Harris Corp, Broadcast Div
Hirschmann Co
Kidd Communications
PAS
QEI Corporation
Ram Broadcast Systems Inc
Riggins Electronic Sales
Television Technology Corp
Transcom Corp
Varian Continental Electronics

101 W - 1 kW
AEG Bayly Inc
Audio Broadcast Group Inc
Bext Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering
CCA Electronics Inc
Comad Communications Ltd
Crouse-Kimzey
Elcom Bauer
Electrex Co
Energy-Onix Broadcast Equip Co
Bernard Gelman Associates
Harris Corp, Broadcast Div
Hirschmann Co
Kidd Communications
PAS
QEI Corporation
Ram Broadcast Systems Inc
Riggins Electronic Sales
Television Technology Corp
Transcom Corp
Varian Continental Electronics

1.01 kW - 10 kW
AEG Bayly Inc
Audio Broadcast Group Inc
Bext Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering
CCA Electronics Inc
Comad Communications Ltd
Crouse-Kimzey
Elcom Bauer
Electrex Co
Energy-Onix Broadcast Equip Co
Bernard Gelman Associates
Harris Corp, Broadcast Div
Hirschmann Co
Kidd Communications
PAS
QEI Corporation
Ram Broadcast Systems Inc
Television Technology Corp
Transcom Corp
Varian Continental Electronics

10.1 kW - 50 kW
Audio Broadcast Group Inc
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering
CCA Electronics Inc
Comad Communications Ltd
Crouse-Kimzey
Elcom Bauer
Electrex Co
Energy-Onix Broadcast Equip Co
Bernard Gelman Associates
Guarantee Radio Supply

FM 10.1 kW - 50 kW (contd)

Harris Corp, Broadcast Div
Hirschmann Co
Holzberg Inc
Kidd Communications
LDL Communications Inc
PAS
QEI Corporation
Ram Broadcast Systems Inc
Research Associates Inc
Television Technology Corp
Transcom Corp
Varian Continental Electronics

50.01 kW - 100 kW

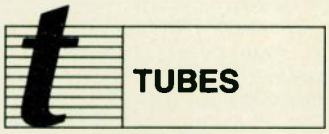
Broadcast Electronics Inc
CCA Electronics Inc
Crouse-Kimzey
Energy-Onix Broadcast Equip Co
Harris Corp, Broadcast Div
Kidd Communications
PAS
Ram Broadcast Systems Inc
Transcom Corp
Varian Continental Electronics

100 kW+

Crouse-Kimzey
Kidd Communications
PAS
Transcom Corp

CARRIER CURRENT

Energy-Onix Broadcast Equip Co
Guarantee Radio Supply
LPB Inc



TRANSMITTING

BSW (Broadcast Supply West)
Broadcast Electronics Inc
CCA Electronics Inc
Eimac Div of Varian
Electrex Co
Freeland Products Inc
Bernard Gelman Associates
Guarantee Radio Supply
Hirschmann Co
Holzberg Inc
Industrial Equipment Representatives IER
PAS (Professional Audio Supply)
Richardson Electronics L&D
Schafer World Communications
Varian Continental Electronics

RECEIVING

CCA Electronics Inc
Electrex Co
Guarantee Radio Supply
Holzberg Inc
Industrial Equipment Representatives IER
Martin Audio Video Corp
PAS (Professional Audio Supply)
Richardson Electronics L&D

AUDIO

AVC Systems Division ofVaughn Communications
Allied Broadcast Equipment
BJM Electronics Ltd
BSW (Broadcast Supply West)
Benchmark Media Systems Inc
Beyer Dynamic Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
CCA Electronics Inc
Canare Cable Inc
Connectronics Corp
Crouse-Kimzey
Electrex Co
Full Compass Systems
Guarantee Radio Supply
Hall Electronics
Industrial Equipment Representatives IER
La Salle Audio Systems
Martin Audio Video Corp
Milam Audio Co
New World Audio Express
Northeast Broadcast Lab Inc
PAS (Professional Audio Supply)
S C M S Inc
Schafer World Communications
Sound Com Corp
Vaughn Communications

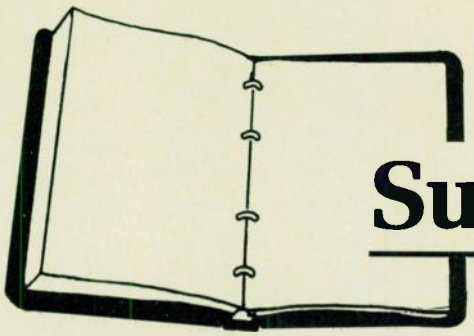
COAX

AVC Systems Division of Vaughn Communications
Allied Broadcast Equipment
BJM Electronics Ltd
BSW (Broadcast Supply West)
Belden Electronic Wire & Cable
Broadcast Electronics Inc
Broadcast Equipment Sales & Engineering Inc
Broadcast Services Co
CCA Electronics Inc
Canare Cable Inc
Connectronics Corp
Crouse-Kimzey
Electrex Co
Full Compass Systems
Guarantee Radio Supply
Hall Electronics
Industrial Equipment Representatives IER
Martin Audio Video Corp
New World Audio Express
Northeast Broadcast Lab Inc
S C M S Inc
Scala Electronic Corp
Schafer World Communications
Tennaplex Systems Ltd
Vaughn Communications

CONVERSION CHART

Powers of Two		
0	1	
1	2	
2	4	
3	8	
4	16	
5	32	
6	64	
7	128	
8	256	
9	512	
10	1,024	$\cong 1.02 \times 10^3$
11	2,048	$\cong 2.04 \times 10^3$
12	4,096	$\cong 4.09 \times 10^3$
13	8,192	$\cong 8.19 \times 10^3$
14	16,384	$\cong 1.63 \times 10^4$
15	32,768	$\cong 3.27 \times 10^4$
16	65,536	$\cong 6.55 \times 10^4$
17	131,072	$\cong 1.31 \times 10^5$
18	262,144	$\cong 2.62 \times 10^5$
19	524,288	$\cong 5.24 \times 10^5$
20	1,048,576	$\cong 1.04 \times 10^6$
21	2,097,152	$\cong 2.09 \times 10^6$
22	4,194,304	$\cong 4.19 \times 10^6$
23	8,388,608	$\cong 8.38 \times 10^6$
24	16,777,216	$\cong 1.67 \times 10^7$
25	33,554,432	$\cong 3.35 \times 10^7$
26	67,108,864	$\cong 6.71 \times 10^7$
27	134,217,728	$\cong 1.34 \times 10^8$
28	268,435,456	$\cong 2.68 \times 10^8$
29	536,870,912	$\cong 5.36 \times 10^8$
30	1,073,741,824	$\cong 1.07 \times 10^9$
31	2,147,483,648	$\cong 2.14 \times 10^9$
32	4,294,967,296	$\cong 4.29 \times 10^9$
33	8,589,934,592	$\cong 8.58 \times 10^9$
34	17,179,869,184	$\cong 1.71 \times 10^{10}$
35	34,359,738,368	$\cong 3.43 \times 10^{10}$
36	68,719,476,736	$\cong 6.87 \times 10^{10}$
37	137,438,953,472	$\cong 1.37 \times 10^{11}$
38	274,877,906,944	$\cong 2.74 \times 10^{11}$
39	549,755,813,888	$\cong 5.49 \times 10^{11}$
40	1,099,511,627,776	$\cong 1.09 \times 10^{12}$
41	2,199,023,255,552	$\cong 2.19 \times 10^{12}$
42	4,398,046,511,104	$\cong 4.39 \times 10^{12}$
43	8,796,093,022,208	$\cong 8.79 \times 10^{12}$
44	17,592,186,044,416	$\cong 1.75 \times 10^{13}$
45	35,184,372,088,832	$\cong 3.51 \times 10^{13}$
46	70,368,744,177,664	$\cong 7.03 \times 10^{13}$
47	140,737,488,355,328	$\cong 1.40 \times 10^{14}$
48	281,474,976,710,656	$\cong 2.81 \times 10^{14}$
49	562,949,953,421,312	$\cong 5.62 \times 10^{14}$
50	1,125,899,906,842,624	$\cong 1.12 \times 10^{15}$

courtesy of Modulation Sciences



Supplier Source Book

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Ampex Corp Magnetic Tape Div
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Barrett Associates Inc
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Basys Inc
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Coaxial Dynamics Inc
15210 Industrial Pkwy
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Coherent Communications
13756 Glenoaks Blvd
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Columbine Systems Inc
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Comad Communications Ltd
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Comark Communications Inc
Rte 309 & Advance Lane
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215-822-0777 FAX: 413-569-0679

Comex Corp
1645 NW 79th Ave
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Commercial Radio Co
PO Box 43
Cavendish, VT 05142
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Communitronics Ltd
160 Wilbur Place
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Competition Specialties
4535 S Blosser Rd
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Comprompter Inc
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Computer Concepts Corp
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Comrex Corp
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Comsearch Inc
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Comtech Antenna Corp
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Comtech Data
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Connectronics Corp
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Continental Electronics
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Control Concepts Corp
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Control Technology Inc
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Cortana Corp
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Cortland Cable Co
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Creative Support Services
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G & M Power Products Inc
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GBC Electronics
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GKM Mfg Corp
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James Grunder & Assoc Inc
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800-533-3388 FAX: 617-536-4878

Lacentra Advertising
1101 Embarcadero Rd
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Lake Systems
287 Grove St
Newton, MA 02166
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617-244-6881

Landy Associates Inc
1890 E Marlton Pike
Cherry Hill, NJ 08003
609-424-4660

Landy Associates Inc
330 Bear Hill Rd
Waltham, MA 02154
617-890-6325

Larcan Communications Equipment Inc
6520 Northam Dr
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Contact: P A Dickie, Pres
416-678-9970

D N Latus & Co Inc
PO Box 1720
Helena, MT 59624
406-442-3940

Lauderdale Electronic Labs
16 Southwest 13th St
Ft Lauderdale, FL 33315
305-764-7755

Lawrence Behr Associates Inc
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Greenville, NC 27835
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Leader Instruments Corp
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Leaming Industries
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Lenco
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Leonine Technology
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Lexicon Inc
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Lightning Deterrent Corp
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Lightning Elimination
12516 Lakeland Rd
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Lightning Eliminators & Consultants Inc
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303-447-2828 FAX: 303-447-8122

Lindburg Enterprises Inc
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Lindco Commercial Audio
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Lineau Assoc Inc
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Lines Audio/Visual Systems
219 S Jefferson
Springfield, MO 65806
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Charles J Lipow Inc
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Logitek
3320 Bering Dr
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Lyle Cartridges
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M/A-Com Mac Inc
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MCL Inc
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MDL/Microwave Devlp Lab Inc
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MIT Inc
14130 NW Science Park Dr
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MXR Innovations
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Contact: Mitch Milton

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McCarron Kane Inc
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McCurdy Radio Industries
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Media Computing Inc
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Media Graphics
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Media Touch Systems Inc
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Micro Communications Inc
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Micro Controls Inc
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Micro-Trak Corp
165 Front St Cbdc
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Microdyne Corp
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Microtime Inc
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Microtran Co
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Valley Stream, NY 11582-0236
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Microwave Filter Co
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Mid-America Automation Corp
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New Resource
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New World Audio Express
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Northwestern Inc
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Old Dominion Broadcast Engr Service
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804-321-4506

Omega International
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Irvine, CA 92714
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Oxnard, CA 93033-7147

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Orban Associates Inc
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Orcad Systems Corp
1049 SW Base Line St Ste 500
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Douglas Ordon & Co Inc
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Ortofon Inc
122 Dupont St
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Otari Corp
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PAS (Professional Audio Supply)
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Pacific Recorders & Engineering Corp
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Phase Linear
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Potomac Instruments
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Quantum Audio Labs Inc
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Quick Set Inc
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R-Columbia Products Co Inc
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Contact: 206-362-0700

Software Technologies Inc
6 Shetland Cl
Salem, NH 03079
Contact: Mark Richards, GM

Solar Signage Inc
13006 Mula Lane
Stafford, TX 77477
Contact: Kevin L Conlin
713-933-1578 FAX: 713-933-0100

Solid State Logic
Begbroke
Oxford, England OX5 1RU
Contact: Noel Bell
44-08675-4353

Solway Inc
PO Box 7647
Hollywood, FL 33081
Contact: Martin Munger
305-962-8650

Sono-Mag Corp
1833 W Hovey Ave
Normal, IL 61761
Contact: J Housour
309-452-5313 FAX: 309-452-2521

Sony Corp of America Communications Products Co
1600 Queen Anne Rd
Teaneck, NJ 07666
Contact: Charles Taylor
201-833-5200

Soper Sound Music Library
PO Box 498
Palo Alto, CA 94301
415-321-4022

Sound Com Corp
227 Depot St
Berea, OH 44017
Contact: Roy Stuewe
216-234-2604 FAX: 216-234-2614

Sound Concepts
Box 135
Brookline, MA 02146
Contact: John Bubbers

Sound Ideas Recording Studio
86 Mcgill St
Toronto, ONT M5B 1H2 Canada
Contact: Brian Nimens, Pres/Sr Engr
416-977-0512

Sound Merchandising
926 Sheridan Rd
Glencoe, IL 60022
Contact: Sales Mgr

Sound Technology
1400 Dell Ave
Campbell, CA 95008
Contact: Kent McGuire, Natl Sales Mgr
408-378-6540 FAX: 408-378-6847

Sound Workshop Pro Audio Products
1324 Motor Pkwy
Hauppauge, NY 11788
516-582-6210

Sound Workshop
79 Express St
Plainview, NY 11803
Contact: Lee B Pomerantz
516-932-6570 FAX: 516-932-6573

Soundcraft
8500 Balboa Blvd
Northridge, CA 91329
Contact: David Kimm
818-893-4351 FAX: 818-893-3639

S

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Southeast Electronics Inc
PO Box 41308
Jacksonville, FL 32203
904-356-3007

Southern Tower Service Co
PO Box 1387
Suffolk, VA 23434
Contact: James L Corlew
804-539-8365 FAX: 804-539-2047

Specialty Vehicles
450 N Somerset Ave
Indianapolis, IN 46222
Contact: W K Kimmel, Pres

Spectra Sonics
3750 Airport Rd
Ogden, UT 84405
Contact: Gregory D Dilley
801-392-7531

Spencer Broadcast Inc
7003 W Union Hills Dr
Peoria, AZ 85345
Contact: Charles Spencer
602-242-2211 FAX: 602-843-2860

A W Sperry Instruments
245 Marcus Blvd
Hauppauge, NY 11788
516-231-7050

Sphere Electronics
9960 Canoga Ave
Chatsworth, CA 91311
Contact: David Holmes

Spool Tool
PO Box 474
Lebanon, OH 45036
Contact: Burdette Sweny, Pres

Sprague Magnetics Inc
15720 Stagg St
Van Nuys, CA 91406
Contacts: John Austin Jr/May Harrow
818-994-6602 FAX: 818-994-2153

Stainless Inc
Third & Montgomery Sts
North Wales, PA 19454
Contact: H William Guzewicz
215-699-4871

Standard Tape Laboratory Inc
26120 Eden Landing Rd #5
Hayward, CA 94545
Contact: Frank G Lennert
415-786-3546

Stanton Magnetics Inc
101 Sunnyside Blvd
Plainview, NY 11803
Contact: Pete Bidwell, Sales Mgr
516-349-0235 FAX: 516-349-0230

Stantron Unit of Zero Corp
6900 Beck Ave
N Hollywood, CA 91605
Contact: Guy Tessier
818-841-1825 FAX: 818-841-8892

Star Case
648 Superior
Munster, IN 46321
219-922-4440 FAX: 219-922-4442

Star Systems
462 Merrimack St
Menthuen, MA 01844
Contact: Ed Burns

Steimke Engrg
PO Box 3101
Quincy, IL 62305
Contact: Jeff Steimke

Storeel Corp
PO Box 80523
Atlanta, GA 30366
Contact: Carolyn Galvin
404-459-3280 FAX: 404-457-5535

Studer Revox America Inc
1425 Elm Hill Pike
Nashville, TN 37210
Contact: Charles Conte, PR Mgr/Writer
615-254-5651 FAX: 615-256-7619

Studio Technologies
5520 West Touhy Ave
Skokie, IL 60077
Contact: Jennifer Shore, Adv Coord
312-676-9177 FAX: 312-982-0747

Studio-Sonics Corp
1165 Tower Rd
Schaumburg, IL 60195
Contact: James R Stemke, Pres
312-843-7400

Suministros Gonzalez
1500 Bay Rd #1158
Miami Beach, FL 33139
Contact: Manuel J Gonzalez, Owner

Summit Software Systems Inc
4810 Riverbend Rd Ste 100
Boulder, CO 80301
Contact: Kathy Waldrop
800-323-2905

Sunbelt Mfg Co
Vienna Industrial Park
Vienna, GA 31092
Contact: Ben Johnston, Mktg Mgr

Surcom Associates
2215 Faraday Ave #A
Carlsbad, CA 92008
Contact: A J Link
619-438-4420

Swaine Studio Inc
2515 Harriman Ln
Redondo Beach, CA 90278
Contact: Gay D Swaine, Pres

Swintek Enterprises
587 Division St
Campbell, CA 95008
Contact: William Swintek, Pres

Switchcraft Inc
5555 N Elston Ave
Chicago, IL 60630
Contact: Patrick Jones
312-792-2700 FAX: 312-792-2129

Symetrix Inc
4211 24th Ave West
Seattle, WA 98199
Contact: Doug Schauer, Mktg Dir
206-282-2555 FAX: 206-283-5504

Systemation
3900 Inverness Lane
Plano, TX 75075
Contact: David Gerety

Systems Wireless Ltd
465 Herndon Parkway
Herndon, VA 22070
Contact: William Sien
703-471-7887 FAX: 703-437-1107

t

TASCAM
7733 Telegraph Rd
Montebello, CA 90640
Contact: Ken Hirata
213-726-0303 FAX: 213-727-7656

TDK Electronics Corp
12 Harbor Park Dr
Port Washington, NY 11050

TFT Inc
3090 Oakmead Village Dr
Santa Clara, CA 95052-8088
Contact: Jesse Maxenchs, Dir Mktg
408-727-7272 FAX: 408-727-5942

TOA Electronics Inc
480 Carlton Ct
S San Francisco, CA 94080
Contact: Joe Green, Mktg Mgr
415-621-2949

TTC (Television Technology Corp)
PO Box 1385
Broomfield, CO 80020
Contact: Alex Delay
303-665-8000 FAX: 303-673-9900

TV Systems
2113 Wells Branch/Bldg 6 #100
Austin, TX 78728
Contact: Cary Fitch

Taber Manufacturing & Engrg Co
1880 Embarcadero Rd
Palo Alto, CA 94303
Contact: Veldon Leverich
415-493-3811

Tandberg of America Inc
1 Labriola Ct
Armonk, NY 10504
914-273-9150

Tannoy North America Inc
300 Gage Ave Unit #1
Kitchener, Ont, N2M 2C8 Canada
Contact: Bill Calma
519-745-1158 FAX: 519-745-2364

Tape-Athon Corp Cavox Stereo Prod
13633 Crenshaw Blvd
Hawthorn, CA 90250
213-676-6752

Tapscan
3000 Riverside Galleria, 1111
Birmingham, AL 35244
Contact: J Christian, Pres

Target Head Enterprise
5360 East Raymond St
Indianapolis, IN 46203
Contact: Geo Cecil Frye

Taube Violante Advert
PO Box 504
Norwalk, CT 06856
Contact: Jean Crawford

Tech Laboratories Inc
500 10th St
Palisades Park, NJ 07650
Contact: Alex Konred, Mktg Mgr
201-944-2221

Techni-Tool
5 Apollo Rd Box 368
Plymouth Meeting, PA 19462
Contact: Bonnie Burgemeister, Adv Mgr

Technology Plus
6502 Robin Forrest
San Antonio, TX 78239
Contact: Bill Smith, Proj Mgr

Tektan Inc
PO Box 271872
Concord, CA 94572
415-798-2222

Tektronix Inc
Box 500
Beaverton, OR 97077
Contact: Sales Mgr
503-627-7111 FAX: 503-627-6905

Tel-Wire Corp
7 Michael Ave
Farmingdale, NY 11735
Contact: Marty Ingram, GM

Tele-Midi
30 N Raymond Ave, #601
Pasadena, CA 91103
Contact: Sales Mgr

Tele-Wire Supply Co
1620 W Crosby Rd
Carrollton, TX 76006

Telectro Systems Corp
96-18 43rd Ave
Corona, NY 11368
718-651-8900

Telex Communications Inc
9600 Aldrich Ave South
Minneapolis, MN 55420
Contact: Donald Mereen, Dir of Mktg
612-884-4051 FAX: 612-884-0043

Telfax Communications
PO Box 31
Webster City, IA 50595
515-832-1263 FAX: 515-832-1217

Telnox Ltd
55 Montpellier Blvd
St Laurent, Quebec, H4N 2G3 Canada
Contact: Jacques Coutellier, Pres
514-744-1785 FAX: 514-744-2797

Temtron Electronics Ltd
15 Main St
E Rockaway, NY 11518
Contact: Sid Sussman
516-599-6400

Tennaplex Systems Ltd
21 Concourse Gate
Nepean, Ontario, K2E 7S4 Canada
Contact: Marvin Crouch
613-226-5870 FAX: 613-727-1247

Tentel Corp
1506 Dell Ave No B
Campbell, CA 95008
Contact: Wayne Graham
800-538-6894

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Tepco Corp
PO Box 680
Rapid City, SD 57709
Contact: Jerry Johnson
605-343-7200

Texas Electronics Inc
PO Box 7225 B
Dallas, TX 75209
Contact: J R Tozer
214-631-2490

Thermodyne Intl Ltd
20850 S Alameda
Long Beach, CA 90810
Contact: Walter Wolf

3M Magnetic Media Division
Bldg 223-55-01, 3M Center
St Paul, MN 55144-1000
Contact: Richard J Collins
612-733-1082

Tinet Inc
2611 Temple Heights Dr Ste F
Oceanside, CA 92056
Contact: Paul Scott

Titus Technological Laboratories
77 Kreiger Lane Ste 914
Glastonbury, CT 06033
Contact: Lawrence Titus, Pres
203-633-5472

Townsend Broadcasting Systems
79 Mainline Dr
Westfield, MA 01085
Contact: Barry R Huntsinger

Transcom Corp
201 Old York Rd Ste 207
Jenkintown, PA 19046
Contact: Martin Cooper
215-884-0888 FAX: 215-884-0738

Transmission Structures Ltd
PO Box 907
Vinita, OK 74301
918-256-7883

Transtector Systems Inc
10701 Airport Dr
Hayden Lake, ID 83835
800-635-2537

Trident USA Inc
280 Mill St Extension
Lancaster, MA 01523

Trimm Inc
PO Box 489
Libertyville, IL 60048
Contact: Nancy Calkins, Ad Mgr
312-362-3700

Trompeter Electronics Inc
31186 La Baya Dr
Westlake Village, CA 91362

u

US Audio Inc
PO Box 40878
Nashville, IN 37204
615-297-1098

US Tape & Label
1561 Fairview Ave
St Louis, MO 63132
Contact: Byron Crecelius, VP Mktg

Uher of America
7067 Vineland Ave
N Hollywood, CA 91605
818-764-1120

United Audio Recording
8535 Fairhaven
San Antiono, TX 78229
Contact: Robert Bruce
512-690-8888

United Recording
681 Fifth Ave
New York, NY 10022
Contact: Anita Adams

UREI
8500 Balboa Blvd
Northridge, CA 91329
Contact: Mark Gander
818-893-8411 FAX: 818-893-3639

Utility Tower Co
PO Box 12369
Oklahoma City, OK 73157
Contact: C E Nelson, Owner
405-946-5551

v

VIF International
1151 Viscaino Ave
Sunnyvale, CA 94086
Contact: Gordon Mackechnie

Thomas Valentino Inc
151 West 46th St
New York, NY 10036
212-869-5210

Valley People Inc
PO Box 40306
Nashville, TN 37204
Contact: Liz Clark, Ad Mgr
615-383-4737 FAX: 615-269-5441

Vanner Inc
745 Harrison Dr
Columbia, OH 43204
614-272-6263

Varian Continental Electronics Div
PO Box 270879
Dallas, TX 75227
Contact: W Rice, US Bdct Sales Mgr
214-381-7161 FAX: 214-381-4949

Vaughn Communications
7951 Computer Ave So
Minneapolis, MN 55435
Contact: Beth Evans
612-831-2248 FAX: 612-831-0791

Vector Technology Inc
203 Airport Rd
Doylestown, PA 18901
Contact: Melvyn Lieberman
215-348-4100 FAX: 215-348-3167

Vega, A Mark IV Company
9900 Baldwin Place
El Monte, CA 91731-2204
Contact: Kenneth M Bourne
818-442-0782 FAX: 818-444-1342

Doug Vernier Broadcast Cslt
1600 Picturesque Dr
Cedar Falls, IA 50613
Contact: Doug Vernier, Pres
319-266-7435

Versa Count
553 Lively Blvd
Elk Grove Village, IL 60007
Contact: Charles Piper

Vertigo Recording
12115 Magnolia Ste 116
N Hollywood, CA 91607
Contact: Charles Bolis
818-907-5161

w

Ward-Beck Systems Ltd
841 Progress Ave
Scarborough, Ont, M1H 2X4
416-438-6550

Waters Manufacturing
Longfellow Ctr
Wayland, MA 01778
Contact: Peggy Angel, Ad Mgr

Weather Central
5725 Tokay Blvd
Madison, WI 53719
Contact: Bob Lindmeier, Bdcst Mgr

Weather Services Corp
131A Great Rd
Bedford, MA 01730
Contact: G Stamos, VP Mktg

Wegener Communications
11350 Technology Cir
Duluth, GA 30136
Contact: Kenneth D Leffingwell
404-623-0096 FAX: 404-623-0698

Weisel Communications
228 1/2 Melrose
Youngstown, OH 44512
Contact: Charles Weisel

West Coast Audio Inc
65 W Easy St Ste 102
Simi Valley, CA 93065
805-583-3800

Western Intl Communications
505 Burrard St Ste 1960
Vancouver, Bc, V7X 1M6 Canada
604-526-3214

Westlake Audio Prof Prod Mfg Grp
2696 Lavery Ct Unit 18
Newbury Park, CA 91320
805-499-3686

Wheatstone Corp
6720 VIP Parkway
Syracuse, NY 13211
Contacts: G Snow, P Bagshaw
315-455-7740 FAX: 315-454-8104

White Instruments Inc
Box 90099
Austin, TX 78709
Contact: Emory Straus
512-892-0752 FAX: 512-892-0855

Brian R White Co, Inc
313 Henry Station Rd
Ukiah, CA 95482
Contact: Larry J Richmond
707-462-9795 FAX: 707-462-4800

Wide Range Electronic
140 Sun Valley Cir
Fenton, MO 63026
Contact: Otto Rauhut, VP
314-343-9191

Wilkinson Electronics
PO Box 1385
Broomfield, CO 80020
Contact: Mkt Mgr

Will-Burt Co, TMD Div
401 Collins Blvd
Orrville, OH 44667
Contact: Donald S Barlow
216-682-7015 FAX: 216-684-1933

Martin Williams
10 So 5th St
Minneapolis, MN 55402
Contact: Marlene Ordof

Wiltronix Inc
16850 Oakmont Ave
Washington Grove, MD 20880
301-258-7676

Winchell Mkting Comm
1315 Cherry St
Philadelphia, PA 19107
Contact: Joan Meagher

Winsted Corp
10901 Hampshire Ave South
Minneapolis, MN 55438
Contact: G R Hoska
800-447-2257 FAX: 612-944-1546

Wireworks Corp
380 Hillside Ave
Hillside, NJ 07205
201-686-7400

Wohler Technologies
1349 Kansas St
San Francisco, CA 94107
Will Wohler, Pres

World Tower Co
PO Box 405
Mayfield, KY 42066
Contact: Nate Sholar

Worrell Assoc
300 College St
Ft Worth, TX 76104
Contact: Chuck Worrell

x

XIT Grounding Systems
25845 S Frampton Ave
Harbor City, CA 90701
213-530-8000

y

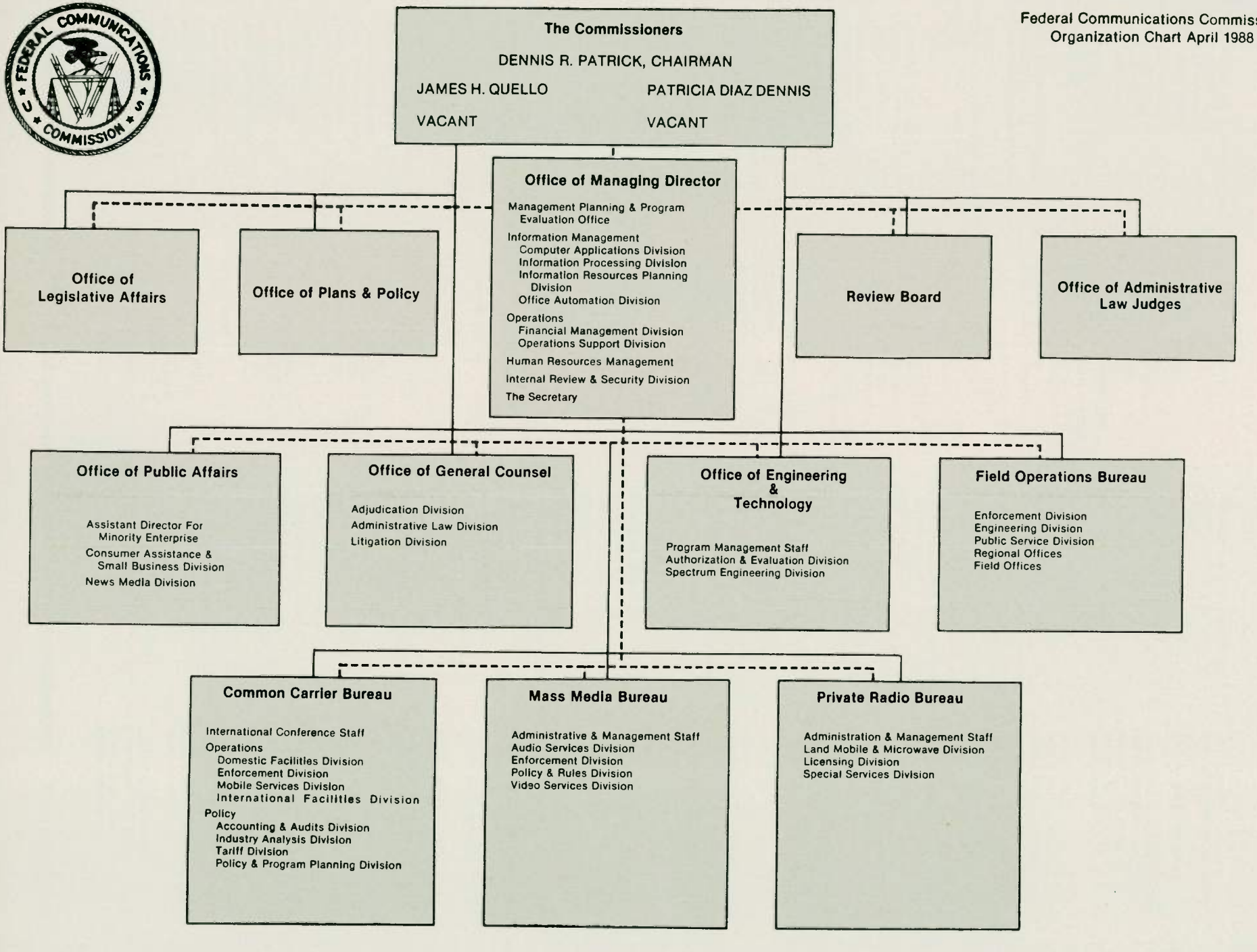
Yamaha International Corp
PO Box 6600
Buena Park, CA 90622
Bob Shomaker
714-522-9011

z

Z-Comm
870 S Sierra Ave
Solana Beach, CA 92075
Larry E Zaiser, Cslt
619-481-5999

Zercom Corp
PO Box 84, Zercom Dr
Merrifield, MN 56465
Jeff Zernov, Pres
218-765-3151 FAX: 218-765-3900

Zimmer Broadcast Co
PO Box 1810
Cape Girardeau, MO 63701
John Zimmer



COMPANY PROFILES

The following section is paid advertisement. Text of the profiles was provided by the companies and is reproduced unchanged, except for minor editorial revisions.
(companies appear in alphabetical order)

ABSOLUTE BROADCAST AUTOMATION

Business office: 82 Main Street, Westernport Maryland 21562

President: *Co Founder Gary L. Daniels* **Vice President:** *Co Founder Jack I. Mullen 2nd*
Secretary/Treasurer: *Dean L. Daniels*
Company headquarters: *Keyser West Virginia* **Factory location:** *Oakland Maryland*

Principles Profile:

Gary L. Daniels: Co-founder of ABA along with Jack Mullen. Owner and Chief Engineer of WMSG AM and WXIE FM radio in Oakland Maryland. Company responsibilities: Chief Software Design Engineer, responsible for the coding of the system 100 software package. Customer Software Support.

Jack I. Mullen, 2nd: Co-founder along with Gary Daniels. Part owner of WKLP AM, WQZK FM, Keyser, West Virginia and WBHN, Bryson City, North Carolina. Company responsibilities: Chief Electronics Engineer, responsible for system hardware design. Customer support for all operations.

Dean L. Daniels: Computer Science Specialist responsible for software design support, system packaging, customer cabinet design and system installation.

History of Company

Absolute Broadcast Automation was formed around a kitchen table in March of 1984. Gary Daniels and Jack Mullen, were discussing the shortcomings of the present-day program automation systems. Both Daniels and Mullins were electrical engineers, and Daniels had already been involved with automation as a result of a business system he developed and marketed during the late 1970s. That business system was one of the first developed and marketed for use on small microcomputer-type hardware. During the development if this system, known as "System Friday," Daniels had clearly anticipated the eventual integration of business software with program automation systems. The software experience gained while developing "System Friday" would prove invaluable as Daniels developed the more powerful "System 100" business and control software.

System 100 Information

ABA received its first order for a complete music system in the summer of 1984. It was at that time Dean Daniels, then completing his degree in Computer Science from the University of Pittsburgh, joined Absolute Broadcast Automation to improve the packaging of the product and the features of the software. The first music system was delivered and installed in May of 1985. Absolute Broadcast Automation did not begin advertising the system nationally until 1987, by which time the system was well developed and debugged.

The company began slowly selling music systems while attention was turned to satellite programming. SYSTEM 100 was upgraded to include special features that would allow the automation to control satellite progammed operations as well. This system is now coalled SATELLITE SYSTEM 100, and is the most powerful and least expensive unit available.

Major Product Lines: *SYSTEM 100 music/business automation system, SATELLITE SYSTEM 100 satellite program automation, featuring the same software as the music automation. This will permit the system to schedule and air in-house music and revert to satellite control on request.*

Additional Products: *Complete radio station business package, including traffic, billing, A/R, A/P, and general ledger, Real Time Transmitter Control (Automation Feature), Legal Remote Control interface for automation system, Music Management software and more.*

Company Representative: *John Harper of John Harper Broadcast Associates in Rock Hill South Carolina. Phone 803-366-8830. Northeast Broadcast Labs, Inc. Glens Falls New York. Phone 518-793-2181.*

Shows Attended: *The company regularly attends state level NAB shows, and recently attended RADIO 88 in September 1988. We plan to attend state shows in 1989 and are currently investigating shraing a suite with a programming company during the Las Vegas NAB Convention.*

Circle 60 On Reader Service Card

The AUDIO broadcast group, Inc.

David E. Veldsma President

Phyllis J. Freeman Vice President

2342 S. Division, Grand Rapids MI 49507
616-452-1596
Service Phone: 616-452-1596
FAX: 616-452-1652
Jerry Bufka, Customer Service Rep
David R. Spoelhof, Production Manager

Systems assembly area

Multitrack studio system in showroom

The Audio Broadcast Group, Inc., was founded in 1960 and today is under the management of David E. Veldsma, President, and Phyllis J. Freeman, VP/Treasurer/General Manager, representing over 100 lines of broadcast equipment, as well as manufacturing custom studio broadcast cabinetry.

Audio has showrooms where typical "on air" and "production" studios are on display with the latest technology being employed along with innovative concepts in studio cabinetry.

These facilities are for the convenience of customers, who are making decisions that they will have to live with for a decade or more, who want to have a first hand opportunity to see what their studios may look like. Studios are, of course, fully functional—To arrange a visit, touch 1-800-999-9281. No obligation, of course.

Audio's location in Western Michigan provides a centralized location for easy access to the nation's broadcasters. Administrative, service, and support along with assembly operations for its extensive broadcast operations are located in Grand Rapids, Michigan.

The Audio Broadcast Group employs direct marketing techniques, selling direct to the user.

The Audio Broadcast Group has, during the last couple of years, built and installed over 100 studios throughout the United States.

The Audio Broadcast Group is the exclusive representative for Broadcast Electronics Mix-Trac 90 consoles and FM transmitters for Michigan, Indiana, Ohio, and Kentucky. Audio also represents Nautel AMFET AM transmitters exclusively in Michigan and Ohio.

Audio has another unique product—the market exclusive Rolling Radio—a complete mobile studio built in a mini-van for promotional purposes.

The company is organized along four product divisions: Audio Equipment, RF Equipment, Studio Systems, and Audio for Video.

The Audio Broadcast Group, Inc., has operated under the same management since 1960, and has been doing business with integrity at the same location for over 28 years.

Trade Shows: *MAB, NAB, Radio 88, NAB Spring Show - Las Vegas 89*

Circle 82 On Reader Service Card

Audiopak

P.O. Box 3100
1680 Tyson Drive
Winchester, VA 22601
703-667-8125
Service: 800-522-2278

Nick Krassowski, *President*
Gordon Stafford, *VP/Marketing*
Shirley DeHaven, *Customer Service Rep*
Rick Yama & Barry Brandon, *Production Managers*

Nick Krassowski has spent most of his professional career in the manufacturing of broadcast tape cartridges. He was with Capitol Magnetics for 18 years until the corporation decided to divest its tape manufacturing division. He then became head of the group which took over assets of Capitol Magnetics to form Audiopak, Inc. Nick received his MS in Industrial Engineering from New York University and is currently studying for an MBA.

Audiopak has been engaged in the design and manufacture of broadcast tape cartridges and lubricated tape for over 25 years, first as Audio Devices, since 1974 as a division of Capitol Magnetics, and since March 1, 1988 as an independent corporation. The company has been responsible for a number of industry "firsts," including the Audiopak Type A, the first reliable broadcast cartridge.

Audiopak's current facilities include the industry's newest manufacturing plant, a 19,000 square foot facility in Winchester, Virginia with 42 employees. Here tape is coated and slit, carts are loaded, and Audiopak's consistent quality is maintained through a rigorous testing and quality control program. The company's West Coast sales office is located at 100 N. Brand Boulevard, Suite 200, Glendale, CA 91203. The West Coast telephone number is 818-240-0282; FAX messages can be sent to 818-240-3041.

Audiopak currently manufactures three broadcast cartridges: the A-2 with full-width tape contact surfaces and 605 lubricated tape; the AA-3 with a "neutral" casing design for enhanced stereo performance and high-performance 613 tape; and the AA-4 with advanced 614 tape which provides extended high frequency saturation headroom. The company also sells back-coated lubricated magnetic tape.

Audiopak products are sold through a domestic and international dealer network that includes all major broadcast distributors. In 1989, Audiopak will exhibit at AES in Hamburg, at the NAB in Las Vegas and at Radio '89 in New Orleans.

Audiopak

Circle 68 On Reader Service Card

auditronics, inc.

3750 OLD GETWELL ROAD MEMPHIS, TN 38118 TEL:(901)362-1350
P.O. BOX 18838 MEMPHIS, TN 36181-0838 TELEX:633358 AUDITRONICS MFS

The company was started in 1964 by Welton Jetton and Steve Sage using the name Audio Design Company. At incorporation in 1966 the name was changed to Auditronics, Inc. During the early years the company concentrated on the Recording Studio market designing and building custom consoles for more than 100 studios throughout the world. Some of the better known were the Record Plant in both New York and Hollywood, MGM, 20th Century Fox and Warner Bros. in Hollywood, EMI in Mexico City and Stax Records in Memphis.

Committed from the beginning to technological advancement, Auditronics, in 1964, built one of the first totally modular, all solid state consoles. Auditronics was also the first to offer a modular console designed specifically for radio production. This was the 110 Series introduced in 1971. More than 1000 were produced during its lifetime. It is estimated that 99% are still in use today.

In 1981 Auditronics introduced the still popular 200 Series of On-air consoles. This was the first Broadcast console to use VCA technology totally solving the age-old problem of noisy faders.

Today, Auditronics is housed in two buildings with a 26,000 square foot manufacturing facility permitting extremely rapid response to both large and small console orders. In keeping with our commitment to technical excellence, our full time R&D product development group is continuously involved with the design of new products and ongoing product improvement.

Auditronics has two divisions, Tapecaster and MFE. The Tapecaster division produces Cart record/playback machines and accessories and is a name well established in the Broadcast industry for over 25 years. The MFE division is the precision metal fabrication arm responsible for the superior quality enclosures and packaging of all Auditronics products. MFE also supplies metal enclosures and assemblies for over 75 other electronic manufacturers. CNC machines give this division a leading edge in the production of prototypes and small runs.

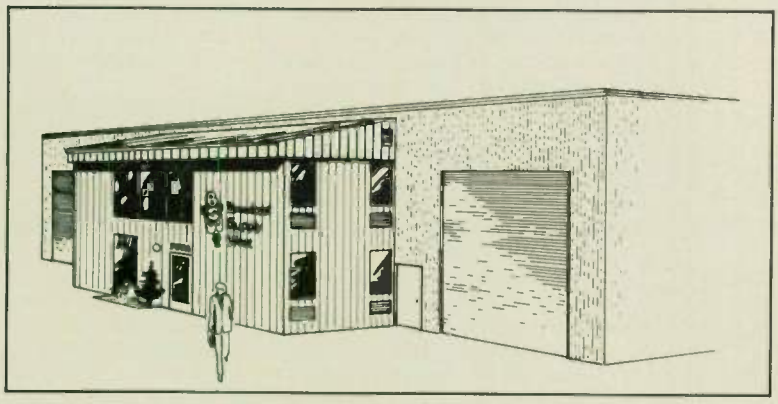
Major Products: 200 Series Radio On-air consoles, 310 Series TV On-air and Production consoles, 400 Series Radio Production consoles, 700 Series Multi-track Broadcast Production consoles, 1100 Series Audio Accessories systems, 1200 Series Stereo Distribution amplifiers.

Circle 72 On Reader Service Card

Broadcast Supply West

7023 27th Street, West
Tacoma WA 98466

1-800-426-8434 FAX: 206-565-8114
TWX: 910-441-2617



BSW Officers (Pictured from left to right):
Bernice McCullough, President
Tim Schwieger, VP/Marketing
Irving D. Law, CEO
Patrick Medved, VP/Sales

BSW was founded by Irv and Betty Law in 1973. Irv's extensive background selling broadcast automation equipment for IGM allowed him to develop relationships with stations all over the country. He saw a need for an equipment supplier to make available a wide array of equipment to all stations, not only the major markets. In order to reach all stations, direct mail advertising was the only cost efficient answer. So BSW sales flyers began to roll out and the phones began to ring. Toll-free 800 service was installed, a first for an equipment supplier.

Now in 1989, BSW is one of the largest independent broadcast distributors in America. We still publish sales flyers, an annual catalog, and offer toll free service. To provide broadcasters with easy access to BSW, we are open 12 hours daily (6 am to 6 pm East, 9 am to 9 pm West). We operate out of one location for better communication, inventory control, faster service and lower overhead. For audio equipment, price and delivery, BSW sets the pace for all others to follow.

To date we represent over 200 product lines of the most prestigious audio equipment available. We supply everything necessary for a new station startup, studio upgrade, or essential parts to keep your current equipment operating.

BSW's active trade show participation includes: NAB, NAB Radio and National SBE.

To our customers over the last 16 years, we thank you.
To our potential customers, we encourage you.
Try us for your next equipment purchase.
You'll be pleasantly surprised.

Circle 62 On Reader Service Card

Bradley Broadcast Sales, Inc.

8101 Cessna Avenue
Gaithersburg MD 20879

Toll Free: 800-732-7665
301-948-0650
Fax: 301-330-7198

General Manager: Art Reed
Sales Manager: Neil Glassman

Bradley Broadcast Sales serves the radio community from our offices and warehouse in suburban Washington, DC. Bradley's proudest asset is our professional staff. We are dedicated to helping you select the right products to solve your problems. Our experience ranges from RF to MIDI, and we have hands-on knowledge of the latest technologies to assist you in putting them to work at your station.

We maintain a diverse, comprehensive inventory, backed by the industry's best computerized order fulfillment system. In-stock items are shipped within 24 hours and special orders are processed rapidly. No one can get you the equipment you need faster than Bradley Broadcast. Additionally, due to our purchasing power, we are able to provide you with the best possible prices.

Annually, Bradley publishes an equipment catalog. This catalog is used extensively by engineers and managers as their most useful desk reference. Several times each year, we issue catalog supplements featuring new product information and special promotions.

The products of over 150 manufacturers are available from Bradley Broadcast. Major product lines include Telos, Studer-Revox, Otari, Tascam, Orban, Logitek, Sennheiser, Yamaha, Fidelipac, ATI, Shure, Technics, Genter, Neumann, Broadcast Electronics, Electro Voice, QEI, Audio Pak, and TFT. Whether your needs are for everyday studio supplies or a complete facility, we have the products to meet your needs. If you are planning an equipment package, a Bradley professional can help you put it all together with advice and special pricing.

Bradley Broadcast is an Associate Member of the National Association of Broadcasters and a Sustaining Member of the Society of Broadcast Engineers. We exhibit annually at the NAB and at regional SBE meetings. Bradley's office hours are 9:00 A.M. to 5:30 P.M. Eastern Time. Net 30 and COD are available to established accounts, and Visa, Master Card, and American Express are honored.

Find out for yourself why each day more professionals turn to Bradley Broadcast ... where service and engineering make the difference.

Circle 94 On Reader Service Card

BROADCAST SERVICES CO.

919-934-6869 • Fax: 919-934-1537 • Telex: 575082
President & Founder: Neal Davis
Inside Manager: Cindy Edwards; Office Manager: Lorine Davis

District Sales Office: P.O. Box 309 Front Royal, VA 22630
Phone: 703-635-1413 • FAX: 703-635-9762
• Telex: 62046263
Keith Arnett, District Sales Manager

Neal Davis has over twenty years experience in the technical areas of broadcasting and recording, including work for the American Forces Radio and Television Network, positions at various radio and television broadcast facilities, and lab engineering work at GTE/Sylvania. Davis holds a degree in electronics and an unlimited FCC Radiotelephone operator's license. He is a former Chapter Officer with the Society of Broadcast Engineers and a member of the Society of Motion Picture and Television Engineers.

In 1975 Davis founded Broadcast Services Co., an equipment dealership offering a variety of added services. Through the years Davis firmly established his company as the leading full-service supplier of broadcast equipment in the mid-Atlantic region. In 1987, he purchased EME, Inc., an established equipment rep firm with a wide range of video and communications product lines, also located in North Carolina. Both companies operate as part of The Davis Communications Group, Inc., a technical management company with broadly-based interests in the communications industry.

A part of The Davis Communications Group, Inc., Broadcast Services Co. serves an extensive list of broadcasters throughout the mid-Atlantic area. Founded in 1975, it is one of the region's oldest broadcast equipment suppliers, and has provided equipment and "value added" service to nearly every major broadcast facility in North and South Carolina, Virginia, Maryland and the District of Columbia.
Broadcast Services is system oriented, and specializes in serving the needs of large broadcast groups. As a result, the company often is the sole source supplier in major facility build-outs.

Founded on the concept of personal service to every customer, Broadcast Services Co. has maintained its customer committment with complete technical service facilities and a parts supply depot for primary product lines. Constant attention has also been paid to administrative support as well. The company maintains operations with a modern Wang computer system, which not only supports Broadcast Services but provides all of the data processing requirements of sister company EME, Inc. via a 120-mile dedicated telco data link. To further enhance response capability, all offices are equipped with facsimile machines and telex terminals.

The home office also maintains a complete electronic publishing system along with its own graphics camera, thus allowing complete in-house control and preparation of up-to-the-minute newsletters, sales notices and product catalogs.

In conjunction with The Davis Communications Group, Inc. and sister company EME, Inc., Broadcast Services Co. has developed the CELLULAR PRODUCTION UNIT, a proprietary interface which allows broadcast audio equipment to be fed directly into the cellular phone network thus providing a reliable and cost effective alternative to conventional RPU systems.

Major Product Lines

Broadcast Services Co. is a full service dealer for Auditronics audio consoles, Otari tape recorders (MX and MIR Series), Fidelipac and ITC cart machines, Broadcast Electronic audio and RF products, West Penn wire, Andrew transmission line and Graphics Express furniture, as well as an extensive array of supporting products. Broadcast Services Co. and EME, Inc. are also dealers for the CELLULAR PRODUCTION UNIT.

Trade Shows

Broadcast Services Co. supports and exhibits at all state broadcast association trade shows in the region. The company also frequently does presentations at area SBE chapters.

Circle 66 On Reader Service Card

Broadcast Technology of Colorado

P.O. Box 1310
Gunnison CO 81230
303-641-5503 Fax: 303-641-3094
President: Wayne Allen
V.P. Engineering: Bob German
V.P Marketing and Sales: Barbara J. Bowman
Acting Production Manager: Wayne Allen

Broadcast Technology is a young innovative company developing new ideas for the broadcast industry. BTC was founded in 1987 by Wayne Allen and Bob German and is located in the picturesque Gunnison River Valley of Colorado.

BTC's dual channel SCA generator was released only 6 weeks after the company's start-up. The generator has received positive customer response in the United States, Canada, South America and Asia. The Company has continued to expand its SCA product line by releasing a synthesized SCA fieldstrength meter.

Broadcast Technology is not just an equipment supplier. By listening to customer needs, BTC is an idea and design resource for broadcasters.

Broadcast Technology employs direct marketing techniques, as well as selling through its distributors and selected agents such as Broadcasters General Store, Broadcast Supply West, Continental Electronics, Radio Systems, Ram Broadcast, Tom Butler and Associates, and selected agents.

Trade shows attended: NAB, NSCA, IBMA, IPMA, SBE, NAB Radio 89

Major Products:

Model 1000 Dual Channel SCA Generator-broadcasts 67 & 92 kHz simultaneously
Model 2200 Synthesized Dual Channel Tuner—a "hot" front end which is very sensitive, individual tone controls for bass and treble, main/carrier presence LEDs on front panel
Model 3000 Synthesized Fieldstrength Meter—everything you ever wanted to know about your SCA signal
Model 3010 SCA Tuner Analyzer—a complete SCA tuner test and trouble-shooting station
Model 6000 SCPC Demodulator System—10 channel choices in one box
Model 7000 Synthesized FM Translator—synthesized on both receive and transmit

Circle 87 On Reader Service Card

Field Engineering Team at work in snowy Gunnison. Bob German at right. Photo by Darlene Reid.

Bob German

Bob German was the Chief Engineer for the International Outlet of the Austrian Broadcasting Corporation in the 1970's. Upon his return to the United States, Mr. German worked in telemetry for Automated Controls, Inc. and as Director of Engineering for McMartin International. Mr. German, co-founder and Vice President of Engineering of Broadcast Technology of Colorado is a well known designer of broadcast equipment. As a result of his expertise in SCA design, Bob was chosen as a panelist to speak on FM and SCA advancements at the 1987 NAB. His current projects include such state of the art products as a Synthesized FM Translator and Boosters.

CCA Electronics, Inc.

360 Bohannon Road
P.O. Box 426
Fairburn GA 30213
404-964-3530
Service Phone: 404-964-3764
Fax: 404-964-2222
President: Ron Baker
Sales: Rod Duncan
Customer Service Rep: Gerry Meier
Production Manager: Jerry Henry

Organized in 1962, CCA's founders were among the finest engineers in the industry with backgrounds at RCA. They pioneered many broadcast transmitter concepts which remain standard practice today. Most of the original transmitters, now over twenty years old, are still on the air throughout the world. While dealing mainly with CCA transmitters in the early stages of the company's foundation, CCA acquired the Sintronic line of transmitters in 1984, and added the CSI line in 1988. The reputation for reliability, sound engineering, and parts and service availability is still the mainstay of the company today.

Distribution

The majority of CCA's products are sold overseas through a world-wide network of agents and communication companies. Most products are sent to the Tropics where CCA's basic technology and sturdy materials are required to meet the severe environmental conditions.

Domestic distribution is accomplished through factory direct marketing, making CCA the most value-competitive transmitter on the market.

Facilities

CCA Electronics, Inc. is located a mere 12 miles from the world's busiest airport, Atlanta Hartsfield International. This location gives CCA's sister company, Broadcast Parts and Service, the necessary resources to ship parts for crisis off-air situations. Broadcast Parts provides spare parts for the Sintronic, CCA, CSI, and various other transmitter lines. In Mexico we are represented by RF Specialty Products, Inc., 5547 Randolph Boulevard, San Antonio, Texas, 78233, (512) 654-4771, and in Canada by Caveco Equipment Limited, 1121 Bellamy Road, N., Unit 10, Scarborough, Ontario M1H3B9, (416) 438-6230.

The facility also houses the production line for CCA and CSI transmitters currently being produced. Also included within the facility are the Engineering, Research and Development, and Sales Departments, along with the Administrative divisions of the company.

Major Products:

AM Plate Modulated Transmitters
FM Grounded Grid Transmitters
Short-Wave Transmitters
Antenna Tuning Units
Dummy Loads

CCA

Ron Baker

Starting out as a disk jockey in the '60s, Ron gained his initial radio engineering experience via military service, college, and hands-on training. Returning to civilian life in the early '70s, he became the Chief Engineer of radio station Z-93 in Atlanta. After his stint at Z-93 he was involved in the construction of over 100 radio stations throughout the country, several in which he had major ownership. In the late '70s he became the leading salesman for the CCA Transmitter line, whereupon he was named CCA's President and Marketing Director in 1984, positions he still holds today.

Circle 75 On Reader Service Card

CUTTING EDGE TECHNOLOGIES

12540 Edgewater Drive, Suite 1206 *Lakewood OH 44107*
216-221-7626 *Fax: 216-621-2801*
President and Founder: Frank Foti *Vice President: Joseph Foti*

President and founder Frank Foti's radio career began at a 500 watt AM daytime station near his hometown of Wickliffe, Ohio just outside of Cleveland. "I was the morning jock, the production director, the music director, and chief engineer." He adds, "When the grass needed cutting, I did that too!"

This first experience did more than trigger his interest in broadcast engineering. Being a jack-of-all-trades, Foti developed a work ethic he diligently adheres to: Successful technical achievements in broadcasting depend on an engineer being sensitive to the concerns of programming, talent, and managers alike. You must listen to and work with them, not against them.

Throughout the next 15 years Frank held chief engineer positions at WMMS-FM/WHK-AM in Cleveland, KSAN-FM/KNEW-AM in San Francisco and, most notably, WHTZ-FM (Z-100) in New York City. It was there that all his technical research came to fruition. Frank designed and built Z-100 along with creating the highly successful audio processing system that is still currently being used at WHTZ.

Having been responsible for the enviable sound of Z-100, Frank was named Director of Engineering for Malrite Communications Group. Realizing that his greatest motivation and satisfaction came from designing new audio processing products, he left Malrite to form his own venture, ***Cutting Edge Technologies.***

Founded in Cleveland in March, 1988, Cutting Edge Technologies produces broadcast equipment that is backed by research and development techniques designed to keep the broadcaster at the forefront of technology.

Adopting an aggressive "Take No Prisoners" attitude, the philosophy, as well as the products of Cutting Edge appeal to the broadcaster that strives to find that added "edge" that is so essential in winning.

New Developments

Relying on a vast audio background, new developments have emerged from Cutting Edge that deal with FM limiting, clipping, and low pass filtering in an effort to try and take the broadcaster to that next step in audio processing (see below).

Research is also being devoted to transforming FM accomplishments to AM Limiting as well. Outside of the audio ideas, the company is in the final development stages of a composite FM filter that will allow better FM composite "housekeeping" for stations that need to process aggressively and utilize SCA channels. The company's goal is to introduce this product at the NAB in Spring 1989.

Long range plans include work with DSP (Digital Signal Processing), along with a few consumer oriented products aimed at improving FM receiver performance.

Currently, the company is producing the Vigilante FM Limiter which is in use at many leading stations throughout the country. It was developed in 1986 by Frank Foti during his 5 year stint as CE at Z-100. Here, he researched, designed, and developed the highly successful Z-100 "sound" that holds the competition for ransome in the nations top competitive market. Broadcasters from outside New York and around the country were always inquiring to find out how Z-100 was able to be the "loudest," yet the most "qualitative" among the Contemporary stations in the market. It was through this development that the concept for the Vigilante-FM limiter was born.

The company also offers outside consulting to broadcasters who are looking to new and better ways to get the most out of their audio chain. Market pricing and exclusivity are available upon request. Outside consulting for facility evaluation and facility improvement is also performed. At the time of this writing, the company is evaluating a "growth" move. Because of this, details of the facility will be changing at the beginning of the new year. Call for current information.

"VIGILANTE" Multiband Limiter

DIAL DOMINANCE! The quest of every competitive, aggressive and successful broadcaster. In an effort to assist the broadcaster in obtaining that DIAL DOMINANT sound over the air, CUTTING EDGE TECHNOLOGIES introduces the "VIGILANTE" limiter. This unit actually began its life as an APHEX DOMINATOR, but through the design, ingeniuty, and circuit modifications provided by CUTTING EDGE, the ability of this unit is further refined for enhanced operation.

Circle 97 On Reader Service Card

DELTA ELECTRONICS

"Over 25 years of service to broadcasters"

5730 General Washington Drive
Post Office Box 11268
Alexandria, VA 22312
703-354-3350
FAX: 703-354-0216

Telex: 90-1963

Founded: 1962, by Stephen Kershner and Charles Wright
President: John Wright
VP/Marketing: Joseph Novak
VP/Engineering: William Fox
VP/Production: Friedel Groene
VP/Finance: Robert Stebbins
General Manager: Ron Wheeler
Broadcast Products Sales Manager: John Bisset

An Introduction To Delta Electronics

In 1962, the principals left the consulting engineering firm of A.D. Ring to form Delta Electronics. With their extensive background in consulting, a number of unique products were developed for the broadcast engineer. The OIB Operating Impedance Bridge and TCA Toroidal Coupled Ammeter are two such products that have revolutionized the maintenance of broadcast stations. Delta's special expertise in transmitter/receiver-to-antenna interfacing and remote monitor/control systems has led to a number of product developments for the HF Communications industry as well as commercial broadcast. Strip-line switching matrices, receiver multicouplers, and balanced line antenna switches are a few of our HF products. Though the company's roots are in HF and AM broadcast, Delta also provides products for the FM and TV industries. The High Power Pulse Reflectometer, Coaxial Transfer Switches, and Transmitter Power Controller are examples.

Delta Electronics is located in Alexandria, Virginia—just a few miles from Washington, D.C. Manufacturing, testing, laboratory, engineering and administrative functions are housed in a single, modern, 35,000 square foot building. By combining all areas of a products construction into one location, high standards of quality—synonymous with the Delta name—can be maintained.

Trade Shows: *NAB, SBE, NAB Radio 89*
Delta also participates in many state and regional SBE shows. If you are interested in Delta providing an SBE presentation for your chapter, call today.

Major Products:
AM Splatter Monitor, AM Stereo Exciter/Monitor, Stereo Matrix Audio Processor, High Power Pulse Reflectometer— *(see our Buyers Guide Reprint on page 164)*

DELTA ELECTRONICS

Delta Electronics is now employee-owned. In 1984, an Employee Stock Ownership Program (ESOP) was formed. Now, the employees have a more tangible incentive to provide better products and service.

Call us today and Discover the Delta Difference!

Circle 100 On Reader Service Card

Crouse-Kimzey Company

3507 West Vickery Boulevard
Fort Worth TX 76107

817-737-9911
Service Phone: 800-433-2105
Fax: 817-377-9707

President: John Paul Kimzey
General Manager: Mark Bradford
Assistant Manager: Dave Barkin
Service Manager: Chuck Hair

Crouse-Kimzey Company was founded in 1971 by J.R.

Crouse and John Paul Kimzey as a broadcast engineering and consulting firm. In order to provide complete turnkey installations, the partners established direct access to a variety of broadcast equipment dealers in the nation and now offer over 150 lines of broadcast and studio equipment.

With offices and warehouse in Fort Worth, Texas, Crouse-Kimzey offers studio equipment, RF equipment, studio furniture, test equipment, tape and a variety of supplies. Major lines include Otari, Orban, Auditronics, Telos, Arrakis, Sennheiser, JBL, Electrovoice, Gentner, Nakamichi, Ramsa, Technics, Tascam, Shure and TFT.

Each year, Crouse-Kimzey co-sponsors a picnic with SBE Chapter 67 in Dallas and presents programs at local SBE chapters throughout Texas. The company is also represented at the SBE National Convention as well as the Texas Association of Broadcasters (TAB) and National Association of Broadcasters conventions.

Circle 78 On Reader Service Card

Energy-Onix

Broadcast Equipment Company

PO Box 923
Hudson NY 12534
518-828-1690
Fax: 518-828-8476

President: Bernard Wise
VP Engineering: Evan Pezirtzoglou
Customer Service Rep: Blair Davis
Production Manager: Jack Wise

Energy-Onix was formed in 1987. During its first year of operation, emphasis was made to develop a complete line of FM Broadcast Transmitters which incorporated the field proven circuitry of our founder as well as present state-of-the-art technology. Our first shipments were ready after nine months. At present, there are 20 Energy-Onix FM Broadcast Transmitters operating worldwide at power levels from 300 to 30,000 watts. Engineering is now developing AM Transmitters with availability projected for December 1988.

Energy-Onix occupies a modern 6000 square foot plant and a 4000 square foot storage facility. At present, 20 people are active in assembly, test, engineering and general administration. Hudson, New York is located 35 miles south of Albany and is in close proximity to all major air carriers.

Energy-Onix designs, manufactures and distributes AM & FM Transmitters and AM NRSC products. The FM Transmitters offered include solid state transmitters to 1 kW as standard and higher solid state powers on a custom basis. One tube, zero bias triode designs are utilized from 1.5 kW to 50 KW. AM Transmitters are now available to 10 kW in both high efficiency solid state and high level vacuum tube configurations. Higher powers are available for quotation.

Energy-Onix is one of the major suppliers of NRSC AM products, including pre-emphasis, low pass filters and de-emphasis circuits.

Energy-Onix Broadcast products are sold worldwide through established distributors. Contact the factory for your area distributor. Latin American and Carribean sales are handled exclusively by Electrex of Miami, Florida.

Trade Shows: Energy-Onix will exhibit at NAB in Las Vegas booths #1730-1732.

Bernard Wise

Bernard Wise, President of Energy-Onix, is the former founder of CCA Electronics and is considered to be one of the leading and experienced Engineers in the design and manufacture of Broadcast Transmitters. His designs are presently in service in thousands of installations throughout the world. Bernie sold CCA in 1974 and started Energy-Onix in 1987.

Circle 61 On Reader Service Card

Fidelipac Corporation

Founded in 1954

P.O. Box 808, Moorestown NJ 08057
609-235-3900 • FAX: 609-235-7779

President: Robert S. Thanhauser, Jr.
VP/General Mgr: Dan McCloskey
Sales Director: Jack Ducart
Customer Service Mgr: Dr. Fred Buehler

Robert S. Thanhauser, Jr.

Robert S. Thanhauser, Jr. purchased the assets of Fidelipac from Harvel Corporation (formerly TelePro Industries Corp.) in October 1979. Prior to ownership of Fidelipac, Thanhauser worked in New York in the Investment Brokerage field.

Fidelipac invented and patented the endless loop tape cartridge, with patents awarded in 1957. The Model 300 cartridge was first adapted for broadcast use around 1958, and has become synonymous with commercial broadcasting ever since.

Fidelipac moved to its present location (shown) on April 3, 1983, and manufactured its first magnetic recording tape in 1984. The first DYNAMAX cartridge machines were shipped in November 1984. Fidelipac employs 54 full time, in a 44,000 square foot building in beautiful scenic Moorestown, NJ. All facilities are at this one location.

In January 1989, Fidelipac completed its AES/Hamburg promotion in which purchasers of DYNAMAX CTR100 Series Tape Cartridge machines received a free trip to the AES Convention in Hamburg, W. Germany this March.

Major Products and Product Lines

Models 300, 350, 600, 1200, Master Cart and DYNAMAX Cobalt NAB Tape Cartridges. DYNAMAX 1/4-inch back-lubricated magnetic recording tape. DYNAMAX Tape Cartridge Machines in single and triple deck configurations, ESD10 Eraser/Splice Detector. ON AIR and RECORDING studio warning lamps. Cartridge Racks. Accessories.

Fidelipac products are sold through a worldwide network of Authorized Distributors.

Contact the factory for your nearest Fidelipac Distributor.

Trade Shows

NAB, AES Hamburg, Radio 89, SBE National and most regionals, NRB.

Fidelipac Corporation

Henry Engineering

503 Key Vista Drive
Sierra Madre CA 91024
818-355-3656
Fax: 818-355-0077

Henry Engineering was founded in 1982 by current President Hank Landsberg to formally produce products which Landsberg originally "built from scratch" during his career as a Chief Engineer. His first products were retro-fit modules for Autogram broadcast consoles and the well-known Matchbox, selling over 5000 units since its introduction.

Henry Engineering specializes in unique, low cost "problem-solver" products.

Henry Engineering products are manufactured in a 4000 square-foot facility by six assemblers, a staff which has remained unchanged since 1983. All products receive 100% testing before shipment; return rate is below one percent.

Major products:
The Matchbox—the Standard-of-the-Industry level and impedance converter; Turntable Controller; Telecart; Mixminus Plus—the only way to add mix-minus to older consoles; Superelay Logiconverter—solves remote control problems; USDA—a new mini-DA 1-in, 4-out or stereo 1x2 with outputs switchable stereo/mono; Turbo-Modules for Autogram consoles; SWA products coming soon!

Henry Engineering products are distributed through dealers such as Allied Broadcast Equipment, BSW, Bradley Broadcast Sales, Crouse-Kimzey, Broadcasters General Store, Broadcast Services Company and others. Contact Henry Engineering for the name of your nearest dealer.

Trade Shows: NAB, SBE National

We Build Solutions

Circle 30 On Reader Service Card

Hank Landsberg
President

Director of Engineer for Drake-Chenault for 15 years/designed/built multi-studio complex includes custom designed audio consoles and tape duplicating system/in broadcast industry since 1972/hobbies: ham radio, photography, live music recording, antique jukebox collection.

Holaday Industries, Inc.

Burton Gran, President

Burton Gran has been with the Holaday Industries, Inc. for twelve years. He was vice president and general manager for two years before recently being named president. Prior to that he was vice president of marketing, and in his first years with the company he was responsible for technical writing, manuals, government agency interface, and product improvements. Previous to joining Holaday, he spent many years in Quality Control and Reliability positions at Litton Microwave, Control Data and Univac, as well as several years doing research at Honeywell.

14825 Martin Drive, Eden Prairie, MN 55344
612-934-920 FAX: 612-934-3604
Burton Gran, President & Sales Director
David Baron, VP/Engineering
David Thompson, Production Manager

Major Products:
Microwave survey meters for measuring microwave oven leakage, Isotropic broadband field strength meters for assessing RF exposure hazards, low frequency instruments for measuring electric and magnetic fields from VDT's and from electric power lines.

Holaday Industries sells direct in the United States and through distributors overseas.

Our company was founded in 1966 by Reed Holaday. In 1970 the company introduced its first microwave oven leakage instrument. During the next several years new models of microwave survey meters were introduced and, in 1980, a new line of isotropic broadband RF and microwave field strength meters was introduced. In 1986 the HI-5000-SX was introduced to assist broadcasters in measuring the time-averaged and spatial averaged field strengths as required by the new FCC RF exposure requirements. Recently a new line of low frequency field strength meters was introduced for measuring VDT radiation and power line electric and magnetic fields.

In the early 1980s we greatly expanded our export sales by establishing distributors in many foreign countries. Today Holaday Industries enjoys a worldwide reputation for affordable, high quality instrumentation for measurement of RF and microwave fields. All products are usually in stock for immediate shipment. Our repair and recalibration service is quick and economical.

In the summer of 1988, Holaday became a member of Bowthorpe Holdings PLC, a British international group engaged in the design, development, manufacture and marketing of electronic and electrical components and accessories.

Our 20,000 square foot facility, new in 1980, is conveniently located 15 miles west of the Minneapolis-St. Paul.

Trade show participation in 1989:
Semiconductor Safety Association (SSA), NAB, American Industrial Hygiene Conference (AIHC), Health Physics Society (HPS), EMC Expo (Electromagnetic Compatability) and SBE National.

Circle 63 On Reader Service Card

Kintronic Laboratories

Route 1, Pleasant Grove Rd.
Bluff City, TN 37618

Phone: 615-878-3141
Service Phone: 615-878-3141
FAX: 615-878-4224

President: Thomas F. King
VP/Marketing: Elizabeth H. King
Sales Director: Gwen B. King
Customer Service Rep: Donald Hastings
Production Manager: Boyd Wright

Founded in 1962 by Louis A. King, Kintronic Laboratories got its start in the fabrication of isolation transformers and custom RF components. The company has since grown in size to encompass a facility of 16,000 square feet and a staff of 20 employees.

Kintronic has also grown in reputation to be the leading independent manufacturer of custom AM antenna systems and components in the US. The firm also has established a reputation for high quality service and products worldwide.

Kintronic Laboratories' President Thomas King holds both a Bachelors and a Masters Degree in Electrical Engineering; he also has completed two years of graduate study toward his Doctorate in the field. King has 10 years of experience in defense electronics, and an additional six years in broadcast engineering.

Major products from Kintronic include directional antenna phasing systems, antenna tuning units, AM multiplexers, dummy loads, equipment racks, shortwave antennas, rigid transmission line and accessories, and RF contactors. Other products from the company include RF fixed and variable inductors, isocouplers, lighting chokes and custom RF components.

Kintronic is also the stocking distributor for Jennings vacuum capacitors and contactors, and maintains Andrew and Cablewave products in stock.

Direct marketing and distributors are employed by Kintronic Laboratories for sales, and the company has distribution agreements with RF Specialties, Allied Broadcast Sales, NE Broadcast Lab and Radio Resources.

Kintronic plans to exhibit in 1989 NAB and SBE conventions.

Circle 91 On Reader Service Card

LPB® INC.

28 Bacton Hill Road
Frazer PA 19355
215-644-1123

Founded in 1960 by: *Richard H. Crompton*
President: *Edward W. Devecka, Jr.*
Sales Director: *John P. Tiedeck*
Customer Service Reps.: *Mark Kelleher, Jim Quay*
Production Manager: *Jim Beissel*

Edward W. Devecka Jr.

Edward W. Devecka, Jr., President of LPB, Inc., has an extensive business background in manufacturing, marketing and general management. He graduated from Carnegie-Mellon University in 1963 with a BS degree in Mathematics, and from Harvard Business School in 1968 with an MBA.

Mr. Devecka's background includes 3 years in engineering at RCA, 9 years in manufacturing with a Massachusetts fluid controls producer and a Pennsylvania valve producer, 6 years in finance with a group of manufacturing subsidiaries of ARCO, 3 years in consulting, and 3 years as general manager of a small manager of a small manufacturing subsidiary of ARCO.

"I plan to manage LPB for growth in the current location," Mr. Devecka said. "I bought the business I was impressed by the technical skills of the people at LPB, especially by their pride in quality workmanship, and by the international reputation for reliability and value of LPB audio consoles and AM transmission equipment."

Major Products and Product Lines: Signature III Audio Consoles, Citation Audio Consoles, AM-30P, 60P, 100P AM Transmitters Carrier Current, Travelers' Information and specialized limited area AM Broadcasting Systems.

Distributor/Dealer: Audio Consoles and all other audio products are sold though leading dealers and distributors worldwide.

Trade shows: NAB, NRB, NAB RADIO, SBE, IBS.

LPB History

LPB, Inc. began operations in 1960, originally to produce low power AM broadcast transmitters for college campus carrier current radio stations. Continuing today as the leader in the field, LPB has installed hundreds of carrier current systems across the country in colleges, high schools, federal and state government facilities, and other institutions.

LPB transmitters have also found widespread use in applications such as radio sound systems for drive-in theatres, systems for language translation and assistance for the hearing-impaired in auditoriums, and systems for simulcasting in sports arenas.

With specially-designed transmitters, LPB has become the leader in designing and installing highway information radio systems, beginning with the Los Angeles International Airport (LAX) system which formed the model for the FCC Part 90 TIS regulations. Other well-known LPB systems include Disney World, Epcot Center, Opryland, and Six Flags Great Adventure Safari Park.

The LPB transmitter line now includes Part 73 FCC Type Accepted models, and several hundred are in use at daytime AM stations with low power post-sunset, pre-sunrise, or nighttime authorizations.

In the 1970s, LPB began designing and manufacturing audio consoles, developing the now legendary Signature series. Thousands of Signature, Signature II, and Signature III consoles have won the admiration of broadcasters worldwide. LPB has added the Citation series audio consoles, several related audio items, and studio furniture for the broadcaster.

On December 2, 1988, Edward W. Devecka purchased LPB from founder Richard H. Crompton, who remains with LPB as a consultant and applications engineer for the continuing specialty use of small AM transmitters.

Circle 98 On Reader Service Card

International Map Service

85 South Union Boulevard/D-2
Lakewood CO 80228
303-987-2747
Service Phone: 800-426-8676
FAX: 303-987-2735

President: Paul A. Montoya
VP/Marketing: Lynn Jenkins
Customer Service Rep: Lynn Jenkins

International Map Service organized in May 1987 in response to an industry need to provide engineering maps overnight to the engineering community. It has grown to include maps of all varieties, including aviation and travel maps.

President Paul Montoya has been involved in Broadcast Engineering for the past 14 years working in Denver, Albuquerque, Las Vegas and Phoenix. He is an active member of the Society of Broadcast Engineers.

International Map Service is a small business operating out of Lakewood, Colorado, a suburb of Denver. It operates a retail store with a regular telephone ordering service and employs three people.

International Map Service is an authorized dealer agent for USGS Topographic Maps and NOAA Aviation Maps. It also carries foreign maps, both topographic and travel, city maps for over 100 cities across the United States, wall maps of the world and United States, raised relief maps of the Rocky Mountain States and even maps of the moon.

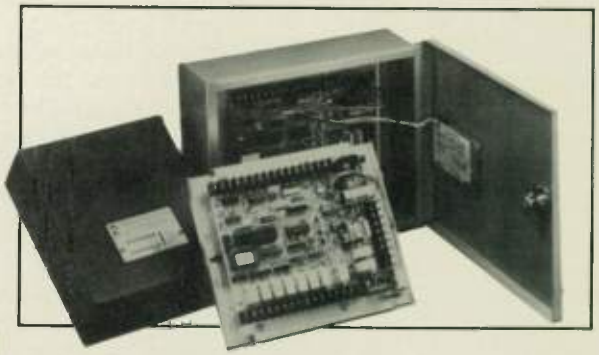
International Map Service is a member of the International Map Dealers Association

Circle 69 On Reader Service Card

MONROE ELECTRONICS, INC.

100 Housel Avenue, Lyndonville, NY 14098
Phone: 716-765-2254 • FAX: 716-765-9330 • Telex: 75-6662

Founder: Robert E. Vosteen
President: William E. Vosteen
VP/Marketing: Brian D. Ives
Customer Service Rep: Roland L. Phillips
Production Managers: William H. Feldman



Monroe Electronics employs 50 people in a modern 15,000 square feet building. The facility includes administrative, engineering, design, production and fabrication operations.

William E. Vosteen, Pres.

A graduate of Syracuse University in Electrical Engineering, William Vosteen has worked at Monroe since graduation. He started in areas of research and development then progressed into management.

Vosteen started specializing in instruments and Control Systems and gained a world wide reputation in electrostatic instruments. In the late 60's a high speed DTMF decoder was developed which was the basis of our touch tone signaling/remote control products.

Major Products:

Systems for Remote Control, status of monitoring of relay, switch closures, audio over dial-up phone lines. FCC registered phone hybrid couplets. Audio detectors, amplifiers, timers.

Monroe Electronics sells both direct and through distributors that include: Allied Broadcast, EMCEE, Maruno Electronics, LTD, Northeast Broadcast Labs, Ram Broadcasting.

Trade Shows: *NAB and CCBE.*

Circle 76 On Reader Service Card

Martin
Audio/Video Corporation

423 West 55th Street
New York NY 10019-4490

212-541-5900
Parts Department: 212-489-4750
Rental: 212-265-4646
Fax: 212-541-9128

Founded in 1962 by: Bruce Martin
VP Sales: Michael Bogen
Sales Manager: David Bellino
Parts Department Manager: Dan White
Rental Manager: K. C. Green
Customer Service Rep: John Tamburello

As New York's leading pro audio dealer, Martin Audio has over 25 years experience in the sales, installation, and servicing of audio equipment for recording, broadcasting, and post-production. In addition to over 200 major lines of equipment, Martin is the exclusive New York area source for Amek, Harrison, Neotek, and Sound Workshop consoles, Otari's MTR and DTR lines of analog and digital tape recorders, Sanken microphones, the Lexicon Opus digital workstation and their Advanced Products signal processors.

For broadcast, Martin features products from such companies as Otari, Tascam, Aphex, Sony ES, B&B Systems, Howe Technologies, Orban, Harrison, Soundcraft, Lexicon, Neumann, Amek, and Technics.

We also offer our customers the latest MIDI synthesizer and digital sampling hardware and software and extensive applications expertise in our Music Technologies division. Among the musical product lines available are Akai, digidesign, Dyaxis, E-mu, Korg, Kurzweil, Mark of the Unicorn, Oberheim, Opcode, Optical Media, Roland, and Sycologic, most of which are on display in a complete, working MIDI studio/demo room.

Martin Audio also features the largest pro audio Parts Department in New York with everything from racks to resistors. Our Technical Services Department is well known for the high level of customer support we provide. With each sale all major consoles and large tape recorders are thoroughly checked out before delivery. We can repair a specific product on an as-need basis, or we can offer you a service contract for preventative maintenance on your entire studio.

Martin Rentals features an extensive selection of the best- maintained rental equipment in the East. We rent Otari MTR-90 multitrack and MTR-12 and MTR-20 two- and four-track analog recorders; Sony PCM-3324 digital multitracks, PCM-1630 two-track digital processors, and PCM-2500 R-DAT two-track recorders; TimeLine Lynx synchronizers; Dolby and dbx noise reduction; digital delays and reverbs by Eventide, Lexicon, Quantec, and Yamaha; a wide assortment of microphones including B&K, Sanken, and both vintage and modern models from AKG and Neumann; wireless mic systems by HME, Sennheiser, and Sony; and a complete range of compressors, de-essers, equalizers, limiters, and signal enhancers, includng some select, vintage tube units.

Circle 59 On Reader Service Card

Founded in 1956 by Ray McMartin

MCMARTIN

201 35th Ave.
Council Bluffs, Iowa 51501
Phone: 712-366-1300
Service Phone: 712-366-1300
FAX: 712-366-3915

President: K. Jerry Martin
VP Operations: Charles Goodrich
Sales Director: Joe Krier
Customer Service Rep: Bill Abbott

In operation since the mid-1950s, McMartin Inc. is a full line supplier of broadcast equipment, engineered sound and FM/SCA background music equipment. The company, which occupies a 17,000 square foot building on five acres of land in Council Bluffs, employs 35 people.

Major products and product lines carried by McMartin include AM and FM transmitters, consoles, and commercial sound amplifiers from 5W to 350 W, in particular, FM/SCA receivers for music and data. The company sells both direct from the factory as well as through distributors and dealers.

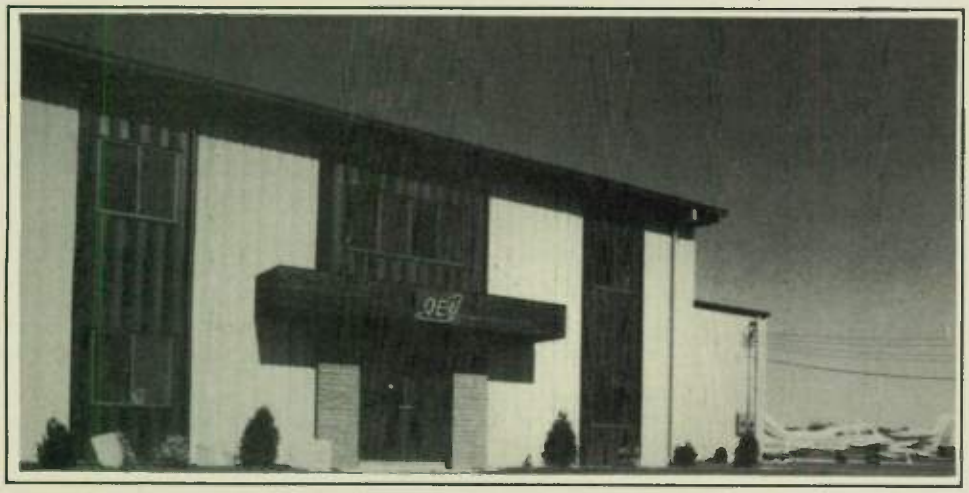
McMartin Inc. plans to exhibit its wares at the 1989 NAB Convention.

Circle 88 On Reader Service Card

One Airport Drive, PO Box 3, Williamstown, NJ 08094
800-334-9154 Service Phone: 609-728-2020 (24 hours)
FAX: 609-629-1751

Founded in 1971

Charles Haubrich, President
William J. Hoelzel III, Sr. VP/Marketing
John Pilman, Sr. VP/Engineering
Jeffrey R. Detweiler, National Sales Manager



Charles Haubrich, President of QEI, established the company after extensive experience with the Burroughs Corporation and the Military Systems Division of AEL and Belar.

QEI designs and manufactures FM transmitters, exciter, modulation monitors and test equipment. Incorporated in May 1971, the company initially designed and manufactured modulation monitors, frequency monitors and special receivers which were brand named and sold by CCA Electronics.

In 1973, QEI Corporation began marketing its products under its own name. The first QEI products developed by the company were the Model 675 FM exciter and the Model 772F stereo generator, along with an SCA generator and various audio processing equipment. The Model 675 was the first all-solid-state, 20 W, phase locked loop, frequency synthesized FM exciter available to the commercial broadcast industry—it is still in production today, having sold over 1000 units, including those made for American Electronics Labs and CSI Electronics. More recently, QEI introduced the Model 695 Exciter. Its phase-locked-loop oscillator, varicap circuitry, fully broadbanded design, nearly unmeasurable distortion and automatic modulation control make the 695 the most advanced exciter available.

QEI developed its first all-solid-state FM amplifier, a 150 W model, in 1976; similar amplifiers with 300 and 500 W output power followed shortly thereafter. All three are still in production, having won industry-wide acceptance along with the Model 675 exciter, both as main transmitters for low-power applications and as emergency backup transmitters. All three of these transmitters have both US FCC type acceptance and Canadian FOC type acceptance.

Building on its established low power designs, QEI next developed a 1 kW solid-state modular FM transmitter, and introduced the FMQ series of grounded grid triode final amplifier FM transmitters, with output power levels of up to 30 kW. QEI's grounded grid triode design provides stable operation and long tube life in the final amplifier stage. The modular solid state driver stages (again based on proven QEI low power transmitters) are conservatively designed for maximum reliability. Many QEI transmitters are available with the optional ARC 27, a microprocessor-based automatic remote control system, including remote diagnostics, developed by QEI engineers.

In 1980, QEI introduced the first test unit designed for FM broadcasting. The Model 691 FM Monitor/Test Set combines specialized modulation monitoring functions with a wide range of other test functions. Thanks to its flexibility, usefulness and reasonable price, the Model 691 has become the industry standard for monitoring and test equipment.

QEI's manufacturing plant, together with its research and development facilities, are located in a 14,000 square foot complex adjacent to Cross Keys Airport in Williamstown, NJ. Its proximity to Philadelphia International Airport makes emergency parts shipments or service calls in response to QEI's 24-hour service phone quick and convenient.

From initial engineering to final board stuffing, soldering and assembly, QEI products are designed and manufactured completely in-house, allowing the company to maintain the highest standards of quality control. The engineering and manufacturing staff uses Tektronics Model 8540 and 8550 microprocessor development systems along with a full complement of Tektronics and Hewlett-Packard test equipment. A complete sheet metal and machine shop is also part of the manufacturing operation.

QEI operates a twin engine Cessna 310 aircraft for sales and service purposes. The company has an excellent credit rating; its Dun and Bradstreet number is Duns 05-901-3805.

QEI markets its products direct and through major broadcast distributors.

Major products: Model 675 FM exciter, Model 691 FM Monitor/Test Set, Model 675T1560/300/500 FM Transmitters, Model FMQ3500/5000/10000 FM Transmitters; 15 kW, 20 kW, 25 kW, 30 kW and 60 kW FM Transmitters, ARC 27 Automatic Remote Control System

Trade Shows: NRB, NAB, SBE National Convention

Circle 89 On Reader Service Card

RPG®

Diffusor systems to enhance the acoustics of critical listening and performing environments.

12003 Wimbleton Street Largo, MD 20772
301-249-5647 FAX: 301-249-3912

Dr. Peter D'Antonio, *President & Co-founder*
Dr. John Konnert, *VP/Marketing and Co-founder*
Elizabeth Werner, *Sales Director*
Cynthia Bonavito, *Customer Service Rep*
Gene Leftwitch, *Production Manager*

Peter D'Antonio was born in Brooklyn, New York in 1941. He received his BS degree from St. John's University in 1963 and his PhD from the Polytechnic Institute of Brooklyn in 1967. Dr. D'Antonio has specialized in a wide variety of scientific disciplines including spectroscopy, x-ray diffraction, electron microscopy, software development, and architectural acoustics. He designed and built Underground Sound Recording Studio, Largo in 1974 where he later developed the reflection phase grating (RPG®) diffusor. Dr. D'Antonio is president of RPG® Diffusor Systems, Inc., founded in 1983, to carry out basic research in room acoustics and develop innovative architectural acoustic design components for critical listening and performance environments. Dr. D'Antonio has lectured extensively on architectural acoustics and his designs and diffusor systems have been used in hundreds of recording, broadcasting, performing and residential listening applications all over the world. He is a member of Sigma Xi, the American Crystallographic Association, American Chemical Society, American Institute of Physics, National Association of Broadcasters, Audio Engineering Society, Acoustical Society of America and a professional affiliate of the American Institute of Architects.

RPG Diffusor Systems', manufacturing facility is located at 3804 Ironwood Place, Landover, MD 20785 (Phone 301-322-4458) and the corporate offices are located at 12003 Wimbleton Street, Largo, MD 20772 (Phone301-249-5647, FAX 301-249-3912).

RPG has 15 employees. RPG distributes worldwide through RPG Europe located in London, Ohba Trading in Tokyo, EXCEL Hi-Fi in Hong Kong and Sonotron in Australia.

Special Events

Dr. D'Antonio is actively involved in broadcast studio design research and lectures extensively at Synergetic Audio Concepts seminars, NAB Engineering Conferences, AES, NSCA, and CES Conventions, as well as at educational institutions.

Major products and product lines

RPG Diffusor Systems manufactures a Complete Acoustical Treatment consisting of a broad-bandwidth sound diffusor, the QRD DIFFUSOR® , a broad-bandwidth sound absorber, the ABFFUSOR® , and a variable acoustics module, the TRIFFUSOR® . RPG has also developed optimized broadcast studio designs which utilize these acoustical ingredients.

Trade Shows: AES, NAB, NSCA, CES

Circle 95 On Reader Service Card

Shure Brothers Inc.

Shure Brothers Inc. was established in 1925 and began designing and manufacturing audio equipment in 1932. Its history of electronic sound reproduction and reinforcement has been marked by numerous milestone products. Because of their technological innovations, functional designs, and superior quality, they are universally recognized as classics.

In the field of remote and studio broadcasting, Shure has developed a standard-setting, extensive line of field production microphone mixers, audio distribution amplifiers, headphone bridging amplifiers, a stereo audio mixer, and a mic-to-line amplifier—including the industry standard, the popular M267 field production mixer.

Shure professional phonograph cartridges are designed to provide clean, undistorted playback of even the toughest-to-track recordings. The highly regarded Shure BC Series Cartridges have been designed specifically for radio station use. They offer true high fidelity sound reproduction and the ruggedness required to withstand constant backcueing.

Few companies in the audio industry have matched the Shure record in developing and manufacturing such products. This record has been achieved through the Company's long-standing policy of devoting extensive resources to engineering research and development and maintaining the highest possible standards of quality and consistency in manufacturing.

Manufacturing locations

Manufacturing is carried out in a number of plants in the U.S.A. and Mexico. Research, development, production, marketing and sales are centered in the world headquarters in Illinois. Shure products are sold throughout the world.

Major Products

Microphones, microphone mixers, broadcast circuitry, wireless and wired sound systems, hi-fi cartridges, automatic microphone systems, teleconferencing systems and home theater sound.

Shure Brothers will be exhibiting at AES, CES, NAB, RTNDA and SBE in 1989.

222 Hartrey Avenue
Evanston IL 60202-3696

312-866-2200
Service phone: 312-866-5731
FAX: 312-866-2279

President: James H. Kogen
VP/Sales: Lottie Morgan
Customer Service Rep: Maureen O'Reilly

James H. Kogen

President and General Manager, James H. Kogen is a graduate of the Illinois Institute of Technology with a degree of BS in Electrical Engineering, and of Northwestern University with an MS degree in Electrical Engineering. He began his career with Shure in 1962.

Circle 70 On Reader Service Card

SPENCER BROADCAST, INC.

PROFESSIONAL BROADCAST EQUIPMENT SALES
7003 W. Union Hills Drive
Peoria AZ 85345
602-242-2211 FAX: 602-843-2860

President: Charles G. Spencer VP/Marketing: Carol S. Spencer

Spencer Broadcast consists of Chuck Spencer and Carol Spencer who keep control of service requirements and client needs. Our offices are highly computerized to insure efficiency in order, process and followup.

Charles G. Spencer

Chuck Spencer has over 27 years experience in electronics with the last twenty in AM/FM broadcasting. He spent three years with Collins Radio in Broadcast Field Service, 10 years as CE with a successful FM in Phoenix and helped conceive, design, and build Churchill Radio Productions.

Spencer Broadcast is celebrating its 10th year as an equipment supplier and designer of radio station properties. With a client base nationwide, Spencer serves as a reliable source for equipment and technical information and services.

Carol Spencer

Product Lines

We proudly carry a complete line of over 150 products for the broadcaster, from cart tape to entire radio stations including towers, buildings, and all accessories. Some major brands handled include Orban Associates, Broadcast Electronics, Fidelipac, Jampro, Dielectric Communications, Electro-Voice, Shure, Technics, Marti, TFT, Sennheiser, JBL, UREI, TTC and Scotch.

Trade show participation

Spencer Broadcast has participated at the past ten NAB shows with equipment suppliers. At these shows, time is set aside for client meetings and a schedule is available from our offices.

Spencer Broadcast actively supports the SBE and assists members with technical problems when the need arises. Chuck Spencer also specializes in station evaluations.

Notes

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INDICES & REPRINTS

In the following pages are indices of the complete news and feature stories appearing in *Radio World* from 1 January to 15 December 1988.

Each index uses a numerical system to denote issue date and page number—the month and day are separated by a slash, while the day and page are separated by a colon. Thus, an entry of 10/15:2, for example, refers to a story in the 15 October 1988 issue, on page 2.

The first of the indices lists feature stories of the past year, by author name. The second lists the news stories, cross-referenced by subject.

Also included in this part of the *Radio World Annual* are selected reprints from the year's Buyers Guides. Companies whose products appear in these reprints have been arranged alphabetically.

Radio World 1988 Author Index

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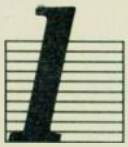

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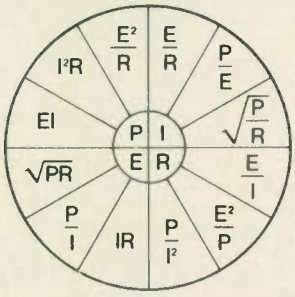
Useful Engineering Formulas

OHM'S LAW FORMULAS FOR DC CIRCUITS



ONE CYCLE TIME DURATION

10kHz =	100μsec
20kHz =	50μsec
100kHz =	10μsec
200kHz =	5μsec
250kHz =	4μsec
1MHz =	1μsec
4MHz =	0.25μsec
10MHz =	0.1μsec

BINARY TO BASE 10 CONVERSION

1 (2^3) =	8
0 (2^2) =	0
1 (2^1) =	2
1 (2^0) =	+ 1
	11

DECIBEL FORMULAS

Where impedances are equal

$$dB = 10 \log \frac{P_1}{P_2} = 20 \log \frac{E_1}{E_2} = 20 \log \frac{I_1}{I_2}$$

Where impedances are unequal

$$dB = 10 \log \frac{P_1}{P_2} = 20 \log \frac{E_1\sqrt{Z_2}}{E_2\sqrt{Z_1}} = 20 \log \frac{I_1\sqrt{Z_1}}{I_2\sqrt{Z_2}}$$

0dBm (1mW) = 0.774 volts across 600 ohms
0.387 volts across 150 ohms
0.224 volts across 50 ohms

TRANSFORMER TURNS RATIOS

Primary Power = Secondary Power

$$\frac{N_P}{N_S} = \frac{E_P}{E_S} = \frac{I_S}{I_P} = \sqrt{\frac{Z_P}{Z_S}}$$

RESISTORS IN PARALLEL

EQUAL RESISTORS

$$R_{TOTAL} = \frac{R}{n}$$ Where n is the total number of resistors

UNEQUAL RESISTORS

$$R_{TOTAL} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots}$$

$$R_{TOTAL} = \frac{R_1R_2}{R_1 + R_2} \qquad R_1 = \frac{R_TR_2}{R_2 - R_T}$$

If the current through a resistor doubles, the power dissipated quadruples

IMPEDANCE FORMULAS

SERIES CIRCUITS — R & X IN SERIES

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

PARALLEL CIRCUITS — R & X IN PARALLEL

$$Z = \frac{RX}{\sqrt{R^2 + X^2}}$$

DIRECT POWER FORMULA

$$P = I^2R$$

Where I is the common point or base current in amperes, and R is the common point or base resistance in ohms

INDIRECT POWER FORMULA

$$P = IE(effy)$$

Where I is the final P.A. current in amperes, E is the final P.A. voltage in volts, and effy is the transmitter efficiency expressed in decimal form (79% = 0.79)

SINE WAVE CONVERSION

Effective Value = 0.707 × Peak Value
Average Value = 0.637 × Peak Value
Peak Value = 1.414 × Effective Value (RMS)
Effective Value = 1.11 × Average Value
Peak Value = 1.57 × Average Value
Average Value = 0.9 × Effective Value (RMS)

Courtesy of Delta Electronics

Radio World 1988 Subject Index

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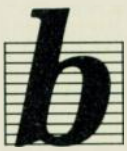

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REACTANCE FORMULAS

$$C = \frac{1}{2\pi f X_C} \qquad X_C = \frac{1}{2\pi f C}$$

$$L = \frac{X_L}{2\pi f} \qquad X_L = 2\pi f L$$

RESONANT FREQUENCY FORMULAS

$$F = \frac{1}{2\pi\sqrt{LC}} \qquad f_{kHz} = \frac{159.2}{\sqrt{LC}}$$

$$L = \frac{1}{4\pi^2 f^2 C} \qquad L_{\mu HY} = \frac{25{,}330}{f^2 C}$$

$$C = \frac{1}{4\pi^2 f^2 L} \qquad C_{\mu FD} = \frac{25{,}330}{f^2 L}$$

Where f is in kHz
L is in microhenries
C is in microfarads

CONVERSION FACTORS

$\pi = 3.14$ $\qquad 2\pi = 6.28$

$\pi^2 = 9.87$ $\qquad \log\pi = 0.497$

1 meter = 3.28 feet
1 inch = 2.54 centimeters
1 radian = 57.3°

FREQUENCY AND WAVELENGTH FORMULAS

$$f_{kHz} = \frac{3 \times 10^5}{\lambda_{METERS}} \qquad \lambda_{METERS} = \frac{3 \times 10^5}{f_{kHz}}$$

$$f_{MHz} = \frac{984}{\lambda_{FEET}} \qquad \lambda_{FEET} = \frac{984}{f_{MHz}}$$

$0.625\lambda = 225° = {}^5/_8$ WAVE
$0.5\lambda = 180° =$ HALF WAVE
$0.311\lambda = 112°$
$0.25\lambda = 90° =$ QUARTER WAVE

RESISTORS IN SERIES

$$R_{TOTAL} = R_1 + R_2 + R_3 + \cdots$$

Courtesy of Delta Electronics

BUYERS GUIDE

Reprints of selected articles paid for by the following companies.

(companies appear in alphabetical order)

System 100 Delivers

by Curtis Durst, GM/Owner WKLP/WQZK

(Editor's note: Absolute Broadcast Automation principal Jack Mullen II is part owner of WKLP/WQZK, where this User Report originated.)

Keyser WV ... My partners and I once said, "We'll never automate; automated stations sound automated." That was before the System 100 Real Time Automation.

User Report

System 100 is promoted by Absolute Broadcast Automation as total radio station automation. I believe the results are consistent with the claim.

After purchasing a poorly equipped AM/FM combo, we decided that a greater profit could result from separate programming of the stations. We quickly realized that our market situation would not economically justify two professional sounding air staffs.

In addition our operating capital was depleted by the equipment needs of the FM station. We decided to consider automation.

System 100 permitted us to take advantage of a small group of talented, hardworking announcers who would be "live" on the FM station and "cut talk tape" on the automated AM station.

We obtained the full business software package so we could print commercial logs for the FM and produce the real time schedule of events used by the AM.

The use of a computerized traffic system alone saved hours of manual log preparation each day. We also replaced the accountant with the A/R, A/P, billing and general ledger programs.

The powerful program automation of the System 100 allowed us to duplicate the live operation we had originally planned to implement.

Editor's note: Curtis Durst is part owner of the Starcast Systems Inc. group of stations. For more information on Absolute Broadcast's System 100, contact Jack Mullen at 301-786-4661. The author may be reached at 304-788-1662.

Since space is limited, I'll confine my discussion of details to the scheduling software responsible for the natural live sound produced by System 100.

The result of the scheduling process is a comprehensive sequence of events including music, spots, talk and news, as well as the exact time each event will air.

Schedule software

The schedule is printed on paper and loaded to the automation system for use on the day for which the schedule was prepared. The printed copy can then be used to record the so-called "real-time talk," which consists of specific talk segments recorded and aired at the designated time and location in the schedule.

To generate this sequence of events the scheduling software takes information from the spot order files, the music library files and the format masterlogs.

This method of pre-producing the schedule of events is novel since it eliminates the manual, "punch-in" of ➤

program sequences and permits live sounding talk to be generated.

In other words, say goodbye to the time announce schemes of the past! All music is scheduled in advance using the music management portions of the scheduling software. Thus programming techniques are handled automatically.

Some of the music management features include song recognition by categories such as current, recurrent, add, oldie and gold. If jingles are used, the software automatically matches the jingle tempo with the tempo of the upcoming song.

Parameters such as flow, artist and song separation, hot clock requirements and others which are user definable determine what songs are scheduled. If station IDs are to be aired over the intro of a song then "intro length matching" of the song is accomplished.

Many other similar considerations are possible so that most format requirements can be satisfied.

After a schedule is produced, the process of recording talk for a typical six hour show is completed in about 20 minutes. System 100 permits talks to air out of the end of a song and over the intro of the next song.

It is therefore possible to have music mixed under a talk segment in a manner analogous to a live music talk mix.

Walk-away time is user set and varies according to talk tape and music rotation requirements. Our typical walk-away time is six hours, after which we change talk tapes. Days of walk-away time are possible.

Our system records newscasts from two networks and airs them each on a delayed basis. Local news is recorded to cart for access by the system five times a day.

The system also airs Paul Harvey news and ABC sportscasts live during the day. The backtiming is automatically taken care of during scheduling and no operator assistance is needed.

The system features computer assisted music and commercial recording. The software is fault tolerant and the on-line prompting makes input of information very easy.

Remote control of the system and legal transmitter remote control is possible with the addition of some soon-to-be-available hardware and software, according to the company.

System 100 can also control satellite programming services and other special configuration situations.

Our future plans include automating our other stations utilizing digital audio tape (DAT) players as the source for music and spots.

Thanks to System 100 we have a professional and consistent sounding AM radio station with little more cost than operating the FM alone.

Our evaluation of the System 100 is good. Our only negative comment concerns the incomplete documentation, which is supposed to be finished soon.

The hardware and software are reliable. Our experience with the system spans more than two years with only minor problems.

Thanks to System 100 we have a professional and consistent sounding AM radio station with little more cost than operating the FM alone.

System 100 has changed my I'll-never-automate attitude.

Reprinted from February 15, 1988

AKG "Effect-ive" at WBCN

by Marty Acuff, CE, WBCN-FM

Boston MA ... WBCN is engaged in rebuilding its facilities with the goal of added practicality. In our main production studio AKG's ADR 68K digital audio processor fits very well into that objective.

There are a number of digital effects boxes on the scene with a variety of features and price tags. In mid-priced digital processors the ADR 68K is a prime value.

The ADR 68K is a versatile reverb and special effects processor with excellent sonics, ease of use and flexibility as an all-around audio processor.

The device comes in two parts: the main processing assembly and the remote unit. The main processor is rack mounted (EIA, two units or 3.5") and needn't be mounted near the operator. This is an important space-saving feature for close-quartered studios.

With the exception of the primary power switch all functions are controlled on the remote unit: a keyboard and display package (measuring 11"×9"×2.5") convenient for tabletop use.

XLR input and output connectors

All audio connections are made to the main processor. The ADR has XLR-style Hi-Z balanced inputs (transformerless) used as stereo or dual mono, depending on the application. Input sensitivities can be changed from the factory set +8 dBm via jumpers.

The four output connections are also XLR type: Main Left and Right, and Aux Left and Right. The outputs are active balanced +17 dBV maximum.

Editor's note: Marty Acuff has 10 years of experience in broadcast engineering and is a certified member of the SBE. He may be reached at 617-266-1111.

For more information on the ADR 68K, contact Richard Ravich at AKG: 203-348-2121.

The pin connections conform to European standards (pin #2 is high, pin #3 is low and pin #1 grounded). Also included are MIDI in, out and thru connections.

The "mainframe" and remote connect with 6-pin DINs and the factory supplied 50' cable. Lengths of up to 100' are possible. The remote unit has four ¼" tip-ring-sleeve standard jacks on the rear panel used for triggering from foot switches, synths, etc.

User Report

AKG's design philosophy of making a completely software-based processor is perceptive. Since the processing isn't dependent on hardware, upgrades are much simpler and cheaper; the ADR will stay current through updates instead of becoming obsolete.

No simulated stereo

The ADR 68K is also *true stereo*. Most low-cost digital effects processors are mono input/simulated stereo output. Some of those try to fool us into thinking that they're full stereo inputs by having left and right input connectors. These low cost processors act on the L+R internally summed audio. Beware!

The ADR at WBCN has enough internal memory to allow audio samples of about 8 seconds, expandable to 32 second samples.

The back-lighted four row LCD display is easy to read. Each program usually has several pages of parameters that are easily scrolled with the cursor buttons. The program menus naturally direct new users to desired effects, while quick direct access to programs is also available.

The manual is thorough in its discussions. Brief theory sections on reverb and sampling are provided to aid the new user. MIDI basics are also covered; most broadcasters aren't up on MIDI ... yet.

The manual also covers field service such as installing software upgrades, power supply problems and troubleshooting hints. A condensed theory of operation is also provided.

As for repairs, the best thing I can say about this product is I don't know, it hasn't broken.

The ADR is exceptionally powerful in its capabilities. There are 11 main categories, or banks, of functions: Plate, Chamber, Room and Hall reverbs; Splits, Sampler, Reverse Reverb, multi-effects, stereo processing (of mono sources), Chorusing and DDL (digital delay lines).

Factory presets sufficient

Many production people will find the factory presets sufficient for their needs. The internal and cartridge presets are available for storing user defined parameters. (The cartridge is removable for use in other ADR 68Ks or additional cartridges can be assigned to each production person.)

A total of 50 registers are available in internal and 50 in the cartridge presets.

Defining presets is quite easy. Each bank (with the exception of Sample) has a number of parameters that allows the user to shape the sounds to his or her own liking.

The parameters are usually controlled with a linear fader-like slider or button. With up to 48-user programmable parameters in each reverb or effect, the ADR 68K has vast potential for the creation of custom effects.

But not everyone has time to program his or her own effects. For this reason, AKG has provided over 100 factory preset sounds. Many of these presets are available with just one or two keystrokes. ➤

AKG provides a huge variety of sounds, from warm and natural reverberating spaces to crazy pitch-changing echo effects. The factory presets are logically arranged so that you do not have to spend a lot of time hunting around to locate a desired effect.

Reverb variety

The ADR 68K includes six different kinds of reverb, each simulating a particular sound situation. The parameters control the apparent size of the room, the decay time and even simulate the type of materials that make up the walls!

We can create the illusion of anything from a small room to a canyon. Spacey effects can be created with Reverse Reverb, making audio sound like it's being played backwards when it's actually going forward (for that "Jimi Hendrix" sound.)

In mid-priced digital processors the ADR 68K is a prime value.

For the "Phil Collins' Drums" effect, gated reverb is available, which "chops off" part of the reverb tail.

The Split is a special bank of two completely independent mono in/stereo out effects at once. The split effects may be used either independently (a separate effect for different voices) or chained together to create rich, complex reverb sounds.

Two examples of this are the Plate/Hall split reverb program and the dual DDL. All internal signal paths are digital, so effects can be cascaded in the digital domain with no loss of signal quality. It's like two reverbs in one box.

A range of effects

The ADR 68K doesn't stop with reverb, but features a wide range of effects. The dual DDL bank can be configured as two completely independent delays, parallel delays (for phasing, flanging or doubling effects) or chained delays.

The Poly-Chorus bank produces chorusing, pitch-shifting, automatic panning and other effects.

The stereo processor bank has several techniques to choose from for creating a stereo image from mono source material. All of the techniques provide mono compatibility when summed back into mono.

Multi-Effects allows the user to combine many of the effects into one process, as though you had a pair of DDLs, a gate, a two-band shelving EQ, a stereo chorus, a reverb and stereo multi-tap all patched together.

This multi-effects bank is so powerful that it leaves the cheaper effects processors far behind.

Powerful sampling capability

The sampling power is truly where the ADR shows its stuff. WBCN's production staff uses sampled audio as the tag for conventional carted dubs to save time.

Sample recording may be triggered by the onset of the sound, or manually. Editing is as simple as moving a single fader.

Playback may be triggered manually, by an audio trigger (with less than 2 ms trigger delay), by a footswitch or by any MIDI keyboard.

Photo by Mim Michelove

Marty Acuff, CE, WBCN radio, poses with AKG's ADR 68K

Up to four different samples may be playing at the same time, each with a different sound and edit points. The ADR 68K also does stereo sampling. And if that's not enough the two-second samples can be used in most of the other reverb and effect modes.

AKG's ADR 68K covers most of the bases for broadcast production. At WBCN, I find that we've barely scratched the surface of it's capabilities. What's most important, though, is how the ADR 68K has enhanced our station's sound.

Reprinted from July 15, 1988

Amber 5500 Earns High Marks

by Rob Meuser, Int'l Bdcst Support Services

Hamilton Ontario ... Test equipment today is becoming a sophisticated field unto its own. Happily it is one area where the products are becoming genuinely more sophisticated and useful.

Often the quality of connection between the test equipment and the test device is the limiting factor of measurement, when the legendary straight wire is anything but.

User Report

Players in this class of high-tech test equipment are few. Of all the available technology, in my opinion none are able to better the quality and power of the Amber 5500.

I first saw the 5500 last year at NAB and left the show modestly impressed.

One high profile purveyor of this class equipment left me with the comment that, "It is one thing to build in a GPIB interface, and quite another to get it to really work."

I left with the mistaken impression that Amber and some other companies might have a lot more work to do.

GPIB interface

For those who are not familiar with GPIB, otherwise known as the IEEE 488 bus or sometimes the HPIB, let me offer a brief explanation.

The GPIB, unlike the various serial interfaces, is a high speed parallel interface bus especially designed for controlling test and measuring equipment.

Each device is given its own special address, and is commanded to either transmit or receive data by the central controller. While the mechanics of the bus are somewhat complex, and timing is important, using the bus is no more trouble than any other standard computer interface.

Looking at the Amber unit and its use of the GPIB certainly reflects the quantum leap computer technology has taken since the heyday of the old Pet computer.

The Amber 5500 is not only a high-tech, high quality piece of stand-alone test equipment, it is also a complete measurement system.

The hardware itself consists of a signal generator, distortion analyzer, sweep system, waveform generator and stereo switching system.

It is capable of audio spectrum analyses, noise generation, controlling an external audio source and much more. IMD measurements according to either SMPTE or CCIF are possible, all automatically.

Editor's note: Since this article first appeared, Amber has added additional hardware and software capability. New options include Phase Measurement (left to right or input to output) and Wow and Flutter measurement to virtually all standards.

The 5500 is also now available as separate Generator (5100) and Analyzer (5300) for split site applications. The AudioCheck™ Software Package can control the distant generator via a simple modem connection without requiring a computer at each site.

Amber continues to add new application procedures to the AudioCheck™ Software Package.

Rob Meuser specializes in all manner of broadcast systems and associated equipment. He is a frequent contributor to **RW.**

For more information contact Wayne Jones at Amber: 514-735-4105 in Canada. The author may be reached via MCI Mail #325-3672, or by calling 416-526-8200.

With the exception of the spectral analysis and high speed sweeping abilities, all the features mentioned are roughly similar to most other equipment in this class. What sets the 5500 apart is the extensively developed software that works with the GPIB interface.

Amber supplies the most complete documentation I have ever seen with any type of software. Each file is listed and explained, and set-up is clear and concise. The documentation avoids the use of "computerese."

When the Amber 5500 is harnessed to any PC/AT compatible computer, what was just minutes before a piece of test equipment is now a development system.

The Amber software not only interfaces the equipment, it also provides a very high-powered analysis system.

The Amber/PC combination offers the user a complete menu driven development system to specify exactly the measurements desired: every possible parameter can be controlled.

It is no problem, for example, to generate either a preemphasis or inverse preemphasis curve merely by editing a chart of frequencies versus output levels established by the system editor.

The exact frequency in a step can be altered with many pieces of test equipment if you specify a logarithmic frequency step from 20 Hz to 20 kHz. The number of measurement points you choose determines the exact frequency. Most times, these perfect logarithmic steps turn out to be oddball values.

While the Amber system will calculate the same oddball frequency as any other piece of gear, its software allows you to edit those values to ones that fit your whim.

After these values are established, you may then make your tests, and then later analyze the results with different scaling. Since all the files are ASCII files of letters and numbers you can also transport them to other systems like Lotus 1-2-3.

Open to possibility

You can even construct word processor macros that insert file table data into pre-formatted test reports. The software supplied by Amber is so flexible and simple to use you can do almost anything your imagination inspires you to do.

The software has its own simple to use control language, including some basic math functions. You can pre-program a sequence of events (measurements or tests) and name them as a file.

You can also control equipment not made by Amber as a part of your procedures. For example, you can program an RS-232 port to control a tape machine and at the same time control the Amber to test it, producing an entire automated set up system.

You can hook another manufacturer's RF spectrum analyzer to the GPIB and program it along with the Amber to do a complete AM mono or stereo transmitter analysis.

Since much broadcast measurement is done in the wee hours of the morning, the power of such a system is truly useful.

Money saver

In major markets equipment like the Amber 5500 properly programmed could save money by vastly reducing off air time for proofs and greatly increasing data quality. Private consultants can benefit in the same manner. As we all know, one night of work kills two days.

What sets the 5500 apart is the extensively developed software that works with the GPIB interface.

There is so much more that the software can do it is worth several articles itself. Weighting, averaging, settling algorithms, compensation for various mediums (delay from record to play on tape machines), the ability to automatically read test tapes in a single-ended manner and much more are available.

Even the hardware alone has vast capabilities. Distortion and noise can be automatically measured through various weighting filters.

Distortion generally uses either a third or fifth harmonic low pass filter and a high pass filter, after 400 Hz, all automatically swept with frequency. There are sixteen weighting filters available including all noise weighting and telecommunications standard filters.

Performance

Like most equipment in this class, it has substantial weight (45 lbs). As mentioned earlier, equipment like this generally has specs that greatly exceed the performance of most equipment as well as that of older test equipment.

In the case of one equipment test, I had another well-known digital, computer-controllable piece of test gear available.

I took the oscillator output of the Amber 5500 and fed it directly into the Brand X machine. Distortion was slightly over 0.001% distortion (−96 dB); the noise floor was more than 10 dB below this. I then fed the Amber into itself and got 10 dB less distortion in the worst case measurement.

In the early stages of this test, erratic results were noted due to the quality of the interconnection (that wire wasn't as straight as we always thought!).

Such results are typical of what you find down near −100 dBm, proving that we can't enter the world of 96 dB dynamic range CDs and other digital audio sources with poor wiring.

The power of this equipment is so extensive that you should really learn more about it on your own. It is truly a strong player in today's world of wide range audio.

ACI Analyzer Practical, Powerful

by Douglas W. Fearn, CE WKSZ-FM

Media PA ... There was a time not too long ago when a third octave audio spectrum analyzer was so expensive that most radio stations could not justify buying one.

But the Audio Control Industrial SA-3050 real time one-third octave spectrum analyzer is truly professional *and* relatively inexpensive—$800 or so, depending on options.

An audio spectrum analyzer is a measuring instrument that displays the instantaneous frequency content of an audio signal. A series of vertical columns of light-emitting diodes display the spectrum much like a graph of frequency response.

User Report

The source could be program material, fixed frequency tones or pink noise. Pink noise is a mathematically defined combination of all frequencies, and sounds very much like the noise in between occupied FM or TV channels.

It's like having an infinite number of audio oscillators all set to different frequencies, all running at once. Instead of measuring one frequency at a time, you can measure them all simultaneously.

The input to the spectrum analyzer can be taken directly from a piece of equipment. For making measurements on loudspeakers, a calibrated microphone with known flat response is used.

In addition, the absolute loudness—the sound pressure level (SPL)—can be measured.

The SA-3050 covers the range from 25 Hz to 20 kHz. It has both microphone and line level inputs.

The sensitivity is set with two controls, a six position switch calibrated in dBm (or SPL with the supplied microphone) and a ±10 dB vernier control with a center detented calibrated position.

The number of dB each light represents is selected with a four-position switch giving 4, 3, 2 or 1 dB per step. This results in a measurement range of from ±4 dB to ±16 dB.

The SA-3050 contains its own pink noise generator with a TRS jack output and level control. This output is capable of driving a 4 ohm speaker directly with 150 mW.

There are three display speeds provided. The fast speed is good for monitoring program material, especially for catching transients. The medium speed displays an average response on program material. The slow speed is the best for use with pink noise.

The unit also has six memories where displays can be saved. An internal battery holds the memory data after the power is turned off.

One of the most useful options available on the SA-3050 is the printer output. With it, you can print any display on an Epson compatible printer (Figure 1).

The classic application for an RTA is loudspeaker equalization. In fact, there is almost no other way to measure speaker frequency response in a listening room.

A monitor system is more than just speakers and amplifiers—the room also has a major effect on the frequency response. Standing waves make it impossible to accurately measure response with steady tones. Hence the value of the spectrum analyzer/pink noise generator.

In our control rooms, speaker crossover adjustment has been hit-or-miss. I set up the SA-3050 with the microphone located at the monitoring position. I fed pink noise to one speaker at a time. The crossovers on the speakers were adjusted while the RTA display was observed.

Pink noise is, by its nature, random. At any given instant, there may be no energy in a particular one-third octave band or there may be a sudden peak many dB above normal. But over time the level averages out over the entire ➤

Doug Fearn is a frequent contributor to **RW**. *For more information contact Mark Hess at Audio Control Industrial: 206-775-8461. The author may be reached at 215-565-8400.*

audio band.

This is why the slow response time setting is necessary. Even so the display does not stand still. By hitting the "Freeze" button repeatedly a variety of results could be assumed. A certain amount of interpretation is necessary.

We expect extremely flat frequency response from most equipment and it may come as a shock to see how "un-flat" a typical monitor system is. It is not unusual to see peaks and dips of 15 dB or more in a poor room. Even the best rooms and speakers are seldom better than ±4 dB.

After adjustment, I felt that the monitors sounded significantly better/ "smoother" and less tiring to listen to.

There was a complaint that our live announcers did not have the "punch" of many voices on carted agency commercials. I suspected that the agency tapes were made with a considerable amount of equalization on the voices.

I hooked the SA-3050 to an air monitor feed and watched it display a few live and recorded voices. It was quickly evident that the agency spots had significantly more presence equalization (3 to 10 kHz) than our air mic.

I "captured" a few examples in the SA-3050 memories. Then I readjusted our mic EQ to resemble the curve apparently used on the outside spots and sure enough, our announcers sounded much more like the commercials.

Of course, someone with experience and a good ear could have done the same thing without test equipment, but it was rewarding to be able to quantify what was heard and "prove" the results.

I wondered about the effect of long cables on microphone frequency response. I used the SA-3050 to observe the response through different lengths of cable.

My conclusion? With the microphone, cable and mixer tested, no significant effect on frequency response could be measured with up to 320' of cable.

In another experiment I measured the effect of grill cloths on loudspeaker frequency response. I found that on my speakers no significant change resulted from the installation of the grills, neither on axis nor 45° off axis.

What about using an RTA and pink noise for routine tape recorder equalization adjustments? If you have a machine with odd frequency response, an RTA can help you obtain the best possible response.

But with good machines, the standard steady tone method provides better accuracy and more meaningful documentation.

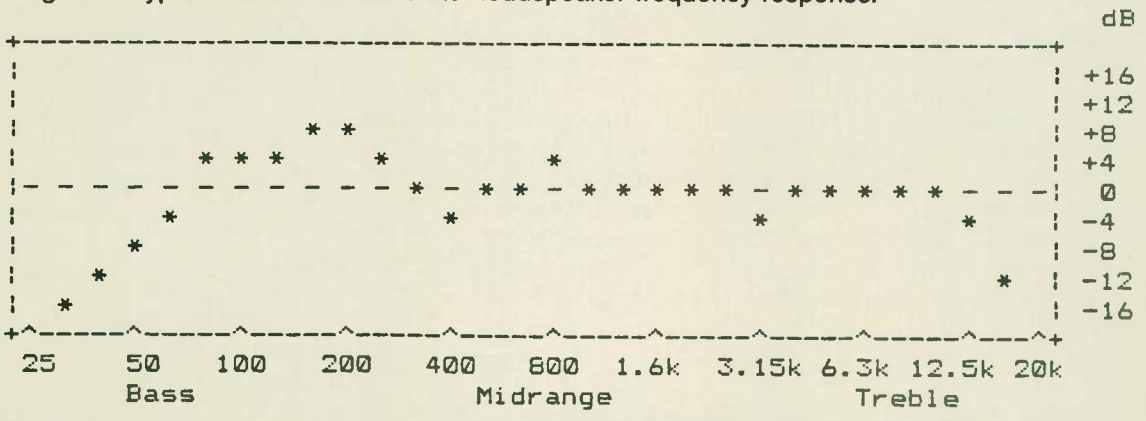
The pink noise source does not have to come from the SA-3050; I also tried using a pink noise band on a compact disc. Results were similar although the high end rolled off somewhat due to the sharp filters in the CD player.

The SA-3050 comes with a calibrated microphone. Other accessories include a rack mount adapter, battery pack, carrying case and printer output. The instruction manual is brief but reasonably complete and clear.

The current model of the SA-3050 has several new features: a peak hold function; digital readout of the SPL; and an averaging function which allows you to observe an average of several displays.

A real time one-third octave spectrum analyzer like the Audio Control Industrial SA-3050 can be a useful and powerful tool, but practice is required to interpret the results. The SA-3050 is priced in a range that makes it practical for broadcast use.

Figure 1. Typical control room monitor loudspeaker frequency response.



AT836 Mic Comes Out on Top

by Rod Rogers, CE, KSKG-FM

User Report

Salina KS ... After upgrading our air chain three years ago the need for a change in studio microphones became obvious. In the search for replacements, I discovered the Audio-Technica AT836. Little did I know about the popularity it was soon to enjoy!

I considered the "standard" mics for this application, but was tired of the proverbial "Music/Voice" switches, broken plastic parts and having mics that, while excellent for other applications, were never intended for close-up work.

I also had the handicap of a small market budget.

Due to the standardization problems with mic specs, I decided to evaluate strictly by ear to see for myself what sounded good.

Our local distributer loaned me several armfuls of mics for evaluation, including some of the "standards." I went into the production room with my private stock of tape and compared mics for several hours.

In test after test, the Audio-Technica AT836 kept coming out on top. It had an open, natural sound and didn't get too muddy when worked close or off axis.

It sounded best from about 5" back, on axis, but it never sounded bad no matter how I worked it. I was a little reluctant to believe that this very economical mic was winning!

Then I realized that there were no "Puberty Switches" on it (M/V), no plastic to break, and it had good internal suspension for handheld use.

It wasn't a condenser model, so I avoided the powering hassles. And it had a price tag of around $130!

The PD and several jocks agreed that it was the best sounding mic.

I sold both of our $400 "standards" on the used market, bought three AT836s, and netted a profit! Needless to say, the GM was also pleased with this new mic.

Being a contract engineer for several other stations, I had them compare the AT836 against their mics. I never got one back!

The AT836 is a simple, cardioid dynamic mic. Output is 250 ohms, balanced, and contains no transformer. It has a very rugged metal housing and the metal screen is not easily bashed in.

I think the secret of this mic is its slight low-end rolloff and very gentle proximity effect. It keeps low frequency noise under control, but has a clean, flat sound when used close up.

. . . the secret of this mic is its slight low-end rolloff and very gentle proximity effect.

The drawbacks of the AT836 are mainly psychological. If you like a large, fat mic, a nerf ball for a wind sock, or a lot of switches to play with, keep looking.

If, however, you want a very clean, natural sound at less then half the price, I seriously recommend the AT836.

There are better mics in the world, and you can spend a fortune if your budget allows. But for the majority of us, especially in smaller markets, good sound and good value are still big priorities.

Editor's note: Rod Rogers also does contract work for stations, commercial sound systems and industrial manufacturing equipment. He confesses he is a "hopeless audiophile" who can't stand bad sound.

For more information on the AT836, contact Greg Silsby at Audio-Technica: 216-686-2600. The author may be reached at 913-825-4631.

Reprinted from March 15, 1988

WKSZ Upgrades to Auditronics

by Douglas W. Fearn, CE, WKSZ-FM

Media PA ... Early in 1987, WKSZ decided to rebuild the existing air and production studios and add a second, more sophisticated, production studio.

After the general specifications for the studios were determined, I began researching the available equipment. For the big production studio, we wanted a console that would conveniently handle eight-track production, with complete signal processing and routing capability.

After the 1987 NAB convention, I decided on the Auditronics 424 console for the eight-track production studio and Auditronics 224 consoles for the air and routine production studios.

User Report

I chose Auditronics for a number of reasons. The company has been around for a long time and I owned one of its recording studio consoles and had excellent results with it.

I also had been through the factory in Memphis and was impressed by it; I felt that its design philosophy always kept the operator in mind.

Early delivery

The 424 was a new product at that time and I was concerned about delivery. Auditronics delivered all three of our consoles early—up to a month ahead of the promised 90 days. They were drop shipped to Radio Systems in Edgemont, PA, which built the furniture and did our installation.

Minor problems aside, the console has been perfectly reliable and readily accepted by all those who use it. It sounds terrific.

The 424 as we specified it has 24 inputs; eight outputs to a multitrack machine plus stereo and mono; two auxiliary sends for echo, effects or headphone feeds and a digital timer and clock.

Other features include talkback and slating; multifrequency test oscillator; VCA faders; cue and solo facilities; three-band equalization on each input; low-pass and high-pass filters; eight-track monitor mixing and monitor controls for a control room and two studios.

Radio Systems installed the eight-track facility in one weekend. Except for a few minor problems, the room was ready for operation on Monday morning.

Our biggest initial problem was not the fault of the manufacturer. Somehow the test oscillator module and the telephone interface module were transposed during installation. This caused some confusing logic problems.

Auditronics was very helpful in tracking down the cause. It only took a couple of phone calls to fix that one.

Editor's note: Doug Fearn is a regular contributor to **RW.** *He may be reached at 215-565-8900.*

For more information on the 424 console, contact Neal Davis at Broadcast Services: 919-934-6869.

We also had a problem with the start logic pulses being too short to reliably start some of our equipment. A change in capacitor value solved that problem. I understand the newer 424s have the larger value capacitors which stretch the start pulse enough to start just about anything.

"Zero insertion force"

The console features "zero insertion force" connectors for all the modules to be removed and inserted while the power is on.

I was reluctant to do this but by phone the factory assured me that nothing unpleasant would happen. They were right. (I wish the 200 series consoles had these more expensive connectors—especially for an on-air console the ability to swap modules while powered up is valuable.)

We had another chronic problem which I believe we have now solved—a ground loop buzz in the monitor circuit. The console outputs were perfectly clean but the control room monitor always had a low level buzz and occasional pops and other noises.

In talking with the Auditronics engineers at the 1988 NAB show I learned that they have changed the location of the console ground terminal from a point on the power supply chassis to a new point on the console ground plane. Changing our ground point similarly seems to have solved about 90% of the problem.

We also had trouble during the winter, when the humidity was low, with modules turning off or on from static electricity. Now that summer is here and the humidity is higher, we're not sure if the revised grounding has this problem completely solved or not.

Minor problems aside, the console has been perfectly reliable and readily accepted by all those who use it. It sounds terrific.

Many of our operators have never used a console as complicated as the 424 but all have found it to be easy to learn and logical in its layout and operation.

Special mention for EQ

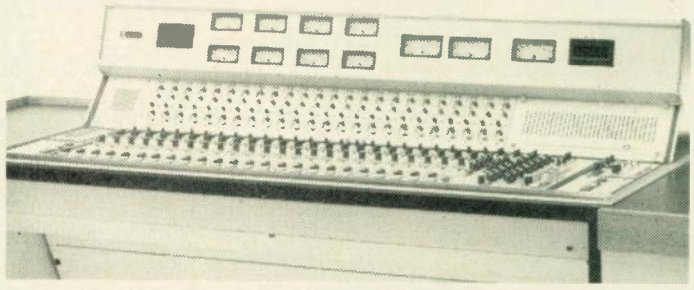
The equalizers deserve special mention. Most modern equalizers use state-variable type circuitry which I find to be very harsh, heavy-handed and nonmusical.

The Auditronics equalizer, however, has none of these drawbacks despite being a version of the state-variable design. It has three bands in which the frequency of each band is continuously adjustable as is the amount of boost or cut.

On the midrange band two different bandwidths can be selected with a pushbutton. In use the equalizer outperforms many rack-mounted multiband parametrics of recent design, in my opinion.

In brightening a voice for example, the EQ can be set to do so without many of the artifacts often heard with equalization.

Auditronics has obviously researched this design (as it did in its early recording console equalizer designs) and come up with a truly useful module.



Auditronics' 424 console met WSKZ's needs.

After a year of operation, we are very pleased with the performance of the console. Operation is relatively simple for a sophisticated board and required maintenance has been virtually nonexistent.

The sound of the console is clean and transparent. Auditronics obviously knows what broadcast production requires and has built a console to fulfill these needs.

by Steve Samet, GM WZOE-AM/FM

Mix Trak 90 Winner for WZOE

Princeton IL ... Buying a console is an emotional decision; it has to be.

I'd been looking at consoles for two years without a glimmer of inspiration. Intellectually I know that most consoles

User Report

are built well and that most spec out well, but it's difficult to get charged up about a console that lacks flexibility.

And most do lack flexibility, you know—that's the tradeoff to keep the price down.

Uninspired or not, I headed for the SBE convention last fall with the firm intention of replacing our faithful but aging AM console.

As it happened John Burtle and the crew from Broadcast Electronics were in attendance with prototypes of the then-unannounced Mix Trak 90 console.

I spent a half hour with the Mix Trak 90 and, a month later, placed a firm order for the unit.

BE has a winner here. Let me tell you why.

The Mix Trak 90 is a modular board and is available in two models: a 12-channel and an 18-channel. The 18-channel offers more metering options but otherwise the features and options are identical on both models.

Out of phase detection

Three mix-minus busses are available for telephone configurations or for driving other equipment. Monaural program output is available through a module which selects the program or audition bus while it monitors phase.

An out-of-phase condition causes a warning light to turn from green to red. The operator can correct the condition by simply pressing a button on the module.

Other operator conveniences include headphone split, speaker dimming and almost unlimited remote start and sequencing options. An FSK decoder board is available if you'd like to do remote logging of commercials. ➤

If the model fits the need why put up with years of engineering headaches just to save a few dollars up front

Editor's note: Steve Samet has been with WZOE since 1975. He is a graduate of the University of Illinois and was a US Army officer during the Viet Nam conflict. He may be reached at 815-875-8014.

For more information on the Mix Trak 90, contact Tim Bealor at BE: 217-224-9600.

One of the nice features of this console is that you can configure it the way you want it for your operation. We run a news/talk operation most of the day and we need a lot of inputs.

BE's Mix Trak 90 console

By purchasing four expander cards we have over 50 inputs on a 12-channel Mix Trak 90 with virtually limitless routing of those inputs. Believe it or not, we no longer have a patch panel in this control room. Happy day!

When you consider the Mix Trak 90, you'll have to consider size. The console is somewhat larger than other modular boards, but not dramatically so.

Modules are 2" wide. It's a little early to tell for sure, but I believe that the slightly larger modules will make the board easier to operate than it would be if they were smaller.

All controls are easily reached and are logically placed. The backlit meters and the clocks (time of day and elapsed time) are large and easily read.

In short, the console has been designed with the operator in mind.

The Mix Trak 90 should please the station engineer, too. As you might expect, all output modules are redundant and interchangeable.

All modules can be removed and inserted with the power applied and the board on the air. Changes take only seconds. Should a board need to be in circuit for repairs, ribbon cables with appropriate plugs are supplied, thus ending the need for the ever-unusable extender card.

PD appeal

I've asked BE to consider writing a short operating guide for the Mix Trak 90 directed at program directors. The idea is to give PDs some insight into the incredible flexibility of the system.

For example, patch points are available on the mixer cards for external signal processing. Many PDs may not be aware that this important feature is readily available even though it is amply documented in the tech manual.

It would be a real shame for an option to go to waste simply because a PD was unaware of its existence.

The Mix Trak 90 is slightly more expensive than some other control room boards, but when you do the math you'll find that the difference between the Mix Trak 90 and an economy board is insignificant when taken over the life of the console.

If the model fits the need why put up with years of engineering headaches just to save a few dollars up front?

We have had our Mix Trak 90 in service for about three months now. It has performed up to expectations and both the operators and the engineering staff give it high marks.

The people at Broadcast Electronics, as always, are eager to answer questions and provide technical assistance.

If you're even thinking about a new board for a control room, get the literature on the Mix Trak 90. Better yet, get your hands on one at the next convention. But be forewarned: your cool, intellectual business sense might be influenced just a little by your emotions. This is one nice piece of equipment.

Reprinted from August 15, 1988

FM-30A Rates High at WKSZ

by Douglas W. Fearn, CE WKSZ-FM

Media PA ... After almost six years of 24-hour a day service, we decided to retire our Broadcast Electronics FM-30 30 kW FM transmitter to auxiliary status and install a new transmitter. This would give us full-power back-up capability, something we never had before.

In almost 50,000 hours of operation the old FM-30 had only failed three times: a defective circuit breaker was discovered in the first days; a filament/high voltage interlock relay developed an open coil after a few years; and a filament contactor failed.

A couple of times a 4CX20000A PA tube suffered a catastrophic failure without warning. But otherwise the transmitter had a perfect reliability record.

BE remains choice

Although there are several other fine transmitters available in this power range, I felt the BE was our best choice, particularly if some of the spare parts were interchangeable between the old and new FM-30s.

The order was placed and the transmitter was delivered a week before our deadline. Fortunately the new room at our transmitter building was ready and the delivery took place smoothly.

Editor's note: Doug Fearn is a contributor to the "Handbook for Sound Engineers (The New Audio Encyclopedia)," as well as a frequent contributor to RW. He may be reached at 215-793-1533.

For more information on the Broadcast Electronics FM-30A transmitter, contact Bill Harland at BE: 217-224-9600.

User Report

The transmitter arrived in good condition except for one broken 200 watt bleeder resistor in the high voltage supply. There are several of these resistors, which are mounted by their lugs on standoff insulators and this is the second FM-30A I have installed that arrived with a broken resistor.

If the installer is not familiar with the layout of the power supply, it is difficult to spot the missing resistor. Fortunately a call to BE resulted in two new resistors arriving the next morning.

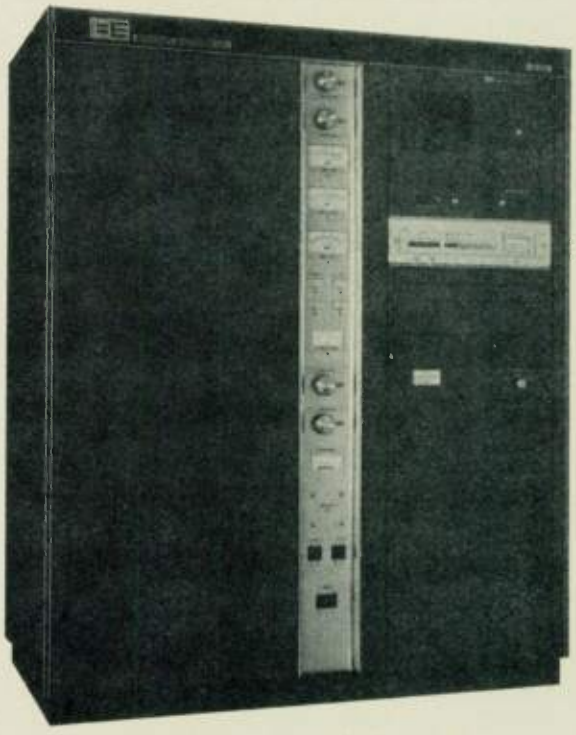
Installation

Installation went smoothly. The instructions are clear and accurate—plus this is the fourth BE transmitter I have installed, so I knew what to expect.

Turning on a new transmitter is always an adventure. There is almost always something you forgot, or something broken or something so far out of tune that the overload trips. But the FM-30A came on perfectly.

In fact, after the last bolt was tightened on the installation, it took only fifteen minutes to get it up and running at full power into the dummy load. The meter readings were very close to the factory check-out sheet.

After a few hours into the dummy load, we felt it was ready to put on the air. On a Sunday night at midnight I went out to the site, turned off the old FM-30, swung the coaxial switch to the FM-30A, turned on the new transmitter and tuned it into the antenna.



Put to the test

We then did complete audio proof of performance measurements on both the new and old transmitters and both passed with plenty of margin. Some crude measurements of incidental amplitude modulation demonstrated ➤

very good performance from both transmitters.

That was three months ago and since that time the FM-30A has continued to work and sound great. The only problem occurred during a severe thunderstorm in August. A direct lightning hit to the power line, or possibly a power line cross, sent a huge overvoltage into our transmitter building.

The station was off the air for 55 minutes. Both our main and back-up remote controls were severely damaged and when I tried to put the FM-30A back on from the site, the lights dimmed in the building when I hit the high voltage switch.

This lasted only a second before the main 200 amp three-phase circuit breaker tripped. Then I tried the old FM-30 but its controller was damaged by the surge.

Problem solving

My first thought was that the PA tube had shorted, so I put in the spare. That didn't cure the problem, so I started looking into the HV power supply. There are eight main rectifier stacks, each with 18 diodes. On one stack, all 18 diodes were shorted.

We didn't have a spare, so I borrowed one from the other transmitter. Unfortunately, they are slightly different in size (the old ones are bigger) so it took some crude rigging with tie wraps to get the borrowed stack in place.

But it worked. BE sent a new rectifier assembly that afternoon and we had it in the next day. The FM-30 problem was just a blown fuse.

Although superficially similar, the FM-30 and FM-30A are quite different transmitters. Both use the FX-30 exciter, and the controllers use the same board, but the automatic power control is completely different and the IPA section uses three modular amplifiers instead of five.

The PA section and the HV power supply look almost identical, except for the minor differences in the HV rectifier stacks. The circuit breaker arrangement is different, as is the front panel control section. I believe all the changes are improvements.

Special features

One feature I particularly like on both transmitters is the step-start and soft-start feature. When the transmitter is turned off the controller automatically cranks the PA screen voltage down to minimum. When the transmitter is turned on, a resistor in series with the plate transformer limits the inrush current for a fraction of a second.

At our power level it takes about five seconds for the screen voltage and output to reach 100%. This prolongs component life and helps prevent damage in case something is wrong when the transmitter is fired up.

At our power level it takes about five seconds for the screen voltage and output to reach 100%

The automatic power control adjusts PA screen voltage through a motor-driven auto-transformer. It maintains the output within 1% (on the power output meter) even when the primary voltage varies more than ±10%.

It is not unusual to see an operating log with "100%" written in 12 times in the "Power Out" column, even though the plate voltage and current may vary significantly.

Controller memory

The controller remembers what was happening at the time of a power failure and will automatically bring the transmitter back up as soon as power is restored. It will first turn the screen voltage all the way down if it didn't have a chance to do it when the transmitter went off. A battery back-up (9 V) maintains the power out setting memory and any overload information.

The solid state driver consists of one drawer-mounted amplifier (running about 37 W) driving two other similar amplifiers (at about 175 W each) through hybrid combiners to provide 300 W of drive to the PA. (Of course this will be different for transmitters set up at different TPOs.)

The only adjustment required is the power output of the first stage.

The PA

The PA is a single tube in a folded half-wave cavity. This output scheme eliminates sliding contacts and the plate blocking capacitor. Tuning is precise, predictable and stable. And the tube can be quickly replaced. In fact, I once changed a tube in five minutes from turn off to turn on and I wasn't even hurrying.

The transmitter interior is very accessible for cleaning, with the exception of the PA grid compartment, which has dozens of screws. This is the weakest area of the transmitter, in my opinion. It tends to get very dirty and this has created PA grid tuning problems in the FM-30.

The grid uses sliding contacts for tuning and loading and when these get dirty, tuning is erratic. The threaded rods that drive the tuning elements get corroded and dirty, making the adjustments hard to turn.

There is a tremendous amount of air rushing through this compartment and into the PA tube and it seems like a lot of dirt gets deposited along the way. Time will tell if the "A" version is any better in this regard.

We have been very happy with the original FM-30 and expect to have comparable results with the FM-30A. It is a rugged transmitter, a well-conceived design that has the maintenance engineer in mind. And the sound is superb.

Phase Trak 90s Find a Home

by Lowell Kiesow, Staff Eng, KPLU-FM

User Report

Tacoma WA ... When I started shopping to replace all of KPLU's cart decks, I had an open mind about brands, features and prices. One machine, the Broadcast Electronics Phase Trak 90, stood out from the rest because it had more unique features that improve sound and reduce maintenance time.

The most outstanding feature of the PT90 is its automatic phase correction system. Phase differences between stereo channels are caused by head azimuth misalignment and by variations and wear of the tape cartridge.

In stereo, phase errors have little effect on sound quality. In mono, however, a small phase error can have a big effect on the sound. This is important, since 50% of all FM listeners regularly listen in mono.

Corrects phase error

A head azimuth error of 0.5° would cause a high frequency roll-off at 10 kHz to the stereo audio. To the summed mono listener, this would create nasty cancellations at 4.3 kHz and 13 kHz. Figure 1 shows this very audible response curve. This is not just a theory, but a real world problem.

Before I bought the PT90s, I borrowed a loaner from a local dealer. I also borrowed some recorded carts from another station since I had none in stereo. At first I listened to the carts in stereo and they sounded fine. Then, with the phase correction defeated, I listened in mono.

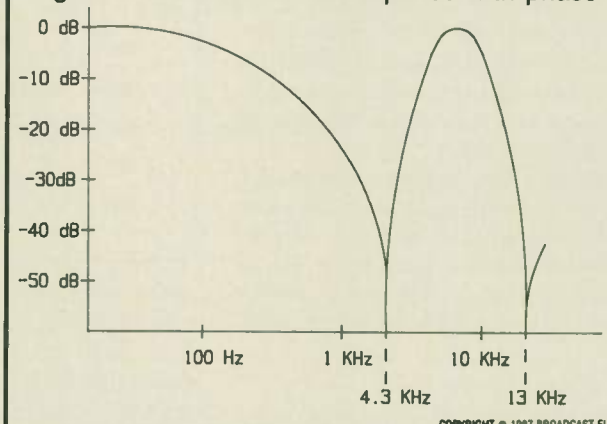
They sounded horrible and had anything but flat response. Then, as I switched in the correction, the sound quality returned. I could switch between mono and stereo and hear no response changes.

Broadcast Electronics does the correction at the proper time, which is during playback. This way any errors caused while recording, changes in the cartridge or playback azimuth are eliminated. The correction is made without any of the problems that are introduced by other phase correction schemes.

The most common phase correction technique on the market is matrix encoding. This way, the stereo audio is recorded as sum and difference signals. This method works, but creates other problems, since there are still phase errors between the L−R and L+R channels.

Its other drawbacks would include decreased separation and reduced S/N ratio. It certainly doesn't work as well as Broadcast Electronics' method.

Figure 1. Summed mono response with phase error



Recording parameter adjustment

Another feature that I find valuable is ➤

Editor's note: KPLU is a National Public Radio affiliate whose format is jazz and news. Lowell Kiesow can be reached at 206-535-8758.

For more information on the Phase Trak 90 recorder, contact Bob Arnold at BE: 217-224-9600.

the PT90's ability to adjust the bias, equalization and record level automatically. Recording tape is not very consistent in its characteristics. Even the same brand, type and length will be different from batch to batch.

If the recording parameters are not changed as the tape changes the frequency response will be unpredictable.

The Phase Trak 90 can optimize the settings for any tape in less than a minute.

Figure 2 shows how different tape types would sound without changing the recording parameters for each one. If the bias, equalization and level are customized for each tape, then the frequency responses would be almost ruler flat.

The Phase Trak 90 can optimize the settings for any tape in less than a minute. Just insert a blank tape, push the button and a microprocessor takes over. It can learn and store the settings of up to ten different tapes.

Changing between tape types is easy, which should save a lot of engineering time tweaking all of those decks. And for you engineers who don't want the air staff making these adjustments, a switch on the back can defeat this learn mode.

Test oscillator

A nice by-product of this system is that each record deck has its own built-in test oscillator. The frequency and level can be selected from the front panel. To simplify things for the air staff, this is also defeated with a hidden switch.

That hidden switch will also let you adjust the bias, equalization and level manually, using the internal test oscillators.

Broadcast Electronics has really worked on the small details also. Our air staff loves its real-time tape timer, and by changing jumpers inside you can choose to have the timer stop on a cue tone. It will reset on removal of the cart or by changing jumpers and pressing play.

Also a hit is the splice finder in the record deck. Now there are no more excuses for recording over the splice. Even the push buttons are quiet. It uses switches with hall-effect magnetic sensors instead of mechanical contacts.

The PT90 also has a noise reduction system. It is non-encoding Dynafex which works during playback. Like all non-encoding noise reduction systems, it can be heard working sometimes. It is defeatable and can be very handy during voice cuts.

For the engineer, the headbox is very well designed. It is especially rigid and the adjustments are locked down tight. The head's azimuth, zenith and height all work independently for easier adjustment. It's too early to tell, but I bet I won't have to realign the heads very often.

A feature that I use a lot is the pinch roller cleaning mode. When you press stop and play together, the pinch roller pops up for cleaning. If you forget, it shuts itself off in 90 seconds.

Other nice touches include a lubrication-free transport, no lamps to burn out and multiturn pots on input and output levels.

A few suggestions

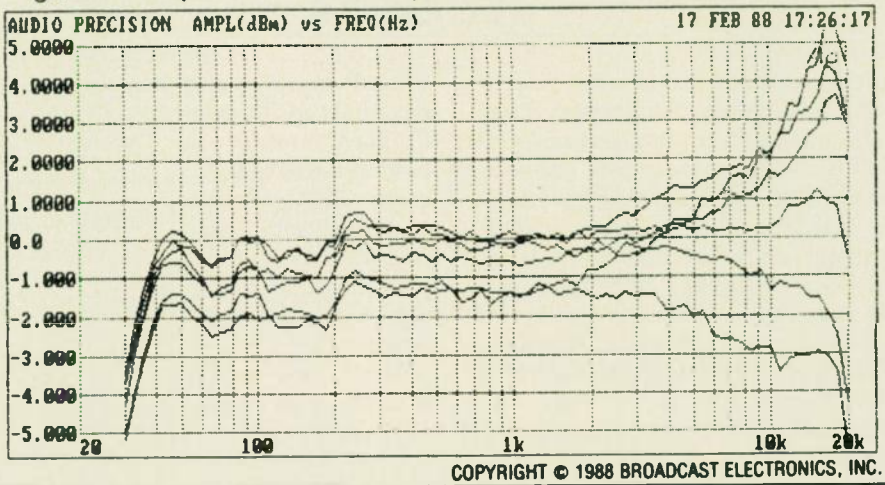
There are some small quirks, however. I found that these machines are a lot longer than my old ones and I had to do a bit of rearranging for them.

I found another small problem when using Scotchcarts. The cartridge's tension adjustment screw goes partly into the mouth of the deck. However, BE says that they are making a tool for tweaking Scotchcarts.

My last criticism is that that the deck's cooling ventilation, while it is adequate, could be more effective. As it is, the holes of the outside cover are restricted by an inner cover.

The Phase Trak 90 is a cart deck with many outstanding and unique features. Even with all of these features, it is simple and easy to use. It is well built and should last many years.

Figure 2. Response of different types of tape without adjustment



by Glen Hopkins, CE, WDBR/WTAX

BE 16x Trouble-Free

Springfield IL ... WDBR replaced its aging, troublesome automation system in late 1982 with the Broadcast Electronics Control 16x. Since then, we have used a format that combines live radio with the control of an automated station.

User Report

We do mostly live-assist with our system. Our morning and afternoon DJs operate it just as if they were on cart, although all material is fed through the automation system as a source.

One of the best features of the Control 16x system is source substitution. If we lose a bearing in a tape motor or have to change heads on a tape machine, this feature allows us to tell the system to use a different source without our having to reprogram it.

The Control 16x also has an alarm system so we can catch mistakes before they occur.

If a source is not ready, the Control 16x will let us know by flashing "Next-Not-Ready" on a monitor screen. There is also a panel on the system with 12 lights connected to slave lights that can be seen in all parts of the building.

If a source is still not ready when the system goes to play it, the Control 16x will skip over it, so we never have a problem with "dead air."

We have had a minimum of problems with our system. Fail-safe measures include a battery to back up the memory in case of a power failure. We also have the system memory stored on cartridge so we can reload it if needed.

The strong RF field caused by our AM and FM towers' close promixmity to our building has not affected our Control 16x.

Some of the audio sources going into the system had RF on them and we had to get that off, but the digital part of the system was never affected by it.

We maintain that the system can run our programming better than any live operator. If you listen to us and can tell that we're automated, then *we're* doing something wrong, not the system.

The Control 16x has an alarm system so we can catch mistakes before they occur.

Glen Hopkins is a consultant for Sage Broadcasting's 17 stations.

For more information on the Control 16x, contact Bob Arnold at BE: 217-224-9600. The author may be reached at 217-753-5400.

Reprinted from February 15, 1988

Star Quad Cable Remedies Noise

by Barry Brenner, GM, Canare Cable, Inc.

Burbank CA ... If you are in the process of specifying or installing new equipment or upgrading an existing studio, take a moment to consider an important, often overlooked link in your audio chain—cable.

Technology Update

Not all cable is created equal. Careful research and investigation will help you select the right cable for your installation.

One of the most important features to look for in any audio cable is its ability to reject noise (EMI and electrostatic).

Let's assume that there is noticeable and annoying hum, buzz or RF garbage creeping into your mic lines. Unfortunately, it is clearly audible throughout your entire facility.

You've ruled out ground loops as the cause because all of your equipment was installed with a unified and well thought out grounding scheme.

The noise problem may be emanating from your transmitter, power lines, lighting dimmers, transformers or any number of things.

Editor's note: For more information, contact the author at Canare: 818-840-0993.

Remedy for noise

Canare offers a remedy to the problem, a microphone cable called Star Quad that can greatly reduce this type of induced noise.

Microphone cables typically carry 600Ω line level signals at +4 dB to +24 dB (1.23 V to 12.3 V). But when they are used to interface mics to mixers or preamps, the signal levels may be very low, on the order of −70 dB to −120 dB (0.3 mV to 1 μV).

Because such signals are subject to a large increase in level due to the high gain of microphone preamplifiers and subsequent amplifier stages, even the smallest noise signals entering the mic cable can become a significant factor.

Noise can "invade" the cable from external sources, by means of electrostatic coupling or electromagnetic induction (EMI)—sources that most engineers are well aware of.

The longer the cable, the greater its susceptibility to potential sources of noise. With runs of 100 m (328') or more, mic cable quality is critical.

Magnetic fields are radiated from power cables, motors and power transformers.

Often power line frequencies can become contaminated by a rich harmonic spectrum which is generated by saturated transformers, the reactive ballasts of fluorescent lights and most drastically, by the clipped waveforms emitted by SCR (Silicon Controlled Rectifier) dimmers.

Canare does not use spiral or serve wrap shield because these can open up with use and degrade cable performance.

Four-conductor cable

The magnetic fields radiated by these sources cut across the conductors of a mic cable and induce a voltage that is heard as hum (or buzz at higher fre- ➤

quencies). The higher the frequency, the greater the induced voltage.

Twisting the inner conductors of a cable minimizes susceptibility to this electromagnetically induced noise.

Canare Star Quad mic cable obtains its name from a four-conductor, overall shielded style of construction. The main benefit of four-conductors (versus the common two-conductors found on ordinary mic cable) is to minimize the "loop area" between twists of the conductors.

This in turn reduces susceptibility to electromagnetically induced noise. The worst offender, SCR dimmer noise, is reduced to less than 1/10th the level found in good two-conductor cables.

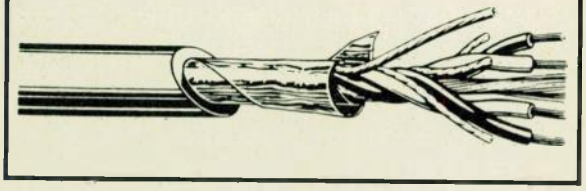
Electrostatic hum may be present when the power line and mic cable act as two plates of a capacitor, causing the AC voltage to be electrostaticallly coupled into the cable.

This capacitive reactance more readily admits high frequencies, and the higher the impedance of the mic circuit, the greater the induced noise voltage.

A grounded, electrically conductive screen (shield) around the cable offers a low-resistance path to ground and can thus shunt the electrostatic hum.

However, the effectiveness depends upon the percent of coverage afforded by the shield.

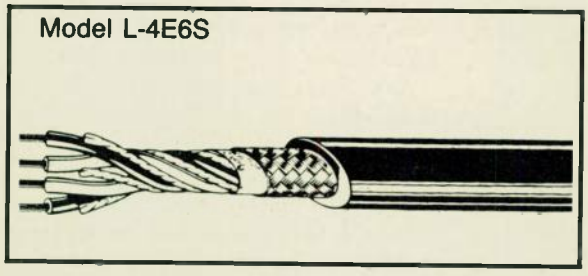
Model L-4E6AT



Canare Star Quad mic cables are available in two different application (shield) types: Model L-4E6AT and Model L-4E6S.

Model L-4E6AT features a fully wrapped, aluminum tape shield with drain wire for 100% coverage. The outside jacket employs a tough PVC compound to resist tears and stretching.

Model L-4E6S



Inside the quad bundle is KEVLAR 29, a fiber filler that is also used in bullet-proof vests and jetfighter aircraft wing skins. The result is a pulling strength of more than 121 lbs.

This model is recommended for fixed installations and when pulling through conduit.

Model L-4E6S is used in places where flexibility, appearance and noise rejection is a consideration. A flexibile PVC jacket surrounds the quad conductors, overall braided shield and cotton pack fillers.

Canare does not use spiral or serve wrap shield because these can open up with use and degrade cable performance. Our high density braided shield offers good flexibility and excellent (96%) coverage.

In some wiring situations, using a multichannel audio snake in place of individual harness bundles can reduce labor time and material costs. Star Quad is available in a multichannel version. Both foil and braided shield styles can be ordered in 2- to 24-channel configurations.

CRL SPF-300 Sets the Standard

by Thomas R. McGinley, DE, Cook Inlet Radio Partners LP

Morningside MD ... Circuit Research Labs, a full line processor manufacturer based in Tempe, AZ, was probably the first company to offer a wraparound NRSC adaptor for AM stations.

The SPF-300 is the same size as other CRL processors and contains two separately accessible NRSC compliant circuits: the modified 75 μs NRSC preemphasis section and the NRSC 10 kHz low-pass filter section.

This approach allows the unit to be used effectively with any combination of AGC and peak limiter units already employed. The SPF-300 preemphasis section is inserted between an AGC compressor unit and the peak limiter unit.

The low-pass filter section is then the final section between the peak limiter and the transmitter's input.

User Report

The performance of each section easily complies with the NRSC limits and specifications. Unless you have a spectrum analyzer, it is not easy to verify compliance with the NRSC curves.

Testing with steady state tones or even white or pink noise does not yield realistic performance results.

For this reason the NRSC has specified the use of the new USASI test signal, a pulsed noise signal containing similar audio spectral distribution and energy levels as normal programming.

The preemphasis section can provide either the modified NRSC curve or can take a standard FM 75 μs preemphasized signal and modify the shelving to enable full NRSC compliance, merely by lifting one resistor in the circuit.

This would be appropriate for AM/FM full simulcast stations which use an already 75 μs preemphasized and processed signal from a composite STL receiver output or FM stereo generator output to feed the AM peak limiter.

For the integrity of the NRSC modified 75 μs curve is to be maintained, keep the summed outputs of any multiband AGC/compressor ahead of the SPF-300 set to flat response, at least above 1 kHz.

CRL SPF-300

Any increase in treble boost in addition to the NRSC preemphasis will only cause stridency and harshness on receivers. The 10 kHz filter performance is really the bottom line of the improvement the NRSC standard provides.

Keeping the response nearly flat to about 9.5 kHz and then achieving 40 dB of attenuation at 10.5 kHz without noticeable ringing or overshoot by-products is by no means an easy task. But the SPF-300 delivers with flying colors.

It is important to recognize that the effectiveness of this filter can be easily compromised by a "dirty" transmitter.

Older plate-modulated rigs with soft or unbalanced modulator sections or PA finals can produce lots of harmonic and intermodulation distortion, as well as incidental phase modulation, which will degrade the 40 dB suppression at the skirts of the NRSC passband to only 30 or even 20 dB.

The result is wider than normal occupied bandwidth, not to mention the distorted audio. If you expect NRSC to deliver improvement, be sure to optimize your transmitter performance first.

There is one other important point to remember about any NRSC processor: when you make A/B comparisons with the NRSC filter in and out at the transmitter, remember that you are probably listening to a wideband modulation monitor.

Ninety-nine percent of all AM listeners are using narrowband receivers. Do your A/B tests using the standard NRSC deemphasis filter. Or better yet, use a standard car radio, a boom box or even an AM/FM component system tuner.

You won't notice any loss of high end on those devices, and you may hear cleaner response on all radios with the NRSC filter in, since many transmitters exhibit degraded harmonic and IM distortion performance when subjected to all that high frequency punishment contained in open-ended preemphasized audio.

Editor's note: Tom McGinley is a member of the NRSC Committee and is engaged in NRSC field testing.

For more information on the SPF-300, contact Bill Ammons at CRL: 1-800-535-7648. The author may be reached at 301-441-3500.

Circle 93 On Reader Service Card

Reprinted from April 15, 1988

WASK Remotes with Comrex PLX

by George H. Williamson, CE, WASK-AM/FM

Lafayette IN ... At WASK/K105 we are now using the Comrex PLX micro with a cellular telephone for many of our broadcast remotes.

For many years, our station used remote transmitters in the VHF band. For distance remotes such as sports, we used telephone lines.

As time went on, problems came up in our area. The VHF band was getting

User Report

congested, and we were beginning to experience a lot of interference. We were also starting to do more remotes which went beyond our remote transmitter range.

Because of the escalation of the installation fees, we were doing away with our dedicated lines and using more dial-up lines, sacrificing quality.

Clearly we needed an alternative for our remote broadcasting.

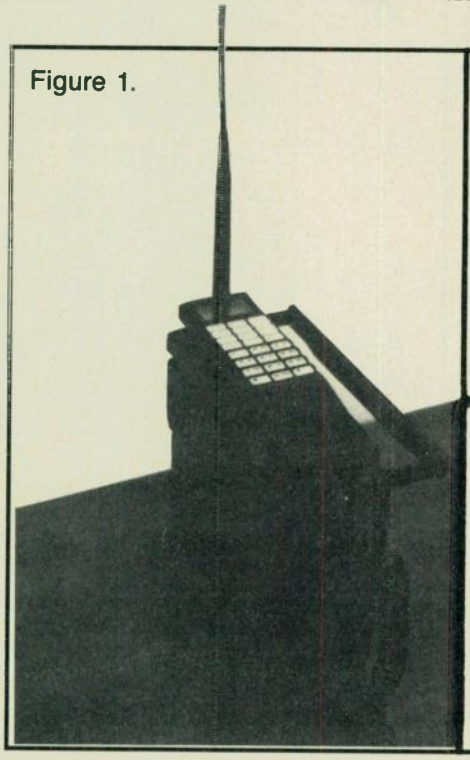


Figure 1.

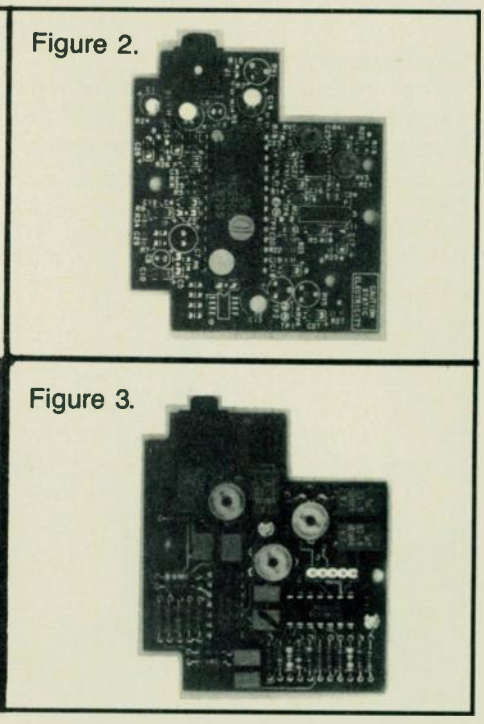


Figure 2.

Figure 3.

Cellular phones

With the cellular telephone system beginning to make its way into the industry, we thought it might be a good alternative. As we analyzed the cellular system, we asked ourselves: How could we obtain better quality from it? This is where the Comrex system came into the picture.

Since 1976 when Comrex equipment was introduced, stations across the country have been using it on their telephone lines. In the past we've had the opportunity to use Comrex equipment and were impressed with it. We began to wonder, could we interface the Comrex system through the cellular phone system?

We contacted Comrex Corporation. They informed us that they had been doing research and had just come out with the Comrex PLX micro for the cellular phone.

Our goal was to interface the PLX micro with our cellular phones as simply as possible and with the least amount of equipment.

Interfacing the PLX

The cellular phones we purchased were Mitsubishi 555Ts, shown in Figure 1. Through the combined efforts of John Cheney of Comrex, Jim Miller of Access Communications and WASK, we started our project.

Since we were not using the hands-free module on the 555Ts, shown in Figure 2, John Cheney said that Comrex was willing to design a replacement module that would enable the Comrex PLX micro to plug directly into the cellular phone.

With this module design, shown in Figure 3, we were able to interface the two units beautifully without another external interface box.

Our main objective of simplicity seemed to have been met. We were able to attach the Comrex PLX micro physically to the Mitsubishi by using velcro ➤

Editor's note: George H. Williamson has been in broadcasting for 33 years—28 years with WASK as CE. He may be reached at 317-447-2186.

For more information on the Comrex PLX micro, contact Lynn Distler at Comrex: 617-263-1800.

material, shown in Figure 4. The complete system can be carried in the Comrex PLX road case (shown in Figure 5).

We have purchased two complete Comrex systems. At the studio, we are using the TH-X Model. The TH-X is a complete telephone line management system containing all of the circuitry needed to interface a telephone line with your broadcast audio facilities.

Line management

The TH-X includes a telephone coupler which will connect to any PABX, an excellent hybrid, an auto-answer system

Figure 4.

which may be programmed to automatically pick up the telephone line only if the proper number of rings is received, an AGC that is designed to set levels only when the caller audio is present, a frequency extension encoder and decoder, and dual isolated "cart start" circuits which provide contact closures whenever the auto-answer system picks up the line.

A send limiter prevents excessive levels from getting to the line and band pass filters reject the extraneous noises often encountered on telephone lines. A tone generator and balance indicator will let you balance the hybrid without having to bring along anything more than a screwdriver.

Anytime we at WASK/K105 install new equipment, we first check to see if the equipment is free of RF interference. Our FM ERP is 50 kW, and a 20 kW transmitter is only a few feet from our control rooms. We were subsequently pleased to find the Comrex equipment completely free of any RF.

Repeated success

We are presently putting our Comrex/Cellular system to heavy use. We have already broadcast the Indiana and Kentucky Basketball High School All-stars and although we feared we might have some dropouts, everything was a success.

Our farm director broadcasts farm reports from all of the surrounding 4-H county fairs and the Indiana State Fair. And we are broadcasting high school football through the system. In all cases we have obtained excellent results.

Figure 5.

We can also see a great expense reduction on remotes by the cellular system, especially when we are broadcasting a one-time event.

We can see many more possibilities in the future, and are planning to interface our news department computers to our farm director's computer via the cellular.

This way, the latest farm markets can then be fed to his computer before he goes on the air from his remote location, regardless of what city he will be in, as long as a cellular system is located in that city.

We are pleased to be using the Cellular/Comrex as an alternative in remote broadcasting. There is a great future for this method.

CAPS 1 Weds Computers, R-DAT

by Nick Solberg, Systems Div Dir, Concept Productions

Roseville CA... Concept Production's CAPS 1 Computer Assisted Programming System is the first of a new family of system controllers to take advantage of new developments in software, PC hardware and digital audio tape. The first two systems are scheduled to be delivered this month.

Ten R-DAT transports are used with CAPS 1 for music, voice tracks, PSAs, commercials, time shift of news and other pre-recorded audio normally associated with a live-assist, partial or full time automation systems.

All ten R-DAT transports are capable of full random access under direct control of the CAPS 1 computer/audio switcher using a serial interface developed by Concept.

The CAPS 1 system mounts in one 70" equipment rack. This rack contains the system audio monitor panel with VU meters, internal monitor speakers and a stereo, 20 W per channel monitor amplifier for external speakers.

The system computer/ten channel audio switcher and ten R-DAT transports also mount within the rack.

External to the rack are the system video monitor, keyboard and optional printer. Additional video monitors and special studio keyboards are available as options for live studio operation.

The CAPS 1 computer, a PC/XT clone with 640K of RAM, one 3½" and one 5¼" disk drive, contains the system audio switcher. The switcher consists of five dual source input control cards and one output control card.

Each input card controls two R-DAT transports, providing audio switching, AFSK (logging data) tone detection and serial remote control for each transport. The output card contains the system program amplifiers and the necesssary tone encoders for recording DAT tapes.

Audio switching is solid state. Digital audio faders are used for control of audio levels.

Each multilevel input board and the system output board were developed to take advantage of ASIC (Application Specific Integrated Circuits) with multiple microprocessors, EPROMS and low noise linear ICs.

The CAPS 1 system software, developed in house by Concept, makes extensive use of menus and windows with single letter or cursor selection of data for control of system programming.

Typical system programming by event numbers or by entering multiple commands has been eliminated with this system.

Commands made simple

All commands available for a specific operation are displayed for the operator and, as necessary, "help" data is displayed. A system command is selected with the cursor keys or by entering a single letter on the keyboard.

A number of operations are also selected using special function keys on the system keyboard. Each of these special keys is labelled.

Extensive use of automatic operations is provided.

For example, scheduling of music and voice tracks for a specific day is accomplished by selecting the "Schedule Day" function from the main system menu, entering the "Day Name" to the schedule, placing the Concept music schedule disk in a disk drive and pressing the enter key.

The system then schedules the correct music rotations with voice tracks, source assignments and EOM data for each selection.

Commercials are scheduled by using a commercial disk generated by an external billing and traffic system or by entering a copy number.

The system selects, from a data base created when the commercial was recorded, all data necessary to play the selected commercial, including the source and location, logging data and EOM placement.

Provision for real-time functions such as time shifting, delay recording network news or time corrections for over-programmed music are included for each day schedule.

After-the-fact data

The system stores five full day schedules and also provides after-the-fact log data, including actual air time and reports of events that did not run on air.

Each event to play is displayed with a full description on the monitor. The system data base contains the necessary source and location of each selection for random access control of the R-DAT transports. The operator or programmer is not required to program or enter this information.

The system is capable of full live assist operation. The studio operator may use events as they are displayed, one event at a time, move them around or even enter data for new events.

At all times the operator has a full display of the system status and a full description of the events on the system monitor.

Commercial recording may be accomplished at the main system or on an optional record center which consists of an R-DAT transport and another PC.

The system stores the EOM time as entered by the operator and also makes a back-up DAT tape.

The Concept CAPS 1 and DAT music formats offer ease of programming, R-DAT transports and digital audio control.

Editor's note: For more information, contact Dick Wagner at Concept: 916-782-7754.

Reprinted from February 15, 1988

by John P. Bisset, Delta Electronics and John Diamantis, CE, WCPT/WCXR

Delta PRH-1 Finds Cable Faults

Alexandria VA ... Most broadcast engineers are familiar with the test instrumentation provided by Delta Electronics, Inc.

But few may realize that the company offers several products manufactured for HF communications that can be adapted to commercial broadcast applications.

One such instrument is the model PRH-1 High Power Pulse Reflectometer. Designed to provide an oscilloscope picture of a station's transmission line system, the PRH-1 can be used to document buried transmission lines as well as determine the location of cable faults.

Operates in high RF

The primary advantage the PRH-1 has over other "time domain pulse reflectometers" is its ability to operate in high RF fields.

With the typical reflectometer, caution must be exercised to prevent high voltages from nearby radiating elements from entering and destroying the instrument's front end.

This drawback can wreak havoc when the line to be examined exists amidst other operating broadcast antennas or arrays.

Measurements conducted at Washington DC's WCPT/WCXR were made with a full power 5 kW AM transmitter and 13 kW TPO FM operating. No degradation of the display or damage to the PRH-1 was noted.

Operation of the PRH-1 is straightforward. A high voltage (5 kV) short duration pulse is applied to the transmission line. A time versus amplitude display of the echoes is then viewed on an oscilloscope.

Technology Update

Faults or discontinuities in the line, as well as the terminating load or antenna cause these echoes.

Reference tool

Although most engineers are introduced to a Pulse Reflectometer after damage to a transmission line has already occurred, the PRH-1 can provide a useful reference which can be consulted should future line damage occur.

The ability to convert these oscilloscope pulse distances allow accurate location of faults or line discontinuities in the field.

Figure 1 illustrates this fact. The photograph displays an expanded scale illustrating a coaxial transfer switch. A is ➤

Editor's note: John Bisset spent seven years at WCPT/WXCR as CE before joining Delta. John Diamantis is now the station's CE.

For more information contact John Bisset at Delta: 703-354-3350. John Diamantis may be reached at 703-683-3000.

the input of the switch, B is the output.

Figure 2 displays the input to two FM transmitter lines. C is the main reference pulse; D shows the input to the coaxial transfer switch; E is the input to a four-bay Jampro FM antenna.

start pulse. G is the input to the coaxial transfer switch, followed by 500' of rigid line. H is the input to a four-bay ERI FM antenna.

The PRH-1 performs equally well in AM applications. Figure 4 demonstrates

the sample line input.

K is the cable termination and L is the input to the sample loop. Since this is a folded unipole tower, the sample loop is mounted parallel to the skirt feed line. That explains the short distance between

Figure 1.

Expanded View - Coaxial Transfer Switch

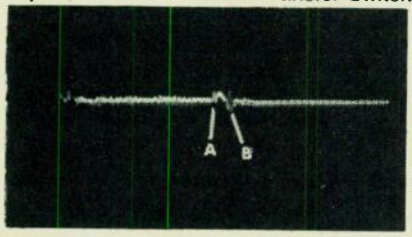
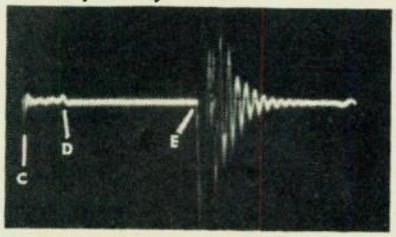


Figure 2.

Auxiliary FM System



Main FM System

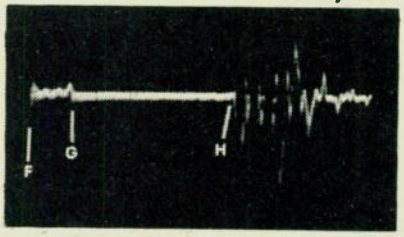
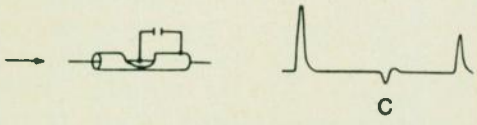


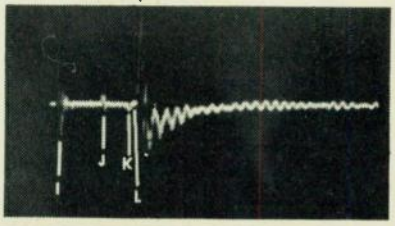
Figure 3.



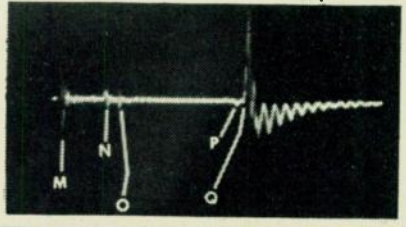
Shunt Capacitance
(Such as a dent in outer conductor)

Figure 4.

Tower 1 Sample Line



Tower 2 Sample Line



The distance between C & D is a 100' test cable which connects the PRH-1 to the coaxial transfer switch. The distance between D and E is the 400' run of heliax to the antenna.

Dents to the outer jacket of the coax would appear along this line as a small downward pip followed by a flattened upward pulse (see Figure 3).

The second photo in Figure 2 displays the main FM antenna. F illustrates the

the station's two sampling lines. Measurements were taken while the AM operated under full power.

Use for AM

As you can see from the traces, there is no visual disturbance due to the 5 kW RF. I is the input reference pulse; J is the input to the sample line. Remember that the distance from I to J is the 100' reference cable which connects the PRH-1 to

J and K.

M shows the reference pulse feeding the sample line for a tower; N is the input to the sample system for this tower. O is a splice in the sample line. P shows the cable termination and Q is the input to the sample loop.

Through measurement of a station's transmission lines, using the PRH-1, reference data can be gathered that is invaluable should a fault occur.

Reprinted from January 15, 1988

Denon Ushers in "CD Cart" Era

by Stephen J. Brown, CE, WHBY-AM/WAPL-FM

Appleton WI ... I spent much of 1985 and 1986 in a state of frustration with the compact disc. Here was a medium that held so much promise for broadcast, but I could not find a way to play it reliably enough for a broadcast control room environment. That is, until Denon introduced its DN-950F CD cart player.

WAPL was the first in its market to use CDs directly on-air a few years ago. We tried a large number of "home-type" CD players with varying results. Some cued up the tracks poorly, while some sounded better than others.

But none had hard-wired remote control capabilities and all were highly susceptible to dirt, pizza and other contaminants getting on the CD itself as it was handled.

This added up to a lot of machine errors and operator inconvenience. Some of the machine errors happened on-air, which was even worse. But even with all of these problems, the percentage of CD-to-air programming was steadily increasing, until 1987 when it approached 35% of our total airtime!

We had put money in the 1987 budget to buy a "professional" quality CD player for the control room. At that time, very few were available. Most were either extreme high end units with one controller and multiple transports or converted home-type players with some features added. Either option made me nervous.

I was struggling about which direction to go when a friend who attended the 1987 NAB convention told me about the newly introduced Denon CD cart player. It sounded like the machine's designers had addressed many of the concerns I had.

One problem that all the machines seemed to have was in the handling of the CD itself. Dirt easily got onto the CD and messed up the tracking of the machine. Early publicity on the CD had seemed to indicate that you could run over the CD with your chair and then pop it in whatever machine was available.

It was difficult to convince announcers who had heard this publicity that it was important to treat the CDs as well as they treated vinyl discs.

. . . I am extremely pleased with the Denon machine. The program director and his staff also really appreciate the player.

The Denon engineers addressed this problem by designing a plastic cartridge in which to house each CD. The CDs are labelled and stored in the cartridge. When ready for play, the entire cartridge is inserted into the player and the player opens a small access door in the cartridge through which the laser can read the disk.

The operator's hands never touch the actual CD, which dramatically reduces on-air problems with the disks, and is much more convenient for the operator.

After the disk is inserted, you select which track is to be played by rotating the selector knob on the front panel. The disc will cue up automatically to the selected track. When started, the selected track will play and the machine will stop. What could be simpler?

If you use it in production and wish ➤

Editor's note: Stephen J. Brown is president of the Fox Valley, WI chapter of the SBE, and is a member of IEEE and NARTE. He does some part time contract engineering work and collects and restores antique radio receivers in his spare time. He may be reached at: 414-734-9226.

For more information on Denon's DN-950F CD cart player, contact Laura Tyson at Denon: 201-882-7467.

to cue to a particular spot inside a track, there are cue buttons on the front of the machine that enable you to cue to the exact point you desire. I have never seen a more accurate or repeatable cueing system on any CD machine.

More front panel features

After you have selected the track, a front panel readout indicates the length of time. When started, the readout counts down while the track is playing. There is also a switch to select a "continuous play" mode in case you want to play the entire CD or several songs in a row.

The front panel of the machine is deliberately simple and easy to operate. It looks very much like a cart machine, so most announcers can learn to operate it very quickly, unlike the players we used before. However, many of the player's important features are visible only when you look at the back panel.

The machine is set up for the standard 600 ohm audio line level output that is standard in most control rooms. The audio connections are made with standard XLR connectors and the audio level controls are accessible on the rear panel of the unit. A rear panel headphone jack and a multiple purpose remote control jack are on the rear.

In our application, we are only using the remote start function, but all front panel controls are available at the remote jack. There are also DIP switches on the rear panel to control cue detect level and EOM relay timing.

The best choice

After investigating the machines, I felt strongly that these were what we should try. This was the first manufacturer to really address many of the problems we saw with CDs in the control room environment.

CDs are easier to handle with Denon's CD cart player

But I was nervous for two reasons. One was that I was unsure of how the "cartridge" concept would be received by our programming department. The other was that I dislike buying the first machines of any radically new design.

But it was clear that the Denon was the best that was available, so we ordered three machines and took delivery in late 1987.

As with any new design, a few problems will come up in the early stages. After running them very successfully for several months on the air, a few minor problems began to show up.

Service a plus

However, a quick call to the factory representative got us action in every case, whether we needed advice and instruction, a part or, in one case, a completely different machine in exchange for our misbehaving model. It is nice to see that Denon has made a commitment to good service support.

One suggestion I would make to the Denon people would be to consider using a metal cabinet instead of plastic. I believe most broadcasters would pay the small added cost.

My machines do not seem affected at all by RFI (my studios are co-located with 1 kW AM and 100 kW FM transmitters), but I have them mounted side by side in an equipment rack.

We are experiencing a little unwanted interaction between the machines, which may or may not be related to the lack of shielding provided by the machine's cabinet. The factory is working with me now to solve this minor problem.

I have to say that overall I am extremely pleased with the Denon machine. The program director and his staff also really appreciate the player.

WAPL is now 80-90% CD-to-air, so you can imagine the workout we are giving these machines. They have cut our CD problems so dramatically that we hope to install the machines in our AM control room and all produciton studios in 1989.

by Hank Landsberg, Pres, Henry Engineering

LogiConverter Ends CE Woes

Technology — Update

Sierra Madre CA ... One problem often encountered when installing a cart machine, cassette deck or CD player is that the remote control circuitry of the machine is not compatible with that of the audio console.

Two of the most popular reel-to-reel decks use 24 V logic, which is incompatible with TTL or CMOS; one machine requires 24 V sourcing rather than the more common ground switching.

Very few cart machines will interface directly with TTL (5 V) or CMOS (12 V) logic, since most machines require a logic "Lo" to start, but the console provides a "Hi" when the channel is on.

Another common headache is figuring out a way to stop a cassette or reel-to-reel deck or CD player.

Henry Engineering's LogiConverter is a remote control interface unit that creates compatible, isolated control circuits between your console and all outboard studio equipment.

It has three basic functions: (a) it isolates the control circuitry, (b) it converts the control signals to those most appropriate for the device being controlled, and (c) it provides a "stop" output where none was available from the console.

Each of the four channels has an opto-isolated input and relay-isolated output. The input signal can be either a voltage or a circuit closure from a transistor or relay.

Since the input is the LED section of an opto-isolator, the input voltage is not critical. Any input from 5 V (TTL) to 12 V (CMOS) or higher can be used.

The input signal can be either momentary or maintained. LogiConverter's circuitry can generate a momentary or maintained output signal from either input. There are 24 combinations possible.

The four LogiConverter channels can operate independently for start-only use, or in pairs for start-stop applications. An internal eight-pole DIP switch can be set by the user to program the unit for the various operating modes.

For example, you can have a maintained input generate a start-pulse output. This would be used to start a cart machine from a logic "Hi." Or you could program the unit to generate a start pulse from a logic "Hi," then a stop pulse when the input went "Lo."

This would be applicable when interfacing a reel-to-reel deck that needed momentary closures for start and stop.

All of LogiConverter's outputs are via SPDT relays. Both the NO and NC poles are available, so equipment that requires an NC contact for the stop function can be accommodated.

The relays are rated up to 120 V/0.5 A, so even older equipment using relay logic can be controlled directly. LogiConverter is self-powered from 120 VAC; no external power supply is required.

The unit is small and lightweight, and can be "velcro-mounted" just about anywhere.

Editor's note: For more information contact the author at 818-355-3656.

Reprinted from March 15, 1989

KKDL Run by Di-trol

by Wayne Edwards, Op Dir KKDL-FM

Detroit Lakes MN..When our automation system's electronic brain became unreliable some 18 months ago, our management asked for a low-cost replacement which could deliver walk-away operation.

We've enjoyed great results with both satellite and tape-delivered music services with the Di-trol System from Innovative Automation.

Our engineer, Richard Tyner, and I were able to use the Di-trol's programming versatility and hardware flexibility to deliver error-free programming.

Di-trol uses an Apple IIe personal computer system and an audio interface with 23 inputs. The system can provide random-access cart selection for up to four carousels with 24 trays each. A monitor, double-disk drive and printer are standard.

Centered around a satellite music network, we used four random-access carousels, two carousels in sequential-play mode, four singleplay cart machines, three reel-to-reel decks, two studios, two Marti receivers and the EBS signal tone generator.

The software has four key areas for operations: Program Log, Exact Time Table, Manual Operations and Carousel Directory.

The system has 7-day programming capacity (1440 events/day in program logs; 192 events/day in exact time tables), with automatic loading of new logs at midnight for continuous operation.

The re-booting characteristics of the computer became a useful function for us immediately.

Although the program log displays event steps as hours and minutes, this is just a labelling procedure without any real time association—unless tied to the exact time table, or in power-down/up sequences.

When re-booting, the software resumes operations at the program step most closely associated with real time. With satellite as our basis of programming, I set up program logs so a re-boot would bring us up in step.

This was a welcome function for the power outages and brown-outs caused by storms, but also became a quick, easy way for an inexperienced operator to correct those occasional unexpected problems that affect automated programming.

User Report

The computer writes to disk after each programming step and alarm situation for about five seconds.

During this time, the system may not detect an end-of-message tone. Our problem was with five-second maximum length image liners.

We solved that beautifully by connecting the liner deck's audio into a summing point. We modified the deck so an ➤

Editor's note: Wayne Edwards has nine years of broadcasting experience under his belt, and has held positions in "everything from news to programming."

For more information on the Di-trol System, contact Don Prentice at Innovative: 505-891-0501. The author may be reached at 218-847-5624.

auxiliary tone laid over the entire liner sent the audio out, on line.

This prevented anyone from placing a wrong cart and having it air over network.

To start the deck, we connected a line carrying the satellite function tone for liners to an interface connected to the deck's remote start. The interface utilized latching relays triggered by two separate momentary pulses from the automation.

At the start of our local commercial breaks, we shut the tone line off, then turned it on immediately after the last commercial played. If we ran long locally, the tone to the deck would never get through. Correctly-timed breaks allowed the liner to play in the five-second window the network allowed.

Legal IDs were handled in a similarly.

Other pulse commands from the computer were used to trigger interfaces to turn our transmitter plate on and off remotely, automatically record closed-circuit feeds and trigger the placing of an auxiliary tone on carts used to record programs off-satellite.

The more we allowed the satellite personnel to control our equipment and the Di-trol to handle scheduled tasks, the better we sounded.

When new management decided to go to a tape service, we were planning to extend the automation even further, using relays and computer commands to change liners automatically with network announcer shift changes, and external timers to step out of remote broadcasts within our local breaks.

I'm not sure total walk-away radio is possible, but we were very close.

During installation, the main difficulty was the conversion of our carousels for binary code data, as we were pioneering the conversion for our brand of equipment.

Di-trol designer Don Prentice provided outstanding support.

The versatility of Di-trol can't be overstated. For example we found the system's switching to be a bit slow when we didn't take an optional break and instead went directly back to the satellite source.

The system answered our needs without requiring much monitoring. That's the kind of dependability you need from an automated system.

That was easily modified in the internal circuitry of the interface. A better solution would be to use a second receiver at another input, with the same network.

Actual use has revealed some irritations, but no major problems. Static electricity discharges, which would cause stepping at wrong times, were handled with static mats and spray.

Transients will cause the system to pulse ahead through the silent sense circuitry. Our most frequent source of transients came with the passage of the leading edge of a storm front, so we'd just switch the silent sense off until the storm was settled in.

If the commercial load is heavy, printer output of the previous day's (or days') logs is slow. Sometimes the system will back out of that print function.

We addressed that by printing out portions of the actual log the same day.

There are two software changes we'd like to see.

First, we'd like the ability to change software labelling of audio sources locally. The current labelling is pre-set and inaccessible. We have device listings in our printouts that don't match with the actual equipment.

The second change would be a synchronization of an exact time update with the intended program step. This would help keep programming in step.

If our programming gets out of step for some reason and goes undetected long enough, stepping problems may occur when the logs go from AM to PM and vice versa.

Experienced and imaginative engineers and programmers can really make use of Di-trol's capacities and versatility.

The system gets my endorsement because it answered our needs without requiring much monitoring. That's the kind of dependability you need from an automated system.

IMS Gets the Blade Out of Edits

by Rob Meuser, Pres Int'l Bdcst Support Services

Hamilton Ontario.. Dyaxis from IMS (Integrated Media Systems) of San Carlos, CA, is one of the new breed of all digital production systems now available for less than the price of a good eight-track machine.

Price in the world of digital audio is established by two primary factors: the cost of hardware development and manufacturing and the cost of storage, both disk and RAM.

Today disk storage is tumbling in cost and increasing in reliability. And while RAM is still costly, it appears to be on a downward price trend.

IMS has tackled part of the price problem by using readily available hardware where possible. The Dyaxis hardware is in the form of a Macintosh computer (of any flavor).

The entire Dyaxis system is comprised of an A/D, D/A converter box, the disk drives and the Mac.

The high quality converter unit accepts balanced inputs at normal studio levels and outputs the finished product in the same form. Additionally this unit can be equipped with MIDI, EBU/EBS interfaces and SMPTE time code.

The converter interfaces to the Macintosh via a serial port for control and via the SCSI bus for the actual digital audio patch. The disk drives, mounted in a separate unit, attach by SCSI.

Smarts for Dyaxis come from the software in the Mac. Mac Mix is normally supplied with the system.

With Mac Mix, you can perform editing that will instantly convince you never to return to the razor blade. Recording and multitrack mixing is also available. Up to 100 mono or 50 stereo tracks are possible.

Editing in a window

The relationship of mixing and editing changes with such digital systems. For one, editing is done graphically in a window which displays a replica of the sound files' amplitude and can show anything from a few milliseconds to several minutes.

Technology — Update

Each edit can be done in one window, and then copied to another. Therefore, one base file can be split into many windows, each with its own special edits.

Since these edits are really only jump instructions in the computer's memory, they can be changed over and over in order to achieve the exact cuts you want.

In the end, the base sound file is still unaltered and ready for more abuse.

Using multiple windows, complex edits will actually be performed as mixes. Because we have an abundance of tracks as well as the ability to re-mix without degradation, such an approach opens new possibilities for radio production.

After the edit windows are placed into the mix window, you can move the individual segments around in order to perfect your timing.

If you re-edit an edit window, that change is reflected in the mix. The operations in Mac Mix are different than the traditional analog methods, but they stand well on their own.

If you are very persistent, you could employ Dyaxis to be the ultimate digital signal processor. The envelope function permits point-by-point alteration of the amplitude window of your sound files.

You could use your knowledge of what that sound actually contains and alter it accordingly—no more messy time constants!

Software enhancements

In addition to Mac Mix, other software such as Cue Sheet and Alchemy broaden the capabilities of Dyaxis.

Cue Sheet allows Dyaxis sound files to be placed in an event window and cued in exactly according to either time code or MIDI commands. Alchemy allows for digital filtering, resampling, reversal, reverb, envelope modification and more.

Dyaxis is an economic way to begin building your digital production room. The system is available for $9,000 to $12,000 with reasonable amounts of disk storage. All you need to add is a Macintosh.

In actual operation, Dyaxis defies technical nit-picking. The measurements are typical of a 16-bit digital system, i.e., near the floor of your test equipment. At 48 kHz sampling, audio response is past 20 kHz.

Operationally Dyaxis is a new experience. Some operators love it, others are shy of a new technology and take more time to become comfortable with it.

At one station consulted by IBSS, the staff put all music editing and special production on Dyaxis within one week.

Editor's note: Rob Meuser is a frequent contributor to **RW.** *He may be reached at 416-526-8200, or via MCI Mail at 325-3672.*

For more information on the Dyaxis, contact Jerry Kirby at IMS: 415-592-8055. Dyaxis is marketed in Canada by Digital Audio Technologies (DAT) of Hamilton, Ontario.

Reprinted from June 15, 1988

Jampro Reduces KNHC RF

by Kelly Alford, CE KNHC-FM

Seattle WA.. RF radiation from FM and TV towers has grown to be a major issue here in the Pacific northwest over the past few years. In Oregon, the city of Portland and Multnomah County have both enacted strict local laws limiting power density levels at broadcast facilities.

King County, WA, has been studying the issue for the past year, and a community coalition group called the "Tower Task Force" has drafted a recommended ordinance for consideration by the board of supervisors.

In this environment, the city of Seattle saw the handwriting on the wall, and began to investigate the problem inside the city limits, with an eye towards drafting its own regulations.

In the course of investigation, the city became aware that one of the worst offending towers might be the transmitting antenna of KNHC-FM, operated by the city's own school district.

KNHC's studios are at Nathan Hale High School, and the transmitter is located a few miles away at Wedgwood Elementary School.

Editor's note: Kelly Alford is also involved in special engineering projects at several other Seattle radio stations.

For more information on Jampro antennas, contact Alex Perchevitch at Jampro: 916-383-1177, or contact John Schneider at RF Specialties: 206-363-7730. The author may be reached at 206-281-6215.

The antenna sits atop a 144' tower on the roof of the elementary school building. KNHC uses a six-bay circularly polarized antenna and a 3.5 kW transmitter to obtain its licensed ERP of 10 kW.

Serious RF interference

RF interference from the station was always a problem at the elementary school. There were many parts of the building where electronic equipment would not work properly.

User Report

To make matters worse, Wedgwood Elementary is the home of a special education program for handicapped students. RF interference was causing some students' electronic wheelchairs to malfunction.

After a near accident, in which the brakes of a wheelchair released while a student was being discharged from a school bus, an ultimatum came down from the administration: KNHC must reduce the RF level on the school property before the start of classes in the fall, or go off the air.

A new antenna was clearly required. Alternatives were studied, and several manufacturers proposed half-wave spaced antennas.

While this method would resolve the immediate problem, it created another: half-wave spaced antennas reduce radiation levels below the horizon, but they do so at the expense of antenna gain. To maintain our ERP we would need to replace six bays with ten, and we were concerned about exceeding the windload rating on our Rohn 45G tower.

When the new signal was turned on, improvements were immediately noticed in the school building.

John Schneider and Bob Arnold at RF Specialties approached us with a unique alternative. They proposed that Jampro Antennas build for us a custom antenna with 0.8 wavelength spacing.

The gain would be identical to a six-bay full wave antenna, but the downward suppression would be almost the same as a half-wave spaced antenna.

Same gain, less money

Further, the cost of the six-bay antenna was almost $10,000 less than the half-wave ten-bay antenna. These cost savings would allow room in our budget to ➤

order range test measurements to verify the downward radiation suppression.

Jampro was willing to guarantee a minimum downward suppression of 20 dB. In short, we could have our cake and eat it, too! An order was placed for the antenna in mid-June.

Jampro built the antenna using a modified version of its standard JSLP antenna bay. Because of the fractional inter-bay spacing, they used a parallel feed system with a six-way power divider.

Each bay is fed from the power divider with its own length of 7/8" air dielectric transmission line.

The antenna was assembled on a 70' section of Rohn 45G tower, which duplicated our tower in Seattle. Full-scale pattern measurements were made on Jampro's test range.

Downward radiation was measured, and the inter-bay spacing was adjusted to provide maximum suppression. The radiation suppression was measured at 20 dB or better below –74°. The gain was measured and verified at 3.2, the same as a standard model.

The antenna was on its way to us by mid-August. We were off the air for seven hours while a crew from SeaComa Communications removed the old antenna and installed our new Jampro.

When the new signal was turned on, improvements were immediately noticed in the school building. A/V equipment worked in places where it had not previously. Wheelchairs operated essentially without problems.

Jampro built a custom antenna with 0.8 wavelength spacing to alleviate KNHC's RF problems.

Additionally, there was another benefit we had not anticipated: we immediately began receiving calls from listeners commenting on our improved signal quality.

Listening tests in the community confirmed that many former multipath areas had been cleaned up with the new antenna. We theorize that signal reflections from the roof of the school had previously been interfering with the primary signal.

Jerry Leitch from the Seattle office of the EPA had measured the power density levels in the school building prior to the antenna change using a Holaday meter.

He returned on 15 December and took another set of measurements on the new antenna. The results confirmed our hunch: the signal levels had been dramatically reduced.

Before the change, the hot signal areas had been in the auditorium and gymnasium, with power density levels of 100 to 265 μW per square centimeter.

The "after" measurements in the same areas were in the range of 13 to 20 μW. Radiation levels in all other parts of the building were similarly reduced, and many were unmeasurable.

The Jampro antenna has performed precisely as promised. We have experienced no problems with the installation or performance of the antenna. We recommend this approach to anyone concerned about RF radiation suppression.

Reprinted from May 15, 1988

WTGC Switches to Nighttime with LPB

by Gary Magill, CE, WTGC-AM

Hollidaysburg PA ... On 30 August 1985, WTGC in Lewisburg, PA was issued a show/cause order for night operations. The power issued was 13.6 W.

At first, we used our old RCA BTA25OM, a 250 W AM transmitter with a dummy load and tapped coil to get 0.5 A on the base current. The transmitter was already set up for post sunset at different powers.

We found the commercial power required to achieve 13.6 W was far more than efficiency prescribed. The audio quality of the old RCA at this low power was not very good, either.

What we needed was a low power transmitter.

I called Dick Crompton at LPB in Frazer, PA to see what he had in the way of equipment because I knew that LPB had a great deal of experience in lower power transmitters.

Dick suggested his LPB AM-30P solid state, 30 W AM transmitter.

We estimated that the savings from electric power costs would pay for the transmitter in one year.

Delivery time was quick/about two weeks. The instructions were very easy to follow, and we were able to install our new night transmitter in August of 1986.

The operating people at WTGC were amazed at the size of the new low power transmitter. It is approximately 12″ high, 6″ wide and 5″ deep.

The unit has adjustable power control and audio input control. The output connector is an S0239 connector. The power input is a standard 120 V plug.

We made a modulation monitor sample connection with the circuit supplied in the book. We used a ceramic switch to switch between the RCA and the LPB units.

LPB AM-60 (left) and AM-30 (right) transmitters

Editor's note: Gary Magill is CE of Cove Broadcasting stations WHPA and WKMC. He is also an engineering consultant for WTGC.

For more information on LPB solid state transmitters, contact John Tiedeck at 215-644-1123. The author may be reached at 814-695-4441.

Circle 18 On Reader Service Card

Our audio is driven with a Dorrough Model 310. The LPB AM-30P modulates positive peaks very well. The adjustable power control makes an easy transition from the power of post sunset into nighttime power.

User Report

The frequency stability is very good at about +10 Hz. The audio quality on the LPB is comparable to that of the main transmitter operating on daytime power.

The LPB operates low level modulation with linear amplifier push/pull. To supply power to the unit, there is a toggle switch inside the front door with an LED indicator on it.

The operating people at WTGC were amazed at the size of the new low power transmitter.

One thing I would like to see is the main power and RF power adjustment mounted on the outside so the unit can be operated with the power on.

Also, the means of sample for the modulation monitor should be mounted inside of the unit with the jack on the side.

Overall, however, I highly recommend the LPB AM-30P to stations looking for economical night transmitters.

Reprinted from April 15, 1988

StereoMaxx Widens Stereo Stage

by Harry Simons, CE, WAEB-AM

Lehigh Valley PA ... Let's get right to the point. I have a very high regard for the StereoMaxx.

Having a unique situation in that I'm given numerous opportunities to try, buy or pass on most any audio processing gear, I've been able to evaluate several stereo enhancement devices.

As a result, I have formed this very pointed opinion: the StereoMaxx is the only box with enough operator adjustment to produce sufficient stereo enhancement and allow for the control necessary to accommodate various program requirements.

User Report

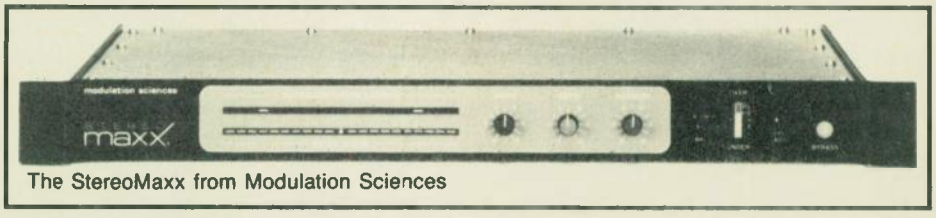
As with any other piece of equipment, the StereoMaxx is not for everyone. But it is a device that the vast majority of stations will find a justifiable addition to their audio processing chain if they plan on keeping up with aggressive technical competition.

Editor's note: Harry Simons is also a member of the NRSC Committee.

For more information on StereoMaxx, contact Eric Small at Modulation Sciences: 718-625-7333. The author may be reached at 215-434-4424.

Some time ago I read an opinion of another engineer who commented on the fact that it was too bad that stereo enhancement was even necessary, and that the problem of lack of stereo was the fault of the recording industry. He made a plea to that industry to get its act together.

In general the fault may be placed there. But to be fair, the recording industry is attempting to produce a product that is all things to all people.



The StereoMaxx from Modulation Sciences

A legitimate place

The recording industry's product, be it vinyl or CD, is certainly not just optimized for broadcast use alone. It appears, therefore, that stereo enhancement does have a legitimate place in radio. The problem of lack of stereo in recordings is ours to solve, not to criticize.

So, how do you choose the right unit for your station and how do you answer questions about the side effects of stereo enhancement?

I have used some form of stereo enhancement for a number of years, all with varying degrees of success and effects.

When I put the StereoMaxx on line I heard a substantial improvement over what I previously thought was great. I was very surprised.

I tried the StereoMaxx at three trade shows and was not motivated enough to try one on the air until practically force fed a unit to my door. I had heard stories about unwanted side effects, multipath problems and mic audio that sounded like the inside of a barrel.

None of these stories was true.

No susceptibility to multipath

I made an effort to hear and confirm increased multipath in the field—a process, I might add, that takes some time and cooperation with the weather. ➤

Our station suffers from textbook worst case multipath. We have done everything within reason to determine all of the station's multipath characteristics, from making unscientific chart recordings of multipath from an airplane to flying radials outbound and inbound to the antenna in increments of 10°, to renting a helicopter for access to areas where man is not meant to go.

With this and much more data on my multipath problem, the installation and aggressive use of the StereoMaxx did not have any effect on the severity of my multipath.

However, let me clarify an issue. This station is a high energy CHR all CD-to-air facility. The stereo content is high already.

My level of susceptibility to increased multipath through an increase in peak L–R is small. With the addition of the StereoMaxx, little change in multipath was perceived as none.

Nothing changed except the station's stereo image. It was greatly improved, the low end had more punch, and the mic sounded more solid and pleasing.

Adjustable enhancement

These results were obtained right out of the box. Some turning of the front panel adjustments quickly gave me an understanding of what the StereoMaxx would do.

I was able to make it sound just about any way I wanted. Giving the StereoMaxx the benefit of the doubt, it took about 20 minutes or so for me to fine tune to the sound I was most happy with.

The StereoMaxx is a well thought out device that employs a great degree of high technology and does not forget common sense engineering. It avoids sum and difference, it does not increase the peak level of L–R and it will not allow too much stereo enhancement, through automatic width limiting.

Also, a unique stereo threshold detector will prevent mono signals that are considered marginal stereo signals (due in some cases to phase shift) from being enhanced as though they were stereo.

The StereoMaxx is also a device that works well with all types of audio processing equipment, simply because it works in the time domain rather than amplitude domain.

The StereoMaxx . . . employs a great deal of high technology and does not forget common sense engineering.

After having been so happy with StereoMaxx, what more could I ask for? Now Eric Small has chosen to offer even greater operating flexibility to users of StereoMaxx through several modifications.

Enhanced enhancer

First, it is now able to make its mono correlation window variable, which allows the user to more accurately compensate for imperfections in phase and amplitude balance in the audio chain prior to the StereoMaxx.

Another modification permits control of the width limit threshold. This allows the user to move the point that the unit will start reducing stereo enhancement.

Both of these modifications are available to current StereoMaxx users by contacting Modulation Sciences. They'll send a free field modification kit, which simply consists of two trimmers, one resistor, instructions and a template for drilling two holes in the top cover.

Units shipped after 1 June will have these modifications included, and will also have a new manufacturer's price of $2,889—$306 less than earlier models due to the company's savings realized in the new version.

A few other details worth mentioning about StereoMaxx are that it is capable of 115/220 V operation without removing the top cover. Container construction is a full steel chassis, which gives effective RF and magnetic protection.

Components used inside are considered to be extremely expensive, such as a $40 analog to digital converter chip (price as purchased in quantity) and Jensen Transformers on the signal output.

Most of you will get around to StereoMaxx sooner or later. And if you're like I once was, Modulation Sciences' trial purchase program will probably change your mind. My guess is that you will quietly become the next user of radio's new secret weapon.

Reprinted from June 15, 1988

Monroe: Control at Your Fingers

by Roland L. Phillips, App Eng, Monroe Electronics

Lyndonville NY ... With the increasing use of dial-up units for remote control broadcast transmitters, continued manual operation has become cumbersome. Today's dial-up remotes are very sophisticated, requiring the operator to look up or remember command codes.

A Monroe Model 6006 Central Controller, with an IBM PC-compatible computer, gives an engineer the option of manual or automatic control of remote sites.

The 6006 can control and monitor up to 99 remote sites via a standard dial-up telephone line and the use of high-speed DTMF.

Its software permits control from the keyboard, formatted storage, display and printing of status information and versatile sorting of files by site.

User-configurable screens present plain English displays of status information. Analog information generated by analog card-equipped remote units is automatically converted into desired engineering units.

This, in conjunction with a Model 6005 Remote Control system (which has eight control relays, eight digital inputs, a 60-event timer, alarm callback on input status change and an optional analog card with eight differential inputs) gives the engineer control of the remote transmitter.

Control relays can be configured to control the transmitter's main power; the antenna load: main or dummy; preset power levels: high, post sunset and nighttime as well as increasing or decreasing power levels via an external motor drive.

Digital and analog inputs

Digital and analog inputs on the model 6005 are used to monitor control points and voltages at the remote transmitter site. If an input is enabled to callback on a change of status and a change of state takes place, the 6005 will autodial the first telephone number stored in memory.

This callback can then be answered by personnel or automatically by the Cen - ➤

. . . with the need for more and more dial-up units in the broadcasting field the Central Controller becomes very cost effective.

Editor's note: For more information, contact the author at 716-765-2254.

tral Controller. If the Central Controller answers the incoming call it can automatically acknowledge the call-in, log it on a hard copy and return the remote control to its normal non-alarm condition.

This mode of monitoring, having the remote unit and the Central Controller work automatically may be very useful to engineers.

They could, for example, have present power levels controlled by the remote's real time clock and the callbacks for power level change automatically acknowledged and logged by the Central Controller.

The advantages to using a Central Controller over manual operation include: the ability to generate plain English labels for control and monitor points at a remote site; station data files created for each remote site; station normals determined for controls and monitor points at each remote site; station programming created, viewed or modified; and printer phrasing creation or modification.

Plain English labelling permits the programmer to label points that correspond to the actual points on the remote site. An example would be "Main Transmitter Power ON."

The programmer would label the appropriate relay with "Main Transmitter Power" and "On" for the response when the remote's relay is energized. Responses can be labelled for the four conditions of each relay output or input.

Station data files contain the remote site's address, telephone number, access code and whether polling, access code or auto acknowledgement of callback are enabled or disabled. Also contained in the station data file are screens generated for plain English labels and responses.

Technology Update

Alarm conditions

Within the station data files, station normals are set to the conditions which can be recognized as normal by the Central Controller for a station's outputs and inputs when the remote calls in with a status report.

These conditions are used by the Central Controller to determine whether an input is in an alarm condition. With this type of setup the remote unit can be enabled for callback on any change of state, but the Central Controller determines if the change is really an alarm condition.

To view a remote's stored program parameters, you use the Central Controller to call out and request a program dump. This will present all program parameters along with time commands.

Usually engineers must call out to the remote site and send touch-tone commands to operate and monitor the remote.

And with the need for more and more dial-up units in the broadcasting field the Central Controller becomes very cost effective, giving engineers more time for things other than going to the telephone and accessing the remote unit, waiting for it to speak English or beep.

Orban Enhances Spatial Image

by Frank Foti, Field Spvsr, Malrite Communications

Cleveland OH ... Audio processing: the mystical manipulation of audio signals in an electronic manner in order to enhance or re-enforce the creative programming of a broadcast station.

Many methods can be employed by a broadcast station in its efforts to create or control a dominant, distinctive and hopefully a quality sound over the air.

User Report

Until recently, almost all audio processing concepts have revolved around the use of compression, limiting and controlled clipping within the individual stereo channels. Through the use of amplitude level control of the audio waveform for the discrete left and right channels, audio processing is achieved.

Another method of processing that can augment an audio processing system is the concept of "stereo" processing, or stereo enhancement.

This concept can be used to create a larger stereo image, an illusion that the "sound" is bigger than it actually is. Increased brightness, impact and definition of music can also be realized through this process.

Stereo processing is achieved through altering the difference signals that exist between the left and right channels.

As can be done with discrete audio signals, stereo information can be processed with compression, equalization, delay and reverb to create the enhanced stereo effect.

But it should be noted that when processing the stereo information of a signal, undesired results can occur. Within the realm of broadcasting these undesired effects can result in unnatural sounding program material and increased multipath distortion within a coverage area.

Natural sound

The Stereo Spatial Enhancer Model 222A from Orban can and does achieve stereo processing without creating any unnatural sounding program and also without affecting multipath possibilities.

It measures one rack unit high, 1¾", and is very easy to install and operate.

Editor's note: Frank Foti has been employed by Malrite Communications for almost ten years, and has been CE of WHTZ (Z-lOO) in New York, KSAN in San Francisco, and the Home of the Buzzard, WMMS in Cleveland. He has twisted the knobs of a few audio processors in other major markets as well.

For more information on the Spatial Enhancer, contact Sid Goldstein at Orban: 415-957-1063. The author may be reached at 216-781-3010.

Orban recommends that it be installed before any processing within a system.

The stereo enhancement method operates on transient information. For this reason, it should be installed at the output of the audio console.

The unit is configured with electronically balanced input and output stages. The output stage of each channel is an electrically balanced circuit that simulates a true transformer output.

This means that in installations where unbalanced equipment is used, one of the active balanced "sides" of the enhancer could be "tied" to ground with no adverse effect to operation. Connections are by means of a terminal strip, but the metal work has been done if XLR connectors are to be used.

The front panel features an LED enhancement level indicator, an enhancement control and a bypass switch. (There is a stereo ratio control that is located behind a capped recess in the front panel.)

The unit operates at unity gain, so there are no level matching problems to be dealt with.

Once installed, switching the bypass control in and out will activate the processing. Setting of the enhancement control should be done subjectively through listening over periods of time.

The theory used with this unit is that ➤

it will not create an exaggerated "echo-ey" sound which may be created when other forms of stereo enhancement are used.

What can be heard is a fuller, warmer sound with greater detail and depth to the overall mix. The stereo separation appears as if there is more "space" present.

On some musical material, certain instruments will actually stand out in the mix. You may even hear other instruments or sounds not heard before within the mix.

Acts on transient information

The technical theory behind the Stereo Spatial Enhancer is an interesting concept. Processing of the stereo information is achieved through the detection of "transient" information within the L+R signal.

This creates a control signal that operates a compressor that controls the level of the L–R or stereo information. Since only transient information is used to "trigger" the stereo enhancement, the added RMS level of L–R energy is kept to a minimum.

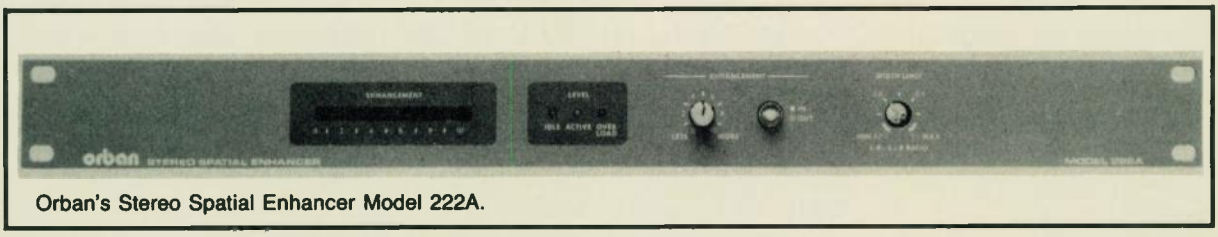
For this reason the effects on multipath distortion are either nonexistent or minimal in worst cases.

Actually the L–R level is only momentarily increased to achieve the effect, so multipath distortion is avoided.

It should be noted here that when added RMS levels of signals are present within the L–R channel, the chances or opportunities for multipath are greater.

Some forms of stereo processing utilize equalization or delay to achieve the enhancement process. This can create an unnatural sound due to the exaggeration of existing echo or reverb that exists already on the audio material.

Since the Spatial Enhancer is operating on transient information, existing echo or reverb is not enhanced because of the low transient content of echo and reverb signals.



Orban's Stereo Spatial Enhancer Model 222A.

In general, what has been created is an audio processing device that operates within another "realm" of processing technologies.

The Spatial Enhancer could be the needed edge to help complement an audio processing system. Here is a device that can "keep them guessing," along with an affordable price tag.

Through stereo processing, any audio chain can be augmented to further lock down or dominate your dial position. Now if we were to try and further define a detailed explanation of audio processing, we would all be mystified!

787A Keeps Mic Levels in Check

by Ken Tankel, CE, WIOQ-FM

Philadelphia PA ... The difficulty of achieving a good live sound from studio microphones has been recognized for a long time. Air chain processing for music leaves something to be desired when it comes to live voice.

As a result, many engineers are presently using a compressor/limiter on the studio microphone. The problem with this approach is that this processor must be set for the level of the average voice.

A voice much softer than average will barely be affected, while the loudest voice will be heavily compressed. It is possible, of course, to use compression so extreme that it becomes an effect in itself, imparting to live voice a punch, presence and larger-than-life feel.

This will eliminate the inconsistencies of more moderate processing but introduces pumping, breathing and even distortion.

I think everyone would agree that asking every jock on your station to accurately reset a number of processor controls every time he or she starts an air shift is not a practical solution to this problem.

When I saw the prototype of the Orban 787A, nearly a year and a half ago, I ordered one on the spot.

Editor's note: Ken Tankel has done acoustical design and construction as well as broadcast studio design for the past 10 years. He may be reached at 215-667-8100.

For more information on the 787A, contact Howard Mullinack at Orban: 415-957-1067.

User Report

The 787A incorporates a three-band, fully parametric equalizer, a gated compressor, a noise gate and a de-esser in a single package under microprocessor control.

Push button adjustment

The conventional controls of other processors (either rotary or linear pots) have been replaced by digitally controlled attenuators.

This allows all adjustments to come under microprocessor control. Adjusting this processor is done via front panel push buttons.

The compressor is the only stage that is always in the signal path. All other functions can be individually bypassed for each setup. Ninety-nine presets can be stored as numbers between one and 99.

The zero position has a permanent setup with the compressor threshold set so high it essentially will not operate. All other functions are set to off.

At any time, you can lock out all the front panel controls except the recall function. Jocks only have to enter the number of their preset. The lockout prevents any other changes.

Noteworthy options

There are several other features worth mentioning.

Even stations running extreme amounts of compression can benefit from (the 787A).

There is an optional RS-232 interface, making the unit ideal for use with computerized formats. A MIDI interface makes it a very powerful production tool.

A simple remote control for recalling presets allows you to mount the unit anywhere.

And, finally, the microprocessor can actually control two audio sections. A slave audio can be set up to operate as half a stereo pair or as a totally indepen- ➤

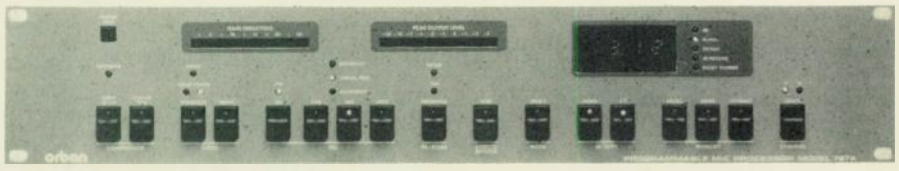
dent unit.

The manual, although preliminary, does not leave out any essential information. The 787A was put in use, without problems, very quickly.

It was first connected off-line in the air studio. This gave me some time to listen to the unit and familiarize myself with the controls.

The control scheme and the use of push buttons and a display took some getting used to, but it didn't take long before I could make adjustments quickly and easily.

Next, to avoid any surprises on the air (either to our listeners or our announcers) we set the unit up in a production room and spent about 10 minutes with our announcers to get a basic processing setup for each of them.



Orban's Model 787A microphone processor.

On-air fine tuning

The unit was then put on the air. Fine tuning and equalization was done with the unit on the air so that the effect of the main processing chain would be taken into account.

We have 12 announcers on the air. A 9 dB range of input adjustment was required to achieve a uniform 10 dB compression for everyone.

The ability to program the compressor threshold and obtain a consistent amount of compression for each of our jocks made the 787A worth having, even as a standalone compressor. The additional features make it outstanding.

The gate threshold is set so that when our mic channel is turned on and the monitors are muted, the compressor gate returns the compressor to 10 dB of gain reduction automatically.

The voice level comes on right where it belongs, with no audible side effects. The noise gate also activates, at the same level, and is set for 6 dB of gain reduction.

I found that 6 dB is the maximum depth that would recover quickly enough not to be audible when the input level comes up fast.

Greater noise gate depth settings are probably possible, depending on interaction with the settings of other controls.

The 6 dB figure is sufficient to noticeably reduce room noise when the mic channel is switched on. The de-esser (which sounds better to me than the stand alone Orban unit) was simply set by ear.

Equalizer settings were difficult to make with the unit live on the air. Our solution was to make an off-air tape of the live breaks of each jock. This was then played back and equalized using a production studio Orban parametric equalizer.

This yielded the EQ curve that would achieve the best vocal sound, taking into account the main processing chain. The curve was then set on the 787A equalizer.

It is important to note that the compressor threshold control is also the input level control to the other audio sections. Therefore, changing the threshold after setting up other processor levels requires that you go back and adjust the operating points of the gates and de-esser accordingly.

This is not made clear in the manual. Also, both gates operate at the same user selectable level, although they can be set in or out of the circuit individually.

One further note—changing between some settings causes the audio output of the 787A to mute. I found this very annoying, but it can be defeated. The defeat instructions are buried in the EQ section of the manual.

Although it was frustrating to wait so long for delivery, this product was worth the wait. Our live sound is noticeably improved.

The EQ has allowed me to take advantage of a mic with a characteristically great low end and compensate for its lack of brilliance.

Most of our jocks immediately noticed and like the difference.

There have been no problems with recall of the presets. The 787A is ideal for achieving a consistent, natural, quiet and distortion-free sound for every jock.

Even stations running extreme amounts of compression can benefit from the EQ, gating and de-essing, although not from the finer points of compression control, which led me to buy it!

I think this is an innovative product that deserves some attention.

by George Stephenson, Jr., Studio Eng Supvr and Jim Gilmore, Audio Eng WSM/Opryland USA, Inc.

WSM Selects Otari for Reliability

Nashville TN ... Most of us can remember the days when audio commercial production at the radio station level was accomplished using little more than a turntable, reel-to-reel, cart machine and a microphone for source equipment.

If we were lucky, there were two reel-to-reel machines, a second turntable and maybe even a couple of cart machines. The main problem was the number of appendages attached to a single operator and of course how many of them could be used for starting machines, manipulating faders, etc.

Multiple operators could alleviate this problem somewhat, but then one faced the task of getting everything coordinated; one blown cue, start, fade or level could ruin the take.

When that occurred, every source had to be rewound and re-cued, levels reset and the whole process repeated ... and overall timing was rarely consistent.

When multitrack recording began to come within reach, the larger production houses were quick to utilize it. This not only increased their efficiency, but allowed a level of sophistication heretofore unattainable in audio production.

It wasn't very long before the larger radio stations began to look to multitrack, not only for the same reasons, but also to bring their own production up to the standards of the agency commercials which the station aired.

But for many of the same reasons which prompted the inclusion of multitrack recording in these facilities, the multitrack machines we have grown to rely on have begun to give way to a new generation of very sophisticated units.

One of these new machines is the Otari MX 70.

User Report

One of the operational difficulties of the earlier multitrack machines was that of "punching in."

Notwithstanding the "pop" which many machines exhibited, there was the problem of switching from the "sync" to "input" monitor position. Without a special system for switching, it was just about impossible for one person to operate the machine in this ➤

Editor's note: George Stephenson, Jr. has been in both operations and manufacturing in broadcasting since 1956 and was CE of several radio and TV stations, as well as an employee for Harris Corporation. Jim Gilmore has been in broadcast engineering since 1963. He taught at MTSU and was CE of several AM and FM stations. He, too, is a former Harris employee. They can be reached at 615-889-6840.

For more information, contact John Carey at Otari: 415-341-5900.

mode.

This seems to have been an area in which Otari took a good close look before they designed the MX 70; from both a cost and performance standpoint, it seems to be right on target.

The MX 70 is controlled by an internal microprocessor which makes it possible to cut down on the number of physical controls and indicators by assigning more than one function to many of them.

This not only reduces the amount of real estate required by the control panel, but keeps the operator appendage requirement at a minimum. The microprocessor control takes care of all the bias/record timing and monitor switching, too.

Admittedly, this does take the fun out of peering into the production room, placing bets and watching a couple of operators perform a poorly orchestrated ballet when they need to punch.

Well thought out

There are many handy features present on the MX 70 including the timer and its associated Search Zero, Set Cue and Search Cue functions, speed timing and location of program material.

The cue button allows a high speed preview, and has a handy feature which attenuates the audio and rolls off the high frequencies in the fast cue mode, thus saving ears and speakers.

Spot Erase can selectively erase small areas on tracks, allowing clean-up of minor glitches and mistakes without reworking the entire track.

The remote control is well thought out and requires a minimum of space, which means it can be placed conveniently near the operator.

The transport functions so smoothly and predictably that there is no great need for the operator to be near it, except for the Spot Erase function—which is as it should be.

We talked with WSM chief production operator Tom Bryant and asked him how he felt about the machine after having used it for the better part of a year.

He told us a number of things he liked about the product. These included:

- Sync frequency response: "We ping (consolidate) a lot of tracks, since we often require more than the eight tracks available, and the sound is great!"

The transport functions so smoothly and predictably that there is no great need for the operator to be near it.

- Good human engineering: "I like the tactile response of the buttons, the control layout and the brightness of the displays; it was also very easy to learn to operate."
- Physical attributes: "It's a nice size, you can see the meters easily, tape handling is super and it's quiet so you can keep it right in the room with an open mic."
- Reliability: "We just don't have any trouble with it."

Next we asked Tom where he saw room for improvement. He could think of only two areas.

One was that he would like to see the relocation of the wire exits on the remote control from the top to the rear. In our situation, the wire exits on the top preclude us from mounting the control at a convenient angle.

His other observation was that the meter lamps have a shorter life than he expected.

Finally, we asked Tom for an overall statement. With no hesitation he replied, "I think the machine is a dream to operate."

Easy to care for

Aside from routine cleaning and setup, there is little maintenance to do; the MX 70 rarely requires more than a slight "tweak" on equalization and biasing and there has been no down time since it was installed.

At some point we will probably elect to expand our eight-track unit to 16 tracks. Since the MX 70s are already wired for 16 channels, the change will require only the addition of eight more electronics cards, a new head stack and realignment.

We thought about any changes we'd like to see incorporated in future models. About the only thing we could come up with was the inclusion of some sort of sensor to determine the presence of tape on the outside of the head shield, thus preventing tape motion if this situation arises.

When the time came to add another production room to the complex, the multitrack choice was obvious—another MX 70.

It was also necessary to add new two-track machines. After a survey of available units we once again chose Otari.

The MTR 10/12 II machines have performed on par with the MX 70s. The similarity of features is convenient, tape handling is superb, electronic performance is excellent and required maintenance is minimal. The operators especially like the Search Cue and Reverse Play functions.

It is very evident that Otari did a lot of market research when the MX 70 and MTR 10/12 machines were conceived. Our choices were made after considerable cost/performance/reliability analyses. We think we made the right ones.

Reprinted from September 15, 1988

Price, Stability Lead WDBI to FMQ-3500

by Don Backus, GM/CE WDBI-FM

Tawas City MI ... There's no worse time to install an FM transmitter and antenna than in the dead of winter. So naturally, that's what we ended up doing.

In January, 1988, WDBI-FM installed a QEI FMQ-3500 transmitter. The next day I started getting calls from people who commented that our station was coming in better ... and sounding better too!

In selecting our FM transmitter, we evaluated several different products. Each had benefits that another didn't offer; each seemed to have shortcomings not shared by another. Our final decision to purchase the QEI FMQ-3500 was based on several key points.

The design of the transmitter is a single tube grounded grid type, felt by our consulting engineer to be generally more stable than other designs. The price of the unit was also a factor, but not an overriding one. We were already replacing a "cheap" transmitter, and didn't want a 1988 version of the "same ol' thing."

Don Backus has been in broadcasting since 1972. From MSU to WSJM to WVIC to VOA to WDBI he just can't get enough of this business! Currently he manages, engineers and co-owns WDBI-FM, Tawas City, MI and loves it. He may be reached at 517-362-6149.

For more information on the QEI FMQ-3500 transmitter, contact Bill Hoelzel at QEI: 609-728-2020.

Power increase potential

Another consideration was the potential for upgrading the transmitter to a higher power level. As a Class A FM, it looked possible (and still does) that the FCC might someday soon offer us the chance to increase power. If it does, the FMQ-3500 can be field upgraded to 5 kW or even 10 kW with optional factory supplied kits.

The FMQ-3500 uses a 3CX3000A7 tube warrantied by QEI for 15,000 hours or two years (whichever comes first) with pro-rated charges applying after the first 10,000 hours. The transmitter itself is housed in a 23" wide by 30" deep by 76" high steel cabinet.

User Report

The meters are located in a tilt-out panel at about mid level of the cabinet. There is about 17" of rack space located above the meter panel for the exciter and processing equipment.

Electric power is supplied from a single phase source of 208 to 240 VAC at 60 Hz (but it can operate at 50 Hz as an option). The IPA is a solid state 250W module that can be replaced quickly if need be.

The control functions and fault indicators are run from a separate 24 V power supply and the unit supports its own microprocessor based remote control system, or outputs to a third party unit.

Practical use

Our application has the FMQ-3500 running at 3500 W TPO into a two-bay circularly polarized antenna at 281' above average terrain.

The new equipment allowed us to move a Sparta 601 1 kW transmitter that drove a seven-bay Jampro antenna into back-up status. At the same time we installed new coax cable and a QEI Model 695 exciter (a very nice unit in itself).

Installation of the FMQ-3500 was fairly straightforward. The only problems we encountered in the initial checkout were neither QEI's fault nor our own.

In delivering the transmitter, antenna and coax cable, the delivery truck got lost, took a wrong turn or two at too high of a speed, and the coax cable spool fell over onto the transmitter.

To the credit of the FMQ-3500, there was little trace of this mishap other than cosmetic damage and a slightly loosened drawer slide.

With consultation from QEI, we spent about an hour looking for damaged ceramic standoffs, internal parts or anything that deviated from what you would expect to find in a brand new transmitter. Having found none, we moved along to check out the FMQ-3500. ➤

Setup manual

The setup and installation instructions were brief and to the point. While not overly elaborate, they did cover the installation and initial operation fairly well. The schematic drawings left something to be desired in legibility, though. I have since spoken to QEI about that and was told that they are redoing them on a CAD system.

The first problems we discovered were during the latter part of the installation and setup. Interfacing the remote control unit that we have was not easy at all.

QEI sells an optional remote control unit called the ARC-27. It provides up to 64 analog and 16 digital inputs. Unfortunately, the FMQ-3500 does not provide the same access to information for a third party remote control as does our Moseley MRC-1600.

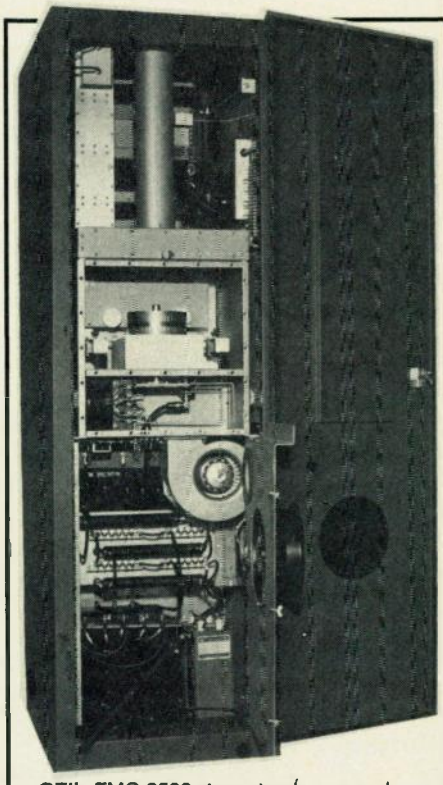
It was easy to hook up the control functions, but some of the readings, like the PA plate current, which is not supplied referenced to ground, were not. We also had to kluge together an optoisolator circuit to provide status light signals to our Moseley.

Possible improvements

There are other parameters supplied by the transmitter to the QEI remote control unit that are not accessible at all by any other remote control system. These include the fault annunciators, stack and ambient temperature to name a few. I think it would be a valuable addition to the FMQ-3500 to allow for easier access to these outputs.

However, since the installation was completed in January, we have had only one serious problem with the transmitter. Over the summer, our IPA current seemed to be gradually increasing without a corresponding increase in output. After consulting with QEI, they sent us a new unit which has since operated perfectly.

In retrospect, I believe the impact of the delivery truck may have had some effect on the IPA. The experience we have had with the customer service people at QEI has been quite good. We have had to talk to them at rather odd hours from time to time and have always received courteous, competent assistance.

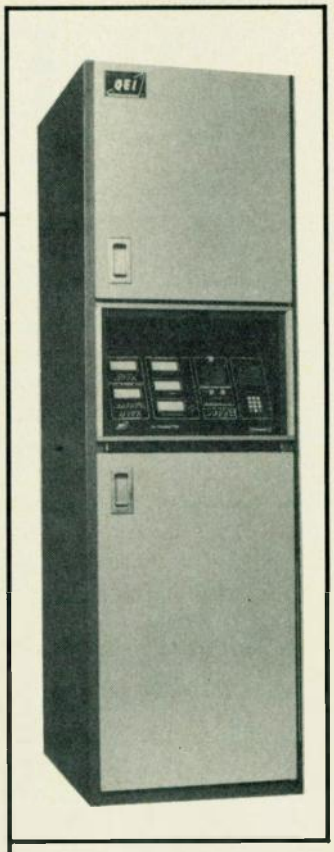


QEI's FMQ-3500 stays steady as a rock, according to WDBI

Maintenance has been a breeze. The cabinet air filters are standard size and easily found even in Tawas City! Cabinet access is good and the unit basically stays steady as a rock ... even when the weather was as hot as the summer of '88.

Price and service right

When we purchased a transmitter that was several thousand dollars less expensive than some of the "big names" we knew we would be making compromises. But with our experience so far using the FMQ-3500, I would have no hesitation in buying another ... regardless of price.



Product quality is just one element of a successful company. Product support is just as important. While QEI is certainly not the only broadcast company to provide both quality and support, based on our experience, they stand right up there with the best.

by Dan Braverman, Pres, Radio Systems Inc.

RS Adapts DAT for On-Air Use

Edgemont PA ... Radio Systems believes strongly in DAT's tremendous potential as a broadcast format.

Unfortunately, like the CD, DAT was developed as a consumer format. A station that tries to implement DAT into an air environment with the hardware available today (grey market or any "pro" model) is in for a major disappointment.

Technology Update

While the digital audio quality is excellent, interface and operational difficulties render the format almost useless as an on-air source.

Enter the RS Controller

Design engineer Mike Sirkis of Peak Audio began work with the Sony DTC-1000ES DAT machine a year ago. Mike literally took the unit apart and probed every aspect of its control and logic infrastructure (at the time, with only the help of a Japanese version of the service manual).

The successful result of Mike's efforts was a prototype of an add-on controller for the Sony unit, shown at this year's NAB convention.

A microprocessor-based production version of this controller with upgraded capabilities is being demonstrated at Radio '88 and will be available for shipment by the end of the year.

The controller has two main functions. First, it converts and interfaces all unit control and audio functions to broadcast standards.

Secondly, it modifies the way the DAT system operates to convert it to a functional on-air or production tool.

This is accomplished via a microprocessor installed internally in the unit which is extensively interconnected to sensor and control circuitry. Sophisticated microprocessor routines constantly scan unit functions to provide complete status information and force certain operations, alien to the unit's basic instruction package.

Perhaps the most basic broadcast need is the ability to remote start and otherwise control the DAT machine.

New routines for different DAT system formats can readily be implemented to easily integrate this machine in any system. User remote control commands and status information is via the microprocessor ports, which process and interface all of this information.

➤

Editor's note: For more information on the DAT controller, contact the author at Radio Systems: 215-356-4700.

Perhaps the most basic broadcast need is the ability to remote start and otherwise control the DAT machine.

Even "pro" units which feature "wired remote control" require that you use the manufacturer's remote control box, which is serially scanned and therefore does not allow a basic remote start closure from a console or user pushbutton.

The Radio Systems' modified Sony DAT provides standard, pull-to-ground contacts for all unit functions. These are available on rear user connectors.

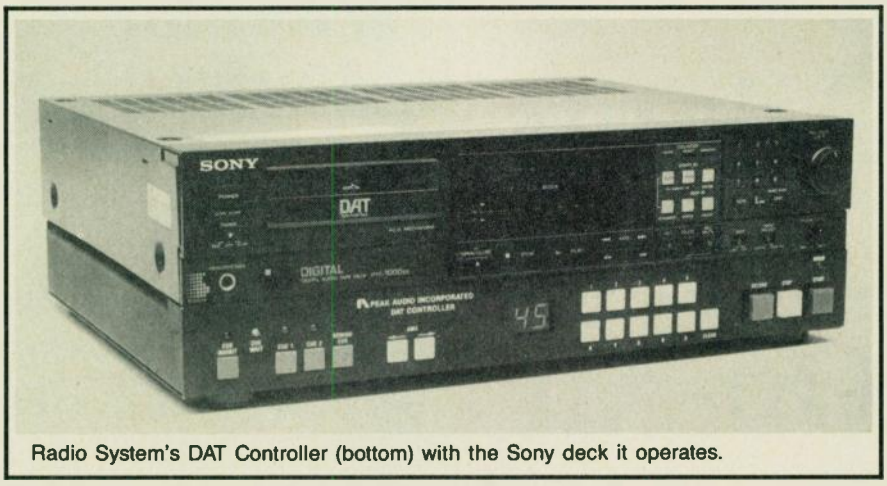
They can be connected to factory or user provided pushbuttons so that the broadcaster never has to fumble with the small, closely clustered buttons on the machine front panel.

Machine status indicators complete with lamp drivers are also provided. Contacts which allow the user to select a cut number as well as an external LED readout are present on the remote connector. The controller also provides balanced in and out audio connections.

A two-way serial port for computer data access to the microprocessor is also available. This is provided for direct automation system control of the machine as well as the interconnection of a soon-to-be-available system sequencer.

Enhanced functions

Your basic DAT machine (yes, even the "pro" models) functions very poorly in a broadcast environment. The operational aspects of the unit are where the Radio Systems controller does its real magic to convert the Sony DAT machine.



Radio System's DAT Controller (bottom) with the Sony deck it operates.

A DAT player "plays through" all the cuts on the tape. The Radio Systems' unit stops at the end of the cut, mutes the audio, cues up to the next cut and waits for a start command.

This minor magic is accomplished via an EOM tone, not available on other DAT machines, which is also provided on the remote connector for user machine sequencing functions. The Radio Systems DAT player will also cue up the next music cut and wait on tape insertion.

The Sony machine, as modified by the Radio Systems controller, also allows the user, or an external controller or automation system to load in future event data to which the unit responds.

During inter-cut travel, the modified unit mutes program audio and provides the left track for logging data.

Radio Systems has been authorized by Sony under special license to import the DAT player and modify the otherwise restricted machine for broadcast use. The warranty is domestically honored by Radio Systems.

The microprocessor based nature of the design and parallel and serial access ports allow a host of external control and interface options. Many of these are currently under design by Radio Systems.

As the format is accepted in the industry, Radio Systems intends to remain a DAT leader and innovator, with a slew of new products and format refinements due out shortly.

RS Series: Low Cost Quality

by Bob Turner, Broadcast Consultant

Bakersfield CA ... Recommending a console to a client, be it new or a replacement, can be an interesting dilemma. If the client is predisposed to make the purchase the budget allocation is generally not enough to support one of the high-powered, "name" brand consoles which run anywhere from $10,000 to $20,000.

So in the name of economy, you begin to look at the lower end consoles and find they either are "toys" in terms of construction or are remarkably similar to the 30-year-old relic which is destined to be replaced.

Radio Systems, among other heads-up manufacturers, has developed a new series of consoles known as the RS Series. The consoles come in 6-, 12- or 18-channel versions.

User Report

I first saw a full color ad for the product and subsequently saw the box at NAB. It met most of my expectations for what a good, well-priced console should be.

I am reluctant to be the laboratory rat for manufacturers, but in this instance I chose to make an exception, and recommended the console to my client. I have been pleased with the results to date.

The console has a clean, neat layout which is impressive to the eye (an element which many manufacturers overlook: if you're spending a lot of money on a product, it had better look like a lot of money).

Radio Systems has used the de facto standard of channel on/off and starts below the P&G fader, with the buss selectors and input selectors above the fader.

Internally the console is built around six-channel motherboards which handle the input switching, dbx VCA mixing and buss routing. The third major circuit card takes care of the mixing, outputs and monitoring functions.

The full-featured RS Series from Radio Systems.

The in and out connections are made at the rear of the console on the six-channel motherboards; inputs are very simple to move around and to prewire. The inputs are differentially balanced instrumentation amplifiers and the outputs are all active-balanced.

Each input is universal in nature and may be mic, line or unbalanced consumer level. With appropriate resistors on a DIP header the nature of the input may be quickly changed.

Logic functions may be assigned or not assigned via Berg jumpers and follow the input selector switches.

The facilities for remoting machines are quite simple and easy to interface to many of the newer tape and cart machines. Radio Systems does, however, supply optional interface boards which convert the logic level outputs to dry contacts for the older style machines.

The monitor section is very good in scope and layout. Monitors and headphones are independently selectable and, as a nice touch, the monitor inputs accept unbalanced sources. So if you're using a consumer receiver for an air monitor, the levels will come out right.

The console has program, audition and mono busses standard and full VU metering with peak indicators for all busses. As a bonus, a resettable timer is also included.

Radio Systems has a two year warranty on the product for parts and labor and will ship overnight to meet the warranty.

The true advantage of this console is the combination of the aesthetics of the package and the price. The 12-channel version is just under $6,000, or about $500 per channel. The RS-18 runs just under $8,000, or about $440 per channel. The six-channel version is about $4,000.

If you are in the market for a well-priced, full-featured console, the RS Series from Radio Systems deserves a thoughtful look.

Editor's note: Bob Turner is a consulting broadcast engineer with more than 20 years' experience. A former station owner, he is based in Bakersfield and serves clients throughout California. He can be reached at 805-835-8869.

For more information on the RS Series, contact Dan Braverman at Radio Systems: 215-356-4700.

Circle 35 On Reader Service Card

Reprinted from August 15, 1988

RPG Diffuses Sound

by Peter D'Antonio, Pres., RPG Diffusor Systems, Inc.

Largo MD ... The introduction of stereo TV, stereo AM radio, digital recording, compact discs, recent advances in 3D stereo image processing and emphasis on quality audio in general, has placed new importance on the acoustic design of recording and broadcast facilities.

The sound that we hear in a room is a combination of the direct sound emitted by a source and the indirect reflected sounds from the room boundaries, which arrive at discrete times related to their travel paths.

Technology Update

Because the magnitude, direction and arrival time of the indirect room reflections determine how we perceive the actual sound source, control of room reflections is a central consideration in acoustical design.

It is becoming increasingly important to be confident that what is heard in the studio is actually going on the air.

Room reflections can be manipulated by absorption and diffusion.

Regardless of how electronically sophisticated a broadcast production facility is, sound must eventually travel the acoustic paths from the speakers to our ears via direct sound and indirect reflections from surface boundaries.

Intense specular reflections from the room boundaries can cause false localization of the stereo images, corruption of spatial textures, frequency coloration, resonances, and confusing slap and flutter echoes.

An optimum listening environment can easily be created to minimize these problems through an appropriate combination of absorptive and diffusive surfaces.

Absorptive surfaces are in widespread use, but essential diffusive surfaces have not been commercially available.

Hence the acoustical design of broadcast facilities has relied heavily on absorption to control interfering reflections, with the accompanying side effect of creating a "dead" sounding space.

Typical broadcast facilities lack adequate sound diffusion because of their small size and the presence of excessive absorption.

In three years the RPG Diffusor System has been available it is quickly becoming an acoustical standard. The company has recently set up worldwide distribution.

In fact a defeatist attitude gave rise to the slogans "deader is better" and "no acoustics are better than bad acoustics."

But now with the discovery of broadbandwidth, wide-angle sound diffusors we no longer have to settle for an acoustically impoverished work space.

Design goals for a pleasant ambient monitoring environment in which we can accurately perceive stereo images, frequency balance, signal processing and signal quality are routinely being met.

RPG Diffusor Systems, Inc. has developed a new and unique approach to providing sound diffusion using a reflection phase-grating. ➤

Editor's note: For more information, contact the author at RPG Diffusor Systems, Inc.: 301-249-5647.

The RPG consists of a periodic grouping of an array of wells of equal width but different depths, separated by thin dividers. The depths are based on mathematical number-theory sequences.

The RPG behaves like an ideal sound diffusor in that the complex computer-designed surface scatters sound arriving from any direction uniformly in all directions over a broad range of frequencies— up to five musical octaves.

The sound scattered by the RPG is also attenuated, thereby minimizing frequency coloration and "comb filtering." Acoustical problems are eliminated without destroying the ambiance of the room.

In fact, the RPG psychoacoustically creates the "open" impression of a large room in a physically small space. Treated walls seem to "disappear."

Voiceover booths, usually relegated to the size of a closet, can be substantially improved.

Incorporating the system into a broadcast facility is very simple; application notes are available on request.

In most instances the RPG is simply wall mounted on the rear wall of a production, on-air or combo studio at ear level.

To enhance stereo imaging a new broad-bandwidth absorption panel called an ABFFUSOR™, because it both absorbs and diffuses sound, can be mounted on the front side walls and ceiling.

The RPG can also be conveniently mounted in standard suspended ceiling grid systems, so that existing and new facilities can easily be treated.

Figure 1. Absorptive treatment incicated by semicircles; diffusor cross section is indicated on wall at right. Solid lines indicate direct sound. S is source and M is microphone with figure "8" sensitivity.

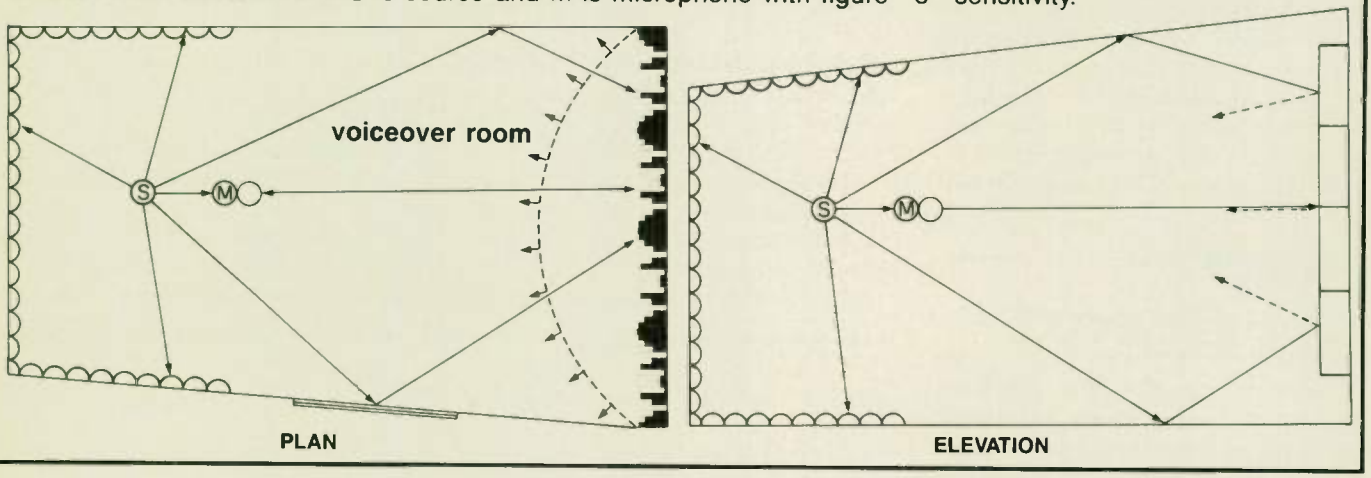


Figure 1 shows an effective design to create the impression of a large space in a physically small room such as a voice-over booth.

In the three years the RPG Diffusor System has been available it is quickly becoming an acoustical standard. The company has recently set up worldwide distribution. Numerous radio stations have already incorporated the RPG in production control rooms and in voice-over booths.

Reprinted from July 15, 1987

KOLA Tests Out Sound Tech

by Dennis J. Martin, CE, KOLA/KMET Radio

Los Angeles CA ... The Sound Technology Model 3000 is a programmable audio test system that is ideally suited for the broadcast environment. Packaged in a single case, or in two to allow split operation of the generator from the analyzer, the Model 3000 is highly portable.

User Report

Since each unit relies on its own internal microprocessor, there's no need to also transport a personal computer (and monitor) to make the system operate.

Internal memories store data for a period of seven to 10 years. In addition, great care in design and construction renders it insensitive to even strong RF fields.

The self-sufficient, modular concept of the Model 3000 is based on suggestions made by the European Broadcasting Union (EBU).

Automated or manual

The Model 3000 can be operated in a manual mode for troubleshooting, or fully automated without an external computer. If a user desires to save test results to a diskette, the Model 3000 offers RS-232 and IEEE-488 (GPIB) ports.

Both the generator and the analyzer are controlled by momentary pushbutton switches. LEDs tell the operator at a glance which test parameters are in use.

Perhaps most impressive, though, is the ability of the generator to control the analyzer even when separated by an STL. To avoid the cost and complexity of two modems and a phone line for test equipment communication, the generator sends commands over the audio channel being tested.

At the beginning and end of each test, the generator emits an FSK signal in the 1 to 2 kHz spectrum that configures the analyzer precisely as desired.

This results in error-free, repeatable tests that can be conducted by a single person, over a single line.

System generator

The generator is a digitally-controlled analog oscillator that uses internal crystals to ensure frequency accuracy to 0.03%. It provides two isolated outputs that are electronically balanced and floating with selectable source resistances of 50, 150 and 600 ohms.

The Model 3000 can be operated in a manual mode for troubleshooting, or fully automated without an external computer.

Whether operated balanced or unbalanced, the generator produces output levels from −90 to +30 dBm, adjustable in 0.05 dB increments.

Since more than 100 dB of attenuation is available after the output amplifier, it's possible to connect the generator directly to an amplifier's microphone input—no pad is necessary.

Extremely low-distortion sine waves (less than 0.0008% in the audio band) ➤

Editor's note: In addition to his responsibilities as CE for KOLA/KMET, Dennis Martin is also DE for House of Music in Costa Mesa, CA, a consulting engineer and a freelance writer.

For more information call Kent McGuire of Sound Technology at 408-378-6540. The author may be reached at 714-684-9992.

can be selected over the range of 1 Hz to greater than 100 kHz.

Square waves from 1 Hz to 50 kHz, in addition, are generated with less than 1 μs rise time. And to simplify tests of pre-emphasized equipment, selectable de-emphasis curves of 10, 25, 50 and 75 μs are available.

Two LED displays provide a continuous readout of level and frequency; in the program mode, these displays show automated test programming instructions. A single 20-button keypad is used to enter level, frequency and program commands.

Automated tests

The generator is capable of performing a number of fully-automated tests such as frequency response and distortion versus frequency or level.

Frequency sweeps can be made with 4 to 255 points per decade resolution—frequencies are calculated to maintain linear increments on a log scale.

Sweep speed is set by specifying a number from 1 (fastest) to 999 (slowest); "1" corresponds to a duration of 30 ms/frequency.

To investigate distortion versus level, the generator will automatically sweep up—or down—in level while the analyzer tracks and stores the results.

Up to 80 different front-panel setups can be stored in the generator's program memory and used in any of 16 "proof" tests. Since the memory allows tests to be "chained," an entire set can be repeated at the push of a button.

Options for the generator include SMPTE IM distortion (60 Hz and 7 kHz, 4:1), tone burst and sine/step.

The analyzer part of the Sound Technology system is a two-channel, alternate-reading device that offers true differential, electronically balanced inputs (100 kΩ, ±1%).

Two simultaneous real-time measurements can be viewed on individual LED displays or you can select test data in memory.

Analog meter

An autoranging analog meter is included for peak/null adjustments. To help in testing "unknown" signals, one of the LED displays becomes a 5-digit, 650 kHz frequency counter.

Level measurements can be displayed in volts, dBm (referenced to 600 or 150 ohms) and watts. Although the analyzer is a true RMS voltmeter, measurements can be made with average, RMS or quasi-peak detection characteristics.

The THD section has a residual distortion of less than 0.001% (10 Hz to 20 kHz) and a rather astonishing minimum level requirement of 30 mV. Readings can be displayed in either percent or dB.

Channel-to-channel phase differential can be measured and displayed in degrees or as a function of time. Whenever bandwidth-limited tests are needed, the unit offers an impressive selection of "stock" filters: 22, 200 and 400 Hz high pass, and 15, 22, 30 and 80 kHz low pass. "A" weighting and CCIR filters are also available.

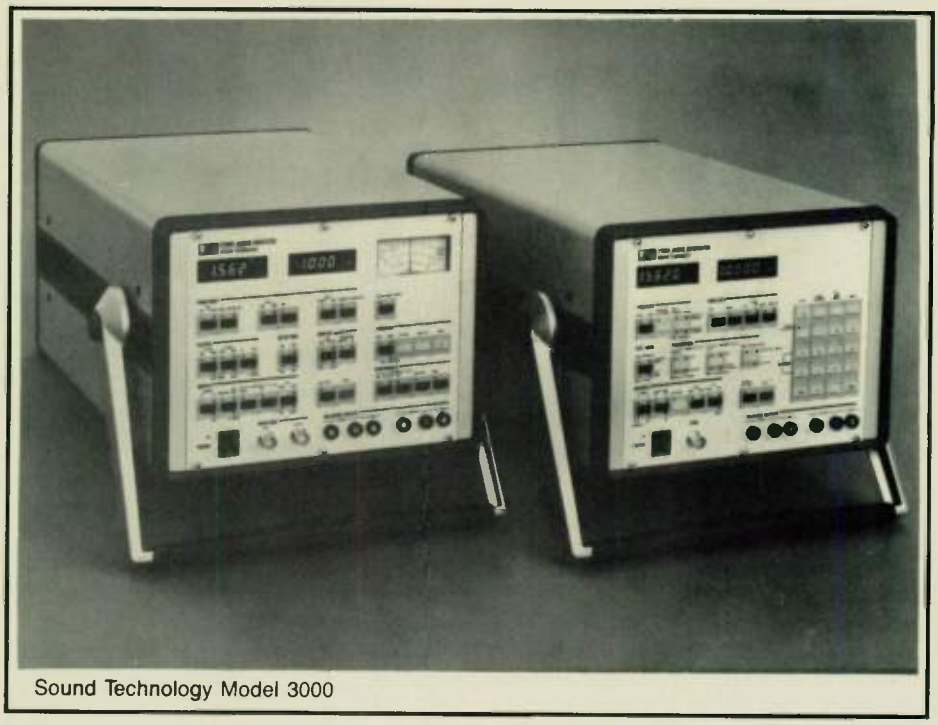
Storage capacity

What sets the Sound Technology unit apart from manual analyzers is its data storage capability: an internal memory stores more than 1200 lines of test data—up to 3600 measurements!

And it's simple to print test results—just connect a compatible printer to the analyzer's Centronics parallel port.

Front-panel "cursor" controls allow the user to "scroll" through the memory—"markers" are used to specify which part of memory you wish to print.

Since all data is automatically stored, it's impossible to make an error by not saving a test run. Besides the tabular printout, 22 different tests can be printed in graphic form *without* an external computer.



Sound Technology Model 3000

Two options are available for the analyzer: SMPTE IMD, to compliment the generator, and a feature called notch ock, which in the THD mode causes the filter to "lock" on frequency when the input signal falls below 100 mV.

Whether the generator and analyzer are used bench top, or split at remote sites, fully automated tests are fast, reliable and error-free.

The Sound Technology Model 3000 is truly a portable and comprehensive audio test system, offering performance capable of testing even 16-bit digital systems.

Circle 44 On Reader Service Card

Reprinted from January 15, 1988

KNIX Cues Up with Studer

by Mike Malo, CE, KNIX-FM

Phoenix AZ ... Nearly three years ago we decided to put CDs on the air at KNIX. In order to take full advantage of the CD format, carting them was out of the question.

We bought two Studer A725 CD players because we felt that the machines were the easiest to operate. Also, at that time the Studer was the only machine that used four times oversampling.

User Report

We quickly realized that the cue point, as dictated by the data information on the CD, was different for each selection. This was a problem. The jocks could no longer just insert a cart, push a button and expect immediate audio.

We developed a procedure to cue the selection using the frame advance keys. Only then were the segues tight and consistent.

Soon the "joywheel" idea was offered as a solution. You cue to the audio back and forth as you would a record. That still required an extra step for the DJ.

After that, another company introduced a machine that would cue to music. It worked well, but in our listening tests it did not sonically compare with the Studer.

Then we learned that Studer was redesigning its CD player. The company queried broadcasters throughout the industry to find out what features would be most desirable.

I asked the guys here at KNIX for their opinions. Virtually every DJ said the A727's were "great," "easy to use," and "(give me) no problems at all."

The overwhelming response was "make it cue to music!" Other desired features were a parallel remote control, single function keys and full time autostop.

By this time we were airing 50% of our music on CD, so we were very anxious to get our hands on the new machine.

Finally our local Studer dealer called and said he had the new A727. "Bring it over!" I said.

The A727 flawlessly cued the CD to the track selected—every time. The start time is so fast that the audio begins before the switch bottoms! We ordered four machines immediately.

The design engineers at Studer added some great new features to the A727. One is full time or defeatable autostop, which causes the machine to pause at the end of the selection.

Another is an exclusive start review/end review mode that allows the user to push a button and hear the start as long as the button is held, or another button to hear the last eight seconds of the track. The laser pick-up then returns to the cue point. The DJs love it.

Unlike the A725, the transport mechanism now stays within the machine, which eliminated the problem of ribbon cables flexing during the loading proc- ➤

Editor's note: Mike Malo began his broadcast career in San Francisco 10 years ago, and has built two California stations.

For more information about the A727 contact Charles Conte at Studer: 615-254-5651. The author may be reached at 602-966-6236.

ess and possibly becoming intermittent.

Also added to the A727 was a rear panel RS-422 interface; a clock input on BNC jacks for user-supplied varispeed plus a clock output so that machines can sync to each other; a 25-pin D-plug for parallel remote which includes tally for lamps; and balanced and unbalanced digital outputs on XLR and RCA jacks.

The audio output is available on balanced XLR connectors, fixed level. Also provided is unbalanced audio on RCA jacks, fixed level and variable level using front panel controls. Unbalanced mono is also available.

Remote control can be configured two ways. You can use ground switching for all play functions, or you can use European-style "fader start."

When you apply 5 to 24 VDC (any polarity) to the fader start terminals, the machine will start the selection and disable front panel play functions. You can't even turn the machine off while in this mode. This definitely eliminates on-air mistakes.

The self-illuminating display shows all modes of operation. You can monitor elapsed/remaining time of the track or disc.

Options available are transformerless output amplifiers (which you specify upon order with no extra charge) and a lighted remote control panel.

The circuit boards are rock-solid. All ICs are socketed. The manual contains all schematics and component layout pictures.

Should a machine ever fail, back-up support from Studer and its dealers is readily available. Sub-assemblies can be quickly swapped out so you can keep the machines in service where they belong.

In addition, customers can retrofit their equipment with any future software improvements Studer may make. This means that it is possible to keep older equipment in step with the latest technology.

When I was preparing for this article, I asked the guys here at KNIX for their opinions. Virtually every DJ said the A727s were "great," "easy to use," and "(give me) no problems at all."

I asked our production director what he liked most and least about the A727. He said, "everything and nothing." Our program director especially likes the "review" feature.

The machines have been in service at KNIX for six months in control and production studios. We now air 75% of our music through two A727 CD players, 24 hours a day. To date we haven't had a single problem.

KNIX CE Mike Malo loads the A727 Compact Disc Player, Studer's second generation machine incorporating features suggested by broadcast engineers.

Possibly the display could be a little brighter, and I'm sure some stations would like to have a vari-speed option, but we have had a hard time coming up with negatives about this machine.

The Studer A727 is a true broadcast professional.

Stepping Up to Studer Revox

by David Bowman, Dir, Professional Dealer Products Studer Revox

Nashville TN ... The Revox C270 Series of recorders offers a step up for the serious professional who needs a solid combination of excellent recording quality, fully professional features and overall value.

The Revox C270 family of recorders includes ¼" two-channel and four-channel machines, as well as a ½" eight-channel machine.

Defining "professional"

The fact that a machine is used in professional applications doesn't necessarily make it a professional machine. A truly professional machine has to perform up to professional standards, in all respects.

All of the C270 Series machines are based on the same mechanical system architecture. They are built on a die-cast, precision-machined deck plate that provides stability within the tape path and assures precise tape tracking and multichannel phase response.

Its basic mechanical stability is intended to ensure that the C270 delivers high performance over a long life with only routine maintenance.

Because stability and precision of the head assembly is critical to all tape recorders, the C270 head assemblies are separate die-cast plates and incorporate an integral scrape flutter filter for eliminating this noise component of the recording process.

Editor's note: For more information on the C270 Series, contact the author at Studer Revox: 615-254-5651.

In addition, ceramic edge guides ensure that the tape is positioned properly as it passes the heads, further improving phase response.

Microprocessor control

Advanced control features are a necessity for a professional machine intended for use in today's varied applications. The C270's microprocessor based control logic makes many special functions possible that aren't usually found in small machines.

Technology Update

In production environments, tape editing is a mainstay operation. The C270 offers manual tape cueing under full servo control.

This means that locating a specific point on tape is a one-hand operation that uses the control systems of the machine rather than "brute force" to move the tape.

Fully constant tape tension control across the record and playback heads, always used in large multitrack recorders, is part of the C270 Series as well.

Constant tape tension minimizes head wear, maximizes recording consistency throughout the length of the tape and assures accurate tape speed regardless of tape reel size.

If an operator has to set the reel size on the machine manually, there's always a chance that he or she will set it incorrectly, thus severely compromising the quality of the recording.

The ability to service a machine in the field quickly is a primary requirement for a truly professional recorder. The front panel of the C270 is dual hinged and opens to two positions.

One is for easy access to all critical alignment controls. The other is for servicing the machine's fully modular audio electronics that can be quickly replaced, if necessary, even if the machine is rack mounted.

Special applications

In addition to traditional recording applications, the four-channel C274 and the eight-channel C278 machines are also available in a low-speed configuration.

These machines are especially suited for logging applications where extended unattended recording is required. Up to 25 hours of information can be continuously recorded on a single reel of tape using the lowest tape speed of 15/32 ips.

Both the low speed C274 and the C278 also incorporate an internal logging time code generator and reader that makes it possible not only to record the information, but also to record the time and date of the recording simultaneously.

All C270 Series machines incorporate RS-232 serial communication. Controlling any of the machine's functions remotely, either automatically or in a computer-assisted environment, is simply a matter of connecting the machine to a computer.

Broadcasters thinking about upgrading their facilities should take a look at the Revox C270 Series.

Reprinted from September 15, 1988

WKSZ Takes Requests with Telos

by Douglas W. Fearn, CE, WKSZ-FM

Media PA ... For years our air studio had little need for a telephone interface—until, that is, an all-request oldies show was added to our weekend schedule. During this program virtually all of the audio was done live while the disc jockey was on the telephone with a caller.

At first we used a standard telephone interface unit, but it soon became apparent that something better was needed. The amount of DJ audio appearing in the telephone output was intolerably high and the adjustment of the hybrid null was a compromise, especially with the 800 lines we used for the show.

To minimize the leakage in the hybrid, the level sent to the caller had to be kept quite low, which hindered communication because some callers could not hear the DJ clearly. Some calls were good, but others were unusable.

After a little research, I concluded that stations using Telos' digital hybrids were all pleased with the results. We arranged to have a Telos 100 delivered to us for evaluation.

Telos makes two digital hybrids: the Model 10, designed for multiline use, particularly with key sets; and the Model 100, for applications that had either a single line or an electronic phone system providing a single line output.

We chose the Model 100 for use with our AT&T Merlin telephone system. The 100 also had somewhat better specs than the older Model 10.

True digital audio

Many electronic devices boast of being "digital" these days, even home appliances. But the Telos 100 Digital Hybrid is truly a digital device.

The caller audio is converted to digital and processed as a digital signal before being converted back to analog. Automatic gain control, noise gating, equalization and the hybrid functions are all done in the digital domain. The audio is sampled at a 16 kHz rate, with a full 16 bits of resolution.

And, as in most better digital audio devices, 2× oversampling is used in the D-to-A conversion to make the filtering side effects less obvious.

As each call is picked up, a 400 msec burst of white noise is sent down the phone line. The burst is used by the Telos circuitry to analyze the impedance of the phone line in use and to null the hybrid for that line.

User Report

During this time, the audio output to the studio equipment is muted, which will also mute any pops or clicks generated by phone system switching.

This burst of noise is not very obvious to the caller, and when I listened to it I didn't find it at all distracting or annoying. In addition, the unit analyzes the line during the conversation and continues to fine-tune the hybrid.

The results are amazing. With a decent telephone, a caller can sound nearly "studio-mic" in quality, while the announcer's microphone feed to the caller is quite loud and easy for them to hear. The amount of DJ feedthrough in the caller's audio is also very low—over 40 dB down, according to the Telos specs.

Installation was fairly simple. The basic connections are easy: XLR connectors are provided for the send and caller audio. Two caller audio outputs are provided, each with a level control.

The telephone line connects to a standard modular jack (with another jack for a telephone instrument loop-through, if desired). We use one output to feed a reel-to-reel machine; the other goes to a console input.

Remote switching

Remote on/off switching was more complicated, however. The Telos requires a momentary closure at the beginning of each call to tell the unit to readapt. In our situation, all phone calls are taped, so a console on/off button isn't necessary.

I have tried to find a reliable pulse in the Merlin telephone (or in the AT&T General Purpose Adapter we use to extract an output of the phone line selected), but have had no luck so far.

So for the time being, a small pushbutton in a box next to the telephone must be pressed at the beginning of each call, an inconvenience that I hope to remedy soon.

But even when a call is picked up without the noise pulse being sent, the Telos adapts to the new line adequately within a few words.

Since only a portion of most of the calls are actually aired, this works out pretty well. In counterpoint, however, when no line is selected, the Telos "hunts" for an adjustment and is way off by the time a line is finally present.

Setup adjustments are few and simple. A coarse null, the desired amount of caller expansion (which reduces the caller level when he or she is not talking) and the degree of override (caller ducking) are all set.

These last two adjustments are made with front panel knobs and are so easy to understand and use that we have encouraged the operators to experiment with the settings.

Three LED meters on the front panel indicate the audio input level, the amount of gain reduction on input or output and the audio output levels (switchable between the two outputs).

Clear instructions

The Telos manual is excellent. In these days, when "unscrew when remove cover" is typical of the language used even in manuals for professional equipment, it is refreshing to find a book that is not only written in standard English but is also entertaining and highly informative.

A very comprehensive section on telephone systems theory is included in the manual, which is the first such explanation that I have ever read that actually made sense.

The Telos 100 has vastly improved the sound of our all-request oldies show—not only on the air but also in the callers' minds, since they can now hear the DJ on the phone much better.

Editor's note: Doug Fearn is a frequent contributor to **RW**. *He may be reached at 215-565-8900.*

For more information on the Telos 100, contact Steve Church at Telos: 216-241-7225.

Circle 28 on Reader Service Card

Reprinted from October 15, 1988

by Sidney J. Levet, Pres & CE WCKW-FM

WCKW Combines with Tennaplex

Laplace LA ... WCKW and KHOM are Class C FM stations operating in southeast Louisiana. One is licensed to Laplace and the other to Houma.

Both stations wanted to retain their full Class C rating, which meant an antenna height center of greater than 300 m or 984'.

Retaining full Class C status is important; along the Gulf of Mexico, FM stations suffer from weather-related "skip," which means that a station hundreds of miles away can clobber your 70 dBu signal.

The FCC noted this problem in the TV rules and has increased the separations between all classes of TV stations. However, there are no such increased separations for FM stations.

User Report

The result (especially in the spring and fall) is that FM station coverage is severely limited when this "tropo" or "skip" is present. The interference can last for hours—even days—just when the fall and spring ratings book is being compiled.

It soon became apparent that separate sites were hard to find, with the FAA voicing the most objection (it appears that sectional aeronautical charts do not show every airway). So a combined site of sufficient height was the answer.

With the cooperation of Clair Billington of the FAA's Fort Worth, TX office, an approved site for the erection of a 2000' tower was found.

With such a facility both WCKW and KHOM would place a city grade signal over the most populated sections of Louisiana.

The selection of the proper antenna was begun. With the assistance of Bob duTreil, of duTreil-Rackley, several design requirements were defined.

The first was that a city grade (70 dBu) signal be placed over Laplace, Houma, New Orleans, Baton Rouge and Hammond. Second, the resultant pattern had to be really omni-directional.

Another requirement was that the antenna had to emit a truly circular polarized signal and be able to withstand the rare ice storms, hurricane winds and industrial pollution. Finally, it had to be reasonably priced.

Side-mounted antennas for each station were quickly eliminated from considera- ➤

Editor's note: Sidney J. Levet III is a 1961 graduate of the University of Southwestern Louisiana with a B.S. in electrical engineering and is a member of the AFCCE. In 1979, he purchased the firm of L.J.N. duTreil.

For more information on the Tennaplex/Kathrein antenna, contact Marvin Crouch at 613-226-5870. The author may be reached at 504-524-9292.

tion. The interaction between the tower and each antenna and between the antennas themselves made precise pattern projection and, more importantly, final actual radiation almost impossible to determine.

The antenna selected was a Tennaplex/Kathrein 12 bay, 36 element panel antenna. Many studies have proven that after the first four miles there is no difference in signal strength between a low gain and a high gain antenna. Also, using a high gain (12 bay) antenna, direct operating costs are greatly reduced.

Compared to a low gain antenna, the Kathrein Starpoint combiner is smaller, costs less and requires no forced air cooling. It is about as large as the boss's desk.

George Klauser, an engineer at Kathrein, designed the cross dipole, twisted sister panel. The twisted sister design has bays 2, 4, 6, 8, 10 and 12 rotated 90° with respect to bays 1, 3, 5, 7, 9 and 11.

This 90° bay phasing allows for automatic VSWR compensation. Ice on the antenna causes no problems, so antenna heaters or radomes are not required.

The antenna has 12 bays, with each bay composed of three panels. Each panel is face-mounted on a 6' wide triangular tower. This tower, 125' in length, is mounted atop an 1875' Stainless G-10.

Each station has a Broadcast Electronics model FM-30 transmitter. Using unflanged 3 1/8" line, each transmitter is connected to a coax switch, and then to its separate input port on the combiner.

The output port of the combiner is connected to 2000' of 4 1/16" rigid SWR Inc. K-Line. At the main power splitter the line goes into an expander that is 4 1/16" in and 6 1/8" out.

Compared to a low gain antenna, the Kathrein Starpoint combiner is smaller, costs less and requires no forced air cooling. It is about as large as the boss's desk.

The main power splitter is composed of 6 1/8" line, which splits into two 3 1/8" lines.

Each 3 1/8" line feeds a splitter that has six output ports.

These 12 ports are connected to the individual bay splitters by 1 1/8" Flexwell line. Each bay splitter has six output ports that feed the two crossed dipoles on each panel with 3/8" Flexwell line.

From the output of the combiner to the input of the crossed dipoles all lines are pressurized. For the total system (combiner, transmission line and antenna) each station has a bandwidth in excess of 1 MHz with a return loss greater than −35 dB.

Once every 10 to 15 years, south Louisiana has snow and ice. On 5 February 1988 the snow and ice came. Since this kind of weather occurs so infrequently, very few stations have antenna heaters. Ice does cause them problems.

Most stations had to drop power, and one apparently had a VSWR trip and was off the air.

WCKW and KHOM operated at 100% power throughout the storm. Looking at the antenna the next day from the ground up, it appeared to be a big Christmas tree flocked with ice. The twisted sister design passed its test with flying colors.

From the reports of listeners, the coverage is great. One even sent in a poem to that effect.

Robert Mury and his crew from SG Communications, Inc. did the installation of the tower and antenna. They hung 2000' of 4 1/16 hard line in 10 hours. Robert Paradise of Tennaplex assisted in the installation.

The antenna has been in operation for about three months. We've experienced no problems.

Reprinted from May 15, 1988

MLW-1 Provides Full Switching

by Rob Meuser, Pres, International Broadcast Support Services

User Report

Hamilton Ontario ... Most day-to-day broadcasting functions are taken care of by devices designed to fill each specific need. One of the few, but very critical functions that has been left to the imagination of the broadcaster is the mundane task of switching in a standby program circuit.

Line switching is one of those unglamorous things you take for granted until you lose your program feed and wish you had an automatic back up.

The MLW-1 is probably one of the most complete back-up switching devices ever marketed.

The usual approach to back-up switching is a silence sensor coupled to some kind of line changing switch or relay. Titus Technological Labs has gone beyond this point to produce a very simple to use, but complete switching system.

The MLW-1 consists of three possible stereo inputs switched, via VCA, to the main output. This switching is done under microprocessor control according to user-set preferences.

Some of the options available include: line two on if line one fails; line one or two switched to mono if one channel is lost; phase reversal of a line if the incoming signal is out of phase; external alarms; manual operation and forced switching via external command.

One of the most important features of the MLW-1 is the built-in bypass function. If the MLW-1 fails, it bypasses line one to the output.

Another important—and unique—feature is the MLW-1's ability to discern the difference between dead air and a failed line.

Microprocessor controlled

The MLW-1 is able to perform its many magic tricks because of its highly logical and straightforward design. Specifically, the MLW-1 functions via a bank of solid state switches under microprocessor control. This means that all routing and sensing is based on the programming of the micro.

One set of VCAs are fed the two signals to be switched, phase flipped, or mono-ed, as the case may be.

The MLW-1's remarkable ability to tell the difference between a bad line and dead air, for instance, is a quite simple function in the mind of the resident micro.

If a line fails, the MLW-1 looks at line two to see if it, too, is dead. If so, then the MLW-1 assumes the problem is either dead air or some other problem which cannot be solved by changing lines.

This feature is very important when the back-up line is not of the same characteristics as the main line. In such cases dead air at the studio causes a line switch and possible alarm, followed by a re-switch (hopefully) when the announcer wakes up or finishes talking on the phone.

It also allows a real failure to switch much faster as operator error need not be considered.

Virtually anything the MLW-1 does or can do is strictly user selectable via DIP switches. Timing and thresholds are set via other DIP switches. The input sensitivity other than for unity gain is set by yet other switches.

Aids in testing

The MLW-1 can also function as a test aid. Many internal features of the MLW-1 are available from the front panel.

Mono only, L–R only, or mono from one channel are available for those who like to dynamically balance either audio processing or stereo generation equipment.

Additionally, any of the three input sources can be selected from the front panel.

My experience with the design and construction of various solid state switching devices makes me tend to be fairly critical of the techniques used in such devices.

The MLW-1 design and construction is strictly first class and sensible. No special circuits requiring odd parts are used.

As I said at the beginning, one normally never thinks about such equipment until after disaster strikes. I had the pleasure of placing one of these units into operation before disaster struck.

The unit got a real workout: a device that fed both program lines dropped one channel due to chip failure. The MLW-1 first switched to line two and then made line two feed mono off the remaining channel.

This went on for quite awhile before anyone actually noticed that there even was a problem. I guess it was a good thing that we had tied the external alarms to a remote status panel.

I now recommend the MLW-1 to stations around the world.

Editor's note: Rob Meuser is a frequent contributor to **RW.**

For more information on the MLW-1, contact Larry Titus at Titus Technological Labs: 203-633-5472. The author may be reached at 416-692-3330, or via MCI Mail: #3253672.

Circle 9 On Reader Service Card

Reprinted from June 15, 1988

Valley Digital Processor A First

by Rick McCollister, Director, Digital Audio Development, Valley International

Nashville TN ... Valley International has just introduced the first digital audio processing system aimed at the broadcast market.

The Digital Dynamics Processor, or DDP, provides multiband dynamic processing of stereo audio. The result is increased loudness and better spectral uniformity with fewer processing "artifacts" than are present in current analog processors.

Technology Update

Signal processing in the DDP occurs entirely in the digital domain. A network of DSP chips allows the system to operate at a processing speed of 300 million instructions per second—supercomputer performance dedicated to audio.

Valley's top of the line

Valley's top of the line unit, the DDP-8, splits the audio signal into eight frequency bands. Finite Impulse Response filtering in the unit allows linear phase response which would be unattainable with analog techniques.

This, combined with precisely overlapping magnitude responses, results in a recombined signal identical with the input.

Each band's dynamic structure is analyzed, then processed using proprietary algorithms. Here again, digital processing allows compression and expansion characteristics to be achieved that would be difficult or impossible in the analog world.

Arbitrary gain transfer curves can be programmed, so the dynamic processing can be matched to the type of program material being processed.

Valley introduced the DDP at this year's NAB show.

One area where the DDP can improve a station's sound is in the car. Ambient noise levels in a car can be fairly high, obscuring quiet musical passages such as ballads or classical material.

The DDP can provide as much as a 15 dB increase in low level material, while preserving the sense of dynamics; soft passages still "feel" soft, but are much more easily heard over background noise.

Compact discs present another area where the DDP can help. CDs are capable of storing and reproducing a wider dynamic range than vinyl discs.

Often, record producers and mastering engineers must use broadband or high frequency limiters in order to "fit" their program onto a disc. However, CDs do not usually receive as much processing, because it isn't required.

At the radio station, the much greater peak content can result in the CD sounding softer. The DDP's multiband digital processing results in more uniform loudness and peak content from different program sources.

An important design goal was to make the system easy to operate. A liquid crystal display and simple keypad allow the DDP to be quickly set up using a menu-driven approach.

A group of factory presets are provided for a quick start, and further presets may be programmed with the user's preferred settings.

Internal testing

Comprehensive metering is provided with the DDP for band and output processing and status indicators warn of any malfunction.

Reliability is further enhanced through the use of continuous internal self-testing. If any band processor should fail, the DDP will instantly reconfigure itself to bypass the problem and keep the system on the air.

Modules may be plugged in while the ➤

Editor's note: For more information on the DDP and the Multi-Format Interface, contact Norman Baker at Valley: 615-383-4737, or your local Allied Broadcast Equipment representative.

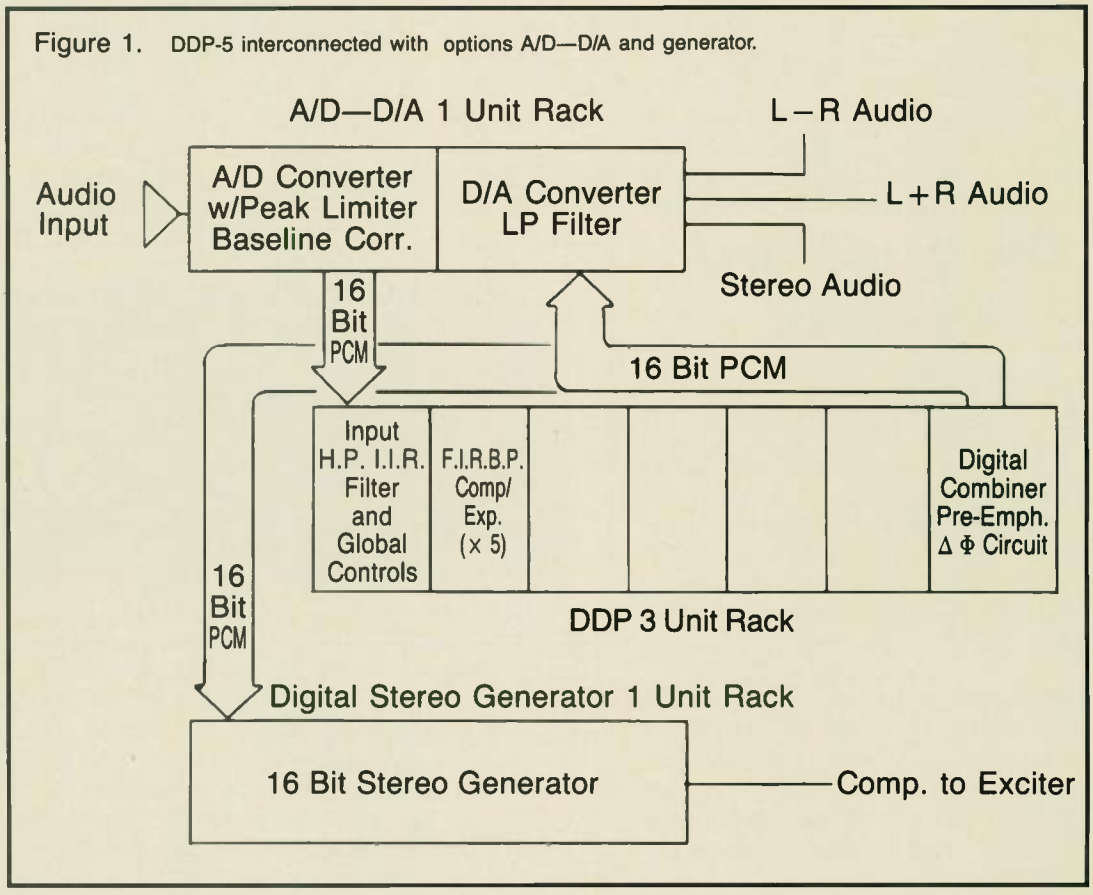
system is operating, and a diagnostic port for the processor is available if needed.

The DDP's digital inputs and outputs accept 16-bit 44.1 kHz or 48 kHz data. For interfacing to analog signals and various digital formats, Valley is introducing a companion unit, the Multi-Format Interface.

Analog-to-digital and digital-to-analog conversion is included, along with the interfaces for two industry standard digital formats: SDIF-2 and AES/EBU. The DDP can also be connected directly to a digital program source and/or digital stereo generator.

The eight-band Digital Dynamics Processor sells for $18,000. A five-band model of the processor is also available for $13,000.

Figure 1. DDP-5 interconnected with options A/D—D/A and generator.



WRTI-FM Produces With SP-6

by Mark Humphrey, Asst GM/CE, WRTI-FM

Philadelphia PA ... We had some unusual requirements when we selected new equipment for the main production room at Temple University's public radio station, Jazz 90/WRTI.

Because our plans included production of live music from an adjacent performance studio we needed a multitrack console with plenty of mic inputs and "recording studio" features, such as equalizers on each input module, effect sends and returns and a solo buss.

User Report

However, our new board would also be used for typical radio production using cart machines, turntables, CD players, R-DAT and Beta PCM digital tape, and analog two-track recorders.

We wanted the console to include muting logic and machine control features like our on-air boards. And it had to be durable and fairly simple to understand to facilitate training the students who perform duties at our station.

WRTI has been using three Wheatstone A-500a on-air boards for nearly two years and I have been impressed with their audio quality, durability and reliability. Based on this experience we chose Wheatstone's SP-6 multitrack console for our new production studio.

Similar features

The SP-6 shares many features and circuit design with the company's other broadcast consoles. Mic inputs are transformer balanced; all other inputs and outputs are active balanced.

The signal path is simple with audio passing through conductive-plastic faders and switched by miniature long-life relays.

WRTI's Mark Humphrey with the Wheatstone SP-6.

The modules are finished with reverse silk-screened Lexan film. The mainframe uses ribbon cable rather than a motherboard for its audio, logic and power busses.

Wheatstone offers numerous module options on the SP-6 series. Our console has 12 mono mic/line input modules which include a gain trimmer, 20 dB pad, polarity reversal switch, 125 Hz high pass filter, three-band semi-parametric equalizer and switchable phantom power.

The remaining 12 input modules on our board accept dual stereo line inputs. Each includes a mode selector, three-band equalizer and balance control.

Each input module can be assigned to any combination of the eight group busses, master stereo buss, four effect send busses or stereo solo/cue buss.

Like most on-air boards the SP-6 input modules have on/off pushbuttons which control audio, muting and timer logic and can start and stop external playback equipment.

There are four multitrack group modules on the console; each controls one send buss, one effect return input, two group outputs and two multitrack tape inputs.

Track assignment

These modules are capable of assigning each tape track to send busses one and two to create a headphone mix for studio musicians and can also mix the eight tracks down to stereo or mono without tying up input modules.

The monitor module controls studio and control room monitors, headphone ➤

Editor's note: SBE-certified Mark Humphrey began his broadcasting career in high school, where he started an FM station. He may be reached at 215-787-8405.

For more information on the SP-6, contact Gary Snow at Wheatstone: 315-455-7740.

and solo levels, and talkback. A four-frequency oscillator and timer are also included.

We purchased a 24-input mainframe, however the SP-6 is offered in standard versions up to 32 inputs. The design permits modules to be arranged in almost any configuration. The people at Wheatstone are able to provide custom modifications at reasonable cost.

Looking at the specs

Audio performance of the SP-6 exceeds most of the specifications of our test set, so it was not possible to obtain valid distortion measurements.

However, Wheatstone claims better than .005% THD at 1 kHz, and .003% IMD on mic and line inputs. We measured SNR of nearly 90 dB on line inputs and 76 dB on mic inputs at normal operating levels (+4 dBu on line inputs/outputs, −5 dBm on mic inputs).

With all 24 input modules assigned to the master buss the residual noise was down 74 dB from normal output level.

Our frequency response tests indicated that both the mic and line inputs are within 0.1 dB from 20 Hz to 20 kHz. The line inputs are down 1 dB at 64 kHz, and mic inputs are down 3 dB at 36 kHz.

Console installation was straightforward. The power supply is in a separate package which takes up two units of rack space. All audio connections to the input modules are through XLR connectors, except for the insert points on the mic modules, which use ¼" connectors.

The remaining audio connections are through 25-pin DB connectors and nine-pin DB connectors are used for logic. Wheatstone provides mating insulation-displacement DB connectors which accept Belden 8451 or West Penn 291 cable but may not work with larger conductor sizes.

Survived the ride

Unfortunately our console was damaged in shipment when a heavy object smashed through the top of the shipping crate and pushed down on several modules, causing the mainframe pan to bend in the middle.

However, due to the flexibility of the ribbon cable buss, the console still worked despite the physical damage. Of course Wheatstone made all of the repair arrangements and we had the console back to us in perfect condition within a month.

In general we are very pleased with the features and performance of the SP-6. Many of our students have been able to use the new board without special training because of its similarity to our on-air boards.

An improvement would be a separate cue buss for line inputs; the present design uses the solo buss for cueing. We needed to provide an outboard cue amplifier and speaker to avoid interrupting the monitor output when cueing records.

The Wheatstone SP-6 is worth considering if you require a sophisticated production console that can handle unusual tasks. We are confident that it will still provide excellent service at WRTI many years from now.

BUYERS GUIDE CALENDAR

Every month ***RW's*** Buyers Guide section focuses on one area of broadcast radio equipment. Published as part of the second issue of each month, the Buyers Guide contains User Reports, articles from manufacturers and new product briefs.

If you have an article idea, call ***RW***'s Buyers Guide editor, Richard Farrell, at 703-998-7600.

JANUARY Test & Monitoring Equipment	**JULY** Studio Audio Equipment
FEBRUARY Digital Workstation & Automation Equipment	**AUGUST** Consoles
MARCH Monitors, Microphones, Turntables & Preamps	**SEPTEMBER** Reel-to-Reel Recorders & DAT
APRIL AM Transmitters & Exciters	**OCTOBER** STL, Remote & Telco Equipment
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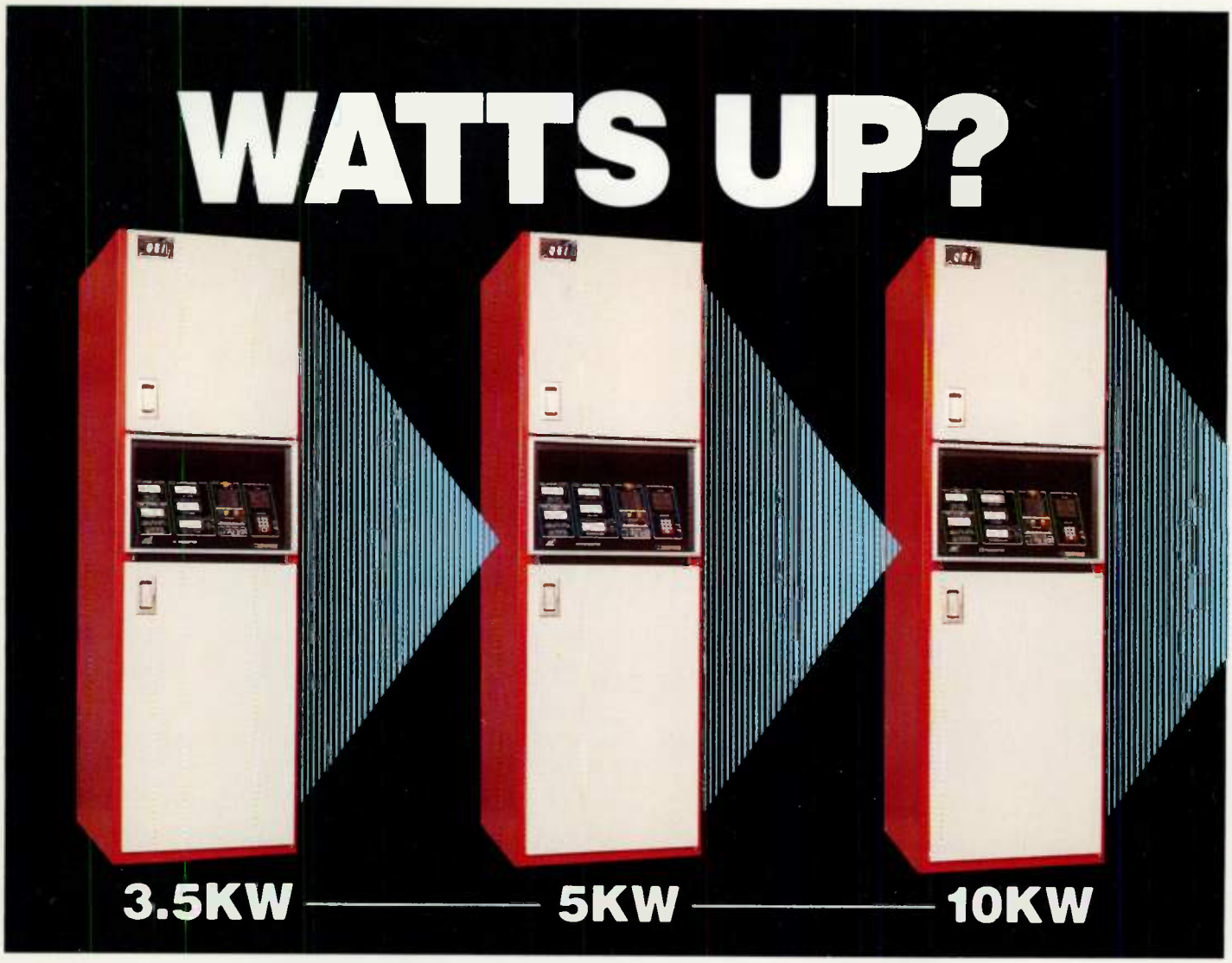

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