

Published
twice
a month

Radio World

Broadcast
Equipment
Exchange
See pages 29-34

Vol 10 No 21

November 1, 1986

\$2.00 Per Copy

CAB Advises Government Pick C-QUAM

Ottawa, Ontario ... The Canadian Association of Broadcasters (CAB) has officially endorsed the Motorola C-QUAM AM stereo standard.

On 3 October, the CAB issued a recommendation and resolution to the Canadian government's Department of Communications (DOC) to choose the C-QUAM system as the nation's AM stereo standard.

If the DOC accepts the CAB recommendation, Canada would join Australia and Brazil as nations that have formally endorsed the C-QUAM system. The DOC's comment period on AM stereo extends through the end of 1986.

CAB Senior VP/Radio Pierre Nadeau told *Radio World* that the DOC could formally endorse the C-QUAM system early next year, after the comment period expires.

"They haven't said they will definitely set a standard, but chances are they will. We (the CAB) want them to make a decision as soon as possible," he said.

The DOC, which develops and defines technical standards for Canadian broadcasters, said it wants to resolve the AM stereo standard question by April 1987.

It had originally planned to decide on an AM stereo standard by April 1986; however, the CAB, claiming that broadcasters had not come to an agreement, asked for a one-year extension.

CAB Technical Consultant Wayne Stacey stressed that the CAB's recommendation was not based on technical grounds.

"We simply decided that a marketplace decision has been made. We realize that both systems have their advantages and disadvantages," he explained.

He said that about 50 Canadian AM stations have gone stereo, with about 80% of those using C-QUAM. The figures fluctuate because an experimental period has been established allowing stations to test both the C-QUAM and the Kahn/Hazeltine systems, Stacey, said.

The CAB has also issued a recommendation to the DOC that would require many AM receivers sold in Canada by 1990 to offer stereo reception.

For more details, including reaction to the decision, see the 15 November edition of *Radio World*.

Texar File Awaits Action

by David Hughes

Washington DC ... The AM stereo "ball" is in the broadcasters' court, according to Texar Inc. President Glen Clark, who filed a petition for rulemaking on 26 September asking the FCC to select an AM stereo standard.

Clark told *Radio World* that when he presented his petition in person to FCC officials they told him that the amount of attention they give it will be in relation to the amount of interest they receive from the public.

While he met with representatives of the Washington, DC broadcasting community regarding the 75-page petition, Clark said it was too early to comment on the overall reaction. He characterized his meeting with FCC officials as "courteous" and "polite."

The petition from Texar, a Pittsburgh area audio processing equipment manufacturer, does not specify which system—Motorola's C-QUAM system or the Kahn-Hazeltine ISB system—should be selected. Clark maintained that if one of the two systems is not picked as a standard soon, manufacturers could lose interest in making AM stereo receivers.

The FCC has consistently refused to set a standard, claiming that the "marketplace" should decide. The number of AM stereo systems on the market has been narrowed down to two. However, only

about 10% of US AM stations have switched to either of the two stereo systems.

The FCC could also be swayed further toward changing its "marketplace" approach to AM stereo, Clark said, if the National Telecommunications and Information Administration (NTIA), the arm of the Commerce Department that forms telecommunications policy for the Executive Branch, also recommends a similar course of action.

NTIA Assistant Secretary for Communication and Information Alfred Sikes announced in late September that his organization had started its three-month study of the AM stereo situation in the US and around the world. The study is due to be completed in December.

Sikes would not say if the NTIA will come out in favor of a single AM stereo standard; he did maintain that it was probably too late for an FCC mandate.

FCC, NAB comment

Bill Hassinger, engineering assistant to FCC Mass Media Bureau Chief Jim McKinney, said the Texar petition is "under consideration." The document touches on some very complex issues, he added.

"We just don't want to send out false signals that could affect the market," Hassinger said. He indicated that the Commission would probably wait until the NTIA report is released before tak-

ing any action.

Hassinger said that, while the FCC is not under any specific time frame to act on the Texar petition, it is required to make some sort of a decision on it.

He said the Commission could pursue one of three courses of action: "turn it down flat," open an official comment period or directly issue a rule-making plan.

Tom Keller, NAB's VP/Science and Technology, said his organization is still studying the petition and has not decided what position to take with regard to it.

While the broadcasters' organization has firmly gone on the record in support of AM stereo in general, it has taken no position on a standard.

"We are not 100% sure what should be done," Keller said. He did say that a formal reopening of the issue by the FCC "could slow things down."

In such a situation, which could take a substantial amount of time, receiver manufacturers may decide to wait and see which standard is recommended, he said. "In the receiver manufacturers' minds, the FCC could go to any system. Another long, protracted (FCC) involvement may hurt AM stereo."

"AM already ill"

However, Clark countered that AM stereo is already seriously ill. Faced with doubts about which system will eventually become a "de facto" standard, broadcasters are delaying a move to stereo, he said.

"You can't slow something down that isn't progressing at all. It's taken 4½ years to get to the 10% level, and things

(continued on page 7)

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Regulatory News

Fowler Proposes Auction Plan

by Alex Zavistovich

Washington DC ... FCC Chairman Mark Fowler has supported the auctioning of common carrier and private radio licenses as a means of generating revenue for the US Treasury and expediting and simplifying the licensing process.

Only vacant channels would be eligible for auction assignment, and auction authority would not be used in the mass media, amateur or public safety services, Fowler said in a 1 October speech to Congress.

Fowler maintained that the auction proposal, which has generated mixed comments from the broadcasting community, would be an alternative to other suggested methods of granting licenses, such as lotteries or hearings.

Auction revenues for mobile assignments, excluding cellular licenses, could be as high as \$2 billion, Fowler main-

tained. Auctions would benefit the public by "significantly" reducing the amount of resources involved in preparing and processing applications, he said.

Although citing an "overwhelming" case for enacting the proposal, Fowler stressed that the FCC's authority over such auctions would be limited.

The authority would not change the FCC's responsibility to allocate spectrum under the public interest standard, he added, and licensees would have no greater or fewer rights and obligations as they would have if they had won assignment by lottery or hearing.

Fowler responded to claims from members of Congress that auctions might lead to the short-term, high-risk investment of FCC licenses and might favor those with "deep pockets"—financially capable but not the most appropriate owners.

He labeled as "misplaced" the concerns

that auctioning might lead to concentration of ownership of FCC licenses.

Licensees already have some freedom to resell their authorizations, Fowler pointed out. Therefore, "neither comparative hearings nor lotteries will greatly change the ultimate disposition of licenses if there is the opportunity for resale."

Fowler said he favored sealed bids for the auctions, along with single bids for multiple channels.

The broadcasting community had mixed opinions about the auctioning plan. Tim Hatfield, of the Seattle-based engineering firm Hatfield and Dawson, said, "It looks like the FCC is selling everything to the highest bidder."

Hatfield maintained that the auctioning proposal is another example of "putting the whole allocation system up for grabs."

Ronald Rackley, a partner in the Washington DC-based engineering firm duTreil-Rackley, said the auctioning proposal made it seem that the FCC was "trying to get out of its responsibility to serve the public."

Robert Hoover, a Potomac, MD-based consulting engineer and former licensee of two radio stations, said broadcasting would be "sadly hurt" if the auctioning proposal were carried through to the commercial spectrum.

Frequencies, Hoover said, had previously been "parceled out to the best corporation, not to the highest bidder." He was skeptical of the affect the proposal would have on the quality of broadcasting in the future.

For additional information, contact the FCC at 202-254-7674.

FCC Clips

Linear Amplifier Case

According to the FCC, the US Court of Appeals for the Fourth Circuit (based in Richmond, VA) in August reversed an order of the US District Court for the Western District of North Carolina that would have allowed the export sale of approximately 340 linear amplifiers seized by the government in a criminal case.

In August 1985, a Shelby, NC, man, in a plea bargain arrangement, pleaded guilty to charges of unlawfully manufacturing, selling and shipping illegal linear amplifiers, which are used to increase the power of CB radios beyond the legal limits. The man received a one-year suspended sentence, two years probation and a \$10,000 fine, the FCC said.

He then requested permission to sell the equipment to a buyer in the British West Indies, the Commission added. The district court ordered the sale as long as proceeds were applied against storage fees and the defendant's fine. However, the government appealed the court's decision.

In overturning the lower court's decision, the Fourth Circuit Court said that since the linear amplifiers had not been manufactured exclusively for export, they must be forfeited to the US government.

For more information, contact the FCC's Norfolk field office at 804-441-6472.

FCC Appointments

John Kamp has been appointed director of the FCC's Office of Congressional and Public Affairs. He had been serving as acting director since the August resignation of Bill Russell. Before that, Kamp had been FCC Chairman Mark Fowler's special assistant for congressional relations.

Dale Brown has been appointed as Fowler's new special assistant for congressional relations. Brown has worked with the Senate since 1974. He has also been a staff member of the Commerce Committee's Subcommittee on Communications.

Carol Melton, a communications attorney and formerly assistant general counsel of the National Cable Television Association (NCTA), has been appointed as a legal assistant to Fowler. Melton will concentrate on mass media issues.

Susan Steiman has been named acting associate general counsel and chief, as well as chief, Administrative Law Division, in the FCC's Office of General Counsel. She joined the Commission in 1977 as an attorney.

For more information, contact the Commission's news media information office at 202-254-7674.

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Regulatory News

FCC OKs \$714K 'Cuba' Award

by David Hughes

Washington DC ... The FCC has approved the seventh—and by far the largest—recommendation in its program to compensate AM stations for improvements made to battle Cuban interference.

On 29 September, the Commission ruled that WQBA, Miami, is eligible for \$714,833 in compensation. The WQBA figure alone is more than the \$501,172 total the FCC had recommended in the past two years for six other Florida stations.

The other stations that have had their claims approved by the FCC include: WINZ, Miami, \$31,461; WVCG, Coral Gables, \$245,751; WNWS, South Miami, \$113,271; WIOD, Miami, \$84,027; WSUN, St. Petersburg, \$12,265; and WEAT, West Palm Beach, \$14,397.

In addition to the seven claims, still more stations are waiting for compensation recommendations, according to Leonore Cunningham of the FCC's Audio Services Division.

WQBA case

Even though WQBA received the largest single compensation recommendation, George Hyde, regional VP for Susquehanna Broadcasting, which owns the station, said the funds will not come close to covering the total upgrade expense. WQBA broadcasts news programming in Spanish to Miami's Cuban-American community.

Hyde said the station spent \$1.2 million for the upgrade—about \$500,000 more than the \$714,833 that was recom-

mended by the FCC.

"We relocated our transmitter site," he said. In 1982 the station "installed five new towers, with new phasers, on new ground. We were not compensated for the land acquisition costs or our legal fees."

The station upgraded its 1140 kHz signal to 50 kW days and 10 kW nights, from 10 kW days and 5 kW nights.

In its recent compensation order, the FCC maintained that the WQBA upgrade "was necessary in order to accommodate the new antenna array required to provide the requisite domestic interference protection." The station filed an application for compensation in October 1984.

Still plagued by interference

Even with the new signal patterns and power increases, WQBA still suffers from Cuban interference.

"At night, if you drive 10 miles south of Miami, you can hear Cuba broadcasting a tone underneath us," Hyde maintained. "Even in the daytime, near the water in downtown Miami, you can hear Cuba."

WQBA, which has a slogan of "Cubanísima" ("the most Cuban"), and other south Florida Spanish language stations that are strong enough to be heard in Cuba are prime targets of jamming, he said.

Even with the jamming, which has been occurring for the past 15 years, the station still receives letters from Cubans who regularly listen, Hyde said.

While the the FCC has recommended that the seven stations receive funds, of-

ficials at most stations report that they have not seen any money yet. The actual disbursement of the funds is handled by the US Information Agency (USIA).

During the late summer, Congress "authorized to appropriate up to \$500,000" for FCC-issued monetary recommendations, according to USIA Counsel John Lindberg.

Even though the funds have been earmarked, as of mid-October, no time frame has been established as to when the stations would actually receive the funds, he added.

However, Lindberg said the original \$500,000 appropriation will not cover future claims, which could come to a \$1.5 million total.

The USIA has not made a decision whether to pay off the claims on a first-come, first-served basis, which would cover the six initial claims, or pay off all the claims on a pro-rated basis, which would allow all recommended stations to

receive a portion of the funds, he added.

In the meantime, the USIA will have to go back to Congress for more money, a time-consuming procedure that involves dealing with "the whole budgetary cycle," Lindberg said.

"We haven't made any decisions on the matter, but we probably will in the next couple of weeks," he added.

Some interference-plagued stations have been waiting for funds since 1984.

The FCC began its compensation program in 1983 in order to compensate stations that made technical improvements to offset increasing Cuban interference.

South Florida stations still report a significant, steady level of interference from Cuba, although, for the most part, there are no reports of it increasing or decreasing.

For more information on the FCC's compensation program, contact Leonore Cunningham at 202-632-6485.

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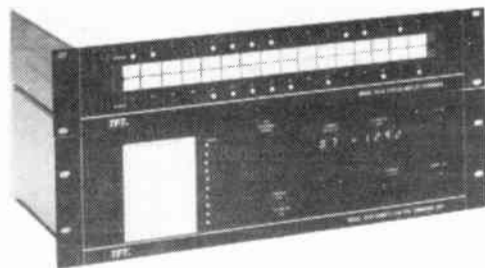
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Continued FMX R&D Expected

by David Hughes

Washington DC . . . NAB and CBS officials appear to be close to reaching an agreement that would allow FMX research and development to continue in the wake of the closing of the CBS Technology Center.

Plans are being worked out to transfer the technology center's FMX activities, which to date have involved lab and on-air tests of the FM stereo transmission extension system, to a separate entity headed by FMX co-developer Emil Torick, who was VP/Audio Technology at the Stamford, CT-based CBS center.

Patents on the FMX system are jointly held by Torick and NAB VP/Science and Technology Tom Keller. Legal contracts between the two organizations indicate that if one party discontinues its interest in FMX, the other party can continue it.

According to Keller, who developed the FMX system with Torick, CBS has indicated that it wants to "dispose" of its FMX activities.

The network has reported that it will transfer some of its technology center activities, such as research on high definition television systems and videotape copy protection, to other CBS divisions.

CBS Spokesman Dick Wien refrained from calling the technology center's demise a "cutback." Instead, he said it was a major effort to "decentralize (the network's) engineering functions." He said the network would improve its efficiency by having engineers work directly with the network's divisions.

New organization

Instead of the NAB directly assuming responsibility for the continuing FMX development, Keller said the broadcast-

ers' association will support a plan that would set up a separate facility in the same general area as the Stamford center to continue FMX work.

"We did not want to upset the people who were working on FMX by transferring the operation to the Washington (DC) area," where NAB's headquarters facility is located, Keller explained. "We wanted to find an arrangement in the Stamford area."

Although the details on the agreement are still sketchy, Keller indicated that Torick personally will assume a portion of CBS's interest in the FMX project, and the NAB will, at the same time, acquire an even larger stake in the project.

"Mr. Torick will set up his own organization as fast as possible," Keller said. "We want to keep the work going. He (through CBS) has already done a lot of work on the project."

Keller added that CBS is cooperating in the FMX transfer. He said the network has allowed Torick to continue utilizing the Stamford facility while it is being phased out, and has "lent (its) full support" for continued FMX development, even though it has decided not to back the system itself.

When the new arrangement could be finalized and full FMX development could continue has not been finalized. About six more months of developmental work is needed in order to reach the actual marketing stage, Keller maintained.

Recent FMX tests have produced mixed results. While some tests—such as those at Connecticut's WPKT and New York's WLTW—have reportedly gone smoothly, tests at Chicago's WFMT and at a San Francisco station have resulted in quadrature rejection problems that produce multipath-type interference in

some non-FMX receivers.

The CBS decision to close the technology center threw an unexpected roadblock into the continued development of FMX generators, Keller said. "That was the last thing we expected to happen."

CBS cutback

In the latest of several recent budget slashing measures, CBS announced in September that it would shut down its 28-year-old technology center.

Although network officials would not comment publicly on the fate of the approximately 90 employees at the facility, sources privately indicated that about 60%-70% of the center's workers will be laid off, with the remainder transferred

Denver RFR Tested

by Alex Zavistovich

Denver CO . . . Complaints of radio frequency (RF) interference and concerns over the biological hazards of exposure to RF radiation recently prompted the FCC and the EPA to conduct a joint survey of RF radiation levels in the outlying areas of Denver.

Richard Tell, chief of the EPA's Office of Radiation Protection, said the survey, held 23-26 September, came at the request of the Jefferson County Planning and Zoning Department and an informally organized citizens' group led by Denver attorney Chris Odell.

The Denver study is the second RFR survey to be jointly conducted by the two federal organizations. On 28 July-1 August, the FCC and EPA recorded RF levels from an antenna farm in the Healy Heights section of Portland, OR.

to other CBS divisions. The facility reportedly had an annual budget of about \$8 million.

The move is the latest chapter in a series of cutbacks at the network, which had been the victim of an unsuccessful corporate takeover attempt by CNN/WTBS owner Ted Turner. On 10 September, the network removed its former Chairman Thomas Wyman and installed Laurence Tisch as its new CEO.

Major cutbacks in CBS operations, including its venerated news department, came before and after the corporate changing of the guard. More layoffs are said to be planned.

CBS Technology Center officials, including Torick, could not be reached for comment on FMX.

For more information, contact Tom Keller at the NAB, 202-429-5346, or Dick Wien at CBS, 212-975-6309.

Official findings from the Portland survey are expected "by the end of November," Tell said.

In Denver, measurements were made of RF levels emanating from broadcast towers located on Lookout Mountain, a point approximately 10-15 miles west of the city, according to Dennis Carlton, an engineer at the FCC's Denver field office.

Robert Cleveland, a physical scientist with the FCC's Office of Engineering and Technology, said the EPA made "baseline measurements" to determine ambient RF levels away from the broadcast site.

This second set of measurements, Tell added, was made in the community of Genessee, approximately five miles from Lookout Mountain.

Cleveland said official findings would be available in "three to four months."

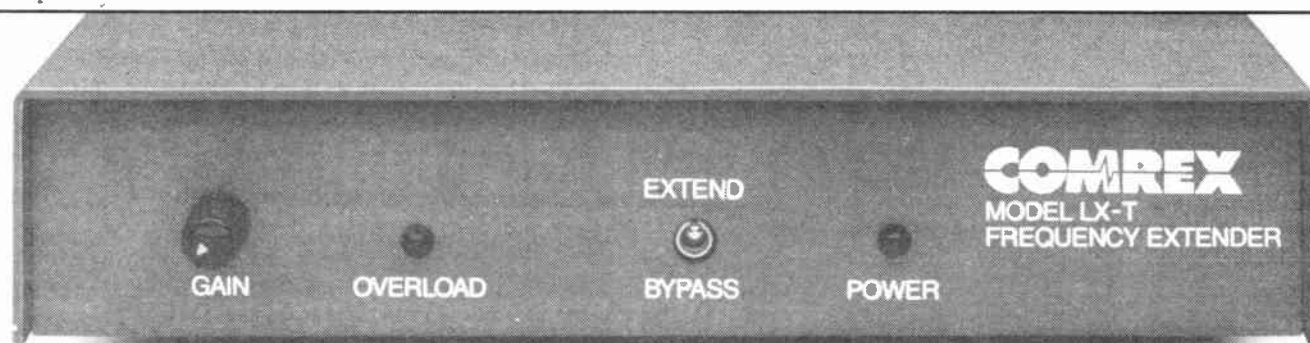
Tell mentioned that RF radiation levels were greater at antennas located lower on the tower. One unidentified FM station was recorded as having a "high RF field," he said.

In related news, the EPA, in a notice of proposed recommendation filed in the 30 July *Federal Register*, was seeking comments on the exemption of AM from future RF radiation standards. The proposal stems from what the EPA has maintained has been an overall absence of biostatistical effects at AM frequencies.

The EPA is seeking to establish a uniform nationwide standard, but in the interim uses the radiation limit set by the American National Standards Institute (ANSI). The ANSI standard recommends a maximum power density exposure limit of 1 mW/cm² on a 6-minute time-averaged basis.

Deadline for comments on the EPA's recommendation was 28 October.

FCC contact is Robert Cleveland: 202-653-8169. Contact the EPA at 202-382-3324 or Richard Tell at 702-798-2440.



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Letter to FCC

Dear RW:

Below is a copy of a recent letter on AM stereo I sent to the FCC. The letter was addressed to Mr. William Tricarico, Secretary, FCC.

"I am writing the commission because I am very concerned about the future of AM radio! If you want AM radio service long-term and AM stereo to have any chance of surviving at all, the commission should, with the greatest of speed, adopt *one national standard for AM stereo broadcasting*.

The average consumer in America today perceives stereo as the standard with which they will hear their music. All the music software (albums, cassettes and compact disks) available for purchase by the consumer today are manufactured in stereo. Those same consumers can also listen to their favorite music in stereo on most FM radio stations. They cannot do that on AM radio.

Surveys over the years show time and time again that the main reason people listen to the radio is for music. When stereo is the consumer standard, is it any wonder that they will choose stereo over monophonic music broadcasts?

WYNE operates as a standalone AM broadcast facility. WYNE went AM stereo March 1, 1985 (spending over \$60,000 to make the change to stereo). Short-term, it has proved to be a very good move for the station . . . WYNE sounds great in stereo. Long-term, the move could prove to be a total waste of

time, energy and money. Why(?) . . . because, if recent trends by some radio receiver manufacturers continue, in time there might not be any receivers available to hear WYNE stereo.

I feel very strongly, that one AM stereo national standard will motivate most of the 90% of the AM stations who are not currently broadcasting in stereo to convert. Also within a short amount of time, all AM radio receivers manufactured for this country would come with AM stereo as a standard, built-in feature. Years ago the FCC established one national standard for FM stereo broadcasting . . . Why can't the FCC do the same for AM radio, now?"

Ned H. Hughes, Pres/GM
Ned Hughes Broadcasting, Inc.
(WYNE-AM)
Kimberly, WI

RW replies: *Let us know if you get an answer . . .*

Dereg sounds like hash

Dear RW:

I have written to you on several occasions on the discussion of AM stereo, supporting the Kahn/Hazeltine system. I am still a strong and stubborn supporter of Kahn ISB. However, aside from that, I am a strong believer in the AM broadcast band. While FM has surpassed AM in terms of listenership, and deservedly so, AM has been put on the back burner both technically and programatically.

To make matters worse, our happy-go-deregulate FCC under Mark Fowler has been shoving more fulltime AM stations into an already overcrowded AM band. The result? Garbage.

I live only 20 miles outside of the nation's sixth largest market, Boston—in Brockton, to be precise. Try to use an AM radio on any of the frequencies other than the three currently occupied by large 50,000 W stations in this market (namely WBZ, WHDH and WRKO) and you will most certainly grow frustrated by the hash you hear. Only as late as 1983, you could tune in to the clear or regional channels and hear one dominant station occupy the frequency.

A couple of nights ago I fiddled across

Texar's petition to the FCC, whatever else it will accomplish, is a catalyst for change in the AM stereo situation. The petition offers broadcasters their first chance since the FCC imposed its "marketplace" approach to speak out in an official forum on the AM stereo situation. As such, it could offer the solution nearly everyone in the industry is seeking—one standard for AM stereo.

To some, the marketplace battle has appeared to stagnate, becoming a seemingly endless face-off. The rationale behind the Texar petition is that this threatens the future of AM stereo, since receiver companies are losing interest in AM stereo.

If the Texar petition forces the FCC into re-opening the regulatory process, its impact would probably slow the marketplace activities further. FCC sources estimate that a new NPRM, comment and reply comment period, *if uncontested*, would take just under a year, at best.

If receiver manufacturers and station owners are losing interest now, this delay could worsen AM stereo's problems.

But, if the FCC chooses not to act on the petition, AM stereo will continue to face the delays imposed by the slow processes of the marketplace.

In the meantime, several countries, including Brazil and Australia, have designated C-QUAM as their national standard. In addition, the Canadian Association of Broadcasters very recently recommended C-QUAM to be the national standard to the Canadian Department of Communications.

Given the NTIA's vow to consider the international arena in assessing the AM stereo situation in its report on the state of AM stereo (due to be released at the end of this year), the FCC may, on the weight of sheer numbers, declare that the marketplace has already chosen a de facto standard, and that therefore no FCC action is needed.

Whatever course of action the FCC takes, it must be done as quickly as possible. The Commissioners need to hear your comments, yea or nay, so they can take the best course of action. Write now; it probably will be your last chance.

—RW

the AM dial and, instead of hearing a dominant station on most every frequency, I heard a dozen or more stations fighting it out on each frequency. This problem is not just isolated to the Northeast, as I have traveled into the Southwest and the mid-Atlantic states and got the same result . . . clutter.

One frequency which really took me by surprise was 1200 kHz, which used to be occupied by one signal—WOAI, San Antonio. Nowadays, 1200 kHz sounds no better than a graveyard frequency with a dozen or more stations fighting it out. In fact, to sum it up, it sounds like hash.

When we had a responsible policy of skywave protection, we had strong, dependable signals at night to provide both the city and rural listener with news,

sports and plenty of music. Nowadays we have these tens of hundreds of stations coming on the air fulltime so that they can provide quality local service by putting on Larry King all night (as if Larry needed any more affiliates).

There is an old saying that 'more is not necessarily better.' In this case, the AM band is no exception. If the FCC continues on its merry quest to add more fulltime stations to the critically ill AM broadcast band, AM radio as we know it, as well as AM stereo, will become nothing but useless relics. You C-QUAM stations pay particular attention to this, as platform motion will become the order of the day, or shall I say . . . night.

Let me close in saying that, in addition to being CE for an educational FM
(continued on page 6)

Radio World

Vol 10 November 1, 1986 No 21



Radio World (ISSN: 0274-8541) is published twice a month by Industrial Marketing Advisory Services, Inc., 5827 Columbia Pike, Suite 310, Falls Church, VA 22041. Phone (703) 998-7600. Copyright 1986 by Industrial Marketing Advisory Services, Inc. All rights reserved.

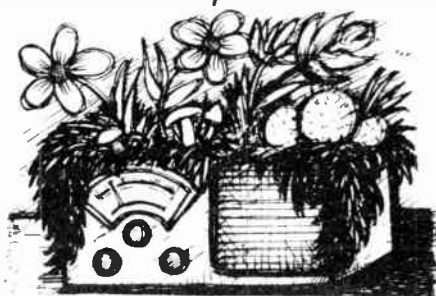
Publisher, Ad Sales Manager: Stevan B. Dana; East Coast, Ernie Robitel (516-671-2502) Editor: Pamela A. White; News Dept: David Hughes/Manager, Alex Zavistovich; Buyer's Guide: Marlene Petska Lane/Editor; Columnists: John M. Cummuta, Mark Durenberger, Tyree S. Ford, Floyd Hall, Bill Sacks, John Q. Shepler, Thomas Vernon; Circulation Manager: Simone Leesser; Production Department: Jean Choi/Manager; Gina R. Rosario/Graphic Artist, Typesetter.

Free subscriptions are available to professional broadcasting and audiovisual equipment users. For address changes, send current and new address to RW a month in advance at the above address. Unsolicited manuscripts are welcomed for review; send to the attention of the appropriate editor.

Designer Radio by Trumbull/Bishop



Solid State Skate



At the Boutique



The Bookends

'Dear RW': Letters Continued

(continued from page 5)

station, that I am also an avid AM DXer, and have been one for 24 out of my 27 years.

Don't try telling me or the other thousands of DXers of all ages that this is no longer an active art. There are still many people who marvel at the ability to hear stations from all over the US, Canada and Mexico (and even beyond). I still get a thrill out of hearing an AM station broadcast in stereo from hundreds of miles away. And yes, there are still many CEs who enjoy a good DX report and send QSLs to the lucky listener.

I feel that the key to saving AM radio is not to put more stations on the air, but to improve that which already exists. The time is now, or tomorrow we all will suffer.

Peter Q. George, CE
WSHL-FM
North Easton, MA

Running rampant

Dear RW:

Regarding the article "Marketplace Ruling Sought" in the 1 August edition, I was amazed at the ignorance that runs rampant at the FCC. Mass Media Bureau Chief James McKinney stated that he couldn't understand why AM general managers had a tough time deciding on which AM stereo system to buy, and

compared purchasing AM stereo gear to the public purchasing a car.

Any fool knows enough not to purchase a car if the fuel to run it is not available. This is the situation that AM general managers face. For once in a long time, broadcasters are asking the FCC to take the lead, but so far the Commission has dropped the ball.

If AM stereo is to get off the ground, the Commission should get off their keesters, or AM stereo will go the way of FM-Quad!

Mike Jeffries, PD
WHWK-FM
Binghamton NY

Technical differences

Dear RW:

I have worked as a radio engineer in all size markets for almost 40 years and do feel qualified to express my advice on what can be done for stereo AM.

First, we have to get on the air with a system. As an engineer, I firmly believe that Kahn ISB is the only system available to us now that will do the job while still maintaining full coverage, high modulation capability with no adverse side effects such as splatter, no out-of-band emissions, less occupied bandwidth, and freedom from the effects of Platform Motion, which is caused by co-channel interference and skywave-groundwave

phase and amplitude differences which can occur in near-field as well as far-field. As co-channel interference can also occur in many cases near your primary coverage area, depending upon your protection ratio. It stands that Platform Motion, the swaying back and forth of the left and right channel information, is not exclusively a far-field problem. C-QUAM, being a phase-separated system, is inherently susceptible to what causes Platform Motion; on the other hand, Kahn ISB is not affected because it is a frequency-separated system. This is all serious business, and one should examine carefully the technical abilities of a system. The Kahn method of transmitting and receiving AM stereo works better within the confines of physical law. By the way, Kahn Communications has given broadcasting many worthwhile products over the years, like the waveform equalizing Symmetra Peak phase scrambler, still used in many stations around the world. It's difficult to imagine a firm such as this one offering the industry a product that is flawed in its performance. Flawed it certainly is not; it is the superior AM stereo system and the one I believe will be accepted as the World Standard for AM stereo transmission. Its excellence is beyond question. Its performance in the field over the past years with leading radio stations is proof of its superior ability to

do the job without compromises of any nature. Ask for technical material on this system, from Kahn and a recent paper published by Hazeltine Research, Inc. There are differences, as you'll discover!

It is primarily from the Orient that we get the best receivers, and Sony, to name one company, has excellent auto and portable receivers that receive ISB-equipped stations. It seems to me that it makes good business sense for stations still in monophonic, to go on the air with the Kahn exciter and promote AM stereo and get involved cooperatively with dealers and manufacturers to help create a wide market nationwide for the AM stereo medium.

Remember, AM listeners want stereo too! It can all happen, if we climb aboard and start to work for it. For many of us it's our future we're talking about. We can help ourselves and give AM a much greater competitive edge . . . if we begin now to work at it.

Get the technical facts on AM stereo and then you'll understand why a great majority of radio broadcast engineers endorse the one system that we consider to be excellent, with no hidden compromises to live with. Most of us are just sincere when we speak up to defend what we know to be the best way to go about transmitting and receiving . . . stereo AM.

If you want to talk with me about it . . . I'm at KDON-AM/FM and my number is 408-422-5363.

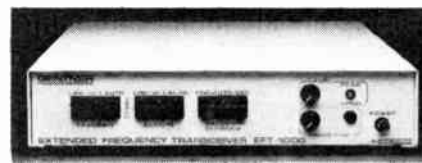
Jim Dacey, CE
(continued on page 26)

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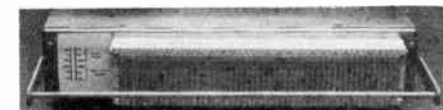
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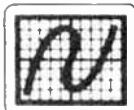
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NABET, WWCK Resume Talks

by Alex Zavistovich

Flint MI ... NABET negotiators and WWCK management returned to the bargaining table in early October to resume contract discussions following union strike authorization against the station in August.

Pete Cavanaugh, chief operating officer for WWCK-AM/FM, said the union had informed him in advance of its intention to request a strike, which was approved 14 August by the NABET Inter-

national Executive Council. He maintained NABET was using the tactic to underscore its position and that the announcement came as "no surprise."

Cavanaugh did not comment further on the case, except to say future discussions with the union will address wages and working conditions.

NABET is negotiating its first contract with WWCK since it was elected to represent the station's employees in January. The 12 union members at the Flint station comprise the engineering staff and

"every on-air personality except the PD," said George Hester, president of Local 46.

A number of issues are being discussed, Hester said, including a five-day workweek, seniority and wage increases.

According to NABET International Representative Mike Tiglio, the station's employees have gone without a pay raise for over a year. The union is proposing a 20% wage increase; the company's offer is 3%, Tiglio said.

The union is also concerned about ar-

bitration language in grievance settlement, Hester added. The company has proposed to have arbitration issues decided by the senior VP for the station, rather than by a neutral third party, he said.

Tiglio said such arbitration would be "the same as having (the union) decide. All the settlements would be in (the union's) favor."

Although strike sanction was granted by the union's International Executive Council, Tiglio said the group is not near a strike. Negotiations with WWCK had "bogged down," he said, and the move was to have "pushed the company a little."

Apparently, the push has been effective, Tiglio said, because negotiations with the company have resumed. One session was held 1-2 October and, at press time, a second was scheduled for 16-17 October.

Tiglio characterized the recently held discussions as "very productive." The union was able to put forth two packages embracing six proposals, and addressed the issues of sick leave, severance pay, member duties, and the role of part-timers, he said.

For additional information, contact George Hester at 313-238-9040, Mike Tiglio at 301-657-8420, or Pete Cavanaugh at 419-248-2627.

Texar Petition Awaiting FCC Action

(continued from page 1)

are leveling off. At this rate, it could take more than 13 years to hit 30%. The receiver manufacturers will not sit there forever," Clark said.

By the time the FCC's "marketplace" plan finally determines a system, receiver manufacturers will have abandoned AM stereo, Clark added. "The FCC already

pact of AM stereo."

Only 6 respondents indicated that their AM station broadcasts in stereo, but 33 said they plan to add it "at a later date." Sixty-four respondents said they would be willing to join a "letter writing campaign," while 32 said they would be willing to "make a trip to Washington, if necessary, to campaign for the cause of AM radio."

Kahn, Motorola comment

Leonard Kahn, developer of the Kahn/Hazeltine ISB system, which has signed about 80 stations, would not comment to RW about the Texar petition.

However, he was quoted in *Broadcasting* magazine as saying the petition was "very irresponsible." He said it would give Texar publicity but accomplish little else.

Clark said he has talked with Kahn and that they are both concerned about the future of AM radio and the eventual development of a single AM stereo standard.

However, Clark said Kahn favors continuing the FCC's marketplace approach.

"We have the same goal, but we differ in how it should be accomplished," Clark added.

Officials from Motorola, with about 300 stations in the US, said that while they would support an effort for the FCC to reach a single standard, they still had questions about how the FCC would deal with the Texar petition.

Company sources have indicated that their system would have a good chance of becoming the standard since more sta-

tions have selected it than the Kahn system. Australia and Brazil have selected the C-QUAM system as their national AM stereo standard.

"The Texar petition is constructive because it serves as a catalyst in evaluating the present AM stereo situation," a Motorola spokesman said. "C-QUAM is the de facto standard in the US."

The spokesman added that he believes the results of the NTIA study "will confirm Motorola's conviction."

For more information on petition, contact Texar at 412-856-4276. For more information on the NTIA study, call 202-377-1840. Contact Kahn at 516-222-2221, or Motorola at 312-576-5304.

By the time the FCC's "marketplace" plan finally determines a system, receiver manufacturers will have abandoned AM stereo, Clark added.

has the data; it can make its decision quickly," he said.

Clark pointed to the results of a September questionnaire sent to Georgia AM radio stations by the Georgia Association of Broadcasters.

With a total of 68 stations responding, 38 said they "were aware that many manufacturers of AM stereo sets are either discontinuing them or not producing more."

Sixty-one respondents agreed with a question that asked if the "FCC's marketplace decision has delayed the im-

Gates: In Memorium

Quincy IL ... Parker Smith Gates, 79, founder of the Gates Radio Company, which became the Broadcast Division of the Harris Corporation, died 17 September.

At 14, he served as designer and engineer with Gates Radio; his parents were company officers. In the 1920s, Gates invented the nonsynchronous sound machine and the synchronization turntable. By the 1930s, he had invented a remote amplifier, a new condenser microphone, a radio station master console and a radio broadcasting transmitter.

After supplying radio transmitters for use in the D-Day invasion of Norman-

dy during World War II, Gates Radio went on to win government contracts for shortwave equipment. In the 1950s, the company constructed Voice of America studios and master control.

Before being acquired by Harris in 1957, Gates' firm developed high-wattage transmitters for FM, a 5 kW AM transmitter and television broadcast equipment. Following the acquisition, Gates continued with Harris, and was named chairman of its Gates Division in 1968.

Gates is survived by his wife of 53 years, Mildred Irene, three daughters and seven grandchildren.

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Madison Sessions High Quality

by Fred Baumgartner

Englewood CO ... When you think about it, the University of Wisconsin has hosted Broadcast Engineering and Management seminar for over half as long as broadcasting has existed. Beginning as the "FM Clinic" in 1954 to educate broadcast engineers on the needs of the then, neophyte FM medium, the clinic has ad-

vanced with the technology and broadened its view to include everything that is related to broadcast engineering.

Don Borchert, DE, WHA Radio and TV, is the moving force behind the seminar, which dedicated the first day to management concerns.

Conferees could attend Monday through Thursday, or skip the management section on Monday. Speakers in-

cluded John Cummuta, GM, WCFL, Chicago (and both management columnist for RW and a representative from the engineering ranks) on modern management techniques.

H. Richard Hiner, director of Navy Broadcasting, addressed a number of management philosophies.

"Congratulations! You Are Our New Chief Engineer," presented by Jim Loup-

as, president, James Loupas Associates, Houston, dealt with the transition to the ranks of management, and particularly with the process of learning the language. "We learned to talk 'telephone' (3 dot 4 ...) because the phone people just aren't going to learn 'broadcast.' You have to learn to speak 'manager' because they aren't going to learn to speak 'engineering.'"

After lunch Hiner and Cummuta guided "problem solving through engineering management case studies and role playing." This can be highly interactive, educational and, frankly, fun. At first glance, management problems look rather individual. Once they are open for discussion, it is amazing how many management issues are rather universal.

Engineering sessions

By 4:30 PM, the exhibitors were pretty much set up and conferees began arriving for the next day's engineering sessions.

Tuesday began with a presentation by Jim Brown, president, Sound Engineering Associates, Chicago. His "Is There Life After the Television Stereo Revolution?" focused on losses in each generation and proper ways of monitoring stereo.

While Jim was emphasizing that the TV folks need to learn what the FM folks already know, I realized that the TV folks had figured out all sorts of neat and important ways of dealing with stereo and were just in the "spread the information around" mode. Key concepts include "absolute polarity" (does the bass drum kick or suck?) and the need to keep it throughout the system. Jim also outlined a series of audio test signals and the use of the X-Y scope as the basic stereo test gear.

Burton Gran of Holaday Industries, Eden Prairie, MN, talked about methods of RF and microwave measurements, and about safety techniques.

Wallace Johnson (president, ABES) spoke during lunch on the surprise of international agreements affecting our broadcast lives. The in-depth presentation included insights into the process by which international agreements are made, and included discussion on developments on the horizon.

Focus on FCC

The afternoon and evening were dedicated to the FCC, including a mock inspection and an open forum. George Sklom of the Chicago FCC office for the last 20 years and Garrett Lysiak of the St. Paul FCC office for the last 13 years are changing jobs (by retiring in George's case). Both have been major contributors to the clinic over the years.

Recalling the sometimes heated discussions of not so long ago over the first class license ... Don Borchert presented George with a plaque inscribed "1st Class." Those present wished him the best of the future.

Continued sessions

Mark Persons and Jim Loupas opened the Wednesday sessions with discussion of the nature of field engineering and contract services. A large number of the audience either made their living or added to it with contract services. Con-

(continued on page 16)

CL-100

Moseley's new CL-100 series transmitter/receiver system offers an economical alternative to aural subcarriers and dedicated telephone lines for conveying control or telemetry data between studio and transmitter locations. The CL-100 system provides for independent control or telemetry while freeing subcarrier channels for other uses.

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Calculate Power Lost in DAs

by Tom Osenkowsky

Brookfield CT ... Last month we looked at loss and some of its causes and cures. In a directional array, we calculate the power lost by first finding the loop current in each element. For a regular vertical radiator (Equation 1):

$$\text{Loop } I_i = \frac{FK}{C_i(1-\text{Cos } G_i)}$$

F_i = Field ratio of the i^{th} tower

K = No loss multiplying constant for the array

C_i = 59.958491 where K is expressed in mV/m/kilometers;

37.256479 where K is expressed in mV/m/mile

G_i = Height of the i^{th} tower

Now using Ohm's Law we find the power lost (Equation 2):

$$P_i = \text{Loop } I^2 \times R_i$$

Where Loop I = As calculated by (Equation 1)

R_i = Loop loss resistance, usually 1 ohm

As you can see, the power loss increases with the value of the loop current. Let's look at a real world example (see Table 1):

RF Readings

A three-tower in-line array is computed to have a no-loss K factor of 662.52 at 1 km. We use a commercially available PC computer program called MASTER© for analysis of the fields and impedances of the array. The total loss in this case is 125.2 W.

But we need to clarify a point here. In a DA system for powers of 5 kW or less, FCC 73.51(b)(2) says the input power shall exceed the nominal power by 8%. For our 5 kW case, the P^2 Rcp at the common point would be 5,400 W. The extra 8% power is to allow for phaser losses before the power reaches the towers. The 1 ohm loss occurs at the loop, or current maxima on the tower.

How can we measure in the real world the actual power lost? Well, we can start by measuring the actual power radiated. Here is a step-by-step procedure to follow:

Step #1

First, check each thermocouple base ammeter, line ammeter (where used) and common point ammeter against a known standard. You can use a dummy load and 60 Hz power source. A variac comes in real handy here.

Tom Osenkowsky is a radio engineering consultant headquartered in Brookfield, CT. He can be reached at 203-775-3060, or by writing to 5 Beechwood Grove, Brookfield CT 06804.

Compare each ammeter against the standard. If you are using toroidal meters, you can usually skip this step.

Two notes should be kept in mind, though. First, when a toroidal meter reads low, the most likely suspect is the MOV placed across the RF input to the meter rectifier unit. Lift one end and see if the reading returns to normal. This short can occur after a lightning strike.

Second, you will note an arrow on the toroid. This is not important in the case of the ammeter, but *very important* in the case of the TCT sampling transformers which feed the antenna monitor.

“ *How can we measure in the real world the actual power lost?* **”**

A reversal on one of the toroids will cause the phase indication to be 180° out. If there is a mechanical mounting problem, you can reverse the arrow, but all TCTs must then be reversed.

Step #2

Now that we can be sure our current indications are accurate, we may proceed to measure the operating resistance at each tower base. Take your OIB out to each tower base and disconnect the feed to the tower and insert the bridge just after the base ammeter. Then carefully measure the operating impedance.

Tower	G° Height	S Spacing	ψ Phasing	F Ratio	φ Azimuth
1	90	0	150.5	0.52	0
2	105	65	0	1.0	225
3	90	130	-150.5	0.52	225

In order to be very precise, you may wish to have an assistant reset the operating parameters if there is considerable insertion effect with the bridge. Keep the OIB after the ammeter but before the sample transformer (if used).

Keep the lighting choke, static drain, etc. in circuit. Be sure to keep track of any phaser adjustments. Carefully read the OIB manual for correction factors that are to apply.

Step #3

Measure the base current. Now perform the P^2 R power calculation for each tower. The total power radiated may be found from Equation 3:

$$\sum_{i=1}^i P^2 R$$

Where I = Base current for the i^{th} tower

R = Base operating resistance for the i^{th} tower

i = Number of towers

How do you fare?

If you didn't come up within 5% of your nominal power, we'll need to look further.

Steps #4-6

The next step is to measure and record each ATU input impedance. We will hope to see $50 \pm j0$ ohms. Remember, this

is the load impedance as seen by the transmission line.

Next, if your system uses toroid sample transformers, you can perform some additional measurements. Dismount one toroid from one tower. Make up two 10' lengths of RG-8/u cable with a PL-259 on one end and a type-N male on the other. Ensure both leads are *exactly* equal.

Finally, bring your antenna monitor out to the tower. Place one toroid at the ATU input and connect the other cable to the base sample toroid. Observe the arrows carefully.

Now record the phase angle. Repeat this for each tower. Now remount the toroid you removed.

The above procedure tells us quite a lot about the system. To review what we have done to date, we have checked out the towers themselves and made sure no water has accumulated in the insulators, no weeds, trees, etc. are eating up the nearfield signal and all grounds are secure and proper.

Power at each tower has been determined and ATU design criteria has been established.

Next month we will use the data we gathered to be certain the networks are optimally designed and adjusted. Don't mothball the OIB just yet; we'll need it when we get into the phaser. Until next time . . .

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'Packaging' Aids CE Presence

by Tim McCartney

Boise ID ... Engineers who are solid performers on the job may feel that station management and staff fail to take adequate notice of their work. These engineers should consider "packaging" their product.

The marketing and public relations fields have something to offer in this regard: the idea is to take that long, extra mile by adding some "hype" to engineering projects. Sometimes it will mean more work after a long night at the transmitter, but most of the time packaging will become a part of the general routine.

While I was a GM, I noticed certain things which made me feel a wonderful engineering presence. I felt that the engineer was alert, listening, on-the-job, and constantly fine-tuning our air sound and the equipment operation.

This presence came not only from the engineer's competent work, but also from the many "extras." Here are a few of the packaging approaches which have worked.

Tim McCartney, CE at KBSU, Boise State University, Boise, ID, recently completed his MA in Training and Human Resources Development at St. Cloud State University, Minnesota, where he was CE of KSJR. He can be reached at 208-385-3663.

To manager: "I looked into the transmitter arcing problem and tried a few ideas out. I'll be in at 11 AM Monday to explain."

To morning announcer: "I worked inside the console overnight. Call me if you have any problems."

In master control: "We are operating at about 60% of full power—transmitter trouble. I'm working on it."

On equipment: "This tape deck does not record on the left channel. To be fixed soon."

To sales manager: "OK on the remote Saturday. I'll discuss it with you Wednesday."

In staff lounge: "We'll go off the air at midnite Sunday night for transmitter maintenance."

In addition, every note should have the engineer's name, date and time the note was written.

Labels, operating instructions

Station equipment should be kept professional in appearance by using high-quality legible lettering. A simple label maker works well and allows variety in the choice of colors.

Examples include console inputs, patch bays, signal routers, remote control units, EBS equipment, and the meaning of certain timers, bulbs and LEDs.

The operation of certain equipment is not always obvious.

An example might be the new tape deck's state-of-the-art tape counter/timer. Written instructions on the operation of such equipment should be available in a central location in the respective studio, hopefully in a clearly identified binder.

An oral explanation from the engineer is necessary to complement the written information. Only then is the job complete!

Answer, explain, analogize

For the sales manager, a missed sale is truly lost revenue.

For the engineer, an inadequately answered question from a staff member is clearly a missed opportunity. This is the best possible moment to make an impression on the person—at the time when their interest is heightened.

Engineers need to see such staff questions as golden opportunities, whether the setting is one-to-one or in a group session.

Technical explanations do not require technical jargon; after all, the idea is not to *baffle*, but to *communicate*. Clear lay-person language and appropriate analogies are effective communication tools for engineers.

A neat and simple flow chart posted at carefully selected station locations can help develop staff interest in engineering.

It also provides a quick reference point during explanations to staff members.

A possibility is a chart outlining three separate operations: the broadcast chain, the monitoring system and the control system with the transmitter.

Be cosmetic

The staff may not notice the results of a long night of diligent labor inside the console. But they will notice attention to

items more cosmetic in nature.

So, it's valuable in this regard to pay attention to:

- Neatness in wiring
- Changing light bulbs and LEDs
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“

While I was a GM, I noticed certain things which made me feel a wonderful engineering presence.

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The reason engineers must move into a marketing and public relations mentality is that they deserve so many more pats-on-the-back. When was the last time an engineer complained about being "complimented-to-death" and unable to bear the "incessant onslaught of praise" every day at work?

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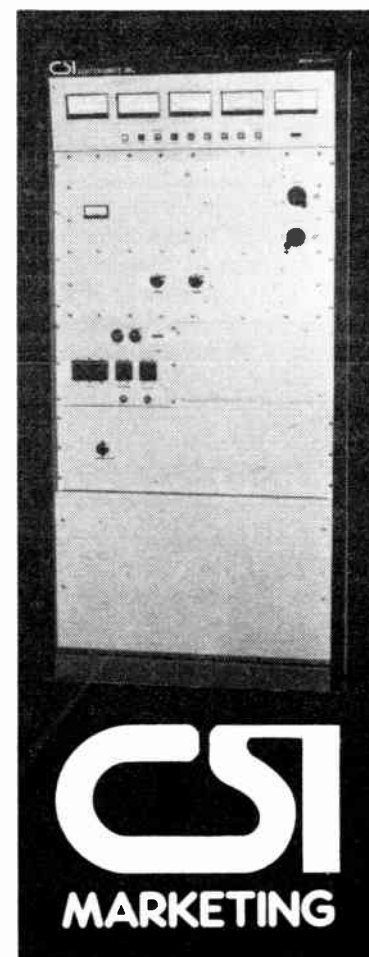
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Circle Reader Service 9 on Page 23



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Circle Reader Service 45 on Page 23

Don't Let Intermittents Bug You

by John "Q" Shepler

Rockford IL ... You know the old story: "How much to fix a transmitter? \$100. That's a buck to kick it and \$99 to know where to apply the foot."

It's a sad fact of engineering that some problems just do not succumb to analysis. They come and they go mysteriously. We call them bugs, glitches, gremlins, transients, or just plain old intermittents. Whatever the name, problems that won't stay put are maddening to fix. Here are some hints that may help your sanity.

It's amazing how often a good rap to the side of the cabinet will get things running again. That's because all electrical and electronic components have connections and sooner or later connections come loose. The ones that are supposed to be loose, such as relay contacts, either stick shut or eventually corrode.

Actually it's a good policy to kick or at least shake the equipment once in a while. This is not to show it who's boss. It already knows that it has the upper hand. The idea is that a little controlled vibration will show up flaky connections that would otherwise break connection during some important program.

I know some of you are horrified at the idea of taunting fate with equipment that is working perfectly well. The fact is, all equipment will develop problems sooner or later, and it might as well be at your convenience rather than at a time when you're 100 miles away.

A good time to shake up the transmitters is during your routine maintenance and cleaning nights. After you blow the dust out, hang one of those fluorescent trouble lights inside and do some poking around.

Loose power connections can arc and cause real damage. Power wires also have fairly large screws and lugs which can vibrate loose over time. Shake each

John Shepler is a broadcast consultant, teacher, writer and former CE. He can be reached after 8 PM at 815-654-0145.

wire to make sure the connections are tight and twist each screw with a screwdriver to make sure it isn't slowly backing out.

A good place to rap the cabinet is right next to a large relay or contactor. With the transmitter running normally, tap the cabinet smartly. You should definitely not see the plate meters wiggle around

Q-Tips

or hear snapping noises. If you do, check the connections inside again and burnish the contacts of the relays and contactors.

I'll pause here with a reminder that transmitter circuits are not to be trusted under any conditions. *Be absolutely sure to use the grounding stick to discharge the filter caps; as a doublecheck, touch a large screwdriver from the chassis to tube plates.* If sparks fly, don't just consider yourself lucky. Fix the bleeder resistor or safety switches before you call it a night.

Cable checks

The obvious way to check for major shorts and opens in a cable is with an ohmmeter.

However, some cable glitches don't show up so well on a meter. For instance, the microphone cables that take a beating on news stories and remotes can easily develop intermittent shorts and opens. Sometimes the strands are actually severed, but still touch most of the time.

Other times there is an almost invisible hair of wire sticking out of the connection in an XLR connector. Eventually it vibrates over and touches another connection. When that happens, the microphone can cut in or out, or just crackle a lot.

A better way to test mic cables is to run an audio tone through one end and use headphones to listen at the other. Yank on the wire and connectors to make sure you don't hear any breaks or

noise (see Figure 1).

Listen from line to line, and from line to ground. An ohmmeter, especially a DMM, is too slow to register any slight noise problems, but they will be audible in the headphones.

RPU antenna wires are also notorious troublemakers. The signal pops in and out for no apparent reason. Must be the weather, or maybe airplanes, right? Wrong.

Put a reflected power meter in the line and watch for the needle to jump as you shake the coax around. Get somebody to take the equipment home and shake it around while you listen to the received audio. This will show up problems with the mic cables, transmitter and antenna, and possibly even the receiving antenna, if the sound crackles with every gust of wind.

Solid state circuits

Tube amplifiers were easy to fix. The bad component was the one that wasn't lit. I worked for a station manager who fixed audio amps by feeling for cold

tubes. Fortunately, his fingers healed between equipment failures.

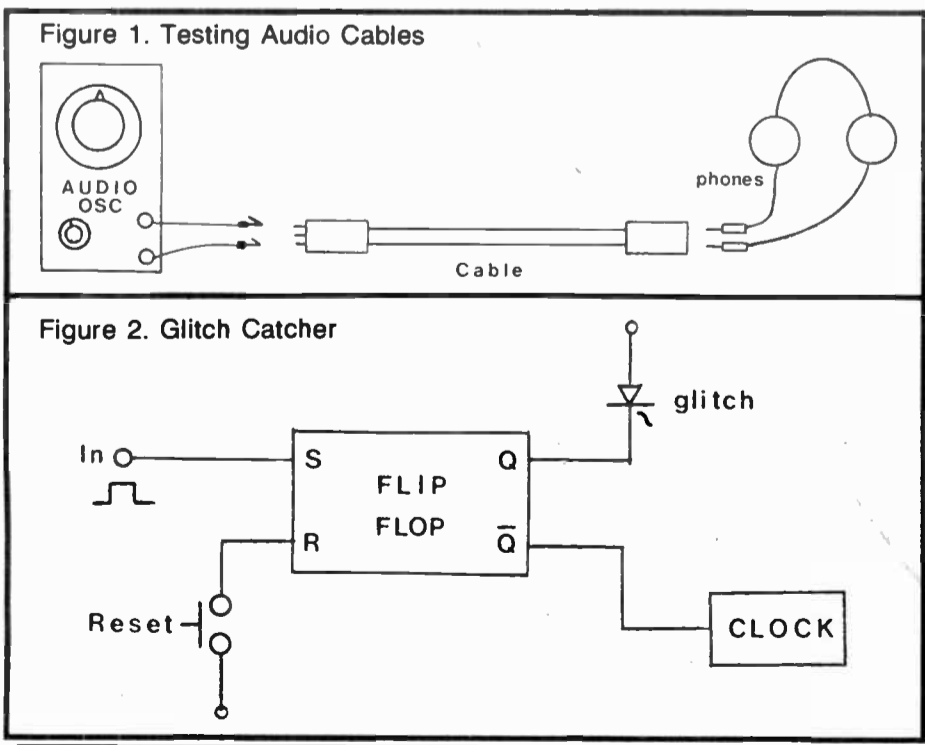
Solid state circuits can be deceptive because there is often no visible sign of trouble. Worse, every connection can be tight, yet the problems still come and go with no pattern.

If you are faced with a temperamental amplifier or cart machine, start with the obvious. Shake the circuit cards and wiggle the head wires. If the problem gets noticeable, you have a connection problem.

Examine the circuit. Are any chips or transistors loose in their sockets? Sockets are nice for repairs, but unless they are of very high quality, adding sockets makes the equipment less reliable, not more.

Any signs of discoloration? Brown spots on PC cards mean something is getting hotter than it probably should. Even the finger heat test can help with power transistors that wouldn't be in those big metal cans if they ran cold. Touch the heat sink fins, not the transistor case,

(continued on page 13)



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Interface Digital to Real World

by Peter Burk

Harvard MA ... For the past few months, we've explored some of the basic devices used in digital circuits: gates, flip-flops, counters, etc. The examples have centered around circuits that are applied strictly in the digital domain. That is, all inputs and outputs are either on or off.

Since most of the universe is more analog in nature, on/off signals aren't good enough. We need a way to interface our digital wizardry to the outside world not just in black and white, but in all the shades between.

Signals representative of physical phenomena can be classified as continuous or discrete. Continuous signals are those that may take on any value, though possibly bound by upper and lower limits. Discrete signals are only allowed to have certain specified values, again with possible limits.

Examples of continuous signals are transmitter power, rainfall, and the rate of acceleration of a rocket. Discrete signals include number of spots per hour, audience size and authorized power level. Graphs of the continuous signals would have no jumps in them, while the discrete signals would graph as a series of steps. Numbers of spots and audience size must be integers, while power level must be one of the FCC powers such as 1 kW, 10 kW, etc.

Digital-to-analog converters

Digital to analog (D/A) converters can turn our digital signal into an analog value, but only if we are satisfied with a discrete output signal. Fortunately, most continuous signals can be sufficiently well approximated using a discrete output.

The D/A converter consists of a voltage reference, a bank of digitally controlled switches, some carefully chosen resistors and, usually, an output amplifier, as shown in Figure 1. We'll discuss each portion of the circuit in detail.

The voltage reference is often a zener diode, compensated for temperature or even kept in an oven when accuracy is important.

Some converters expect you to provide the reference voltage, while others provide an on-chip reference source, usually with the option of using an external reference, if desired.

The actual voltage of the reference source determines the maximum output of the converter, but higher output is possible by adding gain in the output amplifier. More important than the actual voltage is the accuracy and stability of the voltage, since the ultimate accuracy of the converter depends principally on the accuracy of the reference.

A precision reference such as the LM-399 provides very good accuracy over a wide temperature range, but draws significant current for the internal heater.

The reference voltage is applied to a voltage divider, the output of which is fed to the output amplifier. Each resistor

is switched so that it is either connected to the reference voltage or to ground, changing the voltage division to produce the desired voltage.

If the resistors are related by powers of two, as shown in Figure 1, the output will be binary weighted and respond to the input signals in a linear manner.

The output amplifier is used to provide a low-source resistance so that the output voltage is not affected by the load. If the output is instead taken ahead of the amplifier, it is actually a current source.

In our example, we used 4 bits to produce 16 possible output voltages. This

means that the desired output voltage can be as much as 3% in error if we are trying to approximate a continuous signal. More precision can be obtained by adding more switches and resistors, and of course more data lines, to control the converter.

Although this could theoretically be extended to any number of bits, the ratio of resistors gets rather large. For a 12-bit converter, the last resistor would be 2,048 times the first. This poses serious problems if real precision is needed.

Fortunately, there's a better way. The R/2R ladder takes twice as many resis-

tors, but they are all either one value or twice that value.

Figure 2 shows this scheme for a 4-bit converter comparable to Figure 1. This approach may be extended to any practical number of bits, providing very good accuracy.

There are many commercial D/A converters that can be used when required, but the circuit shown here is simple enough that frequently it can be built from parts on hand and serve just as well.

D/A converter applications

Where could you use a D/A? Controlling lamp brightness, audio level or motor speed can often be done with a D/A
(continued on page 23)

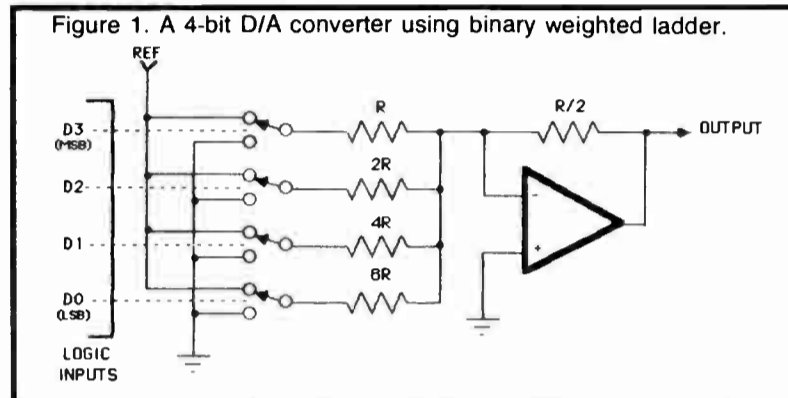


Figure 1. A 4-bit D/A converter using binary weighted ladder.

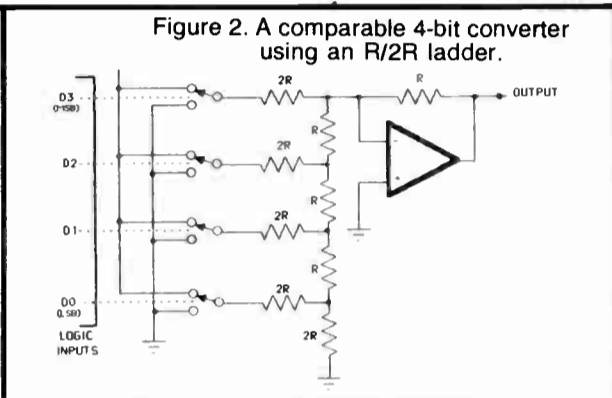


Figure 2. A comparable 4-bit converter using an R/2R ladder.

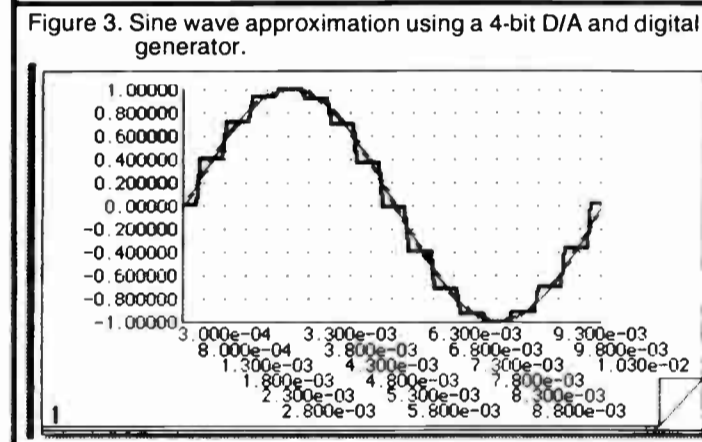


Figure 3. Sine wave approximation using a 4-bit D/A and digital generator.

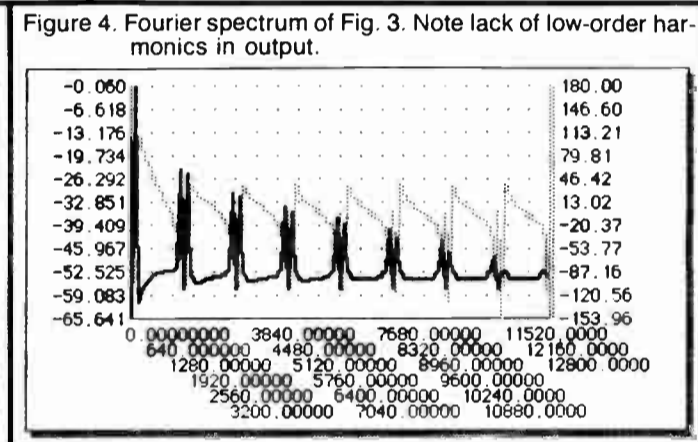


Figure 4. Fourier spectrum of Fig. 3. Note lack of low-order harmonics in output.

Peter Burk, with Advanced Micro-Dynamics, is a regular RW contributor. Call him at 617-456-3570.

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Getting a Grip on Intermittents

(continued from page 11)

which may be at a high voltage as well as a hot temperature.

Nothing obvious? Ok, start the stress tests. Temperature cycling gets the truth from even an innocent looking opamp. Use a small can of freeze spray to instantly lower the temperature of each circuit area while the equipment is operating.

Spray directly from the nozzle about 6" or so above the board. When something acts differently, you've found the circuit area that is temperature sensitive.

Now, attach the long spray tube and squirt each component in the sensitive area. You need to allow a second or two for the temperature change to take effect.

Sometimes the freeze spray doesn't find the problem. For instance, if you have an amplifier out of its cabinet for troubleshooting, the ambient air temperature may keep the components cool enough to keep working. It's only when everything is buttoned up that the temperature builds in the enclosure and overheats the parts.

You can find the troublesome part on a bench by adding some heat of your own. I use a 1600 W hair dryer. A heat-shrink tubing gun will pump out a lot more heat, but make sure you don't melt down the circuit before you isolate the problem.

Many ICs will fail catastrophically when subjected to several hundred degrees. With the hair dryer in one hand and the freeze spray in the other, you ought to be able to flush out just about any temperature problem.

Don't automatically assume that chips or other parts are at fault if intermittents occur during vibration or heat cycling. Connectors and solder joints can have the same problems.

Non-gold PC fingers are especially troublesome because they build up oxidation. I got so frustrated with one control board that I hard-wired the mic preamps by jumpering from board to socket wiring.

That made replacing the module pretty difficult, but the preamp has worked perfectly ever since, so I figure it was worth the risk.

The bad thing about logic circuits is that the signals come and go without a

regular waveform like audio. A single noise burst of a few microseconds wouldn't be noticeable on the air, but it can bring an automation system to its knees.

I went through a hair-ripping experience trying to consolidate a silence sense circuit and an audio switcher into the same box. (There were no problems with the system. I just needed the extra rack space.)

Well, the silence sense board fit nice-

ly and worked great, except that once every 20 or 30 minutes it would go off for no reason. Sometimes several hours would pass with no problem.

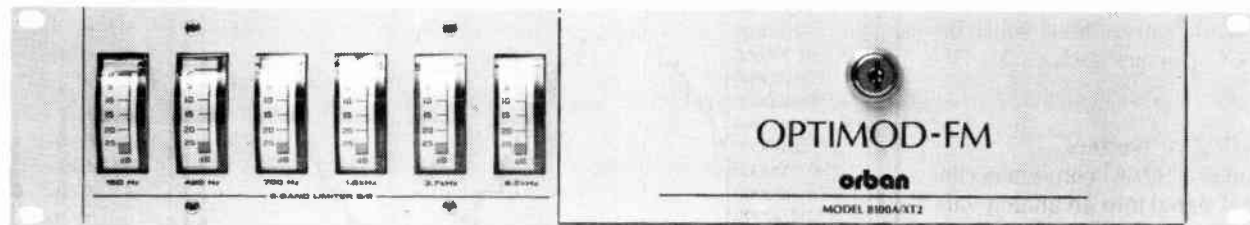
This went on for days. You could no longer hear the silence alarm because the announcers covered up the Sonalert with masking tape.

In the end, the problem turned out to be crosstalk from a tape deck EOM line next to the flip-flop set line of the silence alarm.

I found it when I substituted shielded cable for the alarm logic lines. The pound of bypass capacitors installed prior to this

(continued on page 27)

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'Bozo Proof' Your Agile System

by Fred Baumgartner

Englewood CO... In the first two parts, we talked about why we would consider an agile downlink for radio use, and what was needed to achieve agility. In this section we will examine the internal controls.

The controls are very important. From the beginning, we decided that we would attempt to make them as "bozo proof," or user friendly, as possible.

Besides the structure of the controls, we decided we needed some "software," including not only a set of written instructions, but also a slide show with audio outline on how to use the system. The slides prove very helpful, as they allow step-by-step visual instruction, which solves the problem of having to identify each knob and button.

An operator views the slide show and then takes a simple informal test (e.g., tune in two very different programs). The written instructions in the "WIBA Operators' Manual" reinforce the learning.

Dish control

The controls located in the main studio allow control of positioning (which satellite on the arc), polarity, transponder frequency and format (video, scpc, stereo, etc.).

The position control is a non-rack-mountable plastic box with Velcro to attach to a separator between racks. Inside are 10 pots to preset 10 satellite positions and voltage comparators that monitor the dish location and allow the controller

Frederick Baumgartner is assistant CE of KWGN-TV and former CE of WIBA, Madison, WI. He can be reached at 303-740-2222.

to automatically move to the preset position.

An eight-pin connector allows us to take the unit out to the dish itself for maintenance.

At the dish, solid-state relays send the motor either east or west. One shortcoming of this system is that the operator can reverse direction rapidly (rock the dish), and the motor's inertia and starting current will pop the breakers. To prevent this, Leonard Charles (WIBA's CE) added a box in the studio-to-dish control line that delays the commands to the dish motor.

Other control functions

The polarity control is housed in a separate plastic box, which is, again, not rack mountable. It contains a DC power supply and pot to change polarity by changing a DC control voltage. Again, we used Velcro and a two-conductor connector to allow us to move the unit from the control room out to the dish.

The remaining controls are rack mounted in a 1 3/4" slot. A 12-position selector switch and diode matrix generates BCD commands that, at the dish, are optoisolated and demultiplexed to produce the 12 commands to select the transponder.

A field of 12 LEDs in master control indicate the transponder selected.

The data compression is a matter of economics. Multiplexing the commands is cheaper than the additional lines required to select everything individually. Furthermore, it makes optical isolation easier, which is important when you consider the voltage transients one can expect between the studio ground and the dish ground—which is part of the AM antenna system—with the dish, of course being a better-than-average lightning

target.

This same panel contains the format selector switch. The switch routes the audio from the various demods (SCPC, the fixed tuned 6.8 MHz demod in the receiver/downconverter, the tunable demod in the video demodulator, or the stereo demodulator attached to the video demodulator).

This switch also sends the disable command to the receiver/downconverter's AGC when in the SCPC mode. Furthermore, it selects which video is routed to the house cable system, and to the video and audio monitor, which is part of the control system.

SCPC demodulator

To keep things simple, we decided that the agile system would have only three outputs: two audios that can be called up in any studio as either a stereo pair or

as two separate mono sources, and one video, which is carried on the house cable system as channel 4 (it also has audio from the first of the audio lines out).

The in-house cable system is produced by taking the local cable feed and filtering out everything below channel 5. Two inexpensive video-game type demodulators are padded and inserted onto the line for distribution. When the agile system is in the SCPC mode, there is of course no video.

At this time a VIC-20 is switched onto the video line with "Bars," and over these is written a catalog of popular program sources and settings for receiving them.

Again, the reasons for having the video capability are to aid setup and to make the audio that "rides" along with the video available. Putting all of this on the house cable system (which is very expensive) just adds to the value of the system.

The video demodulator, and the tun-

(continued on page 27)

Foundation Pointers

by Fred Baumgartner

Englewood CO... I won't spend a great deal of time on the foundation for a typical dish, but obviously you should. We poured our own concrete and provided an 8' x 8' pad on which to stand and cleanly mount the dish. This 8' x 8' pad is rather standard for us, as we use the same style on each dish for uniformity.

Most dish manufacturers specify some sort of foundation. Frankly, some are very overbuilt, while others are very underbuilt. Common sense should apply here. The basic considerations are that the foundation hold together, that it be set on firm ground and that it allow for

mounting of the dish.

In considering the structural integrity of the concrete, remember that concrete is by nature rather cohesive, but is prone to crack and scale. Reinforcement rods (re-rod) are used to hold the bulk of the foundation together.

The mesh (optional—as a 6"-thick pad, it is rather stable by itself) is used to prevent the top pad from breaking up. Scaling refers to pieces of concrete that flake off from the exposed concrete that most often doesn't harm the function but does look poorly.

If you're mixing your own concrete, it's wise to learn about the temperature ranges involved, the degree of wetness, slump and mix (four or five bags, most often). Then there's the problem of making the concrete look good; it's a bit of a trick. Having a GM who worked his way through college doing flatwork helps.

The depth and design of the foundation itself are somewhat dependent on local conditions. Of course, you need firm ground, and the foundation must go below the frostline.

One of the more complicated items is the mounting hardware. Some dishes require rather accurate location of the anchors, while others are more forgiving. There are systems that allow the drilling of virgin concrete and the use of chemically bonded anchors.

When using many dishes, the motor arm may be mounted on either the east or west side of the dish, thus allowing movement through only half of the arc.

A piece of aluminum—drilled to fit the existing mounting holes and providing a mounting hole for the motor, so that it can be placed in such a way as to see the full arc—can be used. The motor can now move the dish farther; however, since the stress is somewhat greater, this should be kept in mind.

If the motor is allowed to push the dish too far, the motor may be bent in half as it hits the supports. For these reasons any modification to extend the swing of the dish should not be excessive.

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Downlink/Cable Interface Tips

Englewood CO ... The WIBA system includes an interface between the agile downlink and the house cable system.

A proper cable system could run large amounts of cash. One suitable for a radio station can, with some care, be built around off-the-shelf consumer-grade components.

A necessary tool is a television-style signal strength meter. This is also useful for setting up FM antennas, checking relative signal strength measurements and looking at the levels of the 70 MHz IF of downconverters.

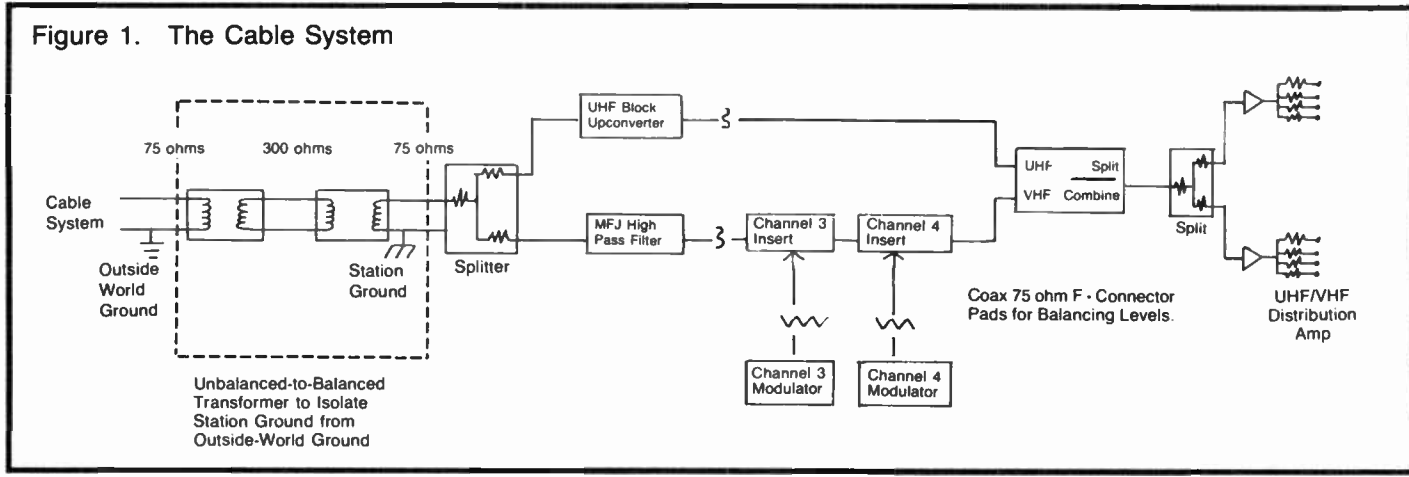
In the case of consumer-grade TV components, overdriving and system slope are a big concern. The meter is a must for dealing with these.

On the "up" side of having a cable system in a radio station is access to sports information, news, weather boards, and even MTV. On the down side is the possible tendency of the staff to watch the soaps, etc. ... although I really haven't seen that happen.

The local cable system enters the building and is converted to 300 ohm balanced line and then back to 75 ohm coax. This allows us to bring the CATV line into the building and assume the station ground on the shield.

The CATV line goes through the AM field and has a whole bunch of AM riding on it, tying directly to the station ground causes many problems.

The signal is then split and fed to



highpass filter that strips off everything below TV channel 5. The other side of the split feeds a cable-type block upconverter which takes everything on the cable and moves it to the top of the UHF TV band.

The VHF line, clean below channel 5, passes through two channel inserters. These inserters filter off the out-of-band trash from the two game-grade TV modulators and filter out a notch to put the signal in.

In-line 75 ohm pads are used to equalize the modulators and the filtered CATV levels. If one TV signal is significantly hotter than the average, it will overdrive the amplifiers downstream and cause massive distortion which "wipes out" whole groups of channels, leaving nothing but garbage.

A UHF/VHF splitter combiner mixes the output of the VHF chain and the UHF block upconverter. The block upconverter has habits as filthy as the game grade modulators as far as out-of-band emissions are concerned. The splitter combiner suppresses the trash that the block upconverter would normally put in the VHF band.

The result is split and fed to a pair of UHF/VHF amplifiers for a total of eight first-generation sources. Five of these feed the studios. Three feed the office floor, the shop, and the conference rooms, where a second set of UHF/VHF amplifiers provides final level to these

TVs. Each amplifier does two bad things; it increases both distortion and system slope.

"System slope" refers to the tendency of amplifiers to work poorly as the frequency increases, and for the coax to attenuate the high frequencies more than the lower. Home-grade gear is prone to both.

Professional gear allows for correcting some of the slope, and of course has better distortion figures.

Two amplifiers deep and a system length of less than 300' seems to work adequately ... but is not suitable for critical viewing.

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Madison Sessions Offer Quality

(continued from page 8)

siderations such as contracts, insurance, fees and much more were covered.

Kevin Rodgers (engineer, Nautel Maine, Inc.) showed us how Nautel uses FET switching mode technology to assemble high power AM transmitters.

One of the more interesting developments was Straight Wire Audio President Bill Sacks' compact disk player, the

CDQue. It cues and uses all the tricks to produce an excellent sound, but it also presents this sound in real (balanced +4 dBm, not IHF) form.

More important, it contains the "DJI" . . . The Disc Jockey Interface (in other words, easy to use). The electronics, DJI and slick packaging make this an interesting entry in the CD field.

Eric Small, president of Modulation

Sciences, spoke about optimizing SCA transmissions. Among the interesting multipath and propagation effects he discussed was that masonry walls turn from absorbers into reflectors when wet. He also mentioned that the choice of frequencies for SCA use are not random; because of receiver characteristics, certain frequencies have a tendency to produce undesirable effects (67 kHz and 92

kHz do work well).

Don Markley, consulting engineer, Peoria, IL, spoke of antenna design considerations for meeting RFR standards. Such choices as moving from one wavelength spacing to half wavelength spacing in FM antennas, and positioning antennas with high vertical radiation further up on the tower were discussed.

Don also talked about PCBs and the requirements for disposal of PCB oils and label requirements. These are very strict rules and affect all but a very few of our plants. The EPA will send information by calling 800-424-9065.

The evening contained the "Nuts and Bolts Session," which is one of the real highlights of the conference. It is a time to trade opinions, ideas, sources and more.

This year it also contained the "Great Idea Giveaway." Thirty-five entries included ideas for equipment modifications, new uses for old tools and more. The prizes were spectacular . . . monitors, CD players, microphones, tool kits and much more, donated by the 50 exhibitors.

Thursday included A. Bruce Jacobs, DE, Prairie Public TV, Fargo ND, and

“Exhibits were well attended, as this conference allows plenty of time and access.”

his "Get the Boom Out," a talk about studio acoustics. Bruce covered it all with live examples and plenty of practical slides of projects.

Exhibit activities

Exhibits were well attended, as this conference allows plenty of time and access. Several transmitters, cart machines and all the other hardware needed were on display, attended by folks who knew their product.

One of the more talked about products was Allied's presentation of the Telnox-LO, a microprocessor based telephone system for on air use.

Just a few pieces of gossip before I sign. Sacks is working on an active hum killing device that looks for problems and goes after them, to be known as the HumGobbler. Look for it by the '87 NAB show.

Lots of folks talking about the economy being better for broadcast engineers this year than last, with lots of new projects on line both at stations and by manufacturers.

Lot of folks talking about stations that got rid of their engineer learning expensive lessons. Noticed at one table that everyone had a ham call . . . Someone said it was the only real license left (that separated the . . .). There is of course a whole lot more.

This year's clinic drew 350 from the Midwest, West, Alaska, California and more. Most filled out an evaluation. This year the median score given by the conferees was just shy of excellent on the 10-step poor-to-excellent scale. I can't think of too many clinics that get that kind of response.



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Circle Reader Service 33 on Page 23

World Radio History

Sequential Test Tones by Design

by David Kuraner

Annandale VA ... The excellent article by David Driessen in the 1 July RW on digital test tone generators prompted me to share the following sequential test tone generator design.

The generator helps me expedite alignment and response checks. The prototype was built and documented several years ago.

I suggest the use of a second opamp wired as an inverter to achieve a balance output. This technique would most likely substitute for the expensive 600 ohm transformer.

All other parts should be readily available locally or by mail order. For cost reasons, the frequency determining resistors shown are fixed values. For exact tones, they should be made variable.

This project is to produce the frequency tones necessary for alignment and frequency response tests of professional recording and related audio equipment. Normally this requires relatively pure sine waves generated at specific frequencies. Since a function generator chip is utilized, triangle and square-wave output are provided as well.

The unique feature of this test oscillator is that the tones needed are automatically changed, thus providing a quick

Dave Kuraner is a senior communications engineer with Inter Systems, Inc. He can be reached at 703-642-1600.

and effortless check of frequency response at standard test points.

Eight tones are used for the frequency response test. Two tones are used for the alignment of the recording function of magnetic tape recorders (1 kHz and 10 kHz). A slow and fast step speed is provided (1.8 and 11.8 seconds per tone). Provisions are made to stop the step sequence in order to hold the tones for extended periods and vary the frequency within the significant audio spectrum.

Visual and aural means of monitoring the output are incorporated. LEDs associated with the sequential stepper circuit indicate the frequency currently being generated.

A calibrated VU meter shows output referenced to a balanced 600 ohms.

The aural monitor permits quick adjustment of the oscillator to any audible tone and conformation of sequential tones without viewing the LEDs. It also provides a monitor for playback adjustments for equipment needing it (most professional units do).

Theory of operation

The heart of the oscillator is the Exar XR-2206 function generator chip. It is designed to be used for generating tones used for FSK, modems and data communications and instrumentation.

It provides a highly stable, accurate and pure sinusoidal, triangle and square wave output. The frequency is dependent on the value of the timing capacitor be-

tween pins 5 and 6, and the timing resistors between pins 7 or 8 and ground.

Sequencing the tones therefore involves changing the value of the timing resistors at fixed intervals of time. This is accomplished via a 3 to 8 addressable decoder (74LS138).

The tone selected is determined by the input address on pins 1-3 in binary. The address presented to the decoder is derived from the 74LS913 binary counter chip.

The binary counter ship is incremented at fixed intervals of time. The fixed intervals are determined by the time-out cycle of the 555 timer chip.

In this application, the time-out cycle is selectable—either 1.8 or 11.8 seconds. At time-out, the counter is incremented, thus changing the address at the decoder and subsequently the tone of the oscillator.

The counter is advanced unless the time-out pulse is interrupted by the hold switch or the counter is reset. The reset is triggered by either the third decoder state or the ninth state of the counter, as selected by the tones switch. The reset is almost instantaneous, and the third or ninth state is not perceptible.

The normal output of the XR-2206 is designed for a nominal 600 ohm impedance. The unbalanced output on the front is through a 22 μ F capacitor. The

balanced output is after the 600-to-600 isolation transformer, which is switched in and out of the circuit. The secondary is monitored via the panel meter and a 620 ohm resistor is switchable across it to ensure correct termination, if needed.

The tap for the audio monitor is at the unbalanced output before the switch. It goes through a normally closed phone jack at the input to the monitor. Audio directed to the phone jack will break the circuit and permit the internal amplifier and speaker to function as a monitor of external audio.

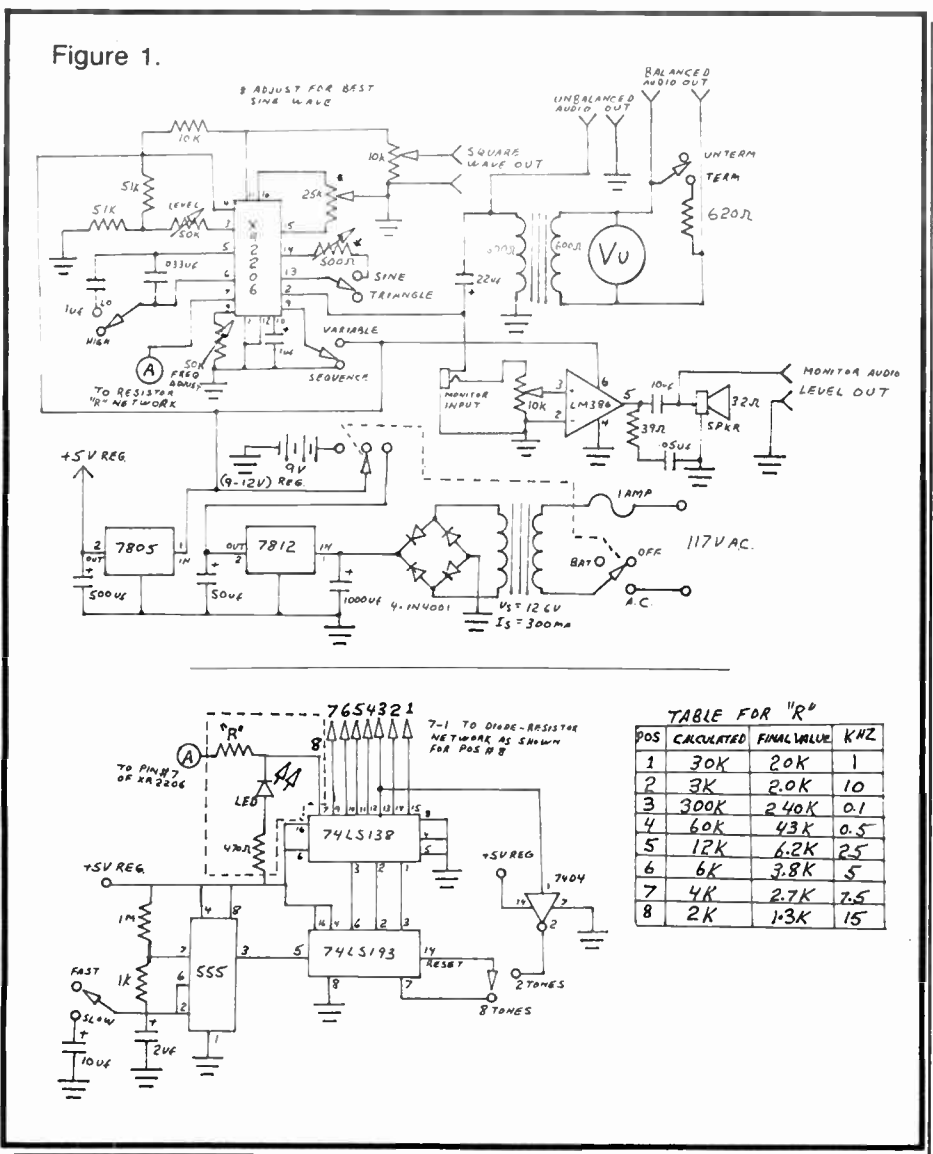
In practice, it is used to listen to the output of a tape recorder with line level audio (+4 dB). The amplifier is an LM-386 monolithic IC which develops approximately 400 μ W into the internal 2 1/2" speaker.

A second normally closed circuit jack feeds the speaker. Voltage from this jack can be fed to an external meter, if needed, to aid in alignment of the playback function.

The power supply

The prototype was designed to be operated from both AC power and internal batteries. For expedience, a 9 V battery pack is used. The AC supply delivers a regulated 12 V.

The added voltage on AC affects the *(continued on page 20)*



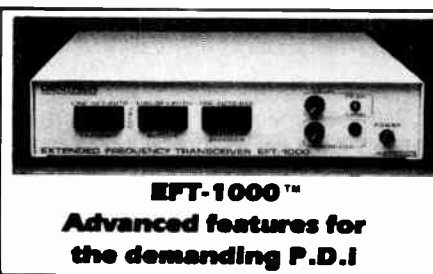
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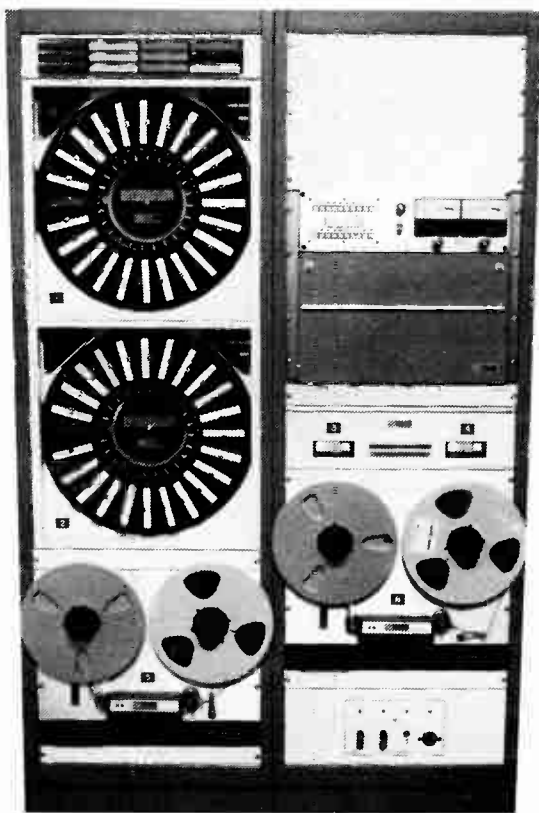
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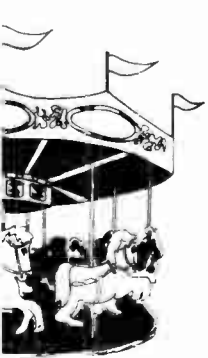
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BMX-II Modification Creates Ideal Device

by Steven B. Johnston

Norfolk VA . . . One of the proudest accomplishments of a broadcast engineer is the simple, inexpensive and sometimes elegant modification. An engineer can take the commercial product, built with speed and quality impossible in an individual shop, and turn it into the ideal device for the job, or at least for the money.

At our station, an opportunity presented itself for just this sort of easy-but-productive modification: a BMX Series II console from Pacific Recorders was to be purchased for installation in a new production studio.

The production facility would consist of top-quality equipment, including an MCI four-track recorder. The question at hand: How best to interface a four-track machine with the two-track console?

After studying the requirements of the production department and the schematics of the console, an answer appeared. The four outputs from the machine could be treated as mono

Steve Johnston is chief engineer, WGH/WRSR Radio, Norfolk, VA. He can be reached at 804-826-1310.

sources for standard line-input modules, and these modules would be modified to allow the single track to be panned from left to right.

This feature would offer a sort of four-track mixdown and could be quite useful. The production department approved of the scheme, and all that remained was to design the modification to allow the pan function.

BMX Series II line-level input modules do not offer a pan pot—they provide a mode selector which allows operation from a mono, stereo, left or right input. The microphone-level input modules have a pan pot installed in the exact location of the mode selector switch in the line modules.

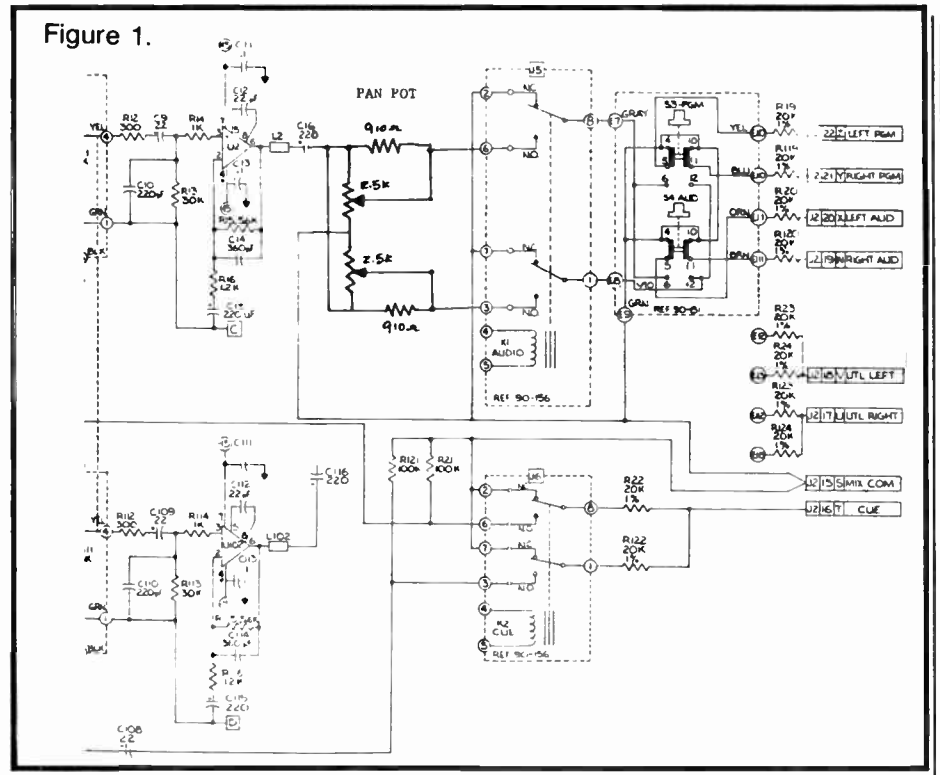
(continued on page 23)

Sequential Test Tones by Design

(continued from page 17)

tone only moderately and provides greater output from the XR-2206. In practice, this has been a great advantage when powering circuits which require higher levels.

A standard full-wave bridge rectifier is used on the secondary of a 12.6 VAC transformer. The output of the bridge is



filtered and directed to a 7812 voltage regulator chip, and is again filtered on the output.

At this point the on-off switch selects the AC supply or battery pack to feed voltage to the rest of the circuits. A 7805 voltage regulator supplies the 5 V needed for the TTL stages (decoder, counter and timer).

Decoder/function generator interface

The 74LS138 decoder chip provides an active low (ground) on the pin which is selected. This is in keeping with the active low required of computer memory chips (the typical function of this chip is to select banks of memory). When the various pins of the decoder are at ground potential, the LED is grounded, completing the circuit.

The lit LED is a visual indication of the decoder pin selected. The same pin is used to ground the chosen timing resistor through a diode switch (1N914).

The sequential tone generator resistors are associated with pin 7 of the function generator chip. The variable resistor is on pin 8.

When pin 9 is brought high, the timing resistor on pin 8 controls the oscillations. When pin 9 is low or permitted to float, pin 7, and therefore the resistor/decoder network, is activated.

Design problems

During the development, two major design problems emerged. The concept of sequential stepper circuit was originally obtained from the M. Morris Mano text *Digital Logic and Computer Design*.

An actual circuit was found in the *Forest Nims III Designers Handbook*. Unfortunately, Mr. Nims left out several details and some important logic level points were discovered to be floating.

Once corrected, the stepper worked perfectly.

The second problem which became evident was the discrepancy between the calculated value of the timing resistors due to the diode switching network. The predicted values were off due to the forward resistance of the diode, which was

now in series with the timing resistor.

It is not impossible, but very difficult, to predict the added resistance in order to compensate. In addition, unless trim pots are used, one has to be satisfied with the tones produced by standard resistances.

Therefore, the most expedient approach was to start with the predicted values and experimentally find the required values. The actual tone frequencies are within reasonable limits for the application.

Performance and recommendations

Since this prototype was constructed, several improvements were incorporated to produce the final product.

The manufacturer's specs call for a distortion of 0.5% and an amplitude variation of 0.2 dB. As yet I've been unable to adjust the trim pots to achieve the 0.5% limit.

The unloaded variation in amplitude over the usable spectrum is approximately as stated. Problems develop when patching into some older distribution circuits. They tend to load down the output at certain frequencies. As a result, the amplitude varies as much as 2 dB.

This could be corrected with a sensing and feedback loop circuit. However, this would significantly increase the complexity and cost of the unit.

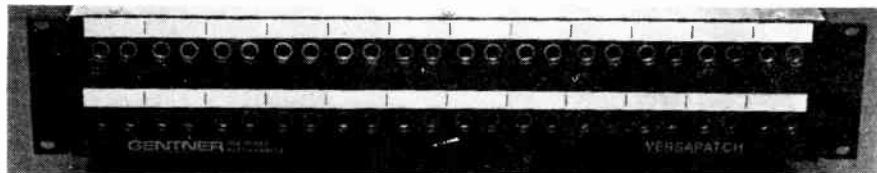
In practice, it is much easier just to mentally compensate for the discrepancy. It has proven *not* to be a problem with direct connection to the tape machine input.

The Sequence Hold feature was a direct result of one technician's suggestion that the tones should be held indefinitely, if need be. During the troubleshooting of recording equipment, this proves to be an invaluable feature.

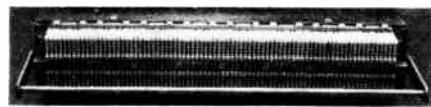
The 600 ohm termination feature was added when it was realized that some of the "professional" recording equipment does not utilize transformer input.

The prototype has been an unqualified success. It greatly increases the efficiency of alignment and frequency response tests.

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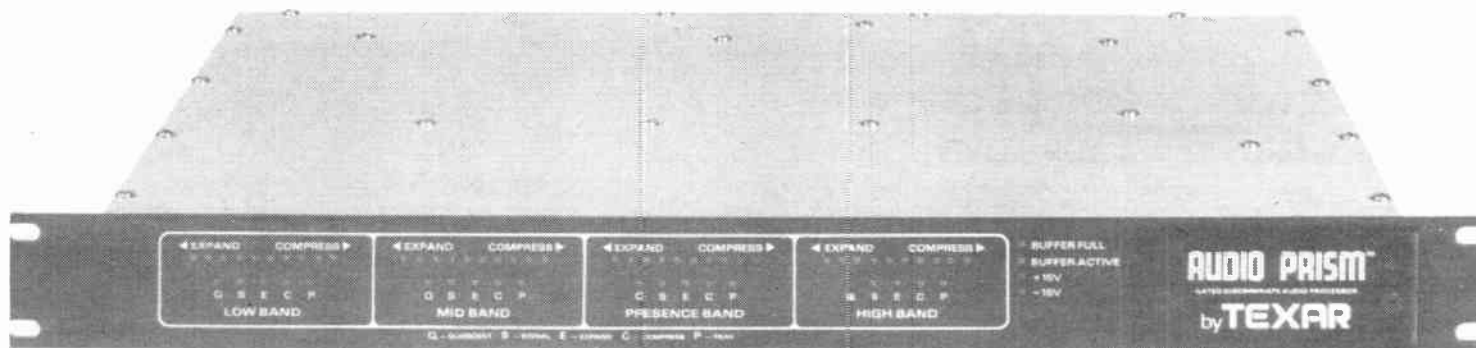
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Is Madison Conclave A Must?

by Mark Durenberger

Minneapolis MN ... I've attended more than half of the 32 Madison, WI Broadcast Engineer's Conferences and am convinced that this conclave will become an ever more important priority to engineers

Mark Durenberger is a senior RW columnist and an independent consulting engineer. He can be reached at 612-822-0041.

interested in professional growth. In spite of concerns about other (new) fall engineering shows, Don Borchert and crew put on a program that was, once again, better than the year before.

The efficacy of early promotion was again proven; the early mailings contained thorough information and resulted in another attendance increase. The reason for the early detailed mailings is that, by the time you read this, Don Borchert will be planning next year's schedule; will

have solicited and reviewed thorough critiques and ideas for next year from all attendees and will have talked with his program committee, which consists of engineering leaders from the five-state area.

The result of all this input is a multiple-interest schedule, and while some thought the overall program lacked specific focus, I'm not at all convinced that's a detriment. There was a lot for everyone.

The most unique feature is the all-day Management Conference and case-study review in which participants get directly involved in day-to-day management situations and learn how to deal with them effectively. The remainder of the sessions provide practical information for radio and TV engineers far beyond sales pitches and well into the nuts-and-bolts practical arena.

It's nice to see how every year more and more attendees are getting involved in the give-and-take. This year we helped that along by a refocusing of the "Nuts-and-Bolts" rap session and through the "Great Idea Giveaway" ... two of many offerings which make the Madison Conference quite singular.

The nuts-and-bolts session benefited from an intelligent discussion of modulation measurements and audio processing alternatives, led by Eric Small, and

Engineering Views

from a review of new wiring installation techniques, among many other practical topics.

The great idea giveaway

Thanks to the generosity of many marvelous exhibitors, we were able to award thousands of dollars' worth of serious prizes to attendees who contributed their "Great Ideas" and who were asked to explain how that idea helped make their engineering lives simpler. (Those ideas repose in the safe at RW and are available by contacting their offices.)

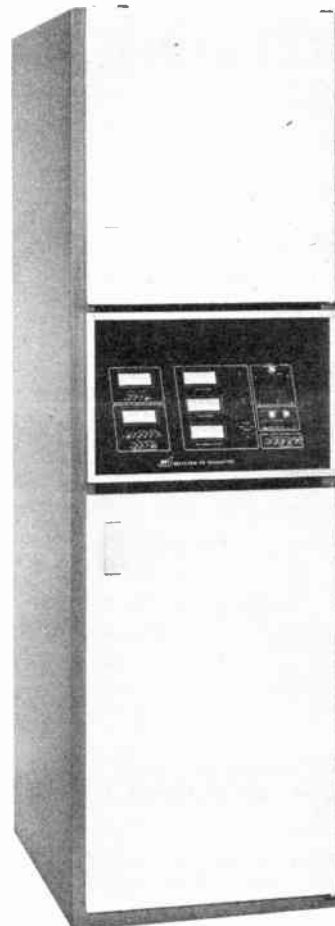
Careers

I spent a lot of time listening at Madison (for a change). For whatever reasons (and there are a lot of them), many attendees are looking to better themselves professionally, whether or not they in-

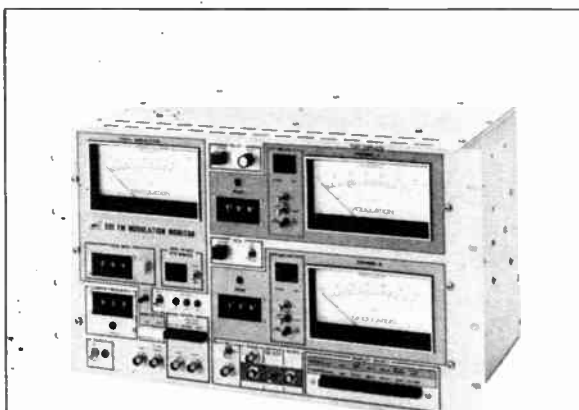
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Is Madison Conclave A Must?

(continued from previous page)

tend to stay in broadcasting.

I saw home-study tomes on advanced electronics in some folks' rooms. And every year we find more good engineers who are providing broadcast services as independent contractors.

This can only be good for the broadcast industry, providing the competition stays healthy.

For the most part, this year's attendees professed to be a lot more comfortable with their present professional situation. There was no time wasted bemoaning the demise of the Proof and the First Phone (though we did kick EBS to several deaths). There was a lot of time spent on information exchange.

The future

What about the future? Madison will be better than ever next year, and will be held about the same time as usual.

This is encouraging to those who have scheduled their lives around this event for the past 32 years.

I didn't attend New Orleans or SBE, St. Louis but heard both were good shows.

But the more I see of the singular qualities of the Madison conclave, the more convinced I become that "Madison is a Must."

The Santa Fe project

I promised to keep you posted on our KOB Santa Fe Synchronous Booster project.

By the time you read this we should be ready to turn the system on.

As soon as we've gained some real experience in measuring the distortion zone effects, we'll share our findings with you.

We're going to be operating about 200 W on 770, duplexed with a station on

1260, and expect to provide excellent nighttime coverage to this state capitol, which is 60 miles from the main KOB transmitter and in a null region of protection KOB affords WABC at night.

As I write this we're wrestling with the best way to get the audio from Albuquerque to Santa Fe, and are concurrent-

ly exploring several different ideas. We'll keep you posted on the results.

Meanwhile . . . don't feel too sorry for us. We'll be doing our measurement work in and around some of God's most beautiful country . . . during a late New Mexico fall. Eat your heart out . . . and stay tuned!

Interfacing Digital to The 'Analog Universe'

(continued from page 12)

converter. Your compact disc player uses a D/A to convert the digital signals into audio.

One practical application that comes to mind is sine wave generation, where excellent frequency accuracy and relatively low distortion are required. A

square wave can be generated at a very precise frequency using digital techniques, but the low-pass filter required to produce a good sine wave has to be sharp enough to get rid of the third harmonic. This is especially difficult if you want to generate several frequencies, since you would have to also switch filters.

Using a D/A converter to produce an approximation of a sine wave greatly simplifies the filter requirements and allows at least some frequency agility. Figure 3 shows the output of a 4-bit D/A superimposed on an ideal sine wave. In this case the resistor values are weighted to accurately represent the sine function, allowing better precision than could be obtained with an off-the-shelf 4-bit D/A.

The Fourier spectrum of this signal is shown in Figure 4. The first offending harmonic is 16 times the fundamental. A simple reconstruction filter easily removes these harmonics, producing a low-distortion sine wave at precisely the desired frequency.

Next month we'll discuss the companion A/D converter which lets us capture real world analog signals and conveniently process them in the digital domain.

Modified BMX-II Ideal Production Tool

(continued from page 20)

A quick look at the "innards" of each module revealed that the pan pot in the mic module was the perfect fit to replace the selector switch in the line module.

The mechanical details are perfect—what about the electrical concerns?

By replacing the mode selector with the pan pot, and treating the left audio path as the mono channel for the machine output, a nice and easy pan connection could be made.

Figure 1 shows the schematic diagram of the modified line input module. Notice the simple hookup and the low parts count of the project. It is hard to imagine a project with only three parts and quick installation that could prove to be as productive.

The parts are available from Pacific Recorders, but I chose to order the pan pot from Pacific and use 910 ohm resis-

tors from my stock. The pot is a Clarostat product and can be had from Pacific Recorders Customer Service for \$12—order part number 24-67.

Installation is quite simple. First remove the mode selector switch from the line-level input module and put in your stock as a spare for the other switches in the console. Mount the pan pot in the same panel hole and solder the 910 ohm resistors on the pot as indicated on the schematic.

Connections to the pot are made using the existing wires—just follow the modification schematic. The output of U2 feeds the pan pots, which track opposite of each other to produce a split feed to the audio relay, K1. This relay connects the split-feed to the left and right outputs.

Repeat the installation for the other modules and relabel the panels to finish

the job.

Tests of the pan-modified module indicate that the specifications are not compromised by this change—at least to the extent we can measure. The ability to pan each of the four tracks allows the operator to "assign" the tracks to either left or right, or to place the source somewhere midway in the stereo image. This is a considerable improvement, and all of our operators are pleased with the result.

This modification does not turn the air-oriented BMX into a full production board, but it does provide added utility for little expense. And, of course, it's a chance to feel the satisfaction of creation—through modification.

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Broadcast Computing

Use Vector Analysis To Tune AM Array

by Mark Chambers

Orlando FL ... If you're faced with having to tune your AM array and dread the thought of all those calculations, this program should prove to be of some benefit.

Using vector analysis as a tool in tuning an array can provide a reliable solution to the problem.

Plugging the variables into a few formulas will assist you in determining the answer.

The only thing that you will have to do is plot the results on paper to determine the resultant vector.

Through the graphic representation of each of the vectors, you will be able to see how each of the variables affects the shape of the array.

The program shown in Figure 1 is written for Model III in Level II BASIC. There may be some display formats that might need to be changed for use with another computer.

The program is designed to be used with any number of towers.

The built-in editing function allows any of the variables to be changed, thus allowing the user to immediately determine the effect of that change.

(continued on next page)

```
DIRECTIONAL ARRAY VECTOR ANALYSIS
ENTER NUMBER OF TOWERS IN ARRAY? 4
ENTER TOWER # 1 RELATIVE AMPLITUDE
? 1
ENTER TOWER # 1 PHASE READING
? 0
ENTER TOWER # 2 RELATIVE AMPLITUDE
? 1.88
ENTER TOWER # 2 PHASE READING
? -148.5
ENTER TOWER # 3 RELATIVE AMPLITUDE
? 1.38
ENTER TOWER # 3 PHASE READING
? 92
ENTER TOWER # 4 RELATIVE AMPLITUDE
? .44
ENTER TOWER # 4 PHASE READING
? -62
ENTRIES ARE :
      AMPLITUDE  PHASE
TOWER # 1 : 1.00   +0.00
TOWER # 2 : 1.88  -148.50
TOWER # 3 : 1.38  +92.00
TOWER # 4 : 0.44  -62.00
ARE ALL ENTRIES CORRECT? (Y)ES, (N)O
```

```
MONITOR POINT BEARING: 163 DEGREES
      RATIO    PHASE    VECTOR
TOWER # 1 : 1.00   +0.00   +0.00
TOWER # 2 : 1.88  -148.50  -154.00
TOWER # 3 : 1.38  +92.00   +79.00
TOWER # 4 : 0.44  -62.00   -80.00

DO YOU WISH TO CHANGE (T)OWER PARAMETERS, (M)ONITOR PT
(R)ERUN ENTIRE PROGRAM OR (E)ND
ENTER DESIRED SELECTION
```

```
10 CLS
20 PRINT CHR$(23)
30 PRINT@400, "DIRECTIONAL ARRAY"
40 PRINT@454, " VECTOR ANALYSIS"
50 PRINT@526, "BY MARK A. CHAMBERS"
60 PRINT@594, "WJYO/WORL RADIO"
70 FOR X=1 TO 1000:NEXT X
80 CLS
90 PRINT"DIRECTIONAL ARRAY VECTOR ANALYSIS"
100 INPUT"ENTER NUMBER OF TOWERS IN ARRAY";T
110 CLS
120 FOR X=1 TO T
130 CLS
140 PRINT"ENTER TOWER #";X;"RELATIVE AMPLITUDE"
150 INPUT I(X)
160 PRINT"ENTER TOWER #";X;"PHASE READING"
170 INPUT P(X)
180 NEXT X
190 CLS
200 PRINT"ENTRIES ARE : "
210 US="###.## +###.##"
220 PRINTTAB(10)"AMPLITUDE  PHASE"
230 FOR X=1 TO T
240 PRINT" TOWER #";X;": ";USING U$;I(X);P(X)
250 NEXT X
260 PRINT"ARE ALL ENTRIES CORRECT? (Y)ES, (N)O"
270 AS=INKEY$:IF AS="" THEN 270
280 IF AS="Y" THEN 310
290 IF AS="N" THEN 110
300 GOTO 270
310 CLS
320 INPUT"WHICH IS YOUR REFERENCE TOWER";REF
330 FOR X=1 TO T
340 CLS
350 PRINT"ENTER THE ANGLE BETWEEN THE SPACE REFERENCE AXIS AND A LINE F
ROM THE SPACE REFERENCE POINT (TOWER#";REF;") TO THE TOWER #";X
360 INPUT PH2(X)
370 PRINT"ENTER DISTANCE IN DEGREES BETWEEN TOWER #";X;"AND TOWER #";REF
380 INPUT S(X)
390 NEXT X
400 CLS:INPUT"ENTER THE DESIRED MONITOR POINT";M
410 CLS
420 FOR X=1 TO T
430 A1(X)=PH2(X)-M:A(X)=COS(A1(X)*.01745329)
440 B(X)=(S(X)*A(X))+P(X)
450 NEXT X
460 TS="X X X X X X"
470 F1$="###.## +###.## +###.##"
480 PRINT"MONITOR POINT BEARING: ";M;" DEGREES"
490 PRINTTAB(12) USING T$;"RATIO", "PHASE", "VECTOR"
500 FOR X=1 TO T
510 PRINT" TOWER #";X;": ";USING F1$;I(X);P(X);FIX(B(X))
520 NEXT X
530 PRINT
540 PRINT"DO YOU WISH TO CHANGE (T)OWER PARAMETERS, (M)ONITOR PT"
550 PRINT"(R)ERUN ENTIRE PROGRAM OR (E)ND"
560 AS=INKEY$:IF AS="" THEN 570 ELSE 580
570 PRINT@640, "ENTER DESIRED SELECTION":FOR Q=1 TO 80:NEXT Q:PRINT@640, "
";:FOR Q=1 TO 20:NEXT Q:GOTO 560
580 IF AS="T" THEN 620
590 IF AS="M" THEN 400
600 IF AS="R" THEN 80
610 IF AS="E" THEN END
620 CLS :PRINT"WHICH TOWER PARAMETERS DO YOU WANT TO CHANGE?"
630 X=0
640 PRINT"ENTER (1) FOR TOWER #1, (2) FOR TOWER #2, (3) FOR TOWER #3, ETC..."
650 AS=STR$(X)
660 AS=INKEY$:IF AS="" THEN 660
670 X=VAL(AS)
680 GOTO 690
690 CLS:PRINT"DO YOU WANT TO CHANGE (A)MPLITUDE OR (P)HASE OF TOWER#";X
700 AS=INKEY$:IF AS="" THEN 700
710 IF AS="A" THEN 740
720 IF AS="P" THEN 770
730 GOTO 700
740 CLS:PRINT"ENTER NEW RELATIVE AMPLITUDE FOR TOWER #";X
750 INPUT I(X)
760 GOTO 410
770 CLS:PRINT"ENTER NEW PHASE READING FOR TOWER #";X
780 INPUT P(X)
790 GOTO 410
```



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Circle Reader Service 15 on Page 23

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Circle Reader Service 26 on Page 23

Broadcast Computing

New Bits: Worth a Scan

On-Line Public Radio Service
Newark NJ ... Radio Resources Network has begun an on-line service for the public radio community. The services include message, news story and actuality exchanges, text retrieval, daily FCC activity reports and NPR DACS message retrieval.

In addition, companies ranging from news services to record companies represent their services through RNN.

Features include an exclusive service that lets members access the broadcast wire services of Associated Press and daily updates of the FCC's "Daily Digest" and various FCC press releases via the FCC Information Database.

Connection time charges for RRN range from \$0.17 to \$0.38 per minute, depending on time of day and modem speed. There is a one-time \$39 setup fee.

Access is via TYMNET from over 650 local phone numbers in the US.

For further information, contact Nathaniel Phillips at RRN: 201-483-0770.

Micro Minutes

Irvington NY ... Micro Minutes™, aka "Computer Knowledge in Byte-Sized Pieces," is a package of one-minute segments for airing that offer listeners tips for buying or using personal computers.

Cost is \$100 (\$75 for public radio stations). For information, contact Jason Rich, executive producer, Software Riches, at 914-591-6470.

National users network

Washington DC ... The American Automation Associations in Computer Technologies and Societies (AAACTS) is providing network coordinators for micro computer users through a toll-free number.

AAACTS' members provide their systems information or requirements to hotline phone counselors, or through the mail. AAACts then guarantees the closest local expertise, whether it be a user group or another AAACts member with the same system.

The system is designed to set up successful user support programs.

AAACTS services to all certified

members include PC planning and guidance, equipment insurance referrals, worldwide user group information, computer theft registration, user systems matching, referrals and discounts with local and regional user groups, referrals for suppliers and maintenance repair centers, national newsletters and a 24-hour member hotline.

Special services include: membership discounts; VIP technical assistance; membership ratings of supply, training and service centers; a worldwide user referral network, including hardware and software ratings and recommendations; a health network and dating services.

For further information or for a membership packet, call AAACts Research at 703-522-3930. The hotline number is 800-826-5643, ext. 222.

Low-cost music management

San Francisco CA ... Ariste Software's new Play List II, a PC-compatible music management program, is now available for \$495.

The program features 26 record categories, 16 dayparts, 6 user-selectable attributes, 24 time patterns and 335 day patterns.

Up to 2,000 titles can be stored on a single floppy disk, with 48-hour protection on title repeat available. Maximum music per hour can also be set by the user.

In addition to daily programming lists, Play List II features several internal management reports.

The program can interface with dBASE II for customized reports.

System requirements are an IBM PC or compatible with two floppy disk drives and 256K RAM.

For information, contact USPME, Inc.: 415-546-9181.

Easy Tuning Method

(continued from previous page)

The variables for the program are as follows:

T = Number towers in array.
I = Relative amplitude of tower
P = Phase reading (read from antenna monitor)

REF = Reference Tower
PH2 = Angle between the space reference axis and a line

from the space reference tower to the tower being calculated.

S = Distance in degrees between reference tower and tower being calculated.
M = Monitor point.

Mark Chambers is assistant CE at WORL/WJYO, Orlando. Call him at 305-298-5510.

Distributor Notes

Got any updates on new product lines, new employees, or changes of address? Send your information or press releases to Radio World.

Microdyne Adds Allied

Microdyne Corp. has appointed Allied International as a stocking distributor of selected Microdyne satellite communications products.

Included will be TVRO and SCPC systems, specifically the 1100-PCDR (5), 1100-FFC(X1)RDC-L SCPC products, various satellite video receivers, and antennas ranging from 1.2 to 7 m for S-band, C-band and Ku-band applications.

For more information, contact Allied at 317-962-8596.

CRL Brings Back Dynafex

CRL Audio has announced that it is in the process of manufacturing and re-tying for distribution the Dynafex line of after-the-fact noise reduction processors.

CRL purchased the assets and products of the former MicMix enterprise in 1985. Products being offered immediately are the Dynafex DX1 and DX2.

For more information, contact CRL: 800-535-7648.

RF Specialties Group

RF Specialties Group has added a new member: Tom Monahan will operate RF Specialties Group of Pennsylvania. He can be reached at 412-733-9114.

RF Specialties Group is a trade association consisting of six independently owned offices located around the country. The offices provide sales and support to area broadcasters, and specialize in RF products, featuring the Nautel line of AM transmitters and Broadcast Electronics' FM transmitter products.

Offices are located in Florida, California, Texas, Nebraska and Washington state, in addition to the new Pennsylvania office.

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New Gadgets Aid Ad Creativity

by Ronald F. Balonis

Wilkes-Barre PA ... The one element that makes most radio broadcasting possible is the commercials. Yet, despite their importance, commercials are also one of the most perplexing aspects of radio.

No one wants too many or too few of them. No one knows how many are the right number to have.

To further cloud this enigma, all commercials are not created equal. Some are more creative than others, and this creativity is their reason for being—and (sometimes) the advertiser's reason for being—on radio in the first place.

Creative radio commercials can work for the benefit of both the advertiser and the station. However, depending as they must on an exclusive human quality, the production of creative radio commercials is, at best, an elusive task.

Aural production gadgets

Tools don't make creative radio commercials; the creative radio people who think of and make them do. But good tools and sufficient and well-maintained equipment can help a little. An assortment of aural production gadgets (processing devices to some) such as equalizers, reverbs and compressors can help a bit, too.

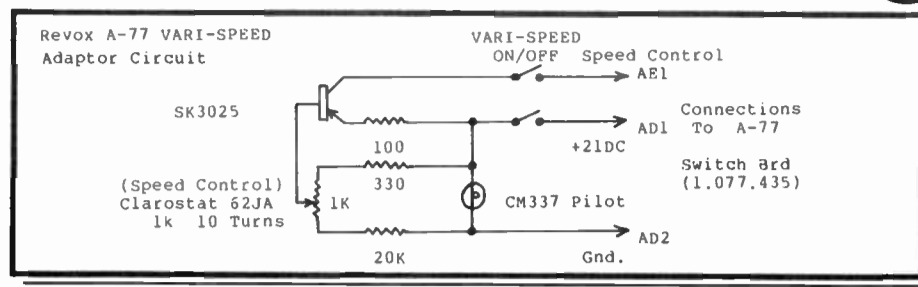
Engineering, in little ways, can also help by providing some of the "not-of-the-ordinary-kind" production gadgets, for, when all else fails, an unusual production gadget can stimulate and crystallize the creativity to make the unique and creative radio commercial.

At WILK we have several production gadgets (devices) which can be called unusual, maybe even odd. The best of our "not-of-the-ordinary-kind" of production gadgets is a simple adaptor which turns a Revox A-77 tape recorder into a varispeed tape recorder.

It may seem sacrilegious to do anything at all to a tape recorder like the Revox A-77; all things considered, it is one of the best tape recorders ever made. But, being able to vary its speed at will can double its worth in a production room.

Normally, a tape recorder running off-speed is a sign that it's in dire need of maintenance. But when intentional, an

Ron Balonis is CE at WILK, Wilkes-Barre, PA and a frequent contributor to RW. He can be reached at 717-824-4666.



off-speed tape recorder is a useful tool for "creative" radio commercial production. It gives you the ability to manipulate, at will, the size qualities of sound, to make sound *bigger or smaller*.

The A-77's innovative technical design, that which gives it its precision-speed characteristic, makes the adaptor possible. The Revox A-77 uses an electronic motor drive circuit for speed regulation and changing; the varispeed adaptor, by controlling the bias on the speed-change/regulation circuit, turns it into a varispeed tape recorder, and thus a production tool for creative, speed related, aural effects. It also becomes a valuable tool to clean up the off-speed recordings produced at other stations and by all those other tape recorders.

The varispeed adaptor mounts out-board alongside the Revox connected to it with a length of shielded cable. The adaptor requires only three connections to the Revox's switchboard (1.077.435).

- +21 VDC to tie-point AD1; it's located just below the upper right-hand corner mounting screw and has a red wire on it.

- The speed control (collector of the transistor) goes to tie-point AE1 (connects to A-77 speed control switch; open = 7½ ips; + 21 VDC = 3¾ ips); it's located just to the upper left of the CH1 playback connector, and it has a red wire on it.

- Ground to tie-point AD2; it's the bottom tie-point, with a blue wire on it, located between the oscillator and relay

connectors.

The only critical part of the adaptor is the 10-turn pot for the speed control (Clarostat 62JA 1K or equivalent); you need the 10 turns for smooth and easy control of the speed. As for the other parts, most anything "close" will do.

Varispeed adaptor operation

The varispeed adaptor works with the Revox in 3¾ ips speed to vary the speed from 3¾ to 7½ ips. So, to increase a recording's playback speed, record at 3¾ ips (varispeed off), then play back with varispeed on to vary the speed from 3¾ to 7½ ips.

To decrease a recording's playback speed, record at 7½ ips (varispeed off), then play back at 3¾ with varispeed on to vary the speed from 3¾ to 7½ ips. Or, for a real weird effect, to play back at speeds above and below a recording's speed, record and playback with varispeed on.

At WILK I have two "runner-up," not-of-the-ordinary-kind production gadgets that will be coming up in RW soon. My second is a "Phaser" to create, in real-time, a pseudo-flanging effect, while my third is a "Product Modulator," an AF-balanced modulator useful for creating computer-like speech and effects.

Readers' Forum: More Views on News

(continued from page 6)
AM stereo judgment

Dear RW:

I am one of the few, the proud, blessed with the opportunity to see, hear and lay hands on both the Kahn and Motorola systems. I had one of each at the same time and was able to do field testing in both day and night modes. I even heard platform motion on the Motorola system before they introduced their corrective measure into the 1986 radios.

For the benefit of the Kahn folks, the corrective measure was to sample for co-channel signals and force the radio to go mono until the cochannel noise went away. That brings up the question I want to ask and the comments I'd like to make.

Do we want a stereo system that pops in and out of stereo (or slow fades to mono) every time the signal from the station drifts? If we allow the receivers to stay in stereo, can we tolerate the disorientation and loss of channel identity they produce to the listener? Do we have any say so about it or not?

I think you will see Class IV AM stations trading in their Motorola gear for Kahn stuff when they find out that it just won't work during critical and nighttime hours.

The folks here in Florida will have no choice, if they want anyone to listen in stereo, but to swallow their junior executive pride and order a Kahn system. That's just my opinion. If you would like to hear what I am talking about, just come on down to Florida and bring your Sony SRF100 radio with you.

This system that will aid in salvaging the AM spectrum must work for all of the radio stations or it is useless to us, and only benefits those who say this is no longer an engineering question.

I am not someone whose was stuck with a Kahn system and is hoping to stall off the Motorola muscle. I had a Motorola station first and had the opportunity to judge that system six months before the Kahn system was installed across town.

Today, the Motorola station is off the air. There are many reasons why that station failed. If one were to study their

technical expenses, it would appear that the decision to invest in stereo equipment in 1984 contributed to their lack of success. The former owner was the first to complain of the poor stereo coverage and the critical hour interference heard on his Sherwood AM stereo radio.

To those who are the least bit interested in restoring AM radio to at least its original position in the marketplace, know that the battle is not over yet. There is much to be done if you want your voice heard over the media blitz, propaganda and power that our friends at Motorola will continue to promote. Whether we win makes little difference to those who will blanket their market and care nothing about their nighttime skywave or fringe (less than 2 mV with no cochannel interference) area coverage. These people are usually 50 kW on clear channels.

Most of them have transmitter supervisors, have tested their system in closed loop configuration and are rejoicing because the GM and SM have little stereo lights that glow when their station is tuned in. What the listener thinks now or five years from now makes no difference to them. They could care less about the 1 kW and 5 kW stations that will struggle for answers as the Motorola system pops its head up in the midst of the upcoming FMX, CD and digital wars.

In defense of Motorola—they make great pagers, TVs and government products. I have two Motorola pagers and they work great. I have never heard platform motion and they never jump to mono. I can take both of them to work and someone can page me on both of them. Great separation. Who could ask for anything more?

Jerry Smith
556 George Taylor
Orange Park FL 32073

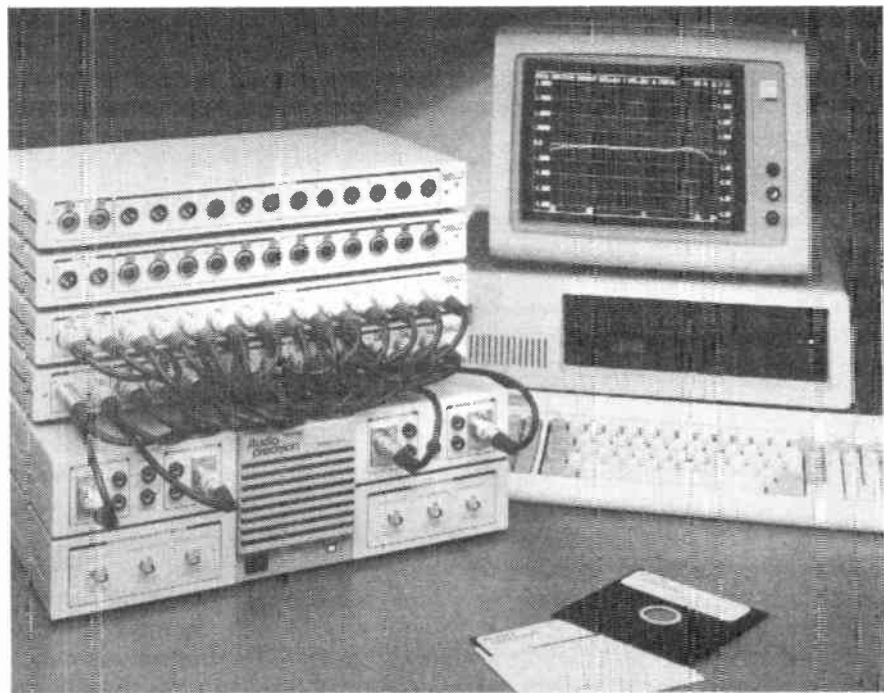
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New Products



Audio Precision Filters for System One

Optional plug-in filters, available from Audio Precision for its System One, allow the measurement of second or third harmonic distortion individually. These are in addition to the previously available capabilities for THD and three forms of IMD.

Tape recorders frequently require measurement of only third or second harmonic distortion. A properly operating recorder will exhibit purely third harmonic distortion in the up-

per portion of its amplitude range, but bias problems can give rise to second harmonics.

The filters can be ordered for second and third harmonic measurement of a number of commonly used fundamental frequencies, including 1 kHz, 400 Hz and 315 Hz. Filters can also be custom ordered for any frequency and audio range.

For more information, contact Audio Precision: 503-297-4837.

Lightning Prevention Systems

Lightning Prevention Systems' ALS-3000 utilizes the "prevention" concept, which renders the tower virtually invisible to lightning. According to the company, its concept makes the lightning rod obsolete.

The system takes full advantage of ion-dissipating technology. Copper radials buried in the ground collect positive charges. The charges travel to the dissipating arrays and are rapidly discharged into the atmosphere, immediately neutralizing the area.

A two-person crew can easily install the complete system in less than a day. It is maintenance free and built to endure. All arrays, related parts and mounting hardware are made of high-grade stainless steel and aluminum.

For more information, contact Gregg Fawthrop, Lightning Prevention Systems: 609-767-7209.

Seck 1282 Console

Connectronics is now offering the Seck 1282 audio mixing console from England.

The Seck 1282 is a studio quality, yet portable console featuring 12 balanced inputs, 8 subgroup busses and 4 auxiliary returns, each with full equalization and routing as well as a stereo output.

Tip-ring-sleeve insert jackets are provided on each of the 12 inputs and each of the 8 subgroups. The equalization is in three bands, with a sweepable mid-range.

The monitor section is "in-line" with

the inputs, allowing for easy use of all the facilities. During mixdown the monitor section can be switched to the channel, allowing up to six auxiliary sends to be used.

A built-in talk-back mic, with push-button access to tape and the fold-back busses, allows communication during recording sessions. Metering is via twin bargraph LED meters, which can be switched from "averaging" to "peak" reading displays.

For more information, contact Connectronics Corp.: 800-322-2537.



Electro-Voice N/D Series Mics

Electro-Voice's new N/D Series music microphones make use of an exotic magnet material the company calls N/DYM—a neodymium alloy—and, according to the company, it has defined a new structure and geometry for a microphone element.

N/D mics contain a magnet smaller than conventional dynamics, and a surrounding magnet structure which is both shorter and wider than most magnetic assemblies. The configuration allows for large-diameter voice coils, oversized diaphragms with typically 50% more surface area than other designs and smaller, more precise magnetic circuits.

The large N/D diaphragm intercepts more soundwaves and converts the energy into more output, reliably coupling high-frequency pressures and voice-coil movement up to 20,000 Hz.

The capsule element of the N/D is cradled in an energy-absorbing elastomer to cushion against impact. The windscreen sports a rubber bumper to eliminate "thuds" when a mic is placed on a hard surface.

For more information, contact Mary Ellen Long, Electro-Voice, Inc.: 616-695-6831.

Making Agile System User Friendly

(continued from page 14)

able audio demodulator that is part of it, is a home-grade piece of gear (KLM) meant to run on the 70 MHz from an LNC (an LNA with a tunable downconverter built in). The demodulator delivers a wideband output that is suitable to drive an outboard stereo demodulator.

The stereo demodulator is mounted in

the video demodulator, runs on its power supply and, with line driver amps, feeds out balanced audio. The stereo demodulator contains a matrix for discrete and multiplexed stereo audio.

Most of the time, the system is in the SCPC mode. The last components in the control room are then the SCPC demodulators. These are driven by the 70 MHz drop cable coming from the receiver/downconverter at the dish and looped through each unit. A 70 MHz drop also goes to the shop, which of course makes maintenance much easier.

Each program source has a "satellite information sheet" which, with drawings of the front controls of each unit (polar rotator, positioner, transponder/format selector and demodulator) indicate the

proper sequence for setting and visual position of each switch.

When the program source is "roughed in," all of the controls are "tweaked" for best performance. The worst-case change still takes less than five minutes.

Frankly, in order to achieve this kind of reliability and speed, the "human interface" factor is the most important. The system really does not do what it should if an engineer is required for changes.

This article is not intended as a "how to," as, even since we built the project two years ago, the equipment available has changed. However, I hope it accomplished the task of laying out the needed components and some of the hurdles to be overcome, as well as the benefits that might be gained from an agile system.

Glitches

(continued from page 13)

fix proved unnecessary.

I'll pass along a circuit idea for a glitch catcher similar to the type included in some logic probes. Build a flip-flop and clip the set lead into lines you expect are getting extra pulses.

An additional feature might be to disable a digital clock when the flip-flop sets. This will give you the exact time that the problem occurred.

Don't forget housecleaning

One overlooked cause of intermittent problems is just plain old dirt. It builds up quietly on contacts, tube sockets and in patch bays.

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A regular cleaning, burnishing and exercising of moving contacts will prevent a lot of nasty surprises.

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AMPLIFIERS

Want to Sell

Belar RFA-1 AM RF amp, solid state. \$175. D Doelitzsch, WDDD, 1 Bdct Ctr. Marion IL 62959. 618-997-8123.

Crown D150A 150 W power amp. \$290. B DeFelice DeFelice Consulting, 621 Bishop, Bridgeport CT 06610. 203-336-5606.

Harman-Kardon Citation 12 (2), rack mountable power amps, gd cond. BO. J Von Vleck, Aras Consultants, 2321 N Utah, Arlington VA 22207. 703-524-5067.

Dynaco Mark III, 60 W tube pwr amp. \$50. E Helvey, Successtrax, POB 1357, Winchester VA 22601. 703-877-1191.

Biampt TC60 power amp. \$295. D Kocher, 1901 Hanover Ave. Allentown PA 18103. 215-776-1455.

Ampex monitor amp & speaker. \$100. B Hunter, KIXE, Box 9, Redding CA 96099. 916-221-5800.

Scott tube-type Stereomaster 299-D preamp & amp. \$20; matching Scott Stereomaster 333-B AM/FM tuner. \$15; Scott tube-type stereo lab amp, from a kit. \$20. C Brennan, 661 Horseshoe Curve, Pike Road AL 36064. 205-277-0139.

Langevin tube & solid state & preamps. large quantities. BO. R Van Dyke, Squires Ave. E Quogue NY 11942. 516-728-1327.

Sansui CA-F1 straight-line preamp, black, rack mt. like new. \$200. W Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

Bogen MTA 60 PA amp. \$50; McMartin MA20 PA amp. \$25. J Reichard, POB 557, Mechanicsville MD 20659. 301-373-3339.

University 100W basic amp, rack mount, excel cond. \$100. W Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

Tapescaster 3 chan remote amp. AC or battery ops. VU meter, compact metal case, like new cond. \$150 plus ship. M Gollub, Maine Reel Comm, 67 Green, Augusta ME 04330. 207-623-1941.

Crown D-150, excel cond. \$425. P Costa, Eastern Snd/Video, 462 Merrimack, Methuen MA 01844. 617-685-1832.

Want to Buy

Marantz, McIntosh, WE & related elect. C Dripps, Kurlaff Enter, 4331 Maxson Rd. El Monte CA 91732. 818-444-7079.

McIntosh, Marantz, Dynaco Quad. Audio Research, etc. amps; WE, Tannoy, Altec. EV, JBL, Hartsfield, Olympus, Harness, Laguna speakers; Thorens, Fairchild turntables; WE tubes & microphones. Lapine, 3920 August Dr. Lake Worth FL 33461. 305-588-8195.

Marantz/McIntosh MC2300 MC2500, C29 tube & solid state equip, C Dripps, Kurlaff Ent, 4331 Maxson Rd. El Monte CA 91732. 818-444-7079.

ANTENNAS & TOWERS

Want to Sell

Truscon tower, 4 leg. angle steel, heavy galvan. self-supporter. 183', excel cond w/4 base insulators. \$16,000. R Brosig, WTAN, St. Petersburg FL. 813-461-1341.

Heavy duty type, self standing tower. 40', in (5) 8' sections. \$330. S Lawson, KAK FM, 928 Hyland, Santa Rosa CA 95404. 707-528-4055.

RCA 7 bay circular antenna, 98.1 MHz, \$3000/BO. K Harnack, WKQQ, POB 100, Lexington KY 40590. 606-252-6694.

AM tower, 150' self-supporting w/4 legs, approx 7' sq base w/insulators, tapered, constructed of right angled steel, obstruction lights, currently on ground, avail for immed delivery. BO. C Thornton, WAGE, Box 1290, Leesburg VA 22075. 703-777-1200.

Windcharger, 400', 18" face, on ground ready for pickup. \$4000/BO. JP Robillard, KLUV, 1803 N 1st East St. Haynesville LA 71038. 318-624-0105.

Utility tower, 130', 16" face, on ground ready for pickup. \$1000/BO. JP Robillard, KLUV, 1803 N 1st East St. Haynesville LA 71038. 318-624-0105.

Cetec JSLP2R 2 bay w/radomes, 96.7 MHz, 5 mos old. \$2500. D Dobrowski, WSEY, 6313 Odana, Madison WI 53719. 608-274-1441.

Truscon 4 leg self-support angle steel, 183', excel cond. w/base insulators. \$16000. R Brosig, WTAN, 200 Pierce, Clearwater FL 33516. 813-461-1341.

Scala FMVH 4 bay, vert. antenna & divider network, 500 W max. \$1000. S Lawson, KAK FM, 928 Hyland, Santa Rosa CA 95404. 707-528-4055.

Phelps Dodge-Celwave CFMHP-10 10 bay CP FM wideicers, 103.3 MHz, 385', 3-1/8" line, heliax w/connectors. \$7500/BO. D Overby, Overbye Assoc, 229 E Johnson, River Falls WI 54022. 715-425-5421.

Dual directional coupler, 1030-1090 MHz, 7/8" EIA flange reduces to N-jack, new. \$35; 50 ohm 1-5/8" EIA 90 degree miter elbow w/bullet & insulator, new, equal to Andrew type 1061 (5). \$30. J Cunningham, YSDA, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

Phelps Dodge Isocoupler, 25 kW, FM 90.7, AM 1260, retunable. \$100; RCA BFH-8 horizontal antenna w/tuning section & mounting hardware. A Branch, Alan Audio, 2402 Woodridge Dr, Decatur GA 30033. 404-325-7847.

Cetec JSLP-2R 2 bay antenna at 96.7 w/radomes, less than 6 mos old. \$3000. D George, WSEY FM, 6313 Odana Rd, Madison WI 53719. 608-274-1441.

AM tower, self-supporting, 150', w/4 legs approx 10' sq base w/insulators, tapered w/obstruction lights, avail immed. BO. C Thornton, WAGE, Box 1290, Leesburg VA 22075. 703-777-1200.

Flanged EIA 90° elbows (3), new, 3-1/8", \$200 ea PPD; flanged EIA reducer, new, 3-1/8" to 1-5/8", will fit either sex, \$125 PPD. D Gilliam, KJZZ, 1435 S Dobson, Mesa AZ 85202. 602-969-9099.

Bullets (12), new, 3", 50 ohm. \$10 ea PPD. D Gilliam, KJZZ, 1435 S Dobson, Mesa AZ 85202. 602-969-9099.

Bird 3-1/8" flanged EIA wattmeter section, (2), P/N4600-000, gd cond w/new bullets, \$75 PPD. D Gilliam, KJZZ, 1435 S Dobson, Mesa AZ 85202. 602-969-9099.

Micro Comm diplexer, avail soon, will retune, will handle 2 class C stations. J Sands, KMZQ, 1555 E Flamingo Rd. Ste 335, Las Vegas NV 89119. 702-731-5100.

Andrew 87-Z splice kit for 1-5/8" heliax, \$100 PPD. D Gilliam, KJZZ, 1435 S Dobson, Mesa AZ 85202. 602-969-9099.

RF xmission line hardware for rigid line & heliax, 7/8 to 6-1/8", 500', new HJ5-50 7/8" heliax w/75AR connectors attached. 4 Husbands, 6626 Talmadge Ln, Dallas TX 75230. 214-233-6351.

Gates FMCP 124A 8 bay class A FM antenna, tuned to 105.1 MHz. J Walters, KKJO, POB 166, St Joseph MO 64502. 816-279-6346.

Phelps Dodge CFHP5, 96.9 MHz w/deicers, includes 75' of 3' coax w/connectors. \$4000 (if we remove). J Miner, KFMJ, 1215 NE 7th St, Grants Pass OR 97526. 503-479-5365.

Andrews self-supporting, 150' AM tower w/approx 10' square base w/insulators, obstruction lights, gd cond. BO. C Thornton, WAGE, Box 1290, Leesburg VA 22075. 703-777-1200.

Want to Buy

FM antenna, low power, horizontal tuned to 102.3. M Brasher, 216 Zenalona, Albuquerque NM 87106. 505-242-7163.

FM antenna, 1 to 2 bay, 98.3 MHz. A Bowab, WDLT, 2402 Woolfridge, Mobile AL 36618. 205-344-3698.

AUDIO PRODUCTION (OTHER)

Want to Sell

Eventide 932 3.2 sec digital delay stereo, \$1500; Aphex type II aryl exciter, \$1500. A Baler, WPX, 220 E 42nd, NY NY 10017. 212-210-2773.

Comex digital delay 7 sec, simple to work, 1 yr old. \$1000; ABC Network cue command decoder, brand new, \$1150. B Korngold, Ben Bdcg, POB 2621, Savannah GA 31402. 912-355-9926.

Shure 610 feedback controller. \$90; Realistic stereo mixer, compressor, \$100; 10 band EQ. \$90; dbx 155 4 chan. \$325; Shure gated, all excel. D Kocher, 1901 Hanover, Allentown PA 18103. 215-776-1455.

Telex CS61 sport headsets, 3 pair. \$50/pr. C Springer, KLMR, POB 890, Lamar CO 81052. 303-336-2206.

Comp 8 tk studio w/Tascam 80-8 w/dbx, 15 ch mixer, mic, much equip & tape, call for separate pricing & details. \$5000. B Johnson, Rejoice Recording, POB 45, Rainier OR 97048. 503-556-4052.

Ampeg mixer, 6 inputs, stereo. \$200; (2) bulk tape erasers, \$50 ea; (3) Magnefax tape duplicators. BO. B Hunter, KIXE, Box 9, Redding CA 96099. 916-221-5800.

Yamaha R1000, reverb, new cond. \$750. T Stoller, 2320 Eade Ave. Ft Wayne IN 46805. 219-484-7390.

Shure Audio Masters EQ, \$100 ea; Shure feedback controller. \$100; dbx 155 4-chan. \$325; Linn drum, \$1400, all mint cond. D Kocher, 1901 Hanover Ave, Allentown PA 18103. 215-776-1455.

Altec 9062A 7 band passive EQ's, one pair w/doc. \$40. B Skye, Skye Labs Inc, 58 W Tidbury Dr, Dover DE 19901. 302-697-6226.

Lexicon M97 Super Prime Time digital delay, excel cond. \$1200; UREI 546 2 chan parametric EQ, gd cond. \$250. T Stein, New River Studios, 408 S Andrews, Ft Lauderdale FL 33301. 305-524-4000.

dbx 162 perfect working order. \$350. B Hawkins, WENS, 1099 N Meridian, Indianapolis IN 46204. 317-266-9700.

Eventide BD955 digital delay, mono. 7-1/2 kHz, 7 sec, \$1400. A Soroka, WJRO, POB 159, Glen Burnie MD 21061. 301-761-1590.

Teac 15 w/floor stand, 24 chan cap board w/8 out, excel cond. \$3500. H Saunders, Music Shop Recdg, 1114 Riveria Dr, Greensboro NC 27406. 919-273-9892.

Technics SM-9010 EQ, 5 band stereo. BO. J Sulik, WGBA, 1145 Pine St, Green Bay WI 54305. 414-437-2624.

Burwen TNE-7000 phono NR, black, rack mt, mint cond. \$300. W Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

Sundholm 2100, stereo octave graphic EQ, one rack space. \$240. BO. N Lederman, Oval Window Audio, 306 Congress St, Portland ME 04101. 207-775-7292.

dbx 166 dynamics processor, \$400; dbx 160 compressor/limiter. \$400; (2) Scully 280, \$125 ea; Electro Sound ES-505 R-R in console type mount, \$500; Sennheiser binaural mics w/head, \$400; Rainbow Prod travel case 32x24x24 w/in-case rack mount, \$500/BO. R Sanchez, KUCV, 3800 S 48th, Lincoln NE 68506. 402-488-0996.

UREI 532 10 band graphic EQ, mono. \$150. B Umberger, WNLV, 51 S Main Ave #957, Clearwater FL 33575. 813-446-0957.

Burwen dynamic noise filter, \$25. A Goble, WIOD, POB 381177, Miami FL 33238. 305-759-4311.

Want to Buy

Pultec, Lang, or API EQ. D Kocher, 1901 Hanover, Allentown PA 18103. 215-776-1455.

Misc elect: Westrex 10A, RA1979, Fairchild 627, Davin 910-911, Davin 833A, Davin 811A, Gray 208, Altec 759, many early mono-stereo cartridges. C Dripps, Kurlaff Enter, 4331 Maxson Rd. El Monte CA 91732. 818-444-7079.

R-R, 6-8 chan console, 2 R/P cart machines all in stereo. E Lewis, Sound Audio, POB 1161, Globe AZ 85502. 602-425-3930.

Reverb units, \$1-200. P Douglas, KKAY, Box 759, Plaquemine LA 70765. 504-473-3806.

AUTOMATION EQUIP.

Want to Sell

Cetec Series 7000 automation, complete w/4 ITC 770 R-R's, (2) Audiofile cart machines, CRT terminal & software, in 4 racks, 5 yrs old. A Bishop, WZSH, POB 111, E Rochester NY 14445. 716-586-2263.

RCA DAP-5000 automation system control w/Instacart interface, clock & audio switching panel, \$1800. D Doelitzsch, WDDD, 1 Bdct Ctr, Marion IL 62959. 618-997-8123.

IGM 78 tray Go-Cart, excel cond, stereo, \$2900/BO. D Workman, KPPL, RR 1 Box 203, Stockton IA 52769. 319-785-6069.

AR-2000 automation controller plus lots of spare parts, boards, & source cards. BO. D Doelitzsch, WDDD, 1 Bdct Ctr, Marion IL 62959. 618-997-8123.

SMC 250RS Carousels (2), Gates version, mono. \$500/both. L Snyder, Box 182, Floral Park NY 11001. 718-347-2940.

Harris System 90, 3 racks, 4 ITC reel recorders, 3 stereo SMC Carousels, 10242 events & more. \$13000/BO. B Bereman, WPAD, POB 450, Paducah KY 42001. 317-297-1300.

IGM 48-S stereo Insta-Cart, premium cond. \$5000. T McGinley, 1st Media Corp, POB 10239, Wash DC 20018. 301-441-3500.

BE Control 16 (4) Revox PR99's; (2) SMC 20-A Carousels; IGM Go-Cart 42, vgc, operational & documented, price neg. D Wilbur, WOBL, Box 277, Oberline OH 44074. 216-774-1570.

SMC time announce unit w/2 carts, J Walters, KKJO, POB 166, St Joseph MO 64502. 816-279-6346.

IGM Instacart, 48 tray mono, 5 yrs old, \$3000. J Mason, KJMB, 2222 Kansas Ave Ste L, Riverside CA 92507. 714-682-2222.

IGM Brain, BM format tape sequencer. J Phillips, WDCW, 414 Washington, Defiance OH 43512. 419-782-8591.

Harris 9000-1 inc (5) ARS1000DC, (3) Sonomag Carousels, all w/control, CTR & printer. BO. S McDaniel, WZFX, Ste 700 Wachovia Blvd, Fayetteville NC 28303. 919-486-4991.

Autogram 250 (4) stereo Carousel, excel cond, recently refurb. BO. P Douglas, KKAY, Box 759, Plaquemine LA 70765. 504-473-3806.

IGM Instacart, stereo, like new cond. \$8000. J Neilson, KVN U. POB 267, Logan UT 84321. 801-752-9764.

DAP 5000 automation system, 2000 random access events, audio panel, 10 source cards, Instacart interface, complete, 6 yrs old, excel cond. \$2200. Dutch, WDDD, Marion IL. 618-997-8123.

ABC network command decoder for talk radio (2); ABC network pulse decoder. J Stanford, WQUE, 1440 Canal Ste 800, New Orleans LA 70112. 504-581-1280.

Automation system, inc SMC DS-20 digital switcher, DP-1 digital programmer, DP-1C brains, CC1 interface, PSB pwr supply, (5) 350 RSB 24-cart Carousels, (6) Otari ARS-100s, brains rebuilt, R-R's need work, w/rack mounts, \$7500/BO. H Scanlon, KFMJ, POB 1139, Arcata CA 95521. 707-822-7223.

Stereo PB head for RSC 100 Carousel, new. \$50. J Gabrouy, KEZC, 699 Ave B, Yuma AZ 85364. 602-782-4321.

CAMERAS (VIDEO)

Want to Sell

Ikegami HL-33 camera, 1" plumbs, comp rebuilt, excel cond, many extras. \$2500. U George, George Assoc, 175 5th Ave #3206, NY NY 10010. 212-475-3330.

Ikegami HL79A w/Angenieux lens, 9.5-126, w/wide angle adaptor, w/case, batteries, battery charger, AC adaptor, rain cover. T Ceresste, Lightscape, 420 W 45th, NY NY 10036. 212-757-0204.

GBC CTC5X camera, color, no lens, w/BFM5X view finder & 15' ext cable. \$75. F McCall, Performance Svcs, 1521 W St Mary's Rd, Tucson AZ 85745. 602-323-0901.

RCA TK76B (2), plumbs, Angenieux 15x1 w/studio hand control adaptors, S Dodson, Desert West, 1870 W Prince, Tucson AZ 85705. 602-293-1849.

Sony DXCM3, 126mm Tamron automatic lens, interconnect cables to 1/2 or 3/4 video recorder, tripod mount, \$5500. P Carlson, PKC Ent, POB 568, West Linn OR 97060. 503-656-6998.

Panasonic WV3990B color camera w/3 50' cables, remote control, battery charger, less than 200 hrs use. \$2600. M Hamilton, WSVL, POB 338, Shelbyville IN 46176. 317-398-9757.

JVC BY-110U, w/newer mdl updated 10:1 zoom lens, 3 tube, power supply/charger, (2) batteries, other access. \$3000. B Dobrowski, WhirlWind Prod, 10356 W Warren Ave, Dearborn MI 48126. 313-584-4038.

JVC KY1900, like new w/case, battery, AC adaptor. \$2195. I Kaufman, Natl Rec, 460 W 42nd, NY NY 10036. 212-279-2000.

JVC KY 1900 color cameras (3), two 10x1, one 6x1, w/case, battery pack charger & AC, \$2750 for 10x1 & \$2500 for 6x1. P Costa, Eastern Snd & Video, 462 Merrimack, Methuen MA 01844. 617-685-1832.

Want to Buy

Fujinon zoom & focus controls for 1-1/4" lenses. H Henson, Henson Prod, 4569 Haven Crest Rd, Winston-Salem NC 27106. 919-924-8717.

RCA TK-44's, needed for bdct museum, need not work. H Henson, Henson Prod, 4569 Haven Crest Rd, Winston-Salem NC 27106. 919-924-8717.

RCA TKP-46 Minimax adapter. H Henson, Henson Prod, 4569 Havencrest, Winston-Salem NC 27106. 919-924-8717.

RCA TK760 camera cable. 1500'. B Seaman, WTVN, 1261 Dublin Rd, Columbus OH 43215. 614-481-6663.

CART MACHINES

Want to Sell

Gates PB only mono cart machines (4), \$300. A Loera, Anthony Bdct, 10419 Madison, Pacoima CA 91331. 818-897-2688.

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CART MACHINES ... WTS

BE5304 triple deck stereo w/all tones & 5310 recorder w/tones, needs several parts, as is \$1000. B Hawkins, WENS, 1099 N Meridian, Indianapolis IN 46204. 317-266-9700.

BE FSD-100 splice finder, vgc w/manual. \$275. B Hawkins, WENS, 1099 N Meridian, Indianapolis IN 46204. 317-266-9700.

BE 3100P play only, all aux tones, vgc, \$700. L Snyder, Box 182, Floral Park NY 11001. 718-347-2940.

BE 5304 triple deck stereo w/all tones & BE 5310 stereo record module w/all tones (3), mint cond, light use, \$3000 ea. B Hawkins, WENS, 1099 N Meridian, Indianapolis IN 46204. 317-266-9700.

BE 3200RP w/all aux tones, FF & mic input, vgc, \$950. L Snyder, Box 182, Floral Park NY 11001. 718-347-2940.

BE 3300RPS, like new, used 20 hrs, stereo R/P, no aux tone, L Snyder, Box 182, Floral Park NY 11001. 718-347-2940.

CCA-QRK cart play w/aux det, vgc, \$150 or BO, W Hoisington, WTCG, 303 S Three-Notch St, Andalusia AL 36420. 205-222-8849.

Record amp for ITC 3-D cart machine, mono 3 tone, \$500. D Doelitzsch, WDDD, 1 Bdot Ctr, Marion IL 62959. 618-997-8123.

BE cart winder w/timer, vgc w/manual, \$275. B Hawkins, WENS, 1099 N Meridian, Indianapolis IN 46204. 317-266-9700.

UMC 10 mono R/P, very little use, \$300 ea or BO; UMC 10 play only, very little use, \$250. W Hoisington, WTCG, 303 S Three-Notch St, Andalusia AL 36420. 205-222-8849.

BE Spotmaster stereo, 3200 PS PB only, \$1100; 3200 RPS R/P, \$1900, both machines low hrs, excel cond, w/tones & auto FF, L Wagner, ARN Prod, POB 1788, Orlando FL 32802. 305-299-1299.

Sparta 4625 stereo R/P type A cart, remote control functions & sec tone, gd cond, new motor & heads, \$525/BO, J Kramer, Video Mktg Svcs, Alpha Bldg Rm 523, Easton PA 18042. 215-253-8930.

Tapecaster 700P mono PB, gd cond, l Baron, WCUA, Box 814 Cardinal Station, Wash DC 20064. 202-635-5106.

Collins 642-2 cart player, tube type, w/record amp, gd cond, \$60 plus ship. W DeFelice, CKXN, 621 Bishop Ave, Bridgeport CT 06610. 203-336-5606.

ITC 3D stereo 3 tones (4), \$2200 ea; ITC RP stereo, 3 tones (2), \$1700 ea. J Scherer, KIQL, 2601 Mission, San Fran CA 94110. 415-648-8800.

SMC record cart machine, mono. J Walters, KJJO, POB 166, St Joseph MO 64502. 816-279-6346.

BE 3200RPS (3); BE 3100P (2) play only immaculate. J Rockwell, MGC Corp, 904 Lakeside Dr, Lynchburg VA 24501. 305-744-9751.

ITC 3D mono w/3 tones, works fine, w/manual, \$1700/BO, B Hawkins, WENS, 1099 N Meridian, Indianapolis IN 46204. 317-266-9700.

Gates Criterion R/P stereo w/150 Hz aux cue, rack mt, very low hrs, \$200; Gates Criterion 80, stereo play, 150 Hz aux cue, cabinet, \$250. J Boehm, WFYR, 3000 Olive Rd, Homewood IL 60430. 312-861-8100.

Spotmaster 2000 mono RP, mint cond, BO, J Phillips, WDCW, 414 Washington, Delaware OH 43512. 419-782-8591.

Viking (Telex) 35 cart, \$100; 3M Contata 293AG tape player, needs repair, \$60. E Davison, Multiplex Music, 135 N Illinois, Springfield IL 62702. 217-787-0800.

Rapid Cue PB mono cart machines (2) w/spare motor, in 19" rack; Spot-matic deck w/PB preamp, \$75; \$250 for both. F McCall, Performance Svcs, 1521 W St Mary's Rd, Tucson AZ 85745. 602-323-0901.

Tapecaster 700 R/P, gd cond, just realigned, \$475; Tapecaster 700 P, gd cond, just realigned, \$300; UMC Beaucart 100 series, one R/P & one play, gd cond, includes rack mount for both if purchased together, w/manual, \$1600/R/P & \$900/play, M Lewis, Africa News Service, 720 9th St, Durham NC 27705. 919-286-0747.

BE 2100RPS, like new, hardly used, \$1750. B Guthrie, Stage 4 Prod, 7352 Newburgh, Westland MI 48185. 313-421-5330.

Cue det card & control card for Ampro cart, excel cont, \$1800. S Morse, Morse Prod, 19 12th, Carle Place NY 11514. 516-334-5216.

Want to Buy

Cart machines, stereo & FM audio processing equip. M Brasher, 216 Zenalona, Albuquerque NM 87106. 505-242-7163.

BE 3000 & 2100 cart machines wanted. Exporter needs 90 used machines, working cond, not more than 6 yrs old, reasonable price avail. Send particulars to: RW, POB 1214, Falls Church VA 22041. Attn: Box 1-1.

Gates or other brands, multiple-slot cart players, mono, automation connection, sec tone pref, working or in repairable cond, reasonable. W DeFelice, CKXN, 621 Bishop Ave, Bridgeport CT 06610. 203-336-5606.

Triple stack stereo cart machine, prefer w/tones, S Karwan, KCMJ, 490 S Farrell Ste C-202, Palm Springs CA 92262. 619-320-6818.

Gates 150 Hz cue amp & QC-150 for Gates Criterion, P Wayne, 4915 Heatherdowns #6, Toledo OH 43614.

CASSETTE & REEL-TO-REEL RECORDERS

Want to Sell

Technics SV-100 digital audio processor for R/P/B, \$500. B Graifman, 3111 Broadway-4E, NY NY 10027. 212-866-1099.

Revox A-77, 2 tk, w/manual, 3 3/4-7 1/2 ips, gd cond, \$550 inc ship or BO w/PU. K Buckley, Group W Cable, 3970 N Milwaukee, Chicago IL 60641. 312-794-2174.

Ampex PR500 1/2", 7 trk data recorder, excel cond, transport speeds 15/16, 1-7/8, 3-3/4, 7-1/2, 15 & 30 ips, \$4000/BO, Doug, POB 417, Springfield VA 22150. 703-922-7829.

Ampex 300 FT mono, in roll around cabinet, solid state elect, BO, S Morse, Morse Prod, 19 12th, Carle Place NY 11514. 516-334-5216.

Nagra 4.2 mono w/case & power supply, excel cont, \$1800. S Morse, Morse Prod, 19 12th, Carle Place NY 11514. 516-334-5216.

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Uher Report 4000S w/case, mic, power supply, etc, vgc, \$300. L Waddington, Les Waddington Engr, 16 Garden City Rd, Noroton CT 06820. 203-655-2160.

Ampex AG350 4 trk, 1/2", \$1200. D Hill, Dimension Snd, 368 Center, Jamaica PI MA 02130. 617-522-3100.

Ampex 351-2 recorder, BO & high speed cassette duplicator, stereo, BO, H L Sewell, Oak Ridge Music Recdg Svcs, 2001 Elton Rd, Ft Worth TX 76117. 817-838-8001.

Tascam DX-8 8 chan NR, mint cond, \$580. D Kocher, 1901 Hanover, Allentown PA 18103. 215-776-1455.

Revox A-77 R-R 2 trk recorder w/manual, 3-3/4-7-1/2 ips, gd cond, \$550 includes shipping/\$ negotiable w/pickup.

Revox A77 (2), R/P, gd cond, \$400 ea; Sony TC-640 (2), R/P, bad switches, \$75 ea; Sony TC-645 R/P, bad switches, R McDaniel, KJRG, 209 Meridian, Newton KS 67114. 316-283-1678.

Otari MX7308, 1" 8 trk very low hrs, excel cond, w/remote control, \$5800. L Wagner, ARN Prod, POB 1788, Orlando FL 32802. 305-299-1299.

Ampex 2 trk (2); FT: 3 trk; 4 trk; 8 trk, w/sel-sync, BO, A Oliver, Lynn Oliver Studios, 304 W 89th, NY NY 10024. 212-874-7660.
Otari ARS1000 1/4", 2 chan 1/2 trk PB only, 7.5-15 ips, in Ruslang cabinet, practically new J Green, WHPL, Stuart Ave, Garden City NY 11530. 516-222-7438.

Telex Magnacord 10-24, stereo, mint cond, w/portable cases, BO; Crown 800 mono, FT, vgc w/case, matching amp/speaker unit, 4 chan MicMix built in, BO, B Weiss, KLSI, 1722 Main, Kansas City MO 64108. 816-474-6400.

Scully 280 1" 8 trk, 1/2 & 4 trk heads, block inc synchmaster, custom roll around, T Cereste, Lightscape, 420 W 45th, NY NY 10036. 212-757-0204.

Scully 280B 1/2 4 trk, 15-30 ips, varipitch w/console, gd cond, \$1500/BO, J Von Vleck, Aras Consulting, 2321 N Utah St, Arlington VA 22207. 703-524-5067.

MCI JH110C-8 w/autolocator, 3 transformerless elect, factory cabinet, \$8200/BO, D Green, Wayes Snd Recdrs, 1956 N Cahuanga, Hollywood CA 90068. 213-466-6141.

Technics RSM85 cassette deck, under 200 hrs, \$350. M Fiedler, Mayoney-Fiedler Prod, 5346 DuPont Ave, St Minneapolis MN 55419. 612-822-0013.

Ampex AG-350, 2 trk stereo, 7.5-3.75 ips, vgc in Ampex console, \$750 plus ship; Scully 280, 2 trk stereo, 7.5-15 ips, gd cond, \$750, wood console free; Marantz PMD-360 port stereo cass rec, 3 heads, dbl Dolby B, limiter, mic/line in, built-in monitor amps & speaker, AC/DC, like new, \$250; Sony TC-142 prof port mono cass rec, 3 heads, mic/line in, AC/DC, gd cond, \$125. E Helvey, Successtrax, POB 1357, Winchester VA 22601. 703-877-1191.

Ampex ATR800 R-R, rack mount, BO, C McGinty, WMAK, 109 W 5th, London KY 40741. 606-864-7843.

Pioneer R-R stereo machines (2), \$375. A Loera, Anthony Bdot, 10419 Haddon, Pacoima CA 91331. 818-897-2688.

Nagra 3 studio portable R-R w/sync option, FT mono, \$1000. V Ranieri, 354 Bloomfield, Caldwell NJ 07006. 201-226-4356.

Ruslang RL600 (2) consoles for MX5050BII, \$150. A Soroka, WJRO, POB 159, Glen Burnie MD 21061. 301-761-1590.

Scully 14" PB R-R decks (2), suitable for prod or automation, excel cond, \$500/BO. D. Workman, KPPL, RR 1 Box 203, Stockton IA 52769. 319-785-6069.

AKAI GX-600D, takes 10.5 reels, 7.5 & 3.75" speeds, 4 trk stereo, gd cond w/manual, \$100 plus ship. M Gollub, WMJS, Box 547, Prince Frederick MD 20678. 301-535-2201.

Ampex AG440B 8 trk, mint cond, comp w/remote, \$5500. Elsmere Music, Box 185, Bedford Hills NY 10506. 914-234-9201.

Technics SV-P100 digital audio cassette rec, BO, J Sulik, WGBA, 1145 Pine St, Green Bay WI 54305. 414-437-2624.

Ampex ATR102 1/2" 2 trk w/pedestal & remote, \$4500; MCI JH110A (2) 1/4" 2 trk w/Lang cabinet, \$1800 ea. B Nathan, Unique Recg Std, 701 7th, NY NY 10036. 212-921-1711.

Ampex AG440 recorders (2), mono, FT, \$1000 ea. B Hunter, KIXE, Box 9, Redding CA 96099. 916-221-5800.

Tascam 32 (6) just removed from service, very clean, J Rockwell, MGC Corp, 904 Lakeside Dr, Lynchburg VA 24501. 305-744-9751.

Concord MK III 7" 1/4 trk, 3 spds, ferrite hds, gd cond, \$85; Sony TC-366 7" 1/4 trk, 3 spds, gd cond, \$89; Ampex AG-355 serv manual, BO, W Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

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Crown SP772 tape deck, play only, w/manuals & some spares, stereo 2 trk, works well, \$300. J Boehm, WFYR, 3000 Olive Rd, Homewood IL 60430.

Nagra 4.2L sync recorder w/7" reel cover, \$3500; 4S stereo sync w/7" recorder, \$3800. S Smith, Chicago Audio, 1005 W Webster, Chicago IL 60614. 312-327-5533.

Dolby 330 2 chan stereo tape dup unit w/B-type (consumer) NR char, excel cond, \$950. G Lewis, Lewis Recdg, 216 S Pershing, Arlington VA 22204. 703-521-1871.

Studer A810, (2) 2-2 R-R decks, \$5000 ea. M Hieb, KLTQ, 329 E 200 S, Salt Lake City UT 84111. 801-533-9305.

Teac 80-8 w/DX8, patch cords, align tape manual & console, excel cond, \$2500. H Saunders, Music Shop Recdg, 1114 Riveria Dr, Greensboro NC 27406. 919-273-9892.

Ampex 351-2 (10), all guar within specs, buyer pick up, 2 trk, \$200 & 2 trk play only, \$150; Scully 280 (2), 8 trk w/cabinet in gd cond; also 2 trk w/o cabinet in working cond, \$1750 for both, I Kaufman, Natl Recrd, 460 W 42nd, NY NY 10036. 212-279-2000.

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Scully 284 2TS in console, new heads, \$1500; Ampex 351 FT, needs heads, BO; Tascam 48, new, \$3000. W Priest, Classic Snd & Recd, 1249 Bayshore Blvd, Dunedin FL. 813-736-4474.

Scully 280-4 in console, align tape, service manual, trade for Nagra stereo, write only, J Neuman, Industrial Announcer, POB 7703, Atlanta GA 30357.

Tascam 80-8 w/dbx & roadcase plus 20 reels 1/2" tape, used, \$3000. B Johnson, Rejoice Recording, POB 45, Rainier OR 97048. 503-556-4052.

Ampex PR10 FT, CL-10 deck, spare motor, 2 sets elec, \$100. B Dudley, Location Snd, 6919 19th St, Tampa FL 33610. 813-237-6516.

Ampex 350 FT mono w/Novonics 375 elec, \$750; Scully 284-8 1" 8 trk w/remote & rolling cabinet, \$2500. A Grunwell, Calif Audio, 157 Gray Rd, Ithica NY 14850. 607-272-8964.

24 trk machine, converts to 16 trks, 15 or 30 ips, \$12,500. R Robinson, TNA, 10 George St, Wallingford CT 06492. 203-269-4465.

Ampex 351 reel machine R/P stereo, J Walters, KJJO, POB 166, St Joseph MO 64502. 816-279-6346.

Tape-A-Thon librarian tape player system, (2) 702-10 bi-directional decks, interspacer, pwr amp, in rack cabinet, call for details. D Beatty, Beatty Telesvisual, 1287 Wabash, Springfield IL 62704. 217-787-4855.

Ampex 601 w/port case, working gd, heads fair, \$250; Tape-A-Thon 702-10 R-R, works gd, \$200; other Tape-A-Thon parts & chassis avail. E Davison, Multiplex Music, 125 N Illinois, Springfield IL 62702. 217-787-0800.

Ampex AG-440, 4 trk in Ampex roll-around console w/comp extra AG-440 transport w/two 2 trk head stacks, all heads in vgc, EQ card components matched, w/orig manuals & some spares, \$2200; Ampex 351/440 2 trk, Accurate Sound 351 upgradetransport w/AG-440 elect, matched EQ components, no case, heads in vgc, \$800. B Skye, Skyelabs Inc, 58 W Tidbury Dr, Dover DE 19901. 302-697-6226.

Revox A700 remote cont w/LEDS, \$100; A700 parts/serv man, \$10; A700 dust cover, \$10; hubs & various parts & PR99 serv man, \$10; B710 cass deck full doc remote cont & carton; Studer A810 w/wood panels & full doc, \$4200; Teac 3440 dust cover, \$10. R Cannata, Cantrax Recorders, 2119 Fidler Ave, Long Beach CA 90815. 213-498-6492.

Sony 777-4 portable R-R w/remote control, excel cond, \$250 plus ship or trade for gd quality 10-1/2" reel, stereo or mono, 7-1/2 & 3-3/4 ips, 1/2 trk portable recorder, S Barkett, WPQR, RD2 Box 91, Hopwood PA 15445. 412-438-2336.

Teac DX-8 8 chan NR, excel cond, \$580. D Kocher, 1901 Hanover Ave, Allentown PA 18103. 215-776-1455.

Revox A77, 2 trk, 15 ips w/new heads, excel cond, \$550/BO. H Landsberg, Henry Eng, 503 Key Vista Dr, Sierra Madre CA 91024. 818-355-3656.

Otari Mark III, 8 trk, \$3500. R Robinson, TNA Stds, 10 George St, Wallingford CT 06492. 203-269-4465.

Teac V-350C (2), \$89; Teac V-300, \$79. P Costa, Eastern Snd/Video, 462 Merrimack, Methuen MA 01844. 617-685-1832.

Ampex 351 mono in metal rack, \$400. G Guarino, Acoustilog Inc, 19 Mercer, NY NY 10013. 212-925-1365.

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Ampex 300, (3) transports, & (3) elect. \$300/lot. R Meyers, Sound Masters, 4700 SW 75 Ave. Miami FL 33155. 305-372-5594.

Ampex 300-8, 1" 8 trk restored, new tubes w/remote, \$3000. T Papa, Santa Monica Snd, 2114 Pico Blvd, LA CA. 213-450-2119.

Magnecorder PT6 (2), BO. J Curtis, KFRO, POB 792, Longview TX 75606. 214-663-3700.

Ampex 440A w/roll around, needs work, \$800. B Makson, WSBH, 56 Jagger Ln. Southampton NY 11968. 516-283-9500.

Scully 100 16/8 trk, needs work, \$3500. T Maguire, TMI Engr, 415 W 55th, NY NY 10019. 212-969-9494.

Teac 1/4 trk 7" reel capacity, \$250; Magnecord 728 rack mount, needs some mechanical work, 10" reel capacity, \$100. T Papa, Santa Monica Snd, 2114 Pico Bl, Santa Monica CA. 213-450-2119.

Revox A-77 1/2 trk w/spk & amp, gd shape, \$695; 1/4 trk Teac 2300, \$295. P Costa, Eastern Snd/Video, 462 Merrimack, Methuen MA 01844. 617-685-1832.

Want to Buy

Otari DP4050-OCK cassette duplicator, C Hertzberg, Kinura Records, Box 660236, Miami Springs FL 33166. 305-887-5329.

Stereo PB decks, 2 trk, automation compatible, rack mount, working or repairable, reasonable. W DeFelice, CKXN, 621 Bishop Ave, Bridgeport CT 06610. 203-336-5606.

Ampex MM1000 capstan servo motor, tape lock access, sync lock access, Auditec system. H Henson, Henson Prod, 4569 Havencrest Rd, Winston Salem NC 27106. 919-924-8717.

CATV-MATV EQUIP.

Want to Sell

Jerrold Commander modulator, chan 2, \$250; Dynair Dynamod TX4A chan 11, \$150; Dynair Dynatune demod RX4B, chan 11, \$250; Dynair Dynamod TX4B chan 4, \$300. J Reichard, POB 557, Mechanicsville MD 20659. 301-373-3339.

Sony demods, chan 4, 5, 7, 9, 11, 13, \$100. R Peterson, Pacific Comm, POB 7668, Olympia WA 98507. 206-754-7081.

CONSOLES

Want to Sell

McCurdy 7600 19 chan board, mint cond. stereo, \$5000. A Loera, Anthony Bdct, 10419 Haddon, Picoima CA 91331. 818-897-2688.

Interface 200, 8 in 2 out w/EQ, pan & echo send on ea input, 600 out, in rugged alum case, remote or prod console, \$600; McMartin Accu-Five, 5 chan, mono console, 19" rack mt, cue buss, moni, cue, & TB amps, 13 input cap, like new, \$600, w/UREI LA-5 leveling amp, \$850. E Helvey, Successtrax, POB 1357, Winchester VA 22601. 703-877-1191.

Opamp Labs 2008-4E, 20 in 10 out, gd cond, \$6500. L Wagner, ARN Prod, POB 1788, Orlando FL 32802. 305-299-1299.

Ampro Micro Touch 5 chan stereo, gd cond, \$1500. M Persons, WCMP, RR 2, Pine City MN 55036. 218-829-1326.

Gatesway mixer board w/power supply, 10 ch mono, fair cond. I Baron, WCUA, Box 184 Cardinal Station, Wash DC 20064. 202-635-5106.

BE 8M150, mono 8 chan rotary, gd cond, w/manual, \$1500. R Laine, United Cable of CO, 4757 S Salida Ct, Aurora CO 80015. 303-680-1910.

Howe 9000 Series stereo console, 30 input sources, all elect w/slide faders, less than 2 yrs old, gd cond, \$7500/BO. A Sutton, WMGA, POB 1380, Moultrie GA 31776. 912-985-1130.

Sound Workshop 1280B, excel cond w/Anvil case, \$1350, w/o case, \$1000. B Skye, Skye Labs Inc, 58 W Tidbury Dr, Dover DE 19901. 302-697-6226.

Harris Stereo Statesman, 5 pot, gd cond, \$850; Gates Studioette, BO. D Charles, WHOO, 1 Radio WHOO Rd, Orlando FL 32808. 305-295-3990.

Gates Studioette 80, 4 pot 12 in, not in service, BO. J Phillips, WDCW, 414 Washington, Defiance OH 43512. 419-782-8591.

Howe 9000 Series, 30 input slide pot, gd cond, BO. A Sutton, WMGA, POB 1380, Moultrie GA 31776. 912-985-1130.

Altec 250A tube type console w/able, 9 in 2 out w/cue, gd cond, \$750. B Woolf, Fidelity Sound, 3986 Edidin Dr, Jacksonville FL 32211. 904-744-1661.

Cherokee 300 8 pot mono console w/2 spare modules, J Walters, KKJO, POB 166, St Joseph MO 64502. 816-279-6346.

Tascam 5 16 chan stereo, \$1200. B Johnson, Rejoice Recording, POB 45, Rainier OR 97408. 503-556-4052.

Gates 10 chan stereo, gd cond, w/spares & manual, \$900. G Stevens, KFXV, 409 Duke St, Morgan City LA 70380. 504-384-1430.

Tascam 5 23 input, 8 chan, vgc, no T/B module, \$900. J Boehm, WFYR, 3000 Olive Rd, Homewood IL 60430. 312-861-8100.

Tascam 30 4 chan, like new, \$1000. T Stoller, 2320 Eade Ave, Ft Wayne IN 46805. 219-484-7390.

Sound Workshop series 30 wired to XLR panel 18x3x2; one wired to panel 20x8x2 w/10 stereo modules, perfect cond; Hill B Series 15x8x2 w/snake to XLR panel, factory mod for bdct. J Rockwell, MGC Corp, 904 Lakeside Dr, Lynchburg VA 24501. 305-744-9751.

Altec 250 SU, excel cond, tube type, \$700. B Woolf, Audio & Recdg Systems, 2986 Edidin Dr, Jacksonville FL 32211. 904-744-1661.

Electrodyn console parts, (6) 710 modules, (20) SM-9 switch modules, oscillator, limiters, line amps, R Robinson, TNA Stds, 10 George St, Wallingford CT 06492. 203-269-4465.

Ramko DCBMS 8 chan, 21 input stereo, excel cond, \$1550. B Van Prooyen, Van Prooyen Bdctg, 628 Mulford Dr SE, Grand Rapids MI 49507. 616-452-0133.

Russo Studio Master 505, 5 pot mono, gd shape, \$700. B Umberger, WNLT, 51 S Main #957, Clearwater FL 33575. 813-446-0957.

RCA BC3, disassembled, case, guts, front panel, PC boards new, \$100. R Meyers, Sound Masters, 4700 SW 75 Ave, Miami FL 33155. 305-372-5594.

Studer console for B67, \$200; Neve pots, wide assortment at gd prices. G Guarino, Acoustilog Inc, 19 Mercer, NY NY 10013. 212-925-1365.

RCA BC17 3 chan mono, \$100. A Goble, WIOD, POB 381177, Miami FL 33238. 305-759-4311.

Collins 212S, stereo 6 chan, w/complete spare parts, \$500 plus frt. F Spinetta, KCEA, POB 2585, Atherton CA 94026. 415-321-6049.

Want to Buy

Solid state production console. C McGinty, WMAK, 109 W 5th, London KY 40741. 606-864-7843.

Stereo board, 6-8 chan, solid state pref, working or repairable cond, w/manuals, reasonable. W DeFelice, CKXN, 621 Bishop Ave, Bridgeport CT 06610. 203-336-5606.

Collins IC-6, R Kramer, KSOR, 1250 Siskiyou Blvd, Ashland OR 97520. 503-482-6301.

Ross SMC803, need service manual only. JW Shepard, 539 Westminister Ln, Salem VA 24153. 703-389-1670.

DISCO & SOUND EQUIP.

Want to Sell

Echoplate 2, BO. H L Sewell, Oak Ridge Music Recdg Svcs, 2001 Elton Rd, Ft Worth TX 76117. 817-838-8001.

Thiel 03A speakers, \$700/pr. B Graifman, 3111 Broadway-4E, NY NY 10027. 212-866-1099.

Ursa Major digital reverb, \$850; Delta Lab DL-2 acoustic computer, \$850; Marshall 5002, time modulator, \$900, all excel. D Kocher, 1901 Hanover, Allentown PA 18103. 215-776-1455.

Altec 604C Cab (2) speakers, \$400. A Oliver, Lynn Oliver Studios, 304 W 89th, NY NY 10024. 212-874-7660.

MXR pitch transposer w/display & foot switch, original boxes, perfect, \$600. R Robinson, TNA, 10 George, Wallingford CT 06492. 203-269-4465.

Vanco MM-7, stereo/mono audio prod/disc mixer, 2 mic inputs w/pan, 2 TT inputs, 2 line/tape inputs, cue buss, \$125. E Helvey, Successtrax, POB 1357, Winchester VA 22601. 703-877-1191.

Technics SB7000 time aligned speakers, \$400/pr. L Snyder, Box 182, Floral Park NY 11001. 718-347-2940.

Altec Lansing Voice of Theatre speakers & studio monitors, BO. J Phillips, WDCW, 414 Washington, Defiance OH 43512. 419-782-8591.

Eventide HM-80 Harmonizer, special effects, reverb & pitch change, never used, \$500. T Brazil, WRUP, 832 W Washington, Marquette MI 49855. 906-228-6800.

Lexicon Prime Time II dual tape digital delay, mint cond, \$800. W Whitney, Sub Sound, 2232 Wengler, Overland MO 63114. 314-429-2858.

Altec W horn cabinets (4), \$750 ea. A Grunwell, Calif Audio, 157 Gray Rd, Ithica NY 14850. 607-272-8964.

BTX 4500 (2) synchronizers, excel cond, \$1000 or \$1750/both. I Kaufman, Natl Recdg, 460 W 42nd, NY NY 10036. 212-279-2000.

AKG BX-10-II reverb, used, gd cond, \$400. G Lewis, Lewis Rec, 216 S Pershing, Arlington VA 22204. 703-521-1871.

MicMix XL-305 room reverb, stereo send & return w/3 bands of EQ, vgc, \$350. B Skye, Skyelabs Inc, 58 W Tidbury Dr, Dover DE 19901. 302-697-6226.

JBL 4301, 1 pair, gd cond, \$300/pair. H Underwood, Underwood Audio, 34 Aviation Way, Atlanta GA 30341. 404-457-1268.

Delta Lab DL-2 stereo delay, \$850; MXR digital delay, \$275; Ursa Major digital reverb, \$900, all in mint cond. D Kocher, 1901 Hanover Ave, Allentown PA 18103. 215-776-1455.

Comp 8 trk set up, inc Teac 80-8 w/dbx, Tascam 35-2 w/dbx, mdl 10 mixer MicMix reverb, patchbay, etc., will sell separately, \$3400. B McPeck, Mirror Image, 619 S Main, Gainesville FL 32601. 904-376-1688.

Burwen 1201A dynamic NR, new, \$150. I Kaufman, Natl Recdg, 460 W 42nd, NY NY 10036. 212-279-2000.

Delta-Lab DL-4, \$375; Loft DDL 440, \$275; Eventide phaser, \$350; Omni-Craft 4 chan noise gate, \$250; UREI 550 9 band stereo graphic EQ, \$425; Alesis XT digital reverb, \$425, all in gd to excel cond. P Costa, Eastern Snd/Video, 462 Merrimack, Methuen MA 01844. 617-685-1832.

Yamaha 6x2 echo & reverb, bal & unbal inputs, \$350 incl ship & handling, J Staley, WSGG, 609A Palmer, Corinth NY 12822. 518-654-9058.

Publison, effects processor, does everything, BO. R Kaufman, POB 29804, Atlanta GA 30955. 404-646-9911.

Tapeo 2200 graphic EQ, \$95; Bogue MXM, 5 input, road mixer, XLR, \$50. T Papa, Santa Monica Snd, 2114 Pico Bl, Santa Monica CA. 213-450-2119.

Realistic 10-band stereo EQ w/mixing dubbing facilities, \$75 +ship. J Emmel, Emke Media Ent, POB 401, Olyphant PA 18447. 717-383-1118.

Sundholm 2100, stereo octave graphic EQ, one rack space, mint, \$240/BO. N Lederman, Oval Window Audio, 306 Congress St, Portland ME 04101. 207-775-7292.

EV M8BA 8" speaker, new in box, \$25. W Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

Radio Shack Nova-5 speakers (2), \$40 ea/\$70 pair +ship. J Emmel, Emke Media Ent, POB 401, Olyphant PA 18447. 717-383-1118.

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<p>audiotechniques has it!</p> <ul style="list-style-type: none"> ADC/MRL COMPARISONICS MC-110 PARTS TANNOY MONITORS FREBENT CONSOLES TUBE TECH TUBE EQS SONY DIGITAL SYSTEMS SONY MAX-3000 APR-5000 SUTHER TELE-HYBRID A810, CD PLAYER <p><small>1819 BACKLICKWAY NEW YORK, NEW YORK 10019 (212) 394-3888 (212) 394-3272</small></p>	<p>CART'EM UP ON AUDIOPAK AA-4</p> <p>Call for best price Sales—Service</p> <p> Broadcast Cartridge Service</p> <p>(714)898-7224</p>	<p>TOWER Erection-Maintenance</p> <p>Turnkey-Installation 301 & 340 FCC Engineering</p> <p>EQUIPMENT</p> <p>Radio Tower Co., Inc. Boise, Idaho (208) 344-0947</p>	<p>CORNELL-DUBILIER MICA CAPACITORS</p> <p>FROM STOCK</p> <p>JENNINGS VACUUM CAPACITORS</p> <p>FROM STOCK</p> <p>JENNINGS VACUUM RELAYS</p> <p>SURCOM ASSOCIATES, INC. 305 Wisconsin Avenue Oceanside, California 92054 (619) 722-6162</p>	<p>STAR SYSTEMS</p> <p>Audio Solutions</p> <p>Otari, Tascam ATR, Nakamichi Pro, JBL/UREI, dbx 700, Valley People And much much more!</p> <p>Call for a current quote</p> <p>(617) 794-9399 462 Merrimack Street Methuen, MA 01844</p>	<p>LIMITERS</p> <p>Want to Sell</p> <p>CBS Labs Volumax 4110, gd cond, \$100/BO. B Weeks, WBFL, POB 107, Bellows Falls VT 05101. 802-722-4890.</p> <p>Orban 424A studio Optimod, \$750 or trade for Aphex stereo Compellor. B DeFelice, DeFelice Consulting, 621 Bishop, Bridgeport CT 06610. 203-336-5606.</p> <p>CBS Audimax 4450A stereo in mint cond, \$600; CBS Volumax 411 stereo in mint cond, \$300. J Michaels, WZZK, 530 Beacon Pkwy W, Birmingham AL 35209. 205-942-7800.</p> <p>CRL AM processing system inc APP-300A, SEP-400A, PMC-300A, \$1600; UREI 527-A graphic EQ, \$250. M Ripley, KOZE, Box 936, Lewiston ID 83501. 208-743-2502.</p>

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RW

Broadcast Equipment Exchange

LIMITERS . . . WTS

dbx 162 compressor limiter, stereo balanced in & out, excel cond. \$550. L Wagner, ARN Prod, POB 1788, Orlando FL 32802. 305-299-1299.

UREI LA5, same as LA4, brushed alum panel, w/rack mount, \$300. E Helvey, Successstrax, POB 1357, Winchester VA 22601. 703-877-1191.

EMT POM 156 limiter/compressor, like new cond. \$2500. A Zentz, Zentz Recdg, 688 S Santa Fe #205, LA CA 90021. 213-683-1096.

Orban Optimod 8100A, 18 mos old, \$3500. K Thomas, Thomas Bdcgt, Box 1146, Ardmore OK 73402. 405-226-2524.

CBS 4450A AGC & matching FM limiter, both vgc, \$250 ea or BO. W Hoisington, WTCG, 303 S Three-Notch St, Andalusia AL 36420. 205-222-8849.

CBS Labs 411 FM stereo Volumax, upgraded w/low-noise components, recently aligned, excel cond w/comp doc. \$185/BO plus ship. W DeFelice, CKXN, 621 Bishop Ave, Bridgeport CT 06610. 203-336-5606.

Universal audio limiter, \$200. B Hunter, KIXE, Box 9, Redding CA 96099. 916-221-5800.

CRL AM system SPP800, SEP400A, PNC300A, used 1.5 yrs, \$3000. C Prim, KUHL, 636 Haugen, Billings MT 59101. 406-245-3121.

Ahtec A332C limiter amp w/P511 power supply, serial #53, \$30. B Skye, Skyelabs Inc, 58 W Tidbury Dr, Dover DE 19901. 302-697-6226.

Aphex Compellor limiter, excel cond, boxed w/manual, \$900. J Alan, WMM5, 517 W Giles Rd, Muskegon MI 49445.

Dorrough 610, w/all latest factory mods, \$2700. A Soroka, WJRO, POB 159, Glen Burnie MD 21061. 301-761-1590.

CRL AM4 mono, excel cond, factory refurbished, 2 yrs old, BO. J Saunders, WLM, 45 Pennsylvania Ave, Medford NJ 11763. 516-475-1580.

Inovonics 215 audio processors, includes gated AGC, compressor & FM peak controller modules (2), excel cond, \$800 ea. T Hemingway, WGAJ, Box 248, Deerfield MA 01342. 413-773-9649.

Gates Solid Statesman FM limiters (2). J Walters, KKJO, POB 166, St Joseph MO 64502. 816-279-6346.

UREI LA4's, stereo blackface w/rackmount & manual, work fine. \$550. B Hawkins, WENS, 1099 N Meridian, Indianapolis IN 46204. 317-266-9700.

Orban 422A current mod comp gated lim. BO: UREI BL-40 Mod-u-Limiter, \$250/BO. J Phillips, WDCW, 414 Washington, Defiance OH 43512. 419-782-8591.

Inovonics MAPII #No397, 7 yrs old, gd cond w/manual, \$600/BO. J Mason, KJMB, 2222 Kansas Ave Ste L, Riverside CA 92507. 714-682-2222.

CBS Audimax III, J Walters, KKJO, POB 166, St Joseph MO 64502. 816-279-6346.

DAP 310 w/manuals, recently aligned, \$750. S Wilson, KLSF, 803 S Rusk, Amarillo TX 79106. 806-371-9797.

RCA BAGA tube limiter, \$350. T Papa, Santa Monica Snd, 2114 Pico Bl, Santa Monica CA. 213-450-2119.

CRL AM4 APP400, PNC300, SEP400, BO: Limpander LE35B, BO. J Curtis, KFRO, POB 792, Longview TX 75606. 214-663-3700.

UREI 1176 peak limiters, 5 yrs old, work well. \$200 ea/BO. H Landsberg, Henry Eng, 503 Key Vista Dr, Sierra Madre CA 91024. 818-355-3656.

Kahn Symetra-peak SP58-1A, \$100. B Umberger, WNL, 51 S Main #957, Clearwater FL 33575. 813-446-0957.

Dolby 334 NR unit, \$50. A Goble, WIOD, POB 381177, Miami FL 33238. 305-759-4311.

Orban 9100A2 set up for C-QUAM, excel cond, superb sound, \$4200. C Hemming, KBOR, POB 3407, Brownsville TX 78523. 512-544-1600.

Want to Buy

Pacific Recorders Multimax, AM or FM. D Davis, KMIN, POB 980, Grants NM 87020. 505-287-2989.

Stereo AGC or compressor/limiter for FM processing, working or repairable cond, must have manuals, reasonable. W DeFelice, CKXN, 621 Bishop Ave, Bridgeport CT 06610. 203-336-5606.

MICROPHONES

Want to Sell

RCA 44BX, (2), \$275 ea; (2) 770DX, \$400 ea; 77, \$595, all w/stands & booms; Neumann U-47, \$1200. A Oliver, Lynn Oliver Stds, 304 W 89th, NY NY 10024. 212-874-7660.

Neumann U47 (3) mics, C Hertzburg, Kinura Records, Box 660236, Miami Springs FL 33166. 305-887-5329.

Sennheiser MKH 405 & 404 mics w/power supplies & cables, both need work, offer or trades. R Robinson, TNA, Box 57, Wallingford CT 06492. 203-269-4465.

AKG 224E, \$200 ea; RE20, \$225, mint cond. D Kocher, 1901 Hanover Ave, Allentown PA 18103. 215-776-1455.

Shure SM-81 condenser mics (2) to trade, have AC PS for 1 Neumann U-87, Shure's in mint cond. J Neumann, Sound Results, POB 7903, Atlanta GA 30357.

WE 633 historic mics from UN, will trade for other old mics, \$50; 24A table stand, \$50. R Van Dyke, Squires Ave, E Quogue NY 11942. 516-728-1327.

AKG 224E, dynamic mics (3), \$285 ea, excel cond. G Lewis, Lewis Recdg, 216 S Pershing, Arlington VA 22204. 703-521-1871.

RCA 77-D, excel; RCA MI 4048-D, gd cond, both \$275. D Kocher, 1901 Hanover, Allentown PA 18103. 215-776-1455.

AKG NR-4288 w/CK-9 condenser mic, PS, handle & case; HMR WM-152A wireless mic in Anvil case. S Dodson, Desert West, 1870 W Prince Rd #48, Tucson AZ 85705. 505-287-2989.

Sennheiser MKH-416 P48 w/Rycote windscreen, \$500. S Smith, Chicago Audio, 1005 W Webster, Chicago IL 60614. 312-327-5533.

Sony ECM56FP condenser, like new, \$125 ea or \$200 for two; Ecor wireless mike system w/EV C090 lavalier mike & xtal controlled rcvr, \$250; AKG D110 lavalier mike, \$50; Shure Voice Gates (4) on rack panel, \$50 ea or all for \$125. E Davison, Multiplex Music, 125 N Illinois, Springfield IL 62702. 217-787-0800.

Turner 2302 dynamic new in box \$30; Turner 450D paging mic, new \$10. W Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

RCA 74B, new ribbons, excel cond, \$60. B Woolf, Audio & Recdg Systems, 2986 Edidin Dr, Jacksonville FL 32211. 904-744-1661.

Turner 2302 dynamic, new in box, \$30; Turner 450D lo-Z paging mic(s) have several, new in boxes, \$10 ea. W Laughlin, KDCV, 2636 N 56, Lincoln NE 68504. 402-466-8670.

Want to Buy

Old bdcgt & rec mics, parts, station name plates, stands. R Van Dyke, Squires Ave, E Quogue NY 11942. 516-728-1327.

Mic w/sound similar to EV RE-20, will pay up to \$100. P Wayne, 4915 Heatherdowns #6, Toledo OH 43614.

MISCELLANEOUS

Want to Sell

Walnut finish racks, (3) wall mount, holds 100 carts, \$45 ea. L Snyder, Box 182, Floral Park NY 11001. 718-347-2940.

Stabiline EMS64275YC, never used, \$20,000/BO; Aerovent PB12B-3 blower, never used, \$300/BO; Electro Impulse 20 kW, never used, \$1700/BO. L Maines, Quincy Prod, 707 S 18th, Quincy IL 62301. 217-222-5267.

AM xmters crystals, one 1320 kHz & one 1390 kHz, BO. D Workman, KPPL, RR 1 Box 203, Stockton IA 52769. 319-785-6069.

Alden 9271 D/H/AEC facsimile recorder for NWS map repro by satellite or landline. 4 yrs old, 24 hr clock & stand, 30 rolls of paper & spare blade. BO. C Lewis, KLMS, 1540 S 70th, Lincoln NE 68506. 402-489-6500.

Cabinet, 19" x 62" x 21" depth inside dim, full rear door, 2/3 front door, cutouts for filters, BO plus frgt. C Zaleski, EDS Comm Service, POB 92, Johnson City NY 13790. 607-798-7111.

Atlas gas detector, works well, \$25. J Cunningham, YSDA, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

Symetrix 104 telephone interface system, like new, 3 mos old, \$800. B Bereman, WPAD, POB 450, Paducah KY 42001. 317-297-1300.

Symetrix TI-101 telephone interface, never used, great cond, \$300. D Walker, KTAM, 1240 Villa Maria Rd, Bryan TX 77805. 409-776-1240.

RCA 19" equip rack, J Walters, KKJO, POB 166, St Joseph MO 64502. 816-279-6346.

AT&T desk phones (3) 5 lines & hold for 1A2 system, \$75 ea.; T159 w/printer, dozens of programs, w/carry case & ext printer paper, \$85; shipping crate for Harris Executive console, \$25. L Snyder, Box 182, Floral Park NY 11001. 718-347-2940.

Wood cart rack, 100 slot, pecan finish, new, \$80; 40 slot pecan finish, new, \$35. J Boehm, WFYR, 3000 Olive Rd, Homewood IL 60430. 312-861-8100.

Parts, large box inc tubes, IC's, caps, resistors, hardware, multimeter, tools, RF & AF connectors, \$25 plus \$5 ship. C Daniel, KNCB, Box 1072, Vivian LA 71082. 318-375-3279.

Tellabs 248RF housings (4) w/4008 cards, power supplies & repeat coils, \$250/set PPD. D Gilliam, KJZZ, 1435 S Dobson, Mesa AZ 85202. 602-969-9099.

MONITORS

Want to Sell

Harris STS-1 AM stereo monitor, perfect cond, never used, \$465. L Maines, Quincy Prod, 707 S 18th, Quincy IL 62301. 217-222-5267.

McMartin TBM 2200A stereo monitor FM; TBM 4000A SCA monitor; TBM 2000A, won't sell separately, \$1500 firm. B Coleman Jr, Coleman Bdcgt, 114 Circle Dr, Rocky Mtn NC 27804. 919-443-7870, aft 5PM.

Tek RM 529 waveform monitor, gd working cond, \$500. V Ranieri, 354 Bloomfield, Caldwell NJ 07006. 201-226-4356.

McMartin TBM-3700 baseband FM main chan mod mon; TBM-2500C FM-RF amp. Goodrich Ent, 11435 Manderson, Omaha NE 68164. 402-493-1886.

Gorman Redlich EBS-2 comp EBS encode-decode w/rack mt tuner, J Phillips, WDCW, 414 Washington, Defiance OH 43512. 419-782-8591.

McMartin TBM 3500 FM mod monitor, \$100. H Husbands, 6626 Talmadge Ln, Dallas TX 75230. 214-233-6351.

McMartin TBM-3500 baseband FM; TBM-2200A stereo & pilot freq; TBM-2000B SCA, all solid state & in excel cond. C Springer, KSEC, Box 890, Lamar CO 81052. 303-336-2206.

Belar FMM1 FM mod monitor, gd cond, \$750; RCA mod monitor for AM, \$800. B Jeffreys, WROK, 1100 Tamarack Ln, Rockford IL 61125. 815-399-2233.

Gates M-5693 mod monitor, set for 1370 kHz; GR 1181-A freq monitor, J Curtis, KFRO, POB 792, Longview TX 75606. 214-663-3700.

Want to Buy

FM baseband & composite mod monitors, solid state, working or in repairable cond. W DeFelice, CKXN, 621 Bishop Ave, Bridgeport CT 06610. 203-336-5606.

Employment

To place ads in this section, use the Action-Gram form. To respond to box numbers, write Radio World, Box 1214, Falls Church VA 22041, Attn: ____.

POSITIONS WANTED

CE Radio, general, ham, non-drinker, former CE Boston, Houston, Miami, heavy theory, avail immed. M Gottesman, 3377 Solano Ave #312, Napa CA 94558.

DJ experienced in top 50 market & in the industry since 1962 seeks large or medium market on-air position, currently OM & CE in small market. Write to: Radio World, POB 1214, Falls Church VA 22041. Attn: Box 10-1.

CE, AM/FM, all phases including construction & high power & AM directional. Write: RW, POB 1214, Falls Church VA 22041. Attn: Box 11-1.

Corp CE, hard working, self-starter, wanting FT position, 9 yrs hands-on exper in AM/FM would like single or group owned stations, for KS, CO, MO, NE, OK & Chicago IL, avail immed. Larry Timmons, 913-425-6509.

Air position, mature reliable individual w/5 yrs exp at 100 kW FM A/C. S Wiley, 115 Toulouse Dr, Lafayette LA 20506. 318-989-1869.

Technician (Ampex VR-1100/NPR-2B), seeks FT position in CO, write: Mrs. Smith-Fliesher, 1245 Deering Ln, Radcliff KY 40160.

Announcer, 5 yrs exper looking for position in Wisconsin or Illinois. Last at adult station in Milwaukee. Jeff, 414-543-4775.

Morning man, news, prod, copy writing, ad-mn, 18 yrs exp, good voice, married, stable, avail now, prefer warm climates, medium/bigger markets, Larry Kay, 717-653-2500.

Seeking group chief position, 17 yrs exp, medium & major markets, AM directional, FM, satellite, automation & audio, PO Box 3191, Grand Rapids, MI 49501.

Prof announcer w/4 yrs exp on-air & eng, looking for position within FL, excel refs. L James, 975 S Fla Ave, Tarpon Spring FL 33589. 813-937-1786 or 937-3429.

Corp CE, hard working, self-starter, looking for FT position w/single or group owned stations, 9 yrs, on-hand exp in AM/FM, for KS, CO, MO, NE, OK, avail immed. Larry Timmons, 913-425-6509.

Station mgr seeking AL, GA or SC position, highly qualified, BJ Gilreath, POB 129, Orchard Hill GA 30266.

HELP WANTED

Engineering Mgr for New Hampshire Public Radio. Maintains, designs studio & transmission facilities, 3 yrs in FM engr required. Personnel, WEVO-FM, 26 Pleasant St, Concord NH 03301.

Transmitter Maintenance technician for high power San Francisco AM/FM. Send resumes to: CBS, Placement Office, 7800 Beverly Blvd, Los Angeles CA 90036. E.O.E.

Production Eng, radio reading service for blind, 2 yrs exper plus 2 yrs tech training. \$21311-\$29841. Donna Bensen, Audiovision, 2300 Shyvesant Ave, Trenton NJ 08625. 609-530-3260.

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MONITORS . . . WTB

McMartin TBM-4500A, any cond. Goodrich Ent. 11435 Manderson St. Omaha NE 68164. 402-493-1886.

MOVIE PRODUCTION EQUIP.

Want to Sell

Singer PA200, 35mm projector GPL, sell or trade. J Workman, Maritz Comm, 600 W Lafayette, Detroit MI 48226. 313-963-1200.

Bolox M5 camera w/zoom, sync motor for sound recdg & battery pack. BO. H Deans, Deans Prods, 170 Grand St. White Plains NY 10601. 914-949-5920.

Angenieux 14-525mm lens for Fernseh camera. KCP w/road case, \$300 or BO. S Judge, Taj Comm, 75 Weaver Rd. W Milford NJ 07480. 201-697-8454.

Arriflex UST581 portable mixing amp for sound on Arriflex cameras. Joe. Mainreel Comm, 67 Green St. Augusta ME 04330. 207-623-1941.

Moviola 16mm editing machine optical & magnetic sound, viewer, rewind, etc. \$1200. H Deans, Deans Prod, 170 Grand St. White Plains NY 10601. 914-949-5920.

RECEIVERS & TRANSCEIVERS

Want to Sell

Sony ST-160 FM stereo tuner, quartz tuning, multiple presets, excel cond, \$155 plus ship. W DeFelice, CKXN, 621 Bishop Ave. Bridgeport CT 06610. 203-336-5606.

Drake TR-4C SSB transceiver, speaker, AD/DC power & EV mic, new cond, \$325; Heathkit HW-12 (2) SSB transceivers, 80 meters, lots of power supplies & mics, works great, \$125; Heathkit SB-500 (2) meter transverter, converts 10 meters SSB to 2 meters, works great, \$100. B Boyer, Boyer Assoc, 3349 N E. 28th Ave. Ocala FL 32670. 904-629-5147 (PM wkends).

Crown FM2 tuner, excel cond, BO. P McManus, McManus Enter, 4011 Orchard, San Diego CA 92107. 619-223-1730.

ICOM IC-M6 (10) 6 chan VHF radios, 5 W, \$325 ea. S Smith, Chicago Audio, 1005 W Webster, Chicago IL 60614. 312-327-5533.

TG43 mobile units (2), 161.76 MHz, \$100. A Gable, WIOD, POB 381177, Miami FL 33238. 305-759-4311.

Motorola MT-200 VHF 2 chan w/2 ants (rubber & tele), manual, \$100. D Jordan, POB 6349, Evansville IN 47712. 812-963-6882.

Want to Buy

Old military radios like DC603 & 604, receiver xmtrs, A/D shock mts, FT237 & jeep radios, DC620 & 659 power supply, PE120E & FT250 shock mts. S Barbkowski, 4923 W 28th St, Cicero IL 60650. 312-863-3090 aft 5PM.

REMOTE & MICROWAVE EQUIP.

Want to Sell

Harris 6550 SCPC satellite rcvr, set up for Brownfield, but can be recrystallized, \$1800. D Doelitzsch, WDDD, 1 Bdct Ctr, Marion IL 62959. 618-997-8123.

Shafer 400-R RC system. J Curtis, KFRO, POB 792, Longview TX 75606. 214-663-3700.

QEI 7775-ATS, one unit for telco, one unit for STL, not used since factory check-up, \$2500. B Lord, KQBE, POB 1032, Ellensburg WA 98926. 509-962-2823.

S-A digital satellite system w/dish for ABC, Westwood One, etc, you transport, \$6000 plus frt. D Dougherty, WNVB, POB 1440, Vineland NJ 08360. 609-825-2600.

Moseley PCL 505C, great working cond, tuned to 94.30 MHz, \$5000. E Schechter, KDKB, 1167 W Javelina, Mesa AZ 85202. 602-897-9300.

Moseley PCL 2B STL, tube type, split band system, working when removed from service approx 4 yrs ago. BO. B Umberger, WNL1, 51 S Main #957, Clearwater FL 33575. 813-446-0957.

Elgin ERC 19654 recorder connector, interface to telephone line, \$50. B Umberger, WNL1, 51 S Main #957, Clearwater FL 33575. 813-446-0957.

NEC earth stations, 2-3 yrs old, like new cond, 5.5 meter k-band, avail immed, \$120,000 ea. ISAUS, POB DD, McLean VA 22101. 703-759-2094.

Modulation Assoc Transtar AC demod shelf, inc down converter, (2) SCPC demods cue decoder card & printer card, & power supply, \$2500/BO. K Bartz, KWQB, Box 1301, Fargo ND 58107. 218-236-7900.

Hughes aircraft terminals earth stations, 2-3 yrs old, like new cond, 5.5 meter k-band, avail immed, \$140,000 ea. ISAUS, POB DD, McLean VA 22101. 703-759-2094.

Want to Buy

RPU solid state VHF xmtr & rcvr needed. R Johnson, WRKR, 2200 N Greenbay Rd, Racine WI 53405. 414-637-3036.

Digital satellite system for ABC network, from dish to demod. K Thomas, Thomas Bdctg, Box 1146, Ardmore OK 73402. 405-226-2524.

Remote control for 1 kW AM station. C McGinty, WMAK, 109 W 5th, London KY 40741. 606-864-7843.

RPU type accepted equip, 26 MHz, urgently needed, any make & model. E Nichols, KJNP, POB O, North Pole AK 99705. 907-488-2216.

Marti equip & rcvr in 161 MHz band. P Douglas, KKAY, Box 759, Plaquemine LA 70765. 504-473-3806.

STATIONS

Want to Sell

Colorado mountain town station, 250 W. AM. G Zellmer, KDMN, Box 639, Buena Vista CO 81211. 303-395-2072.

AM 1 kW daytimer 1580 kHz; FM 3 kW 105.5 MHz, comp automated, equip excel. Sunbelt, ideal for owner/operator, only station in market, \$250K, call or write. JP Robillard, 1803 N First East St, Haynesville LA 71038. 318-624-0105.

Sacrifice, smaller AM 1 kW, full-timer in SW Wash coastal area, ideal owner operator, great potential, located on major hwy, apartment, mobile home, studios, land w/tower inc, only AM in market, \$200,000. E Kazmark, POB 1369, Dear Park WA 99006. 206-875-5551 or 509-276-8816.

FT AM stereo station in top 100 markets, due to heart attack must sell, favorable terms to qual buyer, positive cash flow, on air 40 yrs, class B FM avail for combing in 1987. J Rockwell, MGC Corp, 904 Lakeside Dr, Lynchburg VA 24501. 305-744-9751.

Colorado Mtn resort AM/FM radio station, excellent coverage, super buy & terms. J Gayer, 815 Reed, Lakewood CO 80215. 303-233-8433.

Want to Buy

Class A FM radio station or CP, somewhere in Kentucky or surrounding state. J McPherson, McPherson Comm, Rt 1 Box 195, Brodhead, KY 40409. 606-758-8525.

STEREO GENERATORS

Want to Sell

RCA BTX101 SCA gens (2), \$200 ea. A Bater, WPJX, 220 E 42nd, NY NY 10017. 212-210-2773.

SWITCHERS (VIDEO)

Want to Sell

Dynair 153A switcher, B&W, \$1500 plus ship. J Baltar, Maine Reel Comm, 67 Green, Augusta ME 04330. 207-623-1941.

Want to Buy

GWG production switcher. H Henson, Henson Prod, 4569 Haven Crest Rd, Winston-Salem NC 27106. 919-924-8717.

TAPES, CARTS REELS

Want to Sell

Urgent, fire destroyed record/tape collection, no insurance, need immed copies of records/tapes of top 100 or some under each year '53-'85, also copies History of Rock & Roll & other programs etc, leave message. S Stevenson, Stevenson Corp, POB 735, Blaine WA 98230. 604-531-4576.

Ampex 671, three groups to choose from: 7" x 2400" hand picked bulk taped down ends, 70 per ctn 60" ea or \$42 per ctn plus UPS; or hand picked taped down ends in printed box, 50 per ctn, 80" ea, \$40 per ctn plus UPS; or as is bulk, 60 per ctn, 35" ea, \$21 per ctn plus UPS. Call Burlington Audio Tapes, 106 Mott St, Oceanside, NY 11572. 1-800-331-3191 or in NYS 516-678-4414.

Metal reels, 14", NAB 1", like new, minimum order 20, \$3 ea. D Hill, Dimension Snd, 368 Center, Jamaica PI MA 02130. 617-522-3100.

Fidelipak carts, approx 2000, gd shape, BO for all or partial. A Zenn, KGV, 2255 Kuhio #1201, Honolulu HI 96815. 808-923-7600.

Audiopak AA3, 1000 carts various lengths, \$1 ea. P Christensen, WIVY, 3100 University S, Jacksonville FL 32216. 904-721-9111.

Reels, 5" (1000) w/NAB hub. S Voros, Voros Enter, 1537 S 81st, Milwaukee WI 53214. 414-475-6200.

Collection of 45's, LP's & 78's, excel cond, pop, top-40, buys jazz & classical. J Martin, 3655 Old Shell Rd, #321, Mobile AL 36608. 205-460-2001 or 343-2023.

CBS audio tape & Ampex cart tape, 7500' & 8200' pancakes, 1 pack masters, BO, T Haughey, KVMV, POB 3333, McAllen TX 78502. 512-781-5067.

Background music tapes, gd cond, 15-18 yrs old, \$50 buys 12 shipped FOB USA, \$300 buys lot; empty new reels & boxes, 90 7" low torque #6813 reels, \$25. E Davison, Multiplex Music, 135 N Illinois, Springfield IL 62702. 217-787-0800.

Ampex 162 1" video tape on 9-3/4" reels w/NAB hubs, only subjected to 2 passes, BO. S Barkett, WPQR, RD2 Box 91, Hopwood PA 15445. 412-438-2336.

Beautiful Music Library, 425 10" reels, 25 Hz tones, \$5 ea plus ship. P Martinez, KELK, 1800 Idaho, Elko NV 89801. 702-738-7118.

Want to Buy

Top 40's/oldies music libraries on 2 trk reels, automation compatibility desired. W DeFelice, CKXN, 621 Bishop Ave, Bridgeport CT 06610. 203-336-5606.

TAX DEDUCT. EQUIP.

Donations: educ exhibit, antique, working, studio bdctg equip for on-air display, console, TTs, R-Rs, mics, clocks, etc. HD Norman, NDXE, 100 S 8th Ste 200, Opelika AL 36801. 800-872-6393.

Studio to xmtr equip to donate, also (3) CX1000t7 tubes, 8122 tubes, & misc equip; also solid state exciter, 90.1 MHz, Mr. Campbell, Roanoke Christian School, 515 Becker Dr, Roanoke Rapids NC 27870. 919-537-8333.

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Any company or station can run "Help Wanted" ads at the flat rate of \$18 per listing per month (25 words max). Payment must accompany insert; there will be no invoicing. Blind box numbers will be provided at an extra charge of \$2. Responses will be forwarded to listee, unopened, upon receipt. Call 800-336-3045 for display rates.

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Any individual can run a "Position Wanted" ad, FREE of charge (25 words max), and it will appear in the following 3 issues of Radio World. Contact information will be provided, but if a box number is required, there is a \$2 fee which must be paid with the listing (there will be NO invoicing). Responses will be forwarded to the listee, unopened.

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Non-profit college station needs: stereo cart machines, tape decks, TTs, tonearm/headshells, mics, mixers, console boards, mic cables, snake cords, mic stands & remote digital 2-chan processor. G Gutmacher, WYBC, Box WYBC, Yale Station, New Haven CT 06520. 203-432-4116/4117.

TEST EQUIPMENT

Want to Sell

GR 1606A RF impedance bridge, gd working cond. \$750; GR 916AL RF impedance bridge, gd working cond. \$450. V Ranieri, 354 Bloomfield, Caldwell NJ 07006. 201-226-4356.

HP 4000 AC voltmeter, \$60. D Hill, Dimension Snd, 368 Center, Jamaica Pl MA 02130. 617-522-3100.

Tek 555 dual beam scope w/extra power supply & manuals, needs cal. \$250. J Kipski, KIQO, POB 1456, Lompoc CA 93436. 805-865-6536.

GR 1558A octave band noise analyzer w/manual, BO. Mr. Simonsen, KHAT, POB 6006, Lincoln NE 68506. 402-423-1530.

Heathkit IO-104 15 MHz triggered sweep scope, BO. T Stein, New River Studios, 408 S Andrews, Ft Lauderdale FL 33301. 305-524-4000.

Boonton 202E gen, needs pwr supply, \$50. T Maguire, TMI Engr, 415 W 55th, NY NY 10019. 212-969-9494.

Tek 453 scope, needs CRT, \$200. T Maguire, TMI Engr, 415 W 55th, NY NY 10019. 212-969-9494.

H-P 3300-3302 function gen-trigger phase lock for testing electr equip, \$125 plus ship; Grim Corp CP 600 RP 600, 6 chan control panel & 6 chan relay panel used for switching audio & control circuits, \$120 plus ship. J Baltar, Maine Reel Comm, 67 Green, Augusta ME 04330. 207-623-1941.

Want to Buy

2-3 tower phase monitor, T McGinley, 1st Media Corp, POB 10239, Wash DC 20018. 301-441-3500.

Weston 1240 DMM need operators manual or photocopy of same for digital multimeter. E Jacker, WCRW, 2756 Pine Grove, Chicago IL 60614. 312-327-6860.

TRANSMITTERS

Want to Sell

RCA BTA50F 50 kW AM xmtr, excel cond, storage ready for immed pickup, all manuals, electrostatic air filter, solid state rectifiers, proof RF perf avail, \$18,000 plus PU & ship. G Heldenselt, Heidenselt Bdcg, 2880 W Lake, Wilson NY 14172. 716-751-6187.

RCA BTA5F 5 kW AM xmtr, excel cond, in storage for immed pickup, \$10,000 plus PU & ship. G Heldenselt, Heidenselt Bdcg, 2880 W Lake, Wilson NY 14172. 716-751-6187.

Collins 20V2, 1000/500 W; Collins 550A2, 500/250 W. G Zellmer, KDMN, Box 639, Buena Vista CO 81211. 303-395 2072.

QEI exciter & meter readout bridge, new cond \$2000. S Lawson, KAK FM, 928 Hyland, Santa Rosa CA 95404. 707 528-4055.

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R.E. (Dick) Witkovski
Owner. 214-630-3600

McMartin B-910 FM 15 W exciter, factory tuned & tested to your freq, w/ or w/o stereo modules. Goodrich Ent, 11435 Manderson, Omaha NE 68164. 402-493-1886.

Collins FM 5B, 5 kW FM, gd cond, \$7500/BO. D Workman, KPPL, RR 1 Box 203, Stockton IA 52769. 319-785-6069.

Collins 3001 250/100 W AM xmtr, can be used for PSSA, you pick up, \$800. D Doeltzsch, WDDD, 1 Bdcg Ctr, Marion IL 62959. 618-997-8123.

McMartin BF-1K 1500 W FM in vgc, \$7000. J McKinley, WJMR, 388 S James, Columbus OH 43213. 614-855-9171.

Transformers/Chokes-power/modulation for Collins/Gates 1-10 kW; RF inductors fixed/variable; vacuum capacitors fixed/variable; mica caps; crystals, most FM for Collins 310Z-1 & A830 exciters, some AM for Collins 20V/21M; assorted meters for Collins xmtrs & studio equip. H Husbands, 6626 Talmadge Ln, Dallas TX 75230. 214-233-6351.

Versacount V322 FM stereo exciter & LA-150 xmtr, 150 W, 4 yrs old, excel cond, \$3500. T Hemingway, WGAI, Box 248, Deerfield MA 01342. 413-773-9649.

Gates 5G 5 kW FM, excel cond, w/exciter, BO. N Boswell Jr, WBKJ, POB A, Kosciusko MS 39090. 601-289-1340.

Harris FM10G xmtr w/TE-3 exciter, tuned to 105.1 MHz, J Walters, KKJO, POB 166, St Joseph MO 64502. 816-279-6346.

Gates M6408-Vanguard 1 AM 1 kW xmtr, gd cond, used as standby, avail now, freight FOB, \$1500. L Murray, WHOL, 1125 Colorado, Allentown PA 18103. 215-434-4801.

CCA 200000 w/harmonic & low pass filters, working when removed, tuned to 93.3 MHz w/spare parts, \$6000. E Schechter, KDKB, 1167 W Javelina, Mesa AZ 85202. 602-897-9300.

Trade, (2) Gates FM1B 1 kW xmtrs for one 5 kW FM xmtr, B Ladd, WNR, 108 1/2 E Main, Bellevue OH 44811. 419-483-2511.

Bauer 707 AM xmtr, 1.1 kW, 540-1600 kHz, 800 lbs, \$5500. M Barnes-Wing, KBND, 2600 NE Studio Rd, Bend OR 97708. 503-382-5263.

Collins 5 kW stereo FM xmtr, will tune to your freq, \$9000. B Ingram, WBLE, POB 73, Batesville MS 38606. 601-563-4664.

Versa Count V-322 FM exciter, 97.1, \$2000/BO. J Germer, WGLQ, 816 Ludington St, Escanaba MI 49829. 906-789-9700.

Want to Buy

Collins 21-E, 5 kW AM: 1-10 kW FM, any age or cond; chan 12 & 16 or low UHF TV xmtr 1-20 kW peak output, any age or cond, needed immed. J Kouch, KJKL, 105 Gemini Pl, Syracuse NY 13209. 315-487-2393.

Xmtr, 500 W or 1 kW tube or solid state. WLMV, Box 187, Vernon Hills IL 60061. 312-680-7557.

FM, 1 kW or 3.5 kW. L Logan, Family Stations, Oakland CA 94621. 415-568-6200.

CCA or CSI 25-27.5 kW FM xmtr, any cond. T McGinley, 1st Media Corp, POB 10239, Wash DC 20018. 301-441-3500.

Harris MW10, D McDonald, Big M Bdcg, POB 700, Ennis MT 51729. 406-586-6541.

McMartin BA-2.5K 2.5 kW AM, any cond. Goodrich Ent, 11435 Manderson, Omaha NE 68164. 402-493-1886.

5 or 10 kW in gd cond. G Bicochi, IBS, 1771 N Powerline Rd, Pompano Beach FL 33060. 305-977-9111.

20-25W FM, any cond, prefer Collins 831G, send price, cond & spares. H Husbands, 6626 Talmadge Ln, Dallas TX 75230. 214-233-6351.

FM exciter for under \$500. R Larson, WROP, 316 S Maple, Opark IL 60302. 312-848-3172.

AM 5 kW or 10 kW, late mdl pref. P Baillon, Baillon Co, 60 W 4th, St Paul MN 55102. 612-222-5555.

FM 20 kW 1980 or later, with full doc to change freq. E Nichols, KJNP, POB O, North Pole AK 99705. 907-488-2216.

Harris 10 kW FM xmtr, less than 10 yrs old, J Bahr, WVIS, POB 487, Fredericksted, St Croix VI 00840. 809-772-1652.

Versacount LA150 or similar unit, RF amp, J McCann, MTV Networks, 35 Adams Ave, Smithtown NY 11787. 516-423-2464.

FM translator, 1 W, near new in excel cond to meet FCC req. P Holt, Omni-Lambda Assoc, Box 144, Burke NY 12917. 518-483-3900.

TUBES

Want to Sell

Econco rebuilt 4CX5000A, \$650 & 5CX1500A, \$450, never used. G Hill, KSHA, 1151 Hilltop, Redding CA 96003. 916-223-5742.

Eimac 5CX1500A, new \$500; 8877/3CX1500A-7, new \$450; many used amp, rectifier tubes; new sockets for 4CX5000 & 4CX15000. H Husbands, 6626 Talmadge Ln, Dallas TX 75230. 214-233-6351.

Want to Buy

Vidcon E5080 tube for a Concord TV camera. L Auman, Auman Recdg, Rt 1 Box 368, Dover OH 44622. 216-343-2297.

TURNTABLES

Want to Sell

Presto mono cutting lathe, 3 speed, 1D & 1C heads, 2 doz styli, blanks, gd cond. \$350/BO. D Kocher, 1901 Hanover, Allentown PA 18103. 215-776-1455.

Presto 1936, 28" recording lathe w/2 16" cutters. P McManus, McManus Enter, 4011 Orchard, San Diego CA 92107. 619-233-1730.

Russco Studio Pro B, 2 sp, vgc w/Audio Technica tonearm; Gates CB500 transcription TTs w/one Gates base, fair cond. I Baron, WCUA, Box 814 Cardinal Station, Wash DC 20064. 202-635-5106.

QRK & Maze TT, parts & Micro-Trak 303 I Baron, WCUA, Box 814 Cardinal Station, Wash DC 20064. 202-635-5106.

QRK TTs (2), \$250 ea B Hunter, KIXE, Box 9, Redding CA 96099. 916 221 5800.

BE Spotmaster Studio Pro TT w/Micro-Trak tonearm, low hrs, \$200. L Wagner, ARN Prod, POB 1788, Orlando FL 32802. 305-299-1299.

Russco Studio Pro complete pair, arms, preamps, furniture, J Phillips, WDCW, 414 Washington, Defiance OH 43512. 419-782-8591.

Micro-Trak 720 w/tonearm & spare parts, excel cond, \$175. J Cunningham, YSDA, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

Technics SP15, SH15B2 base. Audio Technica ATP12T tonearm, Stanton 6J00A cartridge, new, \$595. A Soroka, WJRO, POB 159, Glen Burnie MD 21061. 301-761-1590.

Sony CDP 6500ESD (2) digital CD players, 6 mos old, excel cond, \$850 ea. J Stitt, WLLT, 250 W Court Ste 300E, Cincinnati OH 45202. 513-241-9500.

Gates CB1200 w/Gray 303 tonearm, \$125; QRK 12-8, no tonearm, BO. M Saady, First City Rec, 141-60 84th Rd #3E, Briarwood NY 11435. 718-846-2062. 7-10PM.

Want to Buy

EMT 927, 928, 930's. C Dripps, Kurlaff Enter, 4331 Maxson Rd, El Monte CA 91732. 818-444-7079.

Ortofon cutting head DSS601, one for parts, any model that works. F Badeaux, Musk Factory, 1812 Proctor St, Port Arthur TX 77640. 409-982-7121. 4-8 PM CST.

Neumann cutting lathes, comp w/console & elec. C Dripps, Kurlaff Ent, 4331 Maxson Rd, El Monte CA 91732. 818-444-7079.

TV FILM EQUIP.

Want to Sell

Beaulieu R16 camera w/Ang 12-120 zoom lens, 4-gang, synchronizer, rewinds, sound readers, viewers, B&H 816 hot splicer, B&H 202 optical magprojector, w/sync motor, B&H 385 projector, recording amps, light meter, reels, other misc access & equip. Polecat lighting mounts, BO. B Howard, Academy Film Prod, 3918 W Estes Ave, Lincolnwood IL 60645. 312-674-2122.

RCA TK27, TP66 film chain, 16mm, multiplexer, TP5 fly chain, 8mm Super 8 transfer, comp system plus spares, \$10,000/BO. S Weiss, Stevens Quality Video, 28759 Greenfield, Southfield MI 48076. 313-424-8439.

VIDEO PRODUCTION EQUIP.

Want to Sell

NEC DVE controller, \$1500. C Malcom, Video Srvs, 1599 Superior #B2, Costa Mesa CA 92627. 714-631-1144.

Sony BVT-2000 TBC, gd, clean, 16 line memory, slo-mo capable w/Sony 1" machines, or use w/3/4", \$4800/BO. 301-220-0662.

Mole-Richardson 126B perambulator, BO. M Fiedler, Mayoney-Fiedler Prod, 5346 DuPont Ave, S Minneapolis MN 55419. 612-822-0013.

Teletext 400 video graphics system, \$3500; Sony CMA-6 (2) camera adapters, rack mountable, mint cond, BO. J Von Vleck, Aras Consulting, 2321 N Utah St, Arlington VA 22207. 703-524-5067.

CMX 1 squares, (2) 2860; AVR2; MM1200; (2) GV1600; VR1200, as lot. H Casteel, Technichrome, 1212 S Main, Las Vegas NV 89104. 702-386-2844.

RCA TK760 (2) remote panels & camera cables. S Dodson, Desert West, 1870 W Prince, Tucson AZ 85705. 602-293-1849.

TV Research Intl EA-3/EA-6 VCR edit controller w/manual, \$250. F McCall, Performance Srvs, 1521 W St Mary's Rd, Tucson AZ 85745. 602-323-0901.

Video prod equip inc: Microtime T-100 TBC, Leader waveform monitor & vectorscope, Panasonic monitors, JVC ESP-2AT edit system, JVC KM 2000 SEG, Panasonic triple 5" BW monitors, Panasonic WV 555 studio camera, Panasonic WV 555 ENG camera, RTS BP 300 comm system, Knox Ki28-MOD 8 char gen, Lowel omni light kit, call for details, sold separately or for \$29,000 complete w/custom console. Baker Street Stds, 10 Wheeler Ct, Watertown MA 02172. 617-924-0065.

Want to Buy

JVC TN-3P video monitors, M Adler, Sherwood Comm, 1310 Industrial Hwy, Southampton PA 18966. 215-357-9065.

Convergence 104 or 204 parts. C Malcom, Video Srvs, 1599 Superior #B2, Costa Mesa CA 92627. 714-631-1144.

VIDEO TAPE RECORDERS

Want to Sell

JVC 8500 U-matic editing system, all 3 pieces complete, gd cond, \$4000. U George, George Assoc, 175 5th Ave # 3206, NY NY 10010. 212-475-3330.

Sony 2850, Sony 2860, JVC 3/4" U-matic recorders (18), BO. H Casteel, Technichrome, 1212 S Main, Las Vegas NV 89104. 702-386-2844.

Sony RM420 (3) U-matic remote control boxes, BO. B Hawkins, WENS, 1099 N Meridian, Indianapolis IN 46204. 317-266-9700.

VR2000B (3) gd cond, \$2500. H Casteel, Technichrome, 1212 S Main, Las Vegas NV 89104. 702-386-2844.

Sony BVH500 1" video w/Anvil case, batteries, charger, AC500 AC adapter, HT 500A chroma stabilizer, T Cereste, Lightscape, 420 W 45th, NY NY 10036. 212-757-0204.

JVC 1" editing system, \$5000. C Malcom, Video Srvs, 1599 Superior #B2, Costa Mesa CA 92627. 714-631-1144.

Ampex VR2000 (3), all rebuilt, 3M-DOC, Velcomp, WFM, S Dodson, Desert West, 1870 W Prince, Tucson AZ 85705. 602-293-1849.

JVC 6060 U 3/4" deck, excel, \$1000. R Robinson, TNA, 10 George St, Wallingford CT 06492. 203-269-4465.

Sony V03800 (2), AC adaptor, charger, gd cond, all for \$2200. E Mateo, KGKL, 1301 S Bryant, San Angelo TX 75903. 915-655-7161.

Want to Buy

RCA TR600A remote panels, H Henson, Henson Prod, 4569 Havencrest Rd, Winston Salem NC 27106. 919-924-8717.

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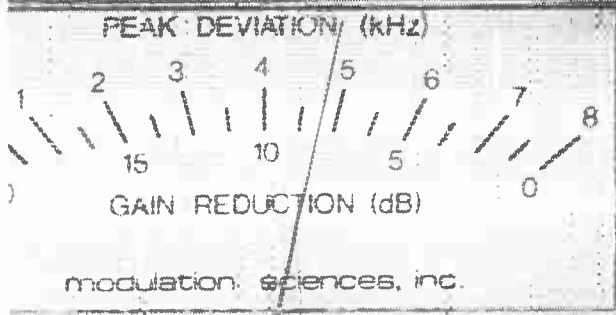
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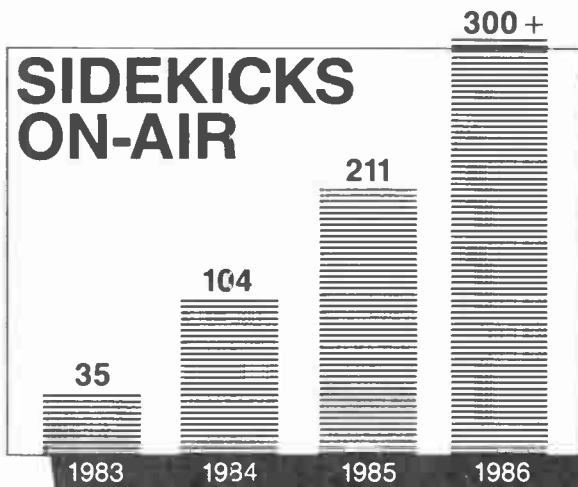
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When Stereo AM Was Binaural

by H. E. "Hal" Davis

Leslie MI . . . I normally don't write technical articles anymore, as I used to do 25 or 30 years ago. There are many younger people—with their new ideas and experiences—to do that now. However, a friend of mine recently suggested that I write and comment on my experi-

ences with stereo AM in the 1950s.

In 1952 I became interested in the idea of stereo AM, although at that time I referred to it as binaural AM. During that year and the following several years, until the summer of 1956, I built and operated no less than four separate binaural AM transmitters for use on the 160 m amateur band, mostly on 1820 kc.

I designed and built several different transmitters, or exciters, using filtered independent sidebands with crystal lattice filters and later using pairs of Collins mechanical filters.

I also built a phasing-type binaural exciter, as well as another exciter using a combination of phasing and filtering techniques.

As far as the receivers I built, they were of only two different types. One used a matched pair of Collins 8 kc mechanical filters, while the other one was a phase-splitting type that used synchronous detection similar to the Crosby (I believe that was the name) synchronous detector circuit that was fairly well known at that time.

At one time I contacted a friend, Stuart Rockafellow, who was one of the founders of the Robotron Corporation. He came to my place in Willow Run, MI on several occasions and witnessed demonstrations of my equipment, and he encouraged me to continue my efforts.

As a holder of many patents, he pointed out to me some of the requirements of a device to be patent-able and said that he doubted if my binaural radio system would be patent-able. I was very enthusiastic though, thinking I really had something new and worthwhile, and was interested in obtaining a patent.

Stu, who incidentally was also a licensed radio amateur (W8NJH, I think), agreed to help me with the finances, which he estimated to be in the area of \$600. Being just recently married and having a family, I was unable at that time to raise the \$600. He then kindly offered to take a detailed description of my system to his attorney in Kalamazoo, MI for evaluation.

Several weeks later he returned with information similar to that which I had already discovered, notably that most of the independent parts of my systems had already been covered by patents to RCA and to the Hazeltine Corporation. Upon discovering that, I dropped interest in further developing binaural AM.

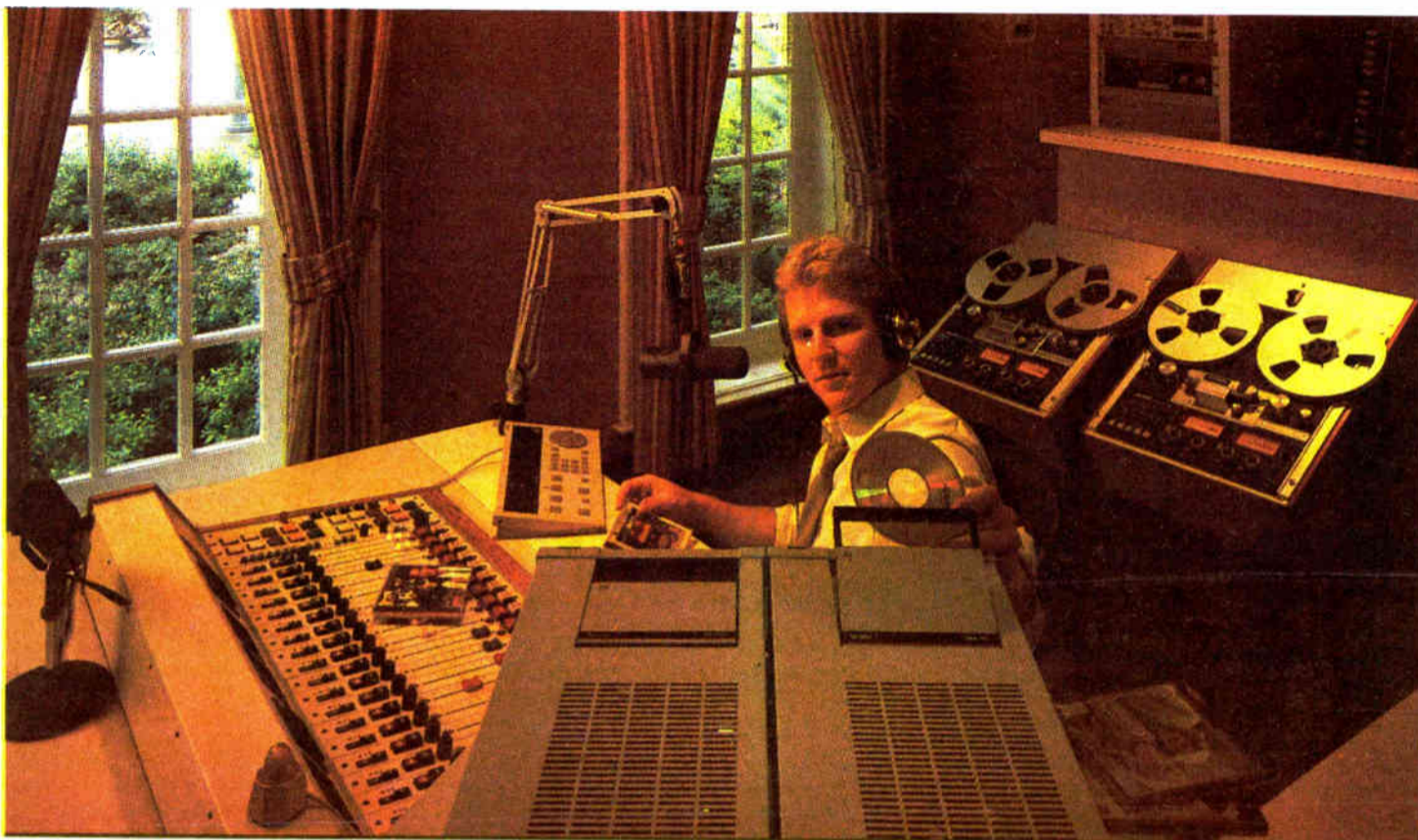
I used the exciters off and on for several months after that. Due to the lack of program material suitable for use on amateur radio, my binaural, or stereo, system was not much more than a curiosity to the several people who took the time and interest to hear and examine it.

The binaural equipment was later used as an AME (amplitude modulation equivalent) station—that is, a carrier with only one sideband. The results were better than with the binaural system for amateur use, enough so that I still use AME occasionally on the 75 m amateur band when I'm not using single sideband without the carrier.

I suppose there are still some fellows out there that recall my binaural, or stereo, transmissions back in the early 1950s, some 30 years ago. My friend John Grover, K8DMJ, currently CE at channel 62 in Detroit, whom I must thank for the suggestion that I write up this history, is one. I still enjoy discussing that episode in radio.

I'm glad to see that stereo AM finally is getting a good trial on a real commercial basis. In fact, a local station, WJCO in Jackson, is one of the stations here in Michigan to go to stereo. I still have a couple of old Collins 75-A-4 receivers that I can use to tune to the upper and lower sidebands of the WJCO signal at 1510 kHz and, at last, after some 30 years, finally, hear somebody else actually transmitting binaural AM.

H. E. "Hal" Davis, aka W8MTI, is with WCXD Broadcast Services, Box 1, Leslie, MI 49251. He can be reached at 517-589-8179.



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