

NEWSWATCH

"Supertuner" Orders Postponed

WASHINGTON NAB attendees who expected to place an order for the Denon/NAB TU-680 "supertuner" at NAB '92 were told that orders were not being taken at the show as previously announced.

Apparently the tuner, which includes an AMAX-spec AM section and C-QUAM AM stereo, is not ready for production, according to Denon and the NAB. Also, the original price, which was to be in the \$450 range, may be higher. Officially, the NAB has not set a price.

The project has taken over four years and has run into many design obstacles. The latest occurred earlier this year when Allegro Microsystems indicated it could not produce the highly effective Sprague AM noise blanking chip nor the Walsh FM decoder chip on the limited production run that NAB requested—about 2,000 initially.

The NAB said that an agreement had been worked out over the chip issues, but the latest delay involves production concerns between Denon of America and its parent company in Japan.

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New Products Dominate NAB '92

International Registration Bolsters Show Attendance

by Arthur Cole

LAS VEGAS When all is said and done about this year's NAB convention, one thing certainly will be clear: it was a memorable event.

Notwithstanding the disruption of former President Ronald Reagan's speech to broadcasters Monday by an apparent anti-nuclear activist—an incident that drew national headlines and made the evening news across the country—the show had significance for the industry because it represented a further coming out of many new technologies.

Of particular interest to radio broadcasters was the announcement by USA Digital Radio of its success in extracting a DAB signal from an FM signal with which it was simulcast. The extraction was accomplished via a single chip; a waveform monitor demonstration was presented at the USA Digital booth and at a session during the convention. It marked a major step forward in the Project Acorn in-band, on-channel DAB system.

Also demonstrated during the show was the LinCom in-band, adjacent channel DAB system, which is supported by Strother Communications Inc. While this system also showed progress, proponent acknowledged its interference problems when



Artwork courtesy of Getris Images

listening to second adjacent channels.

Radio Data System (RDS) technology also moved forward at the convention, with the NAB and the Electronic Industries Association agreeing to investigate the inclusion of ID Logic B in a U.S. RDS standard. The action mollifies AM broadcasters, who the NAB maintained were opposed to any RDS standard without an AM provision.

Held in the newly renovated Las Vegas Convention Center, the NAB '92 convention boasted increased attendance, topping last year by about three percent. Total preregistration reached 52,704, compared to last year's 51,217.

International attendance also continued its annual increase, with preregistration jumping a marked 20 percent, to 8,561.

"Naturally, we are very pleased," said John Abel, NAB executive vice president of operations. "This has been just about the best, logistically, of any convention in past years. That was largely due to the new convention center."

One complaint heard on the floor was the often confusing booth-numbering scheme—especially in the television hall—that made it difficult to locate a particular booth without having to resort to a map—and even then having some problems.

However, Abel said the NAB will concentrate on addressing that annoyance at future shows.

"We are going to tackle that problem," he said. "It is a difficult problem to overcome because, unless all the booths are the same size, we can't make (the floor) look like New York City, with all streets and avenues."

A commonly heard complaint from exhibitors in the radio and audio hall was the "segregation" of their display area from the larger television hall. Some exhibitors felt

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RDS Committee Eyes ID Logic B

by John Gatski

WASHINGTON The NAB and the Electronic Industries Association (EIA) are confident they will be able to follow through on the progress of the Radio Data Systems (RDS) subcommittee meeting held at NAB '92—and eventually adopt a U.S. standard acceptable to both organizations.

The National Radio Systems Committee (NRSC) RDS subcommittee meeting outcome seems to have reduced the strain between NAB and receiver manufacturers that existed since late February. At press time, the NAB was waiting for a report from Pierre Schwob, the developer of ID Logic, a technology that allows format selection of stations based on a program built into receivers.

The NAB was due to receive the report by May 15, and if the addition of ID Logic to an RDS receiver is feasible, the RDS subcommittee is likely to formally endorse the standard at its June 1 meeting in Chicago, according to NAB Engineer for Technical Regulatory Affairs John Marino.

If approved by the subcommittee, the standard will be recommended to the full NRSC.

The NAB issued a statement in February that it would not support a U.S. RDS standard unless it included AM. Receiver manufacturers, represented by the EIA, were angered by the move. They said the intention was to adopt an FM standard now, and an AM standard could be approved

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Interference Tests Outlined

LAS VEGAS Based on tests conducted by the NAB, FM signals require approximately the same protection ratios from co-channel digital signals as from other FM signals, but adjacent channel interference ratios will depend upon the type of modulation scheme selected.

During an NAB '92 panel, NAB Engineer Ken Springer outlined a study that ascertained interference potential between FM and digital MSK signals in the FM band.

The study used CCIR test methods that evaluate interference thresholds for FM-to-FM interference. The study is considered an

important step to determine parameters for an in-band DAB system.

"The results indicate for adjacent channel signals, the dominant mode of interference was spectral spillover onto the desired channel from the adjacent digital transmission," according to Springer.

Springer noted that "adjacent channel protection can be improved by suitable selection of modulation methods and/or spectral shaping."

He said that Orthogonal Frequency Division Multiplexing (OFDM) and Minimum Shift Keying (MSK) schemes are preferable for low interference potential. "For other waveforms, RF filtering and

pulse shaping techniques will probably be required."

Springer acknowledged that the tests did not take into account several factors in the calculations. They included multipath propagation (but it probably can be accounted for by building in a fade margin), and effects of FM subcarriers. Thorough subjective tests also were not made, he added.

In concluding his report, Springer said that it may be advisable to impose a stricter FM-to-digital interference standard than the CCIR's FM-to-FM standard—especially for adjacent channels.

He said an FM signal's worst-case scenario occurs at the boundary of the protection contour. While moving closer to the station, reception improves. But because a DAB adjacent channel system would likely to be broadcast from the same FM antenna, the criteria ceiling will be applied to the

entire coverage area.

Groundwave Curves Available

WASHINGTON The FCC has made available the new AM groundwave propagation curves that were adopted in 1990, but delayed until the sweeping AM ruling, Docket 87-267, became effective.

The curves can be obtained from the FCC by contacting the Downtown Copy Center, 1114 21st St. N.W., Washington, D.C. 20036, or calling 202-452-1422.

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SBE Meeting Reduces Chapter Tension

by John Gatski

LAS VEGAS Tensions within the Society of Broadcast Engineers (SBE) subsided considerably following a chapter chairmen meeting at NAB '92. The meeting resulted in a pledge of better communication from the board of directors to the members.

During the nearly four-hour chapter chair meeting, SBE President Richard Farquhar emphasized that the board needed to do better in communicating with members.

"I think that national headquarters has been poor in that area. We are trying to improve," Farquhar said.

Farquhar announced at the meeting that the board already is instituting policies to make itself more accessible, including publishing an annual financial statement to members, limiting closed meetings, and allowing by-laws to be put before a national vote via chapter petitions.

Mad about dues

Discontent within SBE has been compounded by a feeling the national board has not been responsive to the membership. Tensions ignited when the national board increased the dues from \$30 to \$55 following last year's convention in Houston. Chapters in major cities—including Los Angeles, Seattle, Philadelphia, Baltimore and Washington—said they were considering secession from the SBE.

Members said the dues increase was voted on without their input and that they did not find out about it until late 1991. During the meeting, some SBE members said a dues increase implemented gradually over several years would have been more acceptable.

Members also were upset over the SBE moving the national convention around to venues in various cities, and perceived a lack of openness about the budget.

Current board members said that much of the negative sentiment directed at them was the result of actions by previous boards.

As a result of these concerns, new by-law amendment proposals were drawn up earlier this year by Los Angeles SBE Chapter Chairman Sandra Woodruff.

Much of the board's willingness to become more responsive was based on Woodruff's restructuring proposals that were sent earlier this year to chapter chairs, according to board members' comments at the meeting.

Woodruff had called for resignations of the board and election of a new board based on regional representation. She also had suggested sending in a tea bag with renewals (at the old dues rate) as a symbol of protest over the dues increase.

Regional board members?

Woodruff's proposals not only would amend the rules and elect the board of

directors based on regions, but would require those members to meet with chapters in their regions at least four times each year. The amendment proposals also asked for the elimination of the prohibition on treasury reimbursement for board members to attend board or committee meetings.

Woodruff said many members felt better about the board following the meeting, and she emphasized that the dues strike is over. But, she cautioned, the board is not likely to be receptive to the proposed restructuring that her chapter has proposed.

According to Woodruff, if the board rejects the by-law amendment proposals, they can be brought to a national membership vote if five percent of the chapters vote and approve each item separately. Since SBE has 101 chapters, five percent amounts to five chapters.

Woodruff is confident five chapters will support the amendments, which could then be placed on a national SBE ballot. If the chapter support is not there, she said, "we will drop it."

Much of the chapter chair meeting discussion with the board focused on the national SBE conventions, which have been controversial for several years.

There are several opinions on how to best conduct a national SBE show, based on comments at the meeting.

Some favor leaving the show in a central location, such as St. Louis; the convention appeared to have been successful during the years it was held there. Another faction agreed with the SBE board that moving the gathering around eventually gives most broadcast engineers a chance to attend one, since a lot of them can't afford to attend a show in a central location. Most SBE members said they have to pay for the show attendance out of their own pockets.

Where to put the show?

Still another group favors eliminating the national shows completely and putting resources into regional shows, or combining with the NAB.

Critics of moving the show pointed to the 1991 SBE convention in Houston, which was held jointly with the Texas Association of Broadcasters (TAB), as an example of what happens when a show is constantly relocated from one venue to another.

The Houston convention lost about \$60,000, but SBE board members said that the dismal fiscal performance was the result of a bad economy and high expenses, not location.

Some have blamed the erratic success of SBE national shows on convention coordinator Eddie Barker and Associates, but

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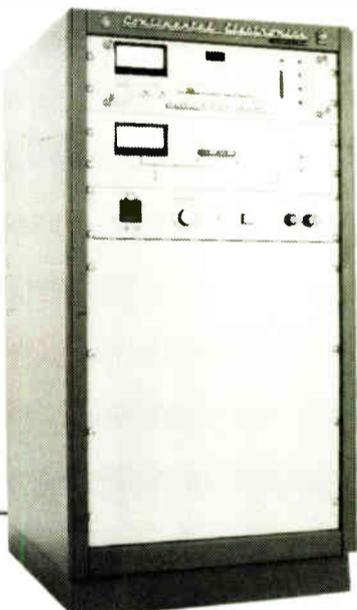
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The Good, the Bad and the NAB

by Alex Zavistovich

WASHINGTON Well, I guess I don't have to worry about whether anyone's reading this column anymore.



In the April 22 installment of *Pilot Tone*, I went out on a limb to relate some rumors about engineering consultants in Washington. The phone rang off the hook after that



Another Elvis sighting—this time at the radio hall



Telos wedding: With this ring...

issue hit the streets.

One comment I got came from Bob Denny, president of Jules Cohen and Associates (hey, I got the spelling right, Bob!). I had mentioned that there was a shortage of engineers at the firm.

It turns out Jules Cohen and Associates is looking for more engineers, but it's not because of the recession. The company has more business than the current staff can handle.

So, there's the straight stuff. By the way, I can also report that Jules Cohen and Associates celebrated its 40th anniversary on April 21. Congratulations, gentlemen.

Well, this issue is *RW's* NAB '92 convention wrap-up, and there's plenty to say about the broadcast industry's biggest get-together. There's so much to say, in fact, that we just didn't have any room for our regular feature writers. But fear not—they'll all be back next month.

Meanwhile, since product introductions and other news from the convention is covered thoroughly in the rest of these pages, I thought I'd take the time to give you a taste of some of the more offbeat parts of the show.

Harris-Allied took a trip down memory lane (in my case, into the history books), showing the Gates American 250-A transmitter. This 250 W

warhorse—circa 1938—was the first transmitter with a standard peak limiting amplifier. It still looked good, even with all the new high-tech gadgetry surrounding it.

My award for the wackiest promotional idea of the show has to go to the Telos wedding, which was held at the Candlelight Wedding Chapel across the street from Circus Circus. Telos "married" its new model 100 Delta to a telephone, which arrived modestly bedecked with bridal veil. This was one case where the bride was also the ring bearer...

The whole Vegas atmosphere seemed to spill over into the exhibit areas this year.



Over 50 years old and still going strong.



Vegas showgirls were sometimes bigger attractions than the equipment.



Everyone's a winner—at least on the show floor, that is.

In the TV hall, one company went so far as to have a real showgirl in full regalia swiveling her hips in a product display.

Meanwhile, TV Answer—an interactive broadcast service—featured an intriguing "un-display." No product on exhibit. No high-pressure sales tactics. In fact, all the company had at the booth was row after row of slot machines. Best of all, unlike their casino counterparts, you never lost on these machines. (Of course, there was no cash payoff, either, but if you're like me you welcomed any winning as a change of pace.)

Over at the audio hall, it was definitely *Viva Las Vegas*, as a larger-than-life Elvis icon smiled down on the traditional emblem of '50s cool, a classic T-bird convertible, sporting a mirror shine on its black paint job.

There was a lot more to see, but for now I'll let the pictures do the talking. The rest of the issue speaks for itself.

That's it for now. Tune in next time,

Alex

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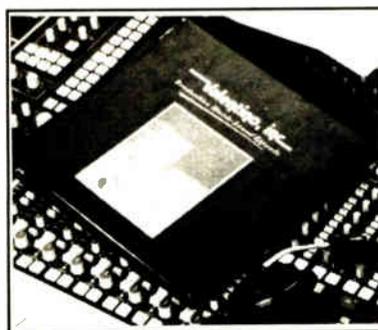
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Consultant's corner

Dear RW,

This letter was prompted by the report in the April 22, 1992 *Pilot Tone* feature concerning rumors that our firm may be planing to move to Florida to "stave off the expense of keeping an office in downtown D.C." It was also suggested that "after-effects of the recession" might be to blame.

It is factual that we are considering a move within the next year out of downtown D.C. and that a community in Florida is being studied as a possible new location. The part about the recession, however, is untrue. We first started examining Florida communities for relocation four years ago, well before the recession.

Washington, D.C. is a very expensive place to run a business. It is not very convenient, either. Our employees endure commuting times of up to 1 1/2 hours, each way. There have been very good reasons, though for the firm's presence here for the past 51 years.

Just about all of the major engineering firms in the 1940s were located in downtown D.C. In order to provide a premium level of service, they took advantage of close proximity to the FCC offices for retrieval of records and supplying testimony in hearings. Filings were all done at the headquarters building and virtually all of the major communications law firms were downtown also.

Just ten years ago, firms such as ours had engineers and researchers who spent many hours each week in the FCC public reference room. Computerized FCC databases have all but eliminated these activities. Hearings today rarely consider engineering issues and all applications are filed in Pittsburgh. We communicate with the nearby law firms by facsimile today, rather than with couriers as was common practice at one time.

We saw most of the changes coming four years ago, when we signed our present lease, and decided at that time that it would possibly be our last one in downtown Washington. Shortly thereafter, we began

studying alternatives for relocation. Given the state of modern communications technology, we saw no reason to limit our search for a new home to the immediate Washington area.

We are considering several locations in the Washington suburbs as well as one community in Florida for the move. We should be making a final decision in the next few months. Factors of quality of life, convenience, and cost are important to us, but the most important consideration of all is a continuing ability to provide the level of service we now provide for our clients after we move. As an additional benefit, we would like to be able to continue offering this level of service without having to pass along the ever-increasing cost of doing business in downtown D.C. to our clients.

Thank you for considering news of our firm worthy of mention in *Pilot Tone* and for this opportunity to clarify the situation.

Ronald D. Rackley
duTreil, Lundin & Rackley
Washington, D.C.

Virtual reality binaural

Dear RW,

I found John Sunier's article on binaural audio (RW, Feb. 5, 1992) interesting. I've often wondered how binaural works. Actually, I wonder how we determine the direction of the source of a sound.

It would appear that we can determine the direction of a sound from the phase relationship between the sounds as detected by each ear. A sound that is to the left reaches my left ear before it reaches the right ear. However, a sound that is behind me to the left also reaches the left ear first. So, how can we tell if the sound is in front or behind?

We may get some cue based on reverberation. A sound behind us will tend to have more reverberation than one in front, due to the directional characteristics of the ear (signals from behind are attenuated). However, I'd expect we determine the front or back source of a sound by slightly unconsciously rotating our head. If the sound gets closer to the right ear as the head is rotated to the left, the sound is in front.

If this is indeed the case, how can we determine the front/back source of a sound with headphones? Further, even if the binaural phones do result in an accurate image being formed, that image does not move when I move my head (as it does in reality). Perhaps we need some "virtual reality" headphones.

These headphones would include a processor that determines the "actual position" of a sound, then properly encode the signal driving the phones to position the sound properly taking into account the head position of the listener. If the sound is in front of me, I should be able to turn around and have the sound behind me. In the classic concepts of binaural, this would be similar to moving the artificial head and ears used in recording in synchronism with head movements of the listener. Then we could truly put our ears on an extension cord.

Harold Hallikainen
Hallikainen & Friends
San Luis Obispo, Calif.

NAB Show Reflects Recovery

What could be said about technology on display at the NAB '92 convention could be observed of the convention in general: It was more a year for refining proven products than breaking new ground.

To be sure, new broadcast equipment was in evidence throughout the trade show. Most of this gear, however, expanded on technology introduced in earlier shows.

Still, the apparent success of the NAB's latest gathering—coupled with the number of exhibitors showing enhanced product lines—indicates that the economy has finally gotten back on its feet. The continued growth of the convention is an encouraging indicator of the improving health of the industry.

Many of the complaints that were raised following the NAB convention last year seemed to have been addressed this year. Renovation of the convention center has been completed, and the newly expanded facility eliminated the need for last year's overflow hall, where some exhibitors claimed traffic was slow.

For their part, exhibitors noticed good traffic through all the halls this year, with a marked presence of international attendees. Many of these attendees came to the show prepared to buy, with the intention of equipping their stations with the best the broadcast industry has to offer.

The show was, however, not without its problems. Some radio exhibitors protested about the separation of the audio and video halls; a few felt that traffic through the radio and audio hall was hurt by this "segregation."

Others, exhibitors and attendees alike, complained about the timing of the show, which fell just before two major religious holidays. This scheduling decision led some attendees to leave the convention early, contributing to what some exhibitors believed was a particularly light last day for the trade show.

Despite these concerns, the NAB '92 convention was overall a success. Preregistration and international attendee figures topped last year's records. The show demonstrated that the broadcast industry is on firm footing for the first time in months, poised to step with confidence into a new period of economic prosperity.

—RW

Get down to business, AM

Dear RW,

The broadcasting industry is changing so rapidly and going downhill so quickly, that I hardly know where to begin. For now I'll try to limit my comments to two areas:

The time may be at hand for AM broadcasters to break away from the NAB and form our own association that will stand up for AM's interests. I say the time may be at hand because I believe that the NAB should be given one last chance to pull out all the stops and attack the problems of AM. Broadcasters on the AM band should set a deadline and ask for real action on the real problems. Should no action be forthcoming, AM broadcasters should pull out of the NAB.

Following the agenda of the NAB, it becomes painfully obvious that the association is most interested in television and high power FM broadcasters. The main events in the press are television's push for yet another 6 MHz for HDTV, and the NAB wanting to make sure the Big Boy FM stations aren't blown away by DAB.

As for the lowly AM broadcaster, hundreds of thousands of dollars were invested in the "Super Radio" receiver and the antenna with no skywave. Besides being big jokes, they didn't work. How about that AM stereo?!!

Wake up NAB, the problem is not separation, it's noise. I own a stereo receiver and the local stereo stations sound great but the noise is still there, and at night—forget it, I can't get them. So, I do just what the listeners do—flip to FM with no noise and the signal comes in day or night.

Anyone can point at the problems. What we need is action. What should we do? I

would leave no stone unturned for ad dollars in my market. No matter how small the business or unlikely the business was to advertise I'd always ask. It's time to leave no stone unturned in the fight to save the AM band.

George W. Yazell's NFR, FM on the AM band, is worth study. I don't know if it will work, but I think we should look into it before we decide it won't work. It certainly is a better idea than the NAB's anti-skywave antenna.

Lawrence J. Tighe Jr.'s proposed FM2, a second FM band for AM broadcasters: Again, it may not work, but the FCC should have at least opened it up for comments. As for the NAB, they didn't like the thought of it getting in the way of their Big Boy TV guys and their quest for another 6 MHz, each, for HDTV.

Did you know that in 1986, WKPT, a Class IV AM station in Kingsport, Tenn., started using the Second Audio Program channel of a local television station to broadcast the WKPT signal? The 1400 kHz signal gets out only a few miles at night, but the "SAP" signal had listeners 70 miles away. I don't know if WKPT is still doing this and I know this idea won't save the AM band itself, but it shows that there are ideas that most AM broadcasters aren't getting the story on. This is the reason that it may now be time to break from the NAB and form a group that is ready to look at every idea that could save the AM band.

The time for the band-aid fix is long past. Let's get the real first aid out and go to work. We should start by putting the NAB on notice that there will be some changes.

Jerry E. White
Pelham, Ga.

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**Next Issue of
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June 10, 1992**

Cable Radio Reaches Out to Broadcasters

by Frank Beacham

LAS VEGAS For radio broadcasters who are losing their at-home audience, three digital cable networks now offer the opportunity to bring these home listeners a direct digital station feed through a cable TV outlet.

In an NAB '92 engineering presentation titled, "Digital Cable Audio: When and Where," Don Lockett, vice president of engineering at National Public Radio, gave an overview of the programming services being offered by the three digital cable radio networks now on the air. He said each

service offers audio quality with a dynamic range slightly less than that of the compact disc, but rated each service's signal as having very high quality.

"The compact disc made consumers much more sophisticated," Lockett said. "With CDs experiencing phenomenal growth, broadcasters are now investigating how to deliver CD quality over radio. Digital Cable Radio, Digital Music Express and Digital Planet are big players now. They compare to pay per view TV."

All use variations of basic quadrature modulation, he said, and each charge from \$7 to \$30 per month, depending on options.

During a question and answer period, Doug Talley, chairman and chief technical officer of Digital Planet, Los Angeles, noted there are now opportunities for

capacity. We are now delivering three over-the-air radio stations from LA on our nationwide feed. We get the feed via digital link directly from their studios."

There are now opportunities for broadcasters to participate with digital cable broadcasting.

broadcasters to participate with digital cable broadcasting.

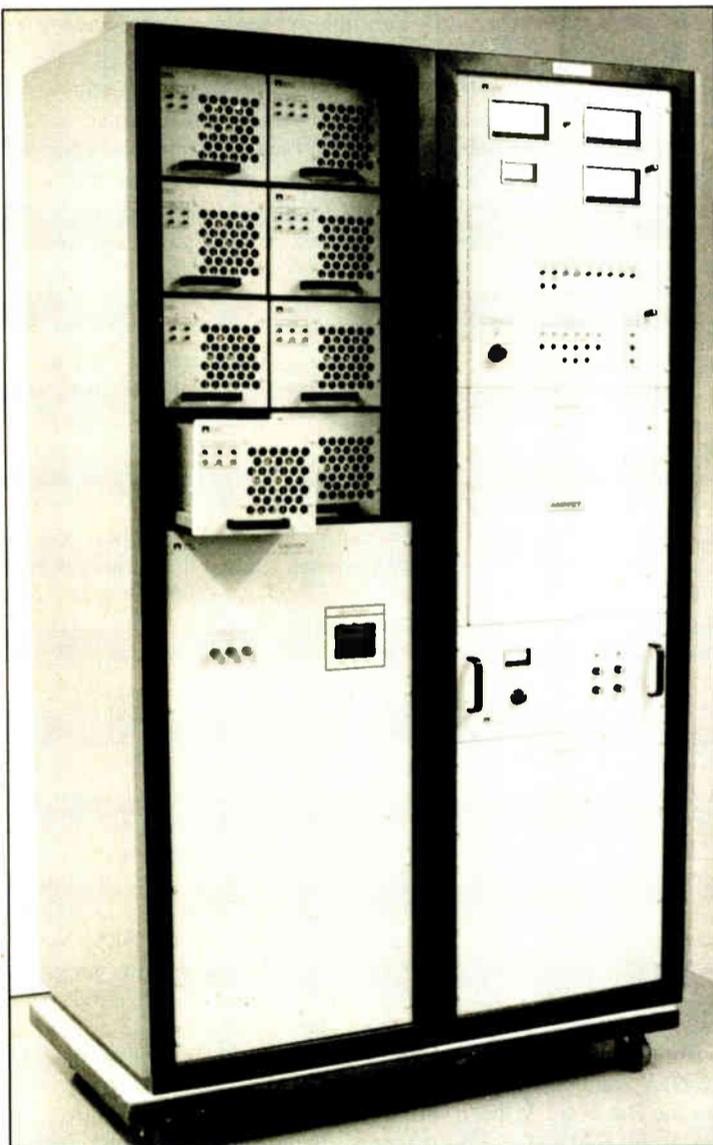
"We are in the process now of wiring 55 million homes to receive digital audio," he said. "All systems have tremendous excess

Digital Planet currently delivers the digital program feeds of KUSC-FM (classical), KLON-FM (jazz/blues) and KNAC-FM (hard rock).

"Broadcasters can get a digital quality signal to homes right now," Talley said. "They do not have to wait for spectrum allocation. They don't have to wait for very expensive new radios. All the station has to do is provide a digital feed to the cable head-end and we'll put you on the air. That can be done through a variety of methods at a very low cost."

NPR's Lockett responded: "Here is another opportunity—with the decline of at-home listenership—that radio broadcasters can improve the quality of the signal delivered to the home audience."

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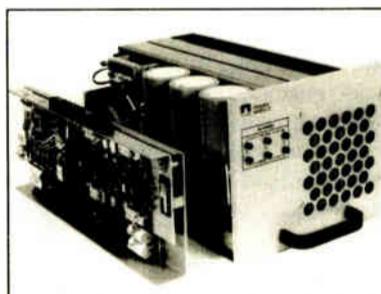
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Costs of DSP Rival Analog

by Frank Beacham

LAS VEGAS A Motorola executive urged radio receiver manufacturers at NAB '92 to begin designing radios based on digital signal processing (DSP) circuitry because the cost of the digital technology is now competitive with traditional analog design costs.

Michael Collins, marketing manager for Motorola's DSP division, said the company is targeting the automotive radio market for a new generation of DSP signal processing receivers.

"DSP technology has in the past been pricey," Collins said. "We realize we need to compete to make it affordable. We have to provide the same quality level as we have at the price of current radios. We'll become more and more affordable."

Collins said Motorola is attempting to assemble a demonstration digital radio based upon the company's DSP 56000 24-bit signal processor. "The functions we might do in a digital radio are source-dependent pre-processing. We do AM stereo decoding, graphic equalization, imaging and time delay. All these things can be done in a DSP-based radio."

In an engineering session at NAB '92, Collins gave an overview of DSP processing. "DSP is the arithmetic processing of real time signals which have been sampled at regular intervals and digitized. The most classic example today is the compact disc," he said.

"DSP problems tend to be environmental—things happening in the real world such as myself speaking into a microphone," Collins said. "Microprocessors, on the other hand, crunch man-made data in a non-real world environment."

"DSP has to be real-time, while microprocessing has to be as soon as possible. There is no exact time for microprocessors to perform. Some computers are faster than others. That's the difference between DSP and microprocessors."

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World Radio History

RDS Promoted as EBS Replacement

by Frank Beacham

LAS VEGAS Use of the SAGE I Radio Data System (RDS) for emergency broadcast system (EBS) information would eliminate the problem of primary alert EBS stations that cannot or choose not to carry emergency messages, according to a paper presented at an NAB '92 technical session.

"This design concept would eliminate the possibility of another WCBS/Hurricane Bob situation (in New York)," said Gerald M. LeBow, president of Sage Alerting System, in Stamford, Conn.

Contending that one of the major weaknesses of the current EBS is the use of the "daisy chain concept," LeBow said if the

primary CPCS-1 fails or opts not to transmit the alert, the entire daisy chain collapses.

The SAGE I system uses the 57 kHz

"The SAGE I system departs from the single CPCS-1 station daisy chain concept."

—Gerald LeBow
Sage Alerting Systems

RDS digital data subcarrier to deliver emergency information in the form of audio and data, and it cannot be thwarted by a CPCS-1 station failure, LeBow contended.

"The SAGE I system departs from the

single CPCS-1 station daisy chain concept to a multiple station concept whereby many stations are directly connected by radio links (both digital data and audio) to any

number of actuation centers," LeBow said. "If a primary alert station cannot or chooses not to carry the emergency message, the SAGE I system automatically retunes all receivers to the backup stations within six seconds."

Encrypted data delivered by SAGE I through the Emergency Warning System (EWS) feature of RDS can address and activate specific receivers and devices in areas affected by an emergency. In addition to providing digital data for full-screen TV text transmission, "the system can selectively turn on addressable receivers, activate sirens, put digital messages onto electronic road signs and page emergency workers," LeBow said.

SAGE I, LeBow said, is superior to proposed in-band alert systems in several ways. In-band systems, he said, use signals which are audible to the public and cause listeners to "tune out" during testing, while SAGE I's tests are totally trans-

parent to the public.

In-band systems also have limited data rate and lack error detection and error correction, he said. And in-band systems, he concluded, are less secure to saboteurs who might send false alerts.

"Many emergencies do not occur 7 a.m. to 10 p.m. when people are normally listening to radio or watching television, LeBow said. "There is a need for an automatic system which will turn radio and TVs on any time of the day or night.

"It is unlikely that any consumer electronics manufacturers will build any in-band alerting system into their car or home radios exclusively for the purpose of emergency alerting. The perceived consumer benefit versus cost will not lead to in-band systems being incorporated into car and home radios."

LeBow said the first fully implemented SAGE I System in the U.S. will be operational in Jefferson County, Texas by September 1992. The new Sage I system will be operated by the Jefferson County Emergency Management Office and will have six actuation centers, one of which is in a mobile van than can operate up to 60 miles from outside the county, LeBow said.

Opponents of SAGE I include many AM broadcasters, who believe that the system puts AM stations at a competitive disadvantage because its primary alerting stations are on the FM band.

Committee Eyes ID Logic B

► continued from page 1
later when adequate technology becomes available.

In response, the NAB said that the RDS standard had been driven by receiver interests and was not adequately representing what broadcasters wanted—especially for AM. With RDS, automatic format scanning is only possible for FM; the NAB said, however, that there are technologies available that can accommodate format selection for AM, including ID Logic.

In order to make ID Logic more palatable to broadcasters and receiver owners, ID Logic B was developed to allow easier programming of station formats. The original ID Logic required the user to have the receiver reprogrammed with the format changes that usually occur each year.

ID Logic B would allow a receiver to select AM formats in a given area via the receiver memory, which can be updated automatically via an RDS data stream. Under the concept, a select RDS station in an area would be responsible for collection and storage of the updated AM formats. It

would then transmit the information periodically so an RDS receiver's ID Logic B section could be updated, Marino explained.

FM format scanning would be handled by the broadcaster-supplied 57 kHz RDS data stream; stations would be assigned a digital code based on their format. RDS receivers would then lock onto that code whenever the format button is pushed. RDS also has the capability to switch between translators, display text, and provide emergency alerting.

Marino said that Schwob believes a design incorporating RDS and ID Logic B into one receiver is possible. "He felt very optimistic that he could come up with a working prototype," Marino said.

EIA Consumer Electronics Group VP Gary Shapiro said that the EIA will be satisfied with the ID Logic B solution and that it wants to facilitate an RDS standard "as soon as possible."

He added that EIA never intended to slight AM broadcasters and the association supports technologies that will improve the AM band.

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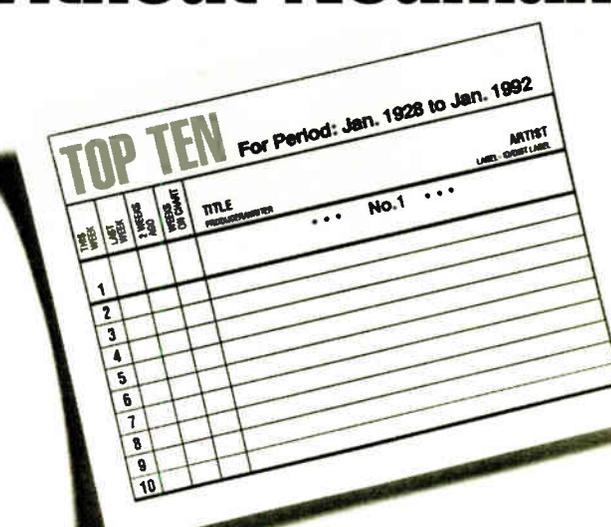
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California EBS Attacked at Session

Former San Francisco CPCS-1 Engineer Criticizes EBS State Leadership, Susceptibility to Human Error

by Frank Beacham

LAS VEGAS A verbal aftershock from the 1989 San Francisco earthquake hit NAB '92 when a Bay Area radio station engineer launched a scathing attack on the Emergency Broadcasting System (EBS) in California.

KNBR Engineering Manager Bill Ruck, whose San Francisco CPCS-1 station was blamed by the California EBS coordinator for failing to follow proper procedures dur-

ing the 1990 emergency, charged at an NAB engineering session that there is "a complete and total lack of leadership" in California's emergency information system.

"There's no emergency broadcast system in the State of California," Ruck charged. "By system, I mean a means to gather time critical information, relay that information to the broadcast community and to get it to the public."

Ruck, who declined to be interviewed by

RW following the the 1989 earthquake, said the California system, which had been completely overhauled, also failed in October 1991 during a fire that killed 25 people and injured 150 in the Oakland hills.

He said Oakland officials chose not to activate EBS due to the perceived inefficiency of the system.

Common threads

Citing common threads in both disasters, Ruck said "nobody knew what to do. Plans were not distributed. People were not trained. The system was not tested."

He said there was no continuing public information made available by local agencies, that the California Office of Emergency Services (OES) "served no useful purpose" and that timely emergency information was

they have now. I think they would have trouble sorting out a tin can and string."

California's EBS coordinator, Jim Gabbert, called Ruck's charges "sour grapes" and a "childish" response to KNBR's removal as CPCS-1 station in San Francisco following the station's performance during the earthquake.

"In the state structure, he's nobody. He's out of the picture," said Gabbert, owner of San Francisco's KOFY-TV. "I don't know why he's making an EBS presentation at NAB."

Following the earthquake, Ruck was admonished by Gabbert for failure to follow emergency procedures. Ruck later denied Gabbert's assertions.

Gabbert said KCBS in San Francisco is the new CPCS-1 station under the latest emergency plan. And he noted, "Ruck's comments are unfair because for the first time all plans in California are now together," Gabbert said.

He noted that the state's digital emergency

During the 1991 Oakland Hills fire, officials chose not to activate EBS due to perceived inefficiency in the system.

—Bill Ruck
Engineering Manager
KNBR

not made available to non-English speaking people or to the hearing-impaired.

According to Ruck, "There was a complete and total lack of leadership. The state EBS chairman would rather give interviews than work to solve problems. His signature is on every one of the non-functioning EBS plans he berates in his interviews. The local San Francisco Bay operational area chair is a revolving door position. The state OES has no funding to promote or train for its plan."

Sour grapes

Ruck said that EBS problems are political and not engineering related. "We have adequate technology. It's just not used," Ruck said. "At the level of participation of our state and local government, a postage stamp would be adequate. They could write a letter and mail it to us. It would be as effective as what

warning system is now undergoing testing and that full implementation of an automated digital EBS system will solve most problems of providing emergency broadcast information.

During the question and answer period following Ruck's remarks at the session, Helena Mitchell, the new FCC chief of the EBS, rose to address the audience. She did not confront Ruck's comments directly but admitted there are problems with EBS.

"We are going to try to change the system. We are going to change the system," Mitchell told the audience. "Work with us. We are really committed. We are going to make the EBS work."

New Products Dominate NAB

► continued from page 1
that being isolated from the larger hall caused fewer attendees to visit the radio displays.

The new convention center facility drew positive reaction, particularly the fact that the entire main exhibit area was under one roof. Last year's West Hall was outside and across the street from the main floor, which prompted a number of complaints.

Wheatstone's Gary Snow said he liked having the radio and audio hall separate. He said "It's easy to get lost in the sauce in the big room." Snow said traffic was good and lots of sales leads were taken.

It was the Reagan incident on Monday, however, that had most people talking throughout the show. Richard Springer—an anti-nuclear activist associated with the Hundredth Monkey protest group—was able to reach the stage and shatter a crystal award presented to the former president before being subdued by Secret Service agents.

The incident led the NAB to tighten up security throughout the show.

"We did beef up security by about 20 people," Abel said. "We stationed them in meeting rooms and in the main area at the bases of escalators and stairwells."

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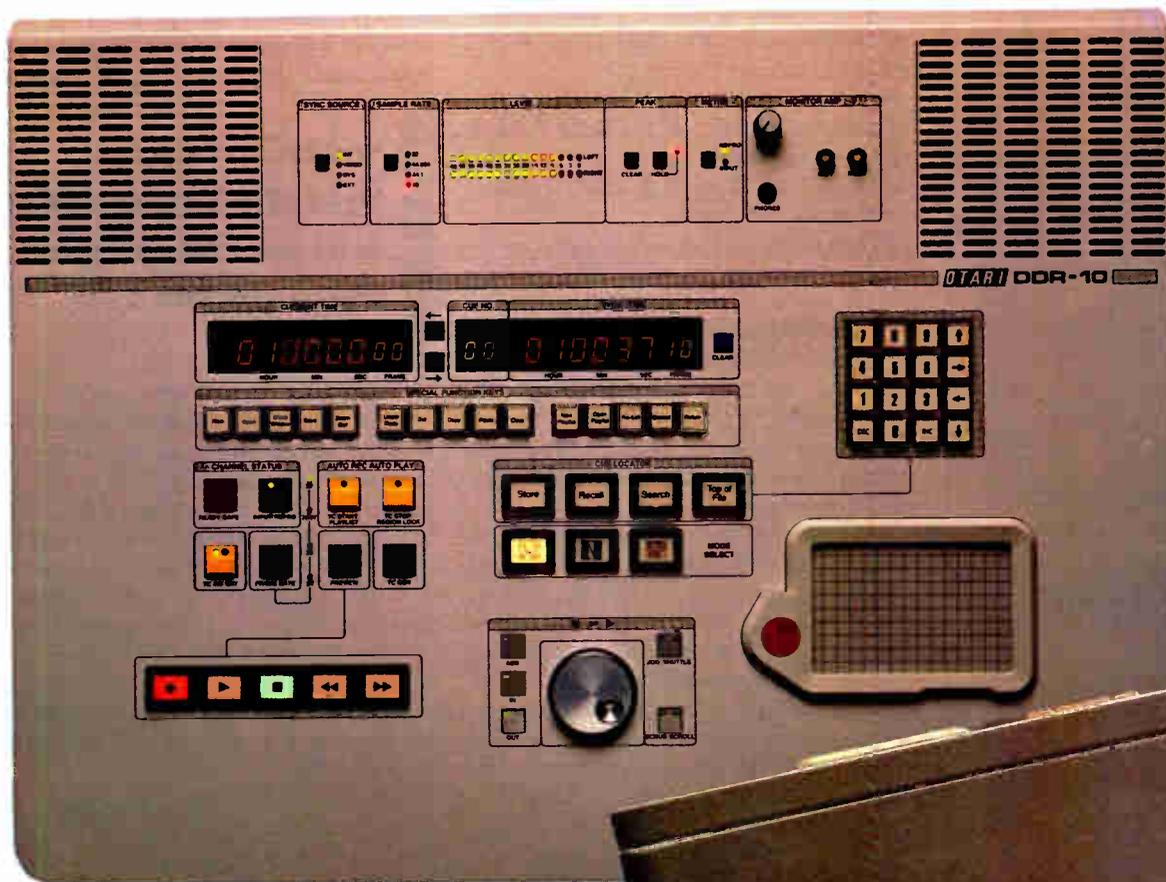
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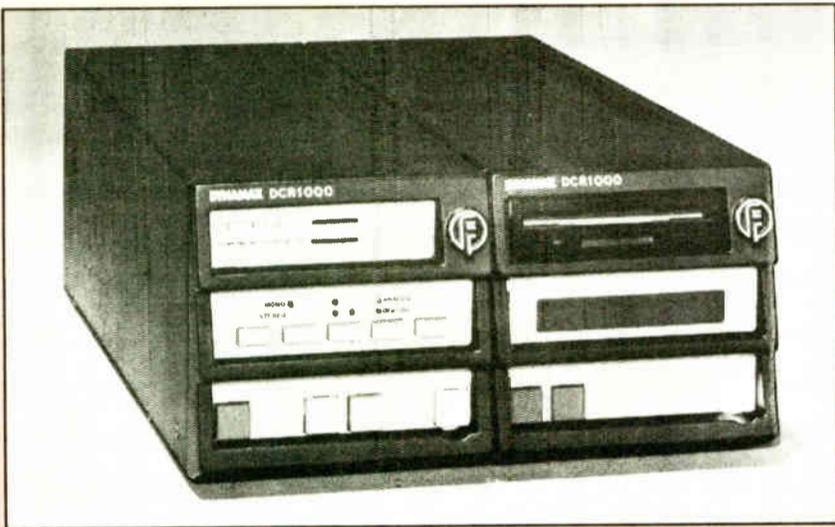
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Budget Constraints Prompt FCC Enforcement Changes

by Nancy Reist

LAS VEGAS FCC enforcement efforts are not business as usual anymore, according to Richard Smith, chief of the FCC's Field Operations Bureau.

During an NAB '92 engineering panel, "Broadcasters Rules of the Road," Smith said that budget constraints and philosophical shifts have changed the FCC enforcement arm's procedures.

Smith explained that broadcasters can expect a change in the methods that field offices use to interact with stations. "Our old-time method was to do a lot of preventive work, routine inspections, monitoring of the spectrum, on-site visits, a lot of personal contact," he said. "Most of that will be diminished. In the future, I also think that we'll be involved in more non-technical compliance areas."

He predicted that the Commission will be conducting more audits on topics ranging from Local Marketing Agreements (LMAs) to tower painting and lighting. Field offices conduct audits by calling stations and asking a series of simple questions.

Smith said the audits have three functions: information gathering, education and enforcement. All the field offices run audits simultaneously, a practice Smith believes enhances their educational impact.

Though it is not typical to announce audits in advance, Smith suggested a major audit about tower lighting and dark stations may be pending.

Although the field offices can no longer afford to maintain mobile monitoring of the

spectrum, Smith explained they are establishing some remote monitoring sites. "Unless you have some ability to know what actually is going on in the spectrum and some ability to act on that information and assure compliance, then the regulatory scheme

**Smith predicted
that the Commission
will be conducting
more audits . . .**

probably doesn't mean very much."

Smith noted that the fines associated with specific violations have increased. He said the Commission had just voted to give the field office the authority to issue fines of up to \$20,000, while fees higher than that have to go to the full Commission for approval.

Smith concluded with a description of the severe budget cuts experienced by field offices. He emphasized that the Commission does not and should not keep the money gathered in fines. He suggested that perhaps user fees could be used to fund the FCC directly.

A technique for saving money was the theme of another presentation in the same panel. James Zoulek, engineer in charge of the FCC's Los Angeles Field Office, explained the FCC AM Broadcast Self-Inspection booklet, a program which is still in development, but which he expects to be implemented nationwide.

SBE Tension Reduced at NAB

► continued from page 3

the board said it is not Barker's fault.

Factors contributing to the Houston loss included an \$18,000 reimbursement to TAB of money the latter would have made from vendors that would have exhibited at a separate TAB show, had the two associations not combined their events.

One board member said the SBE would not make such a deal again.

Stay in one place

Woodruff said the show needs to stay in one place like St. Louis. "Why can't we go where it works?" she asked. "We seem hell bent on moving this across the country."

She pushed the idea of more money for the regional shows—some of which are very successful, such as Seattle and St. Louis. One SBE member, however, maintained that moving the show to different regions allows members from those regions to attend an SBE national show at least "every once in a while."

Another member said, "the regional shows are not the same."

With regard to the next SBE national show, slated for San Jose, the board said the organization is committed to it, and the show will make money. The board said it negotiated a contract for the San Jose show that has far fewer significant expenses than had the contract with Houston.

In 1993, SBE plans to hold its convention in Miami, but many members believe that location is even less central. The Miami show will be held jointly with the Radio-Television

News Directors Association.

Another area that prompted much discussion during the chapter chairs' meeting was the SBE budget. The board was accused of conducting fiscal operations with no accountability to the membership.

Washington, D.C. Chapter Chairman Chip Fetrow said it took a long time for him to get a copy of the 1991 SBE budget from the board. Again, board members said there will be more accountability.

The board also received intense criticism from Charlie Hallinan, who with John Battison was a co-founder of the SBE.

Hallinan said that in the early 1980s, he was asked to head a by-law amendment review committee that was formed to assess the effect of by-law changes, but subsequent boards never utilized it. That, he said, allowed the board to routinely enact by-laws, such as the right to raise dues, without membership input.

In its early years, the membership voted on dues increases and other matters affecting them, he said, but now "the little guy is being ignored. It's the membership who should be voting on the dues increase or anything else."

Hallinan made several suggestions to overhaul the SBE board, including firing the executive director, cancelling the contract with show coordinator Eddie Barker and Associates, amending the by-laws to restore members' rights to votes on new assessments, reactivating the by-laws amendment committee, and releasing by-law amendment proposals at least nine months before they are voted on.

Air Chain Products Continue to Mature

by Jim Somich

LAS VEGAS In the areas of audio processing, amplification, routing and patching, NAB '92 was a display of incremental improvements rather than revolution. There were no breakthrough products, though significant enhancements to equipment introduced in previous years were on display.

Traditionally the "glamour" devices at any show, digital audio processors have settled down to an evolutionary cycle, with each manufacturer touting subtle improvements in software for their existing digital engines.

Air-chain processing

The major players in Digital Signal Processing (DSP)-based air-chain audio processors are continuing to contribute to the art.

Gentner's Lazer 2.0 is an integrated processor: fully DSP from the input connector to the stereo generator output. It is a complete, self-contained digital stereo limiter and stereo generator. The 2.0 software upgrade promises more flexibility and better performance. (One Gentner sales representative confided that if I tried the previous version I would be amazed at the improvements in the 2.0 software.) The company also manufactures the Prizm audio processor.

The Audio Animation paragon DSP processor now sports software V2.2; claims like "louder" and "better" abound. V2.2 also provides stereo-strapping, enhanced digital filters and algorithms (the instructions by which digital engines process), more flexibility and better fidelity. The long-awaited analog stereo generator card, alas, is not yet available but promised within 90 days or so.

The paragon screens display vast amounts of data, often in graphical form. At very least it is a gadget lover's delight. In the right hands I believe it could be a valuable competitive tool. The paragon is controlled by a 286-based PC card and all data is input via a front-panel high density 3.5-inch floppy drive.

Because it takes the paragon about 30 seconds to reboot after a power failure, it is important that you use it with an uninterruptible power source (UPS) to avoid dead air after a power interruption. In the alternative, AA provides bypass terminals at the output that can be routed to a backup analog chain during bootup. A new version of the device, the paragon-transmission, is also available.

The Orban 8200 DSP Optimod has seen software upgrades since its introduction at NAB '91, and an Orban engineer tells me that a new version will be released around July of this year. The company also showed the Optimod-Studio 460.

Like the paragon, the stereo generator in the 8200 is basically analog, the D-to-A conversion taking place before stereo generation. The 8200 falls between the Gentner and Audio Animation boxes in price. Its user interface is also between the two. The Orban unit uses PROM-based software. This allows for faster booting but makes changes more difficult and expensive. Sound is excellent.

If anyone knows competitive processing it is Frank Foti, and his Cutting Edge Technologies' Unity 2000 is the culmination of years of experience in the trenches.

While Frank is a little vague on how the Unity accomplishes what it does, the processor appears to be designed around a pulse-width modulation scheme (well-proven and very effective). Extensive digital control provides flexibility. The signal path includes an AGC, multiband compressors, multiband peak limiters, low-distortion clippers and stereo generator, all under digital control.

For 1992, the Unity 2000 has software improvements that include serial control via a modem (yet to be accomplished by Gentner or Orban) and daypart processing via the internal clock. A side benefit of the analog processing is that there is no delay through the box.

At the other end of the processor spectrum (financially speaking), Inovonics introduced the "David" integrated FM stereo processor-generator. David (as in David and Goliath) is an extremely cost-effective all in one analog box that will find great acceptance in smaller markets. It includes AGC, compression, peak limiting and a digitally synthesized stereo generator. A single knob adjusts density; the unit is very simple to set up and use.

The CRL Amigo is also an extremely simple and inexpensive all in one box (FM AGC, limiter and stereo generator) designed for smaller installations. The company also showed its Signature series audio processing system. CRL's Real Time Event Sequencer, Audio Signature (AGC/compressor) and Modulation Signature (FM limiter/stereo generator) can be controlled via an IBM PC, modem or automation remote control.

Production compressors

On air is not the only place that audio processing is used in the modern station. There was a lot of action this year in production compressors and processors.

UREI introduced the successor to the fa-

mous LA-3 and 4 production and recording processors: the LA-22, 12 and 10 series. The LA-22 is the flagship processor and consists of a dual channel frequency selective compressor, limiter and expander. A built-in parametric equalizer in the side chain permits the user to tailor the control to very specific bands. The LA-12 is the 22 without the expander and parametric EQ; the LA-10 is a mono version of the 12.

The JBL M712 Two Channel Gating Compressor/Limiter is a straight-forward single rack unit and provides complete control over threshold, attenuation, attack and release. The unit has an outstanding 115 dB dynamic range and excellent transient response. Servo balanced outputs provide automatic output level adjustment to accommodate either balanced or unbalanced feeds.

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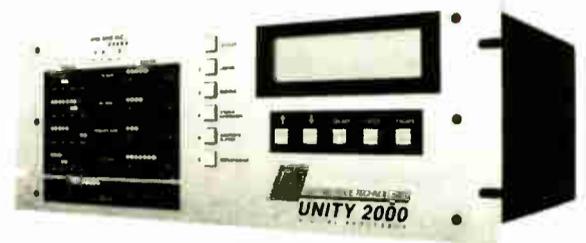
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AEQ MP-10 Portable Broadcast Mixer



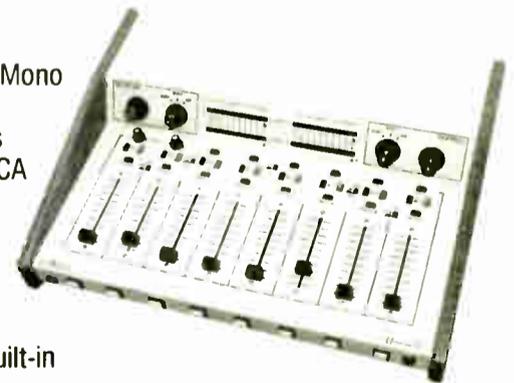
- Digitally stores up to 32 seconds of repetitive messages such as station IDs, etc.
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- 2 Dedicated mike faders
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Console Manufacturers Respond to User Talkback

by Ty Ford

LAS VEGAS Equipment manufacturers have wisely adopted a conservative attitude with regard to the development of new products in light of the ongoing economic downturn. Instead, companies have concentrated more on user feedback to refine existing systems.

A new entry from Pacific Recorders & Engineering was the ADX audio workstation, which marries workstation technology to a flying-fader automated MixStation console.

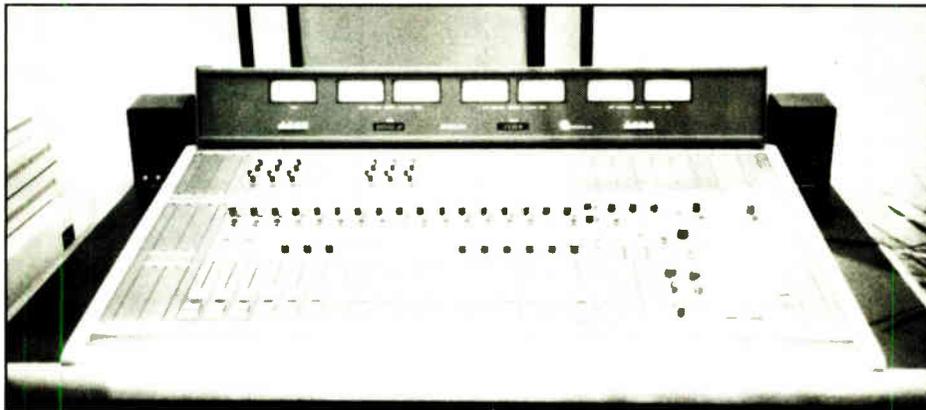
According to Pacific Recorders, each ADX MixStation is a complete eight-input automated mixdown module. The console panel drops into ABX or Productionmixer consoles. Each MixStation input has the same functions as the standard PR&E multitrack module including: channel on/off; solo; pan; dual pre/post sends; three-band quasi-parametric EQ, dual program assigns and dual switchable inputs.

Audioarts furniture also was on display at the Wheatstone booth.

Another well-known console manufacturer, Auditronics, has evolved its on-air 800 Series consoles into the on-air/production 800/850 Series which supports four stereo output busses, two monaural mix-minus busses and a selectable L+R mono output. An internal "voice/music" bussing system allows for separate voice and music processing. Dip switches allow for user-definable programming of the logic system.

Monitor outputs are selectable from nine sources, and there are high and low EQ controls for the headphone amp. There are eight (or 16) position two-way communications systems. External control includes module on/off, end of message detection, VCA level control and more. Depending on configuration and options, the Auditronics 800/850 series ranges from \$20K to \$40K.

Autogram showed its new Mini-Mix 8 and Pacemaker 1644 consoles. The eight-channel



The 850 series on-air production console from Auditronics

New from Wheatstone was the A-6000 for on-air or production. Not your every-day on-air board, the A-6000 offers numerous features including the Bus-Minus™ system that allows every input channel to produce its own mix minus. The modules can have two to four stereo program assign buttons.

Wheatstone offerings

Sends can be stereo or mono, mode selector or an auto-sequencing function that allows programmed play from a number of remote devices with the stroke of a single button. Monitor modules allow for monitoring of four stereo program busses and four external inputs as well as the four mix minus busses and two auxiliary send busses. The headphone amp is equipped with EQ and phase reversal switches.

Also new from Wheatstone was the MR-40 audio mixing console, a four-track production console with four-track bus assign and machine start/stops just below the fader. The MR-40 also features a three-band equalizer section and a stereo send bus that follows stereo channel balance controls. Mono modules have both mic and line inputs.

Wheatstone also had introductions in its Audioarts line of consoles. The R-10 console is a fully modular console with balanced stereo program and audition outputs, a talkback output, and meter select control. Conductive plastic faders, machine start/stop and illuminated mic on-off switches are provided.

The R-30 radio console from Audioarts is available in two mainframe sizes (23 or 18 input channels, with two stereo outputs, mono sum and mix-minus). The modular R-30 features a fully regulated rackmount power supply, logic follow, and full machine control.

Mini-Mix 8 comes with two pannable mono mic preamped inputs. The six mono line level balanced inputs also accept six stereo unbalanced inputs for use with unbalanced CD players, cassette machines and other unbalanced devices.

A full range of options

The Mini-Mix 8 also includes VCA operation, a built-in cue amp and speaker, separate balanced and unbalanced stereo output busses, a balanced mono output bus, a balanced air monitor input and a multi-pin connector for remote start.

Monitor and headphones are both switchable between output busses and the air monitor. The Mini-Mix 8 uses an external power supply to reduce hum. All of these features are packed into a 19"×14"×4" package for \$2,499.

Autogram's Pacemaker 1644 is a 16-module console that can be configured to have up to 44 selectable stereo inputs. The transformerless 1644 offers machine control for all inputs, VCA level control, electronic switching, P&G linear conductive plastic pots, Shadow selector switches and up to eight patchable mic preamps. Multiple outputs include stereo program, stereo audition, mix minus, mono, cue and two line monitor and headphone for a list price of \$8,995. A selection of timers and clocks are optional.

At Broadcast Electronics, the Air Trak 100 is positioned to expand the success of the Air Trak 90. The major feature of the Air Trak 100 is its extended-height vertical metering bridge which also allows for in-line mounting of remote control panels, input selectors, talkback controls and EQ modules.

continued on page 17 ►

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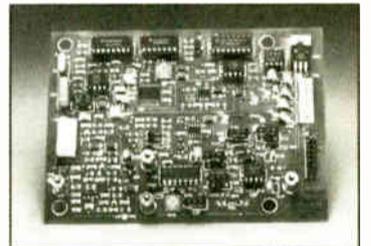
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Air Chain Gear Maturing

► continued from page 11

has tempted us with the model 425 compressor-limiter. The one rack unit box has two channels of simultaneous compression, limiting and downward expansion. Higher average levels and increased presence is created by the variable ratio compressor, while the infinite ratio peak limiter positively prevents overload. The downward expander reduces noise, extending overall dynamic range. The soft-knee compression curve is easy on the ears.

Other production room tools

Alesis and ART, two well-known names in the recording and musical instrument indus-

New from BSS (part of the AKG Acoustics family of companies) is the FCS-926 dual equalizer analyser. It consists of two separate channels of six-band parametric EQ, digitally controlled. An LCD screen graphically shows the curves as they are adjusted as well as control settings.

Two 44.1 kHz/16-bit sampling boards are now available for the Eventide H3000 Ultra-Harmonizer. The HS-322 will provide 23.7 seconds of sampling in mono and the HS-395 provides 95 seconds in mono. Each of the two stereo channels can be independently pitch-shifted without changing its length. MIDI notes can control the pitches of the two samples. A standard sampling mode, which

was the formation of an Audio Products Division of Burk Technology. Burk, which has built its reputation on remote control equipment, introduced the LX-1 stereo selector at NAB '92.

The LX-1 is a six-input selector that allows you to "take" programming from the studio, automation, satellite or tape. It can

and employs surface mount technology (SMT) to pack a large amount of circuitry on each postage stamp-sized module. Application books are available to help you design with Audio SIPS.

Radio Design Labs introduced 10 new "Stick-On" series modules, including utility amplifiers, mic and line mixing amps,



The PS3 delay system, part of the ART line of audio gear



The Optimod-Studio 460, from Orban

tries, are making a bid for the same acceptance in broadcast production rooms.

Alesis exhibited its 3630 RMS/Peak dual channel compressor with gate. The 3630 offers user-selectable hard or soft knee compression as well as RMS or peak-style compression. The Alesis Microverb III is a 16 bit digital reverb and delay with 256 preset programs.

Applied Research and Technology (ART) showed a line including the SGX-T2 that will perform 12 simultaneous audio effect functions. More than 70 effects are available including digital reverb and delay, stereo sampling, pitch transposer, stereo chorusing and flanging.

Aphex now has a modular parametric EQ module, the model 9901. The 9901 has three overlapping bands of fully parametric EQ, each with 15 dB boost or cut. A special feature is the ability to have both peak or shelf filter shapes on each band. It is part of the Aphex modular processing line. The Compellor, Dominator and Aural Exciter were also on hand at Aphex.

changes pitch by changing the playback rate, is also implemented.

Dolby, the world standard in analog noise reduction, has reduced the price of 24 tracks of Dolby SR noise reduction by 25 percent, making it even more affordable for broadcast production. When SR is applied to analog tapes, noise levels approaching 16-bit digital are possible.

A new entrant in the U.S. processing arena is t.c. electronic of Denmark, which introduced its M5000 digital audio mainframe. The M5000 is indicative of what is to come in digital processors: A digital engine that can wear many faces, depending on software.

Utility products

While not as glamorous as DSP processors or high-performance digital engines, utility products are the ground troops in most stations. This was a good year for the introduction of new utility boxes: the products that make our life easier.

One surprise to emerge from the show

be controlled from the front panel, at the studio or even via Burk's ARC-16 remote control. The single rack unit LX-1 enables mixing of sources for two-studio dialog and soft switching allows for transitions without clicks or pops.

Henry Engineering displayed the new Twinmatch dual-stereo interface, perfect for interfacing two CD players to an audio console. Each channel accepts an unbalanced input at -10 dBv and amplifies it to a balanced, low impedance output at +4 dBm. A gain adjustment is provided for each channel. Each output will drive a 600 ohm load to +25 dBm.

The Henry MicroMixer has four inputs and a stereo output. It will accept up to four line-level inputs and mix them to a stereo output.

Russco Electronics showed its line of amplifiers, telephone interfaces, CD interfaces and other utility-type items.

SESCOM has a line of 11 "Audio SIPS." Each SIP measures about an inch square

mic preamps and combiners.

Benchmark showed a new audio router with remote control panel.

Audio Technologies Inc. (ATI) has expanded its Microamp series with the PB2X8 pressbox mike/line mixer, distribution amplifier and two headphone amplifiers: the HD100 single output and HD1000 four-channel units.

OpAmp Labs showed two new audio press boxes with internal rechargeable batteries and built into heavy aluminum travel cases.

Switchcraft now has a punch-down type of audio patch panel. The insulation-displacement connector is similar but different from that used by ADC. A different tool is required.

Sierra Automated Systems (SAS) showed its line of routing and mixing devices, including the SAS 32000 audio routing system. The SAS 32000 is a 32 stereo input/16 stereo output switching subsystem in a three rack unit frame.

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NAB Offers Dynamic Display of Mics

by Ty Ford

LAS VEGAS Microphones are one of the most subjective parts of any audio chain. As such, it was interesting to track the latest entries with broadcast applications since last year's NAB. Most of the manufacturers of dynamic microphones are now offering their own version of mics with the new neodymium magnet.

These stronger magnets mean higher output levels for dynamic mics. Higher output typically translates into lower noise because you can back off the gain stage at the front of the mic pre-amp. Dynamic mic designers are also experimenting with lighter mass diaphragm assemblies which result in improved high frequency and transient response.

AKG showed its unique dual dynamic cardioid D 3600 (\$379), which uses the latest more powerful magnet substances. AKG call its version of the NdFeB alloy Maximum Flux™. The D 3600's two elements—one for highs and one for lows—reduce proximity effect. AKG quotes the frequency response as 20 Hz-22 kHz. The low-cut switch changes the bottom-end response from 20 Hz to 50 Hz.

The D 3400 (\$239) and D 3500 (\$219) single element dynamic mics are designed for live performance, with 80 Hz-20 kHz responses. The D 3500's low-cut switch rolls off at 120 Hz.

AKG also showed its C 547 (\$449),

a C 747 condenser capsule in a sleek goose-neck configuration, and its C 647 (\$429) directional boundary mic for stage, conference room or talk show applications. The company's Blue Line series allows users to choose from a number of different condenser capsules that are attached to the body by a special bayonet mount.

Audio Technica introduced three new products. The AT4033 (\$699) transformerless studio condenser mic debuted at the October 1991 AES show in New York. The AT4033 uses a unique open cell foam windscreen between the element and the front grill to reduce popping. The AT835A (\$450) condenser shotgun can be powered by a replaceable 1.5 V battery or 9-52 V phantom supply.

Audio Technica also displayed the new MT830R (\$299) subminiature condenser lavalier. The mics also are available through distributor Crouse-Kimzey Co.

New from beyerdynamic is a high-output cardioid dynamic, the M-59 (\$399), and wireless TE-170 (\$1,399) body-pack miniature wireless VHF and U 700 UHF wireless microphone system. The U 700 is insertable into the RR 7000 rack-mounted mainframe that can accommodate up to 12 channels within an 8 MHz bandwidth of one television channel. If you're planning lots of multiperson remotes, such as live broadcast from festivals, fairs and conventions, take a look at this system.

BSW, Bradley and Harris-Allied all were showing the three "Perestroika" Microtech Gefell mics from Gotham, the UM 70S (\$1,150), UM 70 (\$995) and M71 (\$795). Based on the original Georg Neumann-designed M7 capsule, they all use a modern FET hybrid amp and re-

quire phantom power. The UM 70S and UM 70 are triple-pattern mics. The M71 is cardioid only.

Crown International demonstrated improved acoustics on its SASS PMKII (\$899) "head" stereo system.

Changes in the ElectroVoice line of broadcast mics were purely decorative. Both the 635A/B (\$145) and RE50/B (\$217) mics are now available in a black-finish version.

continued on page 21 ▶

Source Gear Goes Digital

by Dee McVicker

LAS VEGAS A wave of new source gear flooded the floor at this year's NAB convention, including CD recorders and digital "cart" machines that use standard computer floppy disks in place of NAB-style carts.

The latter was demonstrated by three manufacturers, all moving into the limelight with computer disk-based machines that have the look and feel of analog cart machines.

The three manufacturers base their products on 3.5-inch computer diskettes. Because each has a proprietary operating format, however, it is unlikely these machines will be able to interchange music libraries anytime soon.

Spotlight on digital

The DigiSpot digital cart machine was on display this year, originally introduced at NAB '91 by Digital Broadcast Associ-

ates and distributed by PEP Inc. DigiSpot is capable of recording and playing back eight minutes of stereo audio (frequency range of 50 Hz to 15 kHz) on a 3.5-inch "floptical" computer disk and is priced at \$2,800 for the playback unit and \$4,800 for record/playback units. DigiSpot is in production and available for delivery.

Another disk-based machine shown was Fidelipac's Dynamax DCR 1000. Taking advantage of the latest in removable storage capacity, the DCR 1000 can record or play back five minutes of stereo audio on a 3.5-inch disk, and offers a variety of sampling rates. DCR 1000 units are now in production and are priced at around \$2,800 for the playback unit and \$2,600 for the record unit.

Shown for the first time at the Broadcast Electronics display were the Disc Trak digital record and playback machines. The units are being marketed by BE under an agreement with Sonifex, the British
continued on page 21 ▶

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Console Makers Respond to User Talkback

► continued from page 13

Other new features of the Air Trak 100 include fader start from cue, programmable timer reset logic, optional LED bargraph meters and low profile high-intensity LED input/output selector switches, a remote control serial interface, remote mic control for Orban 787 mic processor, talk-back module, and other custom module capability.

These features will be made available as upgrades for the Air Trak 90 later this year. Prices for the Air Trak 100 start at \$6,395 for six channels, \$9,095 for 12 channels, \$12,095 for 18 channels and \$15,985 for 24 channels.

Responding to industry input, Harrison brought the AIR-790 console to the show. It has three inputs: stereo line, for line level stereo sources that require logic interface; mono microphone, for mic level mono sources that require logic interface for

input selector and clean feed for hybrid use. Remote line input modules include the same stereo/mono flexibility of the stereo line input plus an eight-switch array that allows any one of eight stereo pairs to be selected.

Sophisticated program, monitor, control



Wheatstone introduced several new product lines, including a line of Audioarts furniture.

room, studio monitor and PFL-oscillator modules complete the system, which is available in 20, 28 and 36 module frames. The price for the AIR-790 ranges from \$18,000 to \$35,000.

Logitek is now shipping last year's prototype water-resistant console called The Mariner. Available in six-, 12- and 22-input configurations, it uses molded rubber buttons, sealed pots and has drain holes for flow-through of liquids that make their way to the interior of the console. Gold-plated contacts on all audio connectors, FET switching and sealed relays, plus the use of LEDs over incandescent lamps further improve the reliability of the console in overly moist situations.

The MAR-IMIC mic module includes mic preamp, pan pot and phantom power supply. The MAR-ILC input module is a two-line switchable input with six function machine control. The MAR-2LN input module is a two-line switchable input with integral control.

The Mariner has five mixing busses; two stereo busses which feed the main output

channels, two auxiliary mono busses for mix-minus or IFB and a mono cure bus that feeds a built-in cue amp and speaker. Most modules are plug-in type for easy service. Backup power supply, clock/timer modules and four mic preamp free standing module are options. Prices range from \$4,200 to \$11,000.

Radio Systems showed their largest console ever, the RS-24. It includes new circuitry that provides 48 inputs and up to four additional outputs. The six input mix board provides six stereo balanced bridging inputs. Each input can be wired to any console audio source or to the post input selector.

Up to four of these input boards can be in-

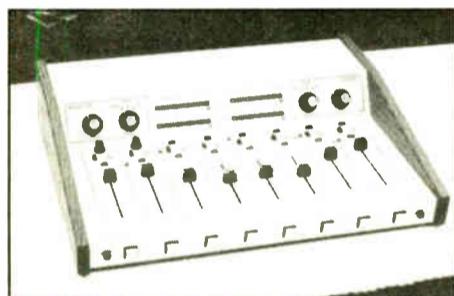
stalled, providing from six to 24 independent stereo mix buss inputs. Each input can then be individually gain-trimmed and jumper-assigned to any of the four mix busses in mono or stereo pairs. The busses are amplified on the companion four output mix buss boards. All of this adds up to unprecedented flexibility for mix minus telephone systems and audio networks starting at \$12,995.

Broadcast Audio, a division of Fidelipac Corp. offered its range of modular audio consoles for on-air and production studios. The current line features from six to 24 channel mixers.

Finally, Arrakis Systems displayed its line of 150; 500; 2000; 2100; 5000; 10,000 and 12,000 series consoles.

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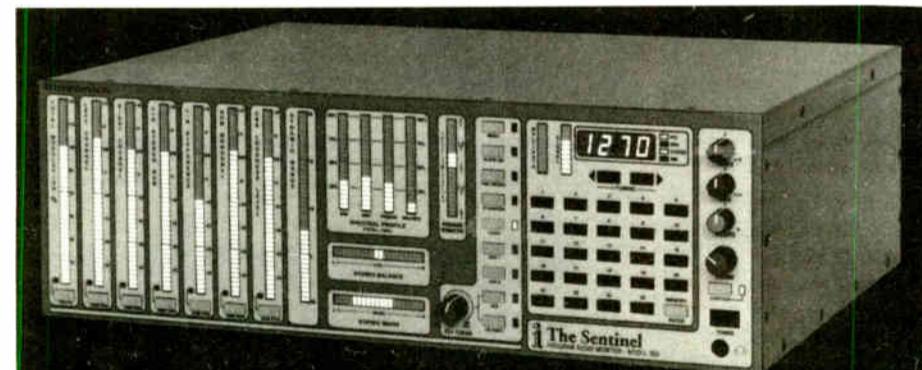
You can reach Ty Ford at 301-889-6201.



The Mini-Mix 8 console from Autogram

the talent (cough buttons, talk buttons and off/on tallies; and remote line input, for line level stereo sources that don't require logic interfaces such as satellite links, phone hybrids and remote lines.

Each stereo input allows for stereo, reversed stereo, mono sum of both channels or mono source from either channel. Mono mic inputs come with pan pot, aux send, A/B



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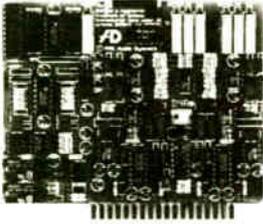
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Zercom Corporation's dual 25Hz detector and dual program amplifier/25Hz notch filter accurately detects tones and removes them from programming.

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Designed as a reel-to-reel playback interface for automation or live assist, some automation systems are using the 25Hz Tone Processor as a program amplifier. The 25Hz filter is only 6Hz wide at the 3 dB point, allowing good bass response of the audio. This is far better than the usual 50Hz high pass filter that removes ALL bass. Maximum output per channel is +17 dBm or +23 dBm with the active balance output option.

Some users are interfacing cassette machines with the 25Hz Tone Processor. A number of stations are using it as a 25Hz detector and filter on satellite networks, including the Beethoven net.

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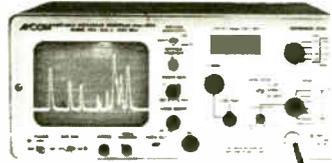
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SCPC-2000E SCPC Satellite Receiver - \$1875

AVCOM's Single Channel Per Carrier Receiver, model SCPC-2000E, has been developed for the reception of FM SCPC signals from satellites operating in the 3.7 to 4.2 GHz band. The SCPC-2000E is a complete receiver that can tune up to 4 specific crystal controlled audio or data channels from a given transponder and adapt to a variety of de-emphasis requirements. The SCPC-2000E is available in either wide or narrow band models and may be used with the SS-1000 (\$1027) Slave for simultaneous reception of additional channels.

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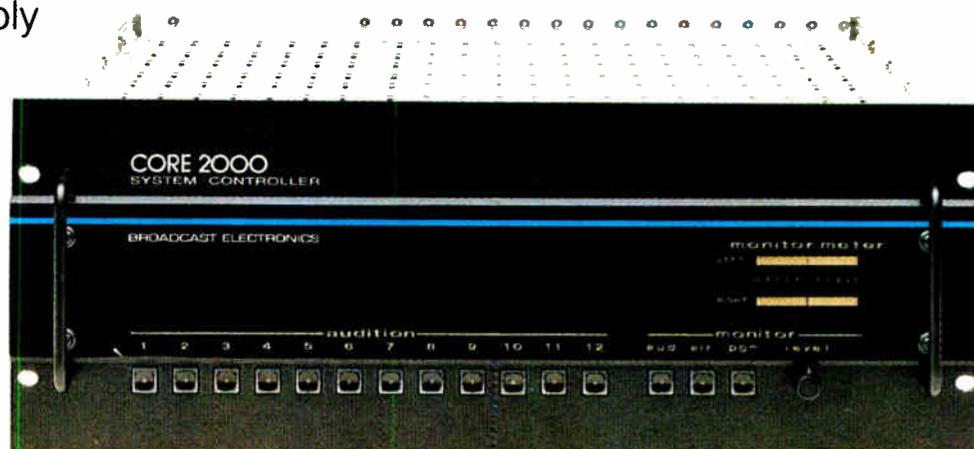
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It's affordable. It's amazingly versatile. It's CORE 2000. Join the revolution!

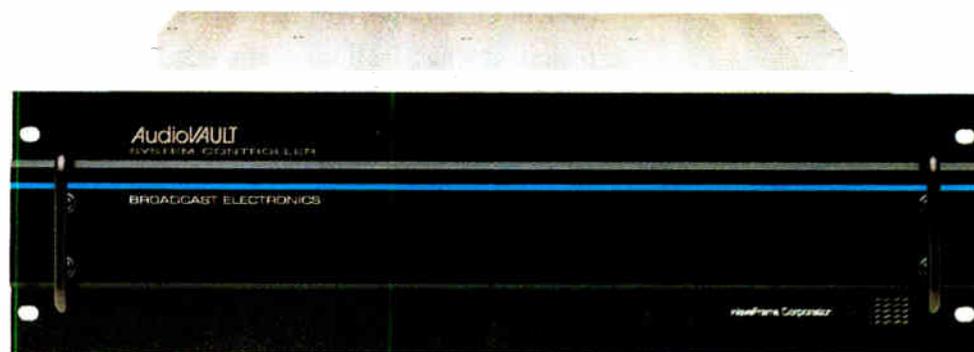
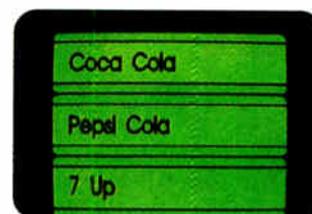


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Hard Disk Audio Systems at Crossroads

Editing Workstations Come within Reach of Average Broadcasters, Now that Storage Is More Affordable

by Mel Lambert

LAS VEGAS Once again, digital technology figured prominently in radio broadcasting and production hardware on display at the NAB convention in Las Vegas.

A new entrant in the field is the British firm Plasmec Systems, which unveiled the ADAS-SA, an stand-alone stereo hard disk recorder/editor. The device offers 16-bit stereo recording at 48 and 44.1 kHz sampling rates and a 64x oversampling stereo A-to-D converter. External drives are accessed via a SCSI port; with SMPTE in/out for timecode triggering and MIDI in/out/thru for MIDI triggering.

AES/EBU or SP DIF digital in/out are available on the ADAS for DAT editing, and a five-pin DIN connector is provided for a PC-compatible QWERTY keyboard.

A/Z Associates introduced the Augan Instruments Model 408 OMX optical multitrack recorder/editor. The 408 OMX is a stand-alone rack-mount unit that uses eight proprietary VLSIs for audio processing. It is configured to resemble a 64-track audio tape recorder. Complete session information can be stored on one or two removable rewritable magneto-optical disks. Each disk side can hold about 100 track-minutes of audio at 44.1 kHz.

Akai Professional announced several enhancements to the S1100 stereo digital sampler. Version 2.0 software provides mono/stereo recording of audio material to hard disk or optical drives, in addition to the system's existing two-channel RAM-based sampling and playback capabilities. Other new features include an improved DAT backup from RAM or optical drives. The firm's DD1000 magneto-optical disk recorder/editor is now available with enhanced Macintosh-based controller software that streamlines the recording, editing and replay or multiple sound files into and from the two-channel system. Built-in RAM storage provides flexible edit location, scrub and wave form display, plus triggering of samples and audio segments. Full timecode sync to external audio and video transports is also featured.

Software Improved

AKG Acoustics unveiled various improvements to the DSE 7000's operating software. Version 2.0 now offers a variety of new features, including high-speed in-load, background shadowing and various internal diagnostics. Scrub-edit and high-speed wind quality have also been improved, to make the rock-and-roll editing process sound even more like its analog equivalent.

Automation Systems Can Tie Together Most Aspects of Station Operations—from Sales to Programming

by Nancy Reist

LAS VEGAS The digital presence at the NAB '92 radio and audio exhibits has continued to grow.

Within the category of on-air hard disk record and replay devices, the most discussed issues were multitasking, user friendly interfaces, flexibility, and the integration of traffic and sales with production and on-air systems.

Prophecy to wizardry

Prophet Systems moved from prophecy to wizardry with the company's NAB preview of the Audio Wizard. The Audio Wizard is a mini-mainframe that can switch between live assist, satellite, hard drive and CD automation. The 48 kHz, 18-bit multitasking system can run up to 15 workstations and 45 audio sources.

The Audio Wizard's functions include

copy editing, unlimited track audio editing, a 10 percent pitchless time shift, incremental mixing, a recording screen that displays both the graphic waveform and VU meters, a standard traffic interface, and a minimum of 650 minutes of stereo storage.

Register Data Systems (RDS) introduced The Phantom, a hard disk digital audio automation system designed specifically for stations using satellite programming. The Phantom features simultaneous record and playback, a minimum of 100 minutes of 48 kHz stereo storage, and traffic verification.

The Digi-Corder, a hard disk cart replacement system, also was on display at the RDS booth. Both the Phantom and the Digi-Corder can be programmed with RDS traffic and billing programs or they can interface with other traffic and billing systems. Continental Electronics also is marketing RDS's

continued on page 22 ►

Alesis Studio Electronics demonstrated its new ADAT eight-track digital audio recorder, which utilizes a video transport to record eight tracks of audio onto standard half-inch S-VHS tape.

The new BRC master remote control reads and writes timecode, allowing up to 16 ADATs to be locked to external sync references, with full sample-accurate autolocate. The optional AI-1 digital in-

terface and sample rate converter is designed to simplify the transfer of material into and between multiple ADAT recorders. In addition, the optional AI-2 ES-bus interface allows direct serial control from existing editors and audio video systems.

Digidesign announced the release of SoundTools II, a dramatic upgrade and

continued on page 24 ►

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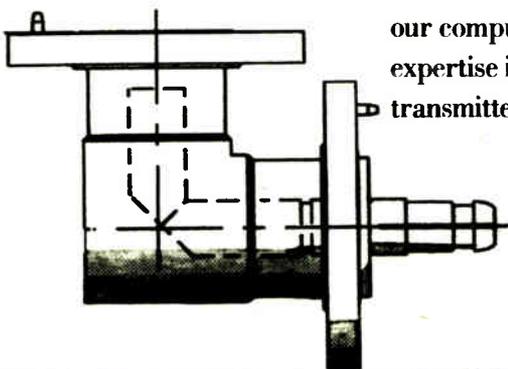
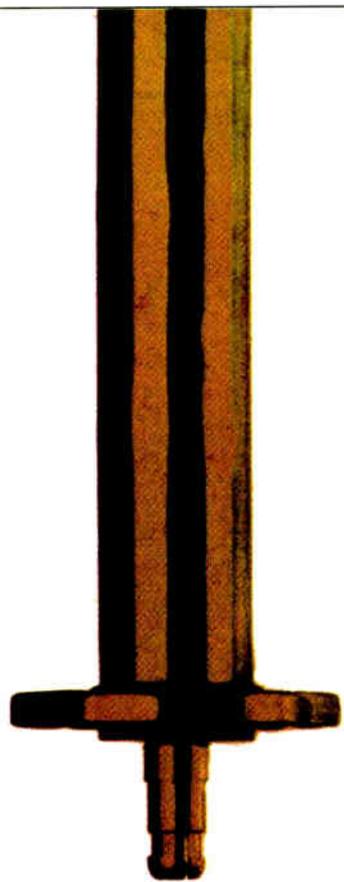
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Source Equipment Embraces Digital

► continued from page 16

company that developed the machines. Like the DCR 1000s, the Disc Trak has selectable sampling rates, a port for disk labeling from a keyboard, and are priced comparably to analog machines at \$2,800 for the playback unit and \$4,995 for record/playback units.

More conventional cart machines and options were also on display at the show. Audiocord brought out its DL Series, billed as the best cart machine buy in the industry with playback units starting as low as \$920.

Radio Systems introduced the RS Squared, a Dolby S noise reduction unit for improv-

troller, which have been reduced in price from almost \$20,000 to \$13,800.

Denon also announced a new event controller for its CD recorder, which will be available for \$6,000 to increase operator control over the CD recording process.

The Marantz CDR600 CD recorder lowered the recordable CD price threshold, making its debut at the Harris-Allied and Bradley booths with a listed price of \$7,500. The new CDR600 is a record-once unit.

Other CD players were also in plentiful supply at this NAB, with established products such as the Sony CD player, the feature-packed Audiometrics CD 10, which

ital audio product line, including digital cart machines, CD players, digital audio workstations and headphone amp for monitoring digital sources.

DATs plentiful

There was no lack of DAT machines at this NAB convention, such as the Sony PCM line of DAT recorders, prominently on display.

Panasonic exhibited its established line of DAT recorders including the SV-3900 computer-controlled recorder, the SV-3700 professional recorder and the SV-255 portable recorder.

Revox displayed its new C221 professional CD player as well as the C270, C274 and C278 reel-to-reel.

Also on display were Alesis' ADAT, which was introduced at the NAB '91 show and is available now for \$3,995, and Yamaha's DTR2 DAT machine. The Alesis unit is actually an eight-track digital stereo recorder which uses standard S-VHS tape as the medium.

Additions to the DAT onslaught were Otari's new DAT machines, ranging from the full-featured DTR-90N priced at \$8,495 to the DTR-7 priced at \$1,695. Shipment is expected within 60 days.

Studer also introduced a new DAT, the D780, which is a front-loader specified for high-speed spooling. Studer's D780 is available now and is priced at \$7,400.

Fostex rolled out its new PD-2 portable timecode DAT, which is priced at \$10,950 and will be available for delivery within a month, and showed its revised D-20 Digital Master Recorder. The D-20 has been streamlined for easier setup and given a few more features.

Radio Systems showed its RS-700 DAT machine along with a new "smart" rack mount option. The \$295 option connects to the base of the RS-700 to give operators easier hands-on rack operation of the machine.

Otari Corp.'s new R-DAT series—including the DTR-7, with a list price of \$1,695—was on display. Other machines in the line include the DTR-90N, at \$8,495. The CB149 editor, also from Otari, can control two DTR-90N units simultaneously.

In the Otari booth, a low-speed version of the popular MX-50 reel-to-reel was introduced. The Otari LR-50 comes in three speeds, and is available now for a list price of \$3,395.

Studer displayed its line of multitrack

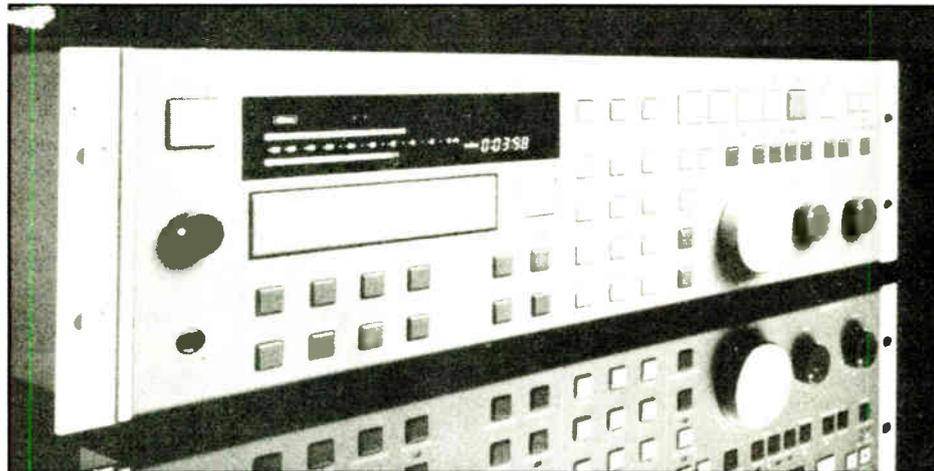
recorders, as did Tascam. Tascam also introduced a new cassette recorder, the 202 MKII, a dual record dubbing deck listed for \$399, and announced that its 238 eight track cassette deck is now available with Dolby S noise reduction.

Tale of the tape

Popular as well as new recording media were also displayed at the show. Audiopak brought out its line of broadcast cartridges while DIC Digital rolled out its new MQ



Denon's DN-951FA CD Cart™ player



The Studer D780 R-DAT

ing the audio performance of existing cart machines or even STLs.

In the ITC booth, the new Series 2 cart machines were on display. The new series is based on the popular ITC Delta series cart machine, with features such as Dolby HX Pro headroom expansion and heavy-duty XLRs, and sell for \$2,400 for the playback unit and \$3,700 for record/playback units.

ITC also introduced a new concept in cart machines with its DigiCenter automation system. The Digital Cart Machine function of the DigiCenter emulates cart machine operation and stores digital audio in a hard disk.

On another digital frontier, 360 Systems featured its DigiCart digital cart machine with a few new features. The DigiCart, which sells for just under \$4,000 and uses Bernoulli cartridges for removable storage of audio, is now available with remote control,

was found in the Harris-Allied booth, and the Studer A727 and A730 CD players.

Studer presented its A728 CD System Controller at the show, a unit that now lets operators control up to three A727s as an integrated system.

Two CD players made their debut at the Denon booth. The new Denon DN-951FA uses CD cartridges to safeguard CDs during handling and is expected to be available in August for \$1,350. The new Denon DN-961FA is a drawer loading CD player, and will be available in September for \$1350.

Tascam showed its CD series of players, along with a new introduction that includes advanced functions previously available only in its multi-transport 701 remote control and CD players.

The new CD-601 compact disc player and remote control RC-601 are available now from Tascam and retail for \$1,399 and \$749, respectively.

Stanton Electronics, a company well known for its turntable cartridges, displayed a dual CD player. The new CD-22 is available now and lists for \$1,699.

Pioneer introduced the CACV 3000, a 300-CD autochanger for automation applications.

Sentry Systems brought the digital DS-1, an economical solution for the storage of jingles,

commercials, liners, etc.

Akai introduced the DD100 Version 2.0 software—for the DD1000 magneto-optical disk recorder—with compression/expansion capabilities and RS 422 machine control with DAT backup; and the S1100 Version 2.0 software—for the S1100 digital sampler—that adds digital recording directly to magneto-optical disks.

Broadcast Services featured its full dig-



BE's Disc Trak floppy disk cart machine is manufactured under license from Sonifex.

six times the storage capacity and AES/EBU and SPDIF digital audio interface.

Studer, Denon and Yamaha showed CD recorders, while Marantz introduced a new CD recorder to sell below the current price threshold. Studer showed its new write-once D740 CD-R recorder priced at \$11,500; Denon showed its DN-7700R CD recorder priced at \$16,000 and Yamaha showed its YPDR601 CD recorder and con-

Mic Makers Show New Gear

► continued from page 16

Sennheiser showed the EK2014 (\$5,825) receiver with higher audio output, higher RF sensitivity for better range and a 12 dB improvement in signal-to-noise ratio (SNR), over its EK2012 wireless system. The transformer provides constant power for up to five hours. Batteries are easily replaceable. Sennheiser's HMD25 (\$395) closed-ear headphone and dynamic mic combination also was displayed for the first time.

Neumann brought two new hand-held mics to market: the KMS140 and KMS150 (both \$1,495) cardioid and hypercardioid small diaphragm transformerless condenser mics. The smaller diaphragms provide close miking with reduced proximity effect.

Shure showed the VP88 (\$995), a mid-side (M/S) stereo mic with on-board circuitry that allows for M/S and three different stereo angles of X/Y matrix. The mic comes with splitter cable and internal battery that recharges by plugging into a power supply. Battery life with a lithium cell is quoted at 60 hours, less with alkaline.

Tannoy/TGI North America displayed its Bruel & Kjaer Series 4000 mics, including omni, hi-intensity omni cardioid designs.

Telex Communications displayed its new micromini series of lapel mics, as well as the Microneck line of goosenecks. The lightweight V-100 headsets and the FMR-100 wireless mic receiver will be available soon.

All-Encompassing Automation

► continued from page 20
product line.

SMARTS Broadcast Systems displayed a wide range of integration systems for use in live assist, satellite and CD automation operations. The Smartkit plugs into the printer and keyboard port of a computer and turns it into a digital storage device for up to 12 programs. The Smartcaster is a digital storage system that also can be connected to a satellite receiver or configured to operate CD or open reel automation.

Using your SMARTS

The basic Smartcaster can store 240 30-second announcements and features automatic spot fill. Both the Smartcaster and the

Smartkit check for outdated copy and product code conflicts and interface with the Smarts Broadcast Software logging, billing, and traffic program.

Clark & Associates introduced the HDS-1000 digital audio storage device. The HDS-1000 stores up to eight hours of audio (50 Hz to 15 kHz), without compression. The device has six simultaneous channels, and modular front plug-in cards for its three rack unit-high chassis.

Wheatstone displayed the Not So Hard Disk, which is divided into an on-air disk playback terminal and a production room record terminal. The playback terminal only has access to the playback functions of the system, while the production room terminal allows the operator to record onto the system's hard disk storage. The Not So Hard Disk features two stereo playback channels, a programmable EOM signal, and networking capabilities.

The Arrakis Digilink and its new multitrack digital editing workstation were shown at both the Arrakis Systems booth and the Harris-Allied booth. The Digilink can replace cart machines in live operations or it can run satellite, CD, tape or hard disk automation. It also can network multiple studios.

Gazing in Audisk

Gentner Communications displayed the Audisk—formerly the MacroMedia Audisk—a digital storage system that can operate in live assist, satellite, or fully automated mode. The Audisk uses a 386 processor and features apt-x100 digital compression, insert editing, a universal traffic interface, simultaneous record and playback capability, and telephone remote control. The unit also is distributed by Harris-Allied.

Computer Concepts Corporation presented a new digital editing option for its Digital Commercial System. The Digital Commercial System is a hard drive recording, editing, and playback system that can handle three stereo sources. When it is configured with a 238 megabyte drive, it will store 59 minutes of 16-bit, mono sound.

Larger drives and/or APT's apt-X compression can increase the storage capacity.

ITC introduced the DPR-612 Digital Program Repeater. The DPR-612 stores up to 15 mono programs that can be repeated throughout the day. DigiCenter, an integrated digital audio system, also was on display at the ITC booth. DigiCenter can operate in satellite, live assist, or full automation mode.

BASYS Automation Systems demonstrated D-CART, a networked digital audio recording, editing and playback system. D-CART's system is password protected and permits simultaneous, independent access to the central archive by multiple users. It can be operated using a PC with Microsoft Windows, the D-CART's Studio Control Unit, touch screens or other automation systems. The sampling rate and storage space can be configured to the needs of individual users.

The Paris-based company Dalet introduced a prototype for a four-track editing workstation which the company expects to integrate into its local area network soon. Currently, Dalet's PC-based network includes recording, playback and traffic workstations run with Microsoft Windows.

Jockeying for position

Rodman-Brown & Associates' Desk Jockey was displayed both at the Broadcasters General Store booth and at the Bonville booth as part of the TruePlay Automation System. The Desk Jockey includes live assist software and hardware, a satellite interface, seven hours of stereo storage, on-line traffic scheduling, and a 14-day walkway time.

For Mac users, Gefen Systems demonstrated two new software packages. Filemaster is an interface for the Panasonic SV-3900 DAT. It facilitates the automated transfer of CD sound effects libraries to DAT. Filemaster then allows the user to access the sound effects through the Mac.

Gefen's other new product, the CDJ Mac Jukebox, is a software package bundled with the NSM CD 2100 CD Changer. Gefen also displayed PC interfaces for one or more NSM CD Changers and for the Pioneer CVC-V3000 300 Auto Disc Changer.

The OpLOG and the OmniPLAY were featured at the Media Touch Systems booth. Both systems run on a Novell Local Area

Network and use touch screens.

The Broadcast Electronics booth featured the CORE 2000, an automated program controller, and AudioVAULT, a digital storage system. The two devices are designed to work independently or together depending on the station's needs. The CORE 2000 can perform in live-assist, semi-automation, full automation, or satellite automation modes and can integrate up to 36 source inputs.

The AudioVAULT record/playback system can support up to four independent workstations simultaneously. A single disk drive stores 99 stereo minutes and up to seven drives can be cascaded together. Both the CORE 2000 and AudioVAULT work with Microsoft Windows.

TM Century brought the Ultimate Digital Studio (UDS) to the NAB. The UDS is a PC-based system that can be configured in a variety of ways depending on a station's needs. It can run satellite or CD automation and can coordinate prerecorded time and temperature announcements with its built-in clock and electronic outdoor thermometer. The UDS includes traffic and billing software, though it can interface with other traffic software packages.

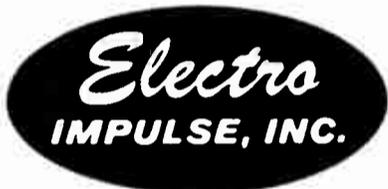
Columbine showed the Columbine Traffic System and the Columbine Sales Systems. Columbine interfaces with most digital audio automation systems, creating a "closed loop" that automatically updates logs and bills when programs change, even at the last minute.

Custom Business Systems, Inc. (CBSI) displayed CustomNet, a new centralized traffic and billing software package designed to accommodate Local Marketing Agreements (LMAs) and regional radio networks. CustomNet produces consolidated program logs, invoices and statements for central orders.

Also on display was CBSI for Windows, the newest version of CBSI's multitasking traffic, billing, and accounting software.

Decision, Inc. introduced the latest version of Broadcast System III, a multi-user, multitasking traffic, scheduling, billing, and accounting package. The new version features "power windows," a graphic user interface. Decision, Inc. also displayed a French version of the software and said they plan to develop Swedish, German, Spanish, and Portuguese versions soon.

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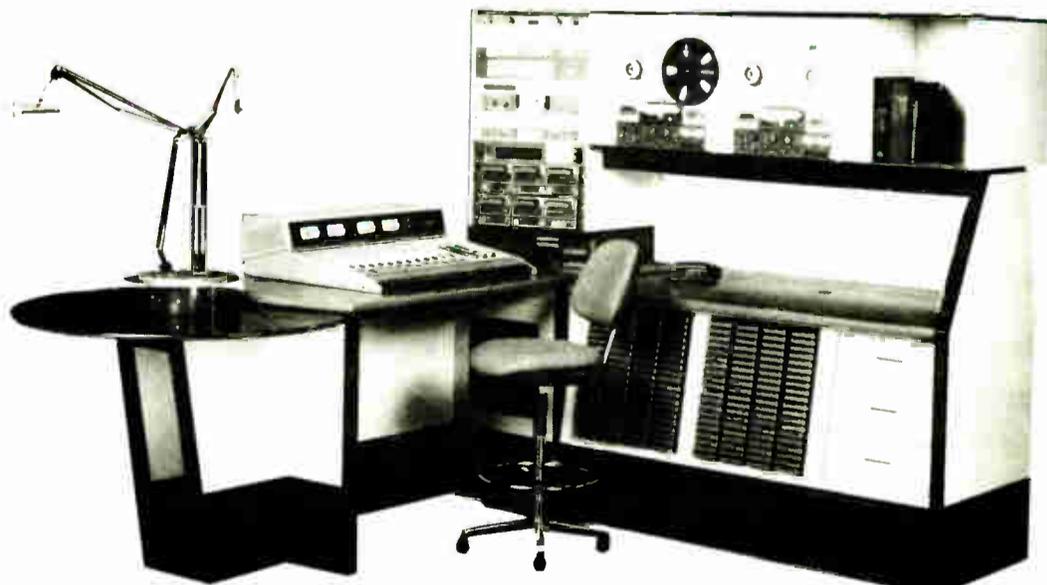
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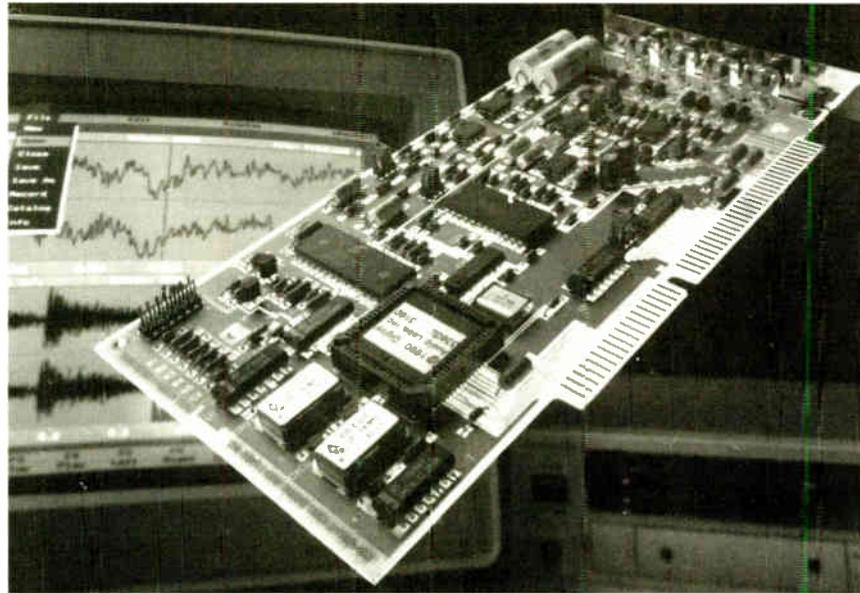
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With this system you will be able to do things found only in \$20,000 workstations. The split screen editor allows extremely accurate, non destructive editing, perfect for all your production and newsroom editing chores. You can cut, copy, and paste audio segments from multiple soundfiles into a final stereo mix. The power of a multi-track recorder and editor is now at your fingertips.

The Catalog feature lets you build collections of soundfiles that you can play by hitting single keys on the keyboard. (Screen resembles a cart rack.) This is perfect in the control room for instant sound effects or the newsroom for playback of news actualities in a newscast.

Audio quality? Check out these numbers. Frequency response at 44.1 kHz sampling is 20Hz to 20kHz, dynamic range 92dB, THD is only .003%. No audio compression is used and the sampling rates are software selectable.

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New Affordability in Editing Workstations

► continued from page 20

enhancement to its existing two-channel direct-to-disk system. The full package comprises Sound Designer II recording/editing software, and the Sound Accelerator II card for the Macintosh controller.

Sound Accelerator II is now fitted with a more powerful Motorola 56001 DSP chip, which provides enhanced time compression/expansion and real-time equalization. A new audio interface allows external MIDI-based sequencers to record and play back four independent channels of digital audio.

In addition to analog I/Os, digital AES/EBU and S/P DIF ports are featured. An upgraded version of I.I Pro-Tool's operating software is also now available.

A new dawn

Doremi Laboratories announced an enhanced version of Digital DAWN, which now offers eight analog/digital inputs plus eight analog/digital outputs, with full MIDI and timecode synchronization. Each system provides eight "digital" tracks of recording, editing and play back; multiple units can be linked together to provide up to 24 channels of simultaneous replay. An optional sound storage unit houses two full-height or a single full-height plus two half-height drives.

Direct serial control of external tape machines, including the Panasonic SV-3900 Pro-DAT, is also featured. System

backup is now to a choice of 4 mm data-DAT or 8 mm Exabyte.

New England Digital offers a wide range of disk- and RAM-based workstations, including the modular PostPro and Synclavier systems. Possibly unique within the firm's design philosophy is the integration of hard-disk recording, editing RAM sampling and sound design, and digital mixing and DSP in a variety of configurations. The PostPro, for example, provides four-track (and beyond) recording/playback, while the Synclavier's RAM sampling allows flexible pitch-changing, looping and other creative sound-design functions.

Otari Corporation unveiled several new enhancements for its ProDisk PD-464 recording and editing system, including the CB-150 hardware control panel that provides dedicated transport and edit controls. Also available are removable 425-Megabyte hard drives, and a dedicated transfer station for off-line archiving to and in-load from SCSI-equipped Exabyte or optical drives.

Version 4.0 software will provide a new GUIDE (graphical user interface for digital editing), designed to greatly simplify the editing of multitrack material.

The current software upgrade offers a unique, audible fast wind feature, which allows an editor to monitor sound files at a range of 2-50 times play speed, plus a batch backup feature. Hardware upgrades include a new system controller PCB that can now follow VITC as well

as LTC timecode, and a 2/4-channel digital interface with AES/EBU and S/P DIF ports.

Direct drive

Siemens announced the new AudioFile Spectra 8/16-track system, which features an on-line magneto-optical drive for



Plasmec displayed its ADAS-SA, a low-cost digital audio workstation.

recording and editing directly from the removable media (thereby reducing in-load/archiving time), a high-speed Exabyte backup and a redesigned control surface with a color LCD active matrix display screen. The new AudioFile Optica is a four-track, optical-based version of AudioFile Plus, designed to simplify track-laying operations from source reels onto MO for use in larger AudioFile systems.

Sonic Solutions has begun shipment of its low-cost SonicStation system, which provides eight channels of playback, real-time filtering and mixing, plus background loading.

Studer Editech unveiled a variety of enhancements to its current line of Dyaxis Series workstations, including the new Dyaxis Lite and Dyaxis II. The former is configured specifically for broadcasters that require a compact, low-cost two-track system for speech and music editing. In addition to MacMix software, the system includes a new dedicated remote con-

troller fitted with transport, scrub-edit functions plus programmable softkeys.

The larger and more powerful Dyaxis II features multichannel record and playback, with real-time crossfades, digital mixing and signal processing. An internal 24-bit bus architecture, enhanced MultiMix software, multi-format digital I/Os, timecode synchronization, five-band parametric EQ and digital overdub feature are also included.

A four-channel processor provides editing, level adjust and crossfade between eight individual "tracks"; up to six processors can be linked together to provide 48 tracks of simultaneous playback for hard disk. The current MacMix 4.0 software now provides integration with Studer's D740 CD-R system and D780 Pro-DAT recorder.

Roland Corporation's DM-80 is available in four- and eight-track versions, with a choice of the DM-80-R dedicated control surface, or external Macintosh controller software. Multiple units can be locked together to provide up to 48 tracks of storage.

The system features three independent SCSI ports—one each for track number one through four and five through eight, plus a third for interface with tape backup/archive and MO drives. An optional DM-80F fader tray comprises a 12-in/stereo, 24-bit digital mixer with EQ. The Mac-based track-management software provides control of all transport, cut/paste, dynamic snapshot mixing and hardware functions.

The system will lock to timecode, video sync and other digital references. Also unveiled: the new SRC-2 dual sample rate converter, which handles two stereo digital inputs mixing to a single stereo output, at sampling rates of 32, 44.1, 44.056, 47.952, 49 and 48.048 kHz, plus display and modification of various channel status flags.

Visitors to the Pacific Recorders & Engineering Corporation booth were given a preview of the ADX Audio Production System. The ADX is a combination of a digital audio workstation and an automated production mixer. It includes processing and levels memory, an autolocator with time code display, optical disk backup, multitrack editing and a minimum of four track-hours of storage.

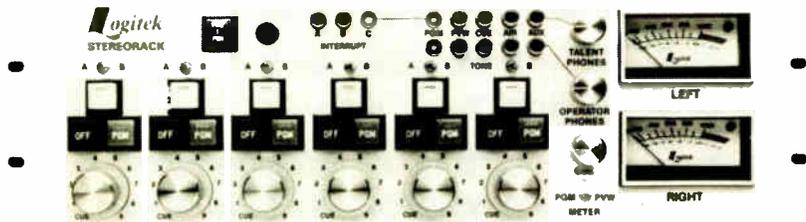
Standard features on the ADX include 1.6 Gigabyte hard drive for four track hours of storage, eight channels analog in and out and AES/EBU and SPDIF digital I/O.

Waveframe Corporation announced the Model 401, a low-cost version of its series of workstations, and designed to provide full eight-track recording, editing and playback. Timecode lock, digital I/Os, mixing and multitrack punch-in recording are featured. Also available for the firm's Model 1000 system is a new interface for Yamaha's programmable disc system, allowing CDs to be produced directly in a radio production studio.

□□□

Mel Lambert has been intimately involved with the production and broadcast industries on both sides of the Atlantic for many years. Now principal of Media&Marketing, a consulting service for the professional audio industry, he can be reached at 818-753-9510.

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Solid State, Digital and RDS Are Hot Topics in RF Gear

by Tom Osenkowsky

LAS VEGAS The NAB '92 trade show featured some of the most sophisticated of new products for AM and FM transmission.

Harris Corp. displayed its digitally modulated DX Series of AM transmitters as well as the lower power PDM Class D amplifier SX and Gates series. According to Harris, a major review of incorporating AM stereo into the DX and SX series transmitters is presently underway. Look for internal incorporation in the DX series and external add-on exciters for the SX series by NAB's Radio '92 show in New Orleans.

Harris also manufactures antenna coupling and phasing equipment for AM and short-wave transmitters. On the FM side, Harris displayed its FM-K and HT series transmitters and digital FM exciter.

Nautel Maine announced the standardization of its ND line of solid state AM transmitters. All power amplifier modules used in the ND line, with power levels from 1 kW through 100 kW will now be fully interchangeable.

Continental Electronics has begun marketing the Omnitronics line of solid state AM transmitters. Dubbed the Continental "T" line, four models are available, generating 300 W, 1000 W, 2500 W and 5000 W of

power, respectively.

The most notable product for AM stereo came from Quincy, Ill.-based Broadcast Electronics, which unveiled its AM series of stereo transmitters. Manufactured in 1, 5 and 10 kW versions, the AM series uses Class E PDM power amplifiers and a built-in C-QUAM AM stereo generator.

Looking for an affordable, high quality AM stereo exciter that occupies just one rack unit? Delta Electronics, well known for its OIB line of impedance bridges, toroidal ammeter and sample elements showed its ASE-2 exciter. With all adjustments available on the front panel, the ASE-2 commands the attention of any AM broadcaster looking to go stereo.

The new AMAX-certified receivers are beginning to appear on the market. A test drive of a new AMAX radio, installed in a Bonneville parked at the Motorola booth, demonstrated the quality of AM stereo.

The Motorola booth featured the company's C-QUAM AM stereo exciter and monitor, with a number of different receivers available for listening. New Sony "Walkman" style radios also were shown; however, these were made for use in Japan where channel spacing is 9 kHz.

For those pondering AM stereo, take a listen to AMAX and look forward to the new Denon AMAX-certified tuner scheduled to be available by this fall.

Newly introduced at NAB '92 is the Continental 802B FM exciter. The 802B features

new design, resulting in a 12 dB improvement in signal-to-noise ratio (SNR), THD rated at .005 percent, greater flexibility and additional front panel metering. The 802B can operate as a stand-alone transmitter or exciter at any power level from 5 W to 50 W. The 802B replaces the 802A.

New for FM

Solid state FM transmitters with power ranges up to 10 kW were introduced at Energy-Onix. Dubbed the "Legend Series," the transmitters offer power levels of 1 kW, 1.5 kW, 2 kW, 2.5 kW, 3 kW, 4 kW and 4.5 kW, and are available in single or three phase configuration.

The Energy-Onix SSA series offers 100 W, 300 W and 500 W FM amplifiers, requiring only an exciter for RF drive. Energy-Onix also manufactures the IPA-300 and IPA-500 as solid state replacements for tube IPAs. The power levels are 300 W and 500 W, respectively. Energy-Onix also manufactures single-tube FM transmitters. The MK series is available in 1.5 through 50 kW models.

In addition to its AM products, Nautel also manufactures solid state FM transmitters, currently shipping the AMPFET FM4 and FM7 models with power outputs of 4 kW and 7 kW respectively. Look for a Nautel 10 kW solid state FM to be ready by year's end.

For those shopping for a "Reliability Through Simplicity" approach to AM and FM transmitter design, CCA Electronics provides a wide range of choices. All CCA FM transmitters, including the new single cabinet 35 kW FM35,000G, feature grounded grid triode PA amplifier design, which eliminates the need for neutralization. CCA AM transmitters, ranging from 5 kW through 15 kW, utilize time-proven, high level plate modulation.

Look for CCA's new 50 W FM exciter with significantly improved specs due out in June as well as the FM40,000G 40 kW FM transmitter.

QEI Corporation introduced its liquid-cooled 10 kW solid state FM transmitter, the QSS-10000. For greater reliability, QEI chose to cool the RF power modules and combiner with a propylene-glycol mixture that is EPA approved, non-toxic and non-corrosive.

The QSS-10000 uses single phase on-line regulator switching. Look for the unit to begin shipping by

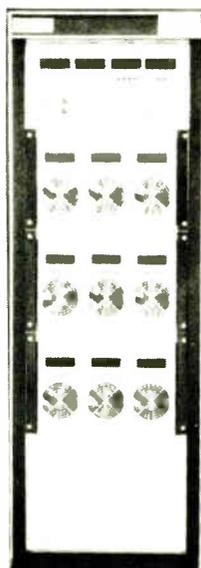
Radio '92. QEI also manufactures FM transmitters ranging from 10 W through 35 kW, FM exciters and the model 710 digital stereo generator.

FM broadcasters requiring a solid state transmitter should also examine the CTE line of MOSFET transmitters. Now available in 1 kW, 2 kW and 5 kW power levels, the CTE product line is in its second step of improvement. Look for solid state FM transmitters in the 250 W and 500 W power category by fall NAB show. CTE is based in Italy.

continued on page 35 ▶



Continental's new 314T-1 solid state AM transmitter



The Legend solid state FM transmitter from Energy-Onix



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No audible delays

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Flexible signal path options

• 23 GHz

Stations across the country are avoiding 950 MHz problems by using 23 GHz with CAT-LINK. They've stopped worrying about frequency congestion and interference, repeater-induced signal degradation, and fresnel zone clearance fading. 23 GHz dish sizes also reduce wind loading and tower space requirements.

• DS1 (T1) Data Line

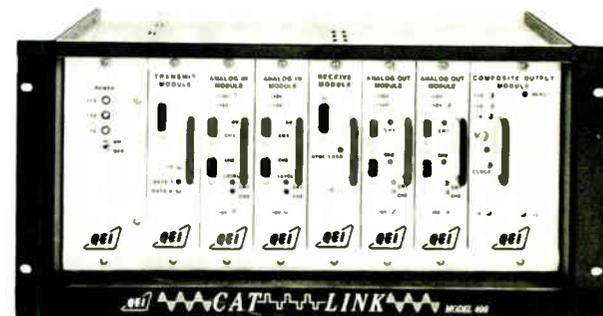
CAT-LINK is cutting phone bills for stations that don't have a clear microwave path. With CAT-LINK, a single bidirectional DS1 line replaces multiple Class A telco lines, providing multi-channel STL and TSL over the same link. Already available virtually anywhere, DS1 service is getting cheaper every day.

• Fiber Optic

CAT-LINK and its optional fiber optic modem provide direct connection to discrete fiber.

• Twisted Pair

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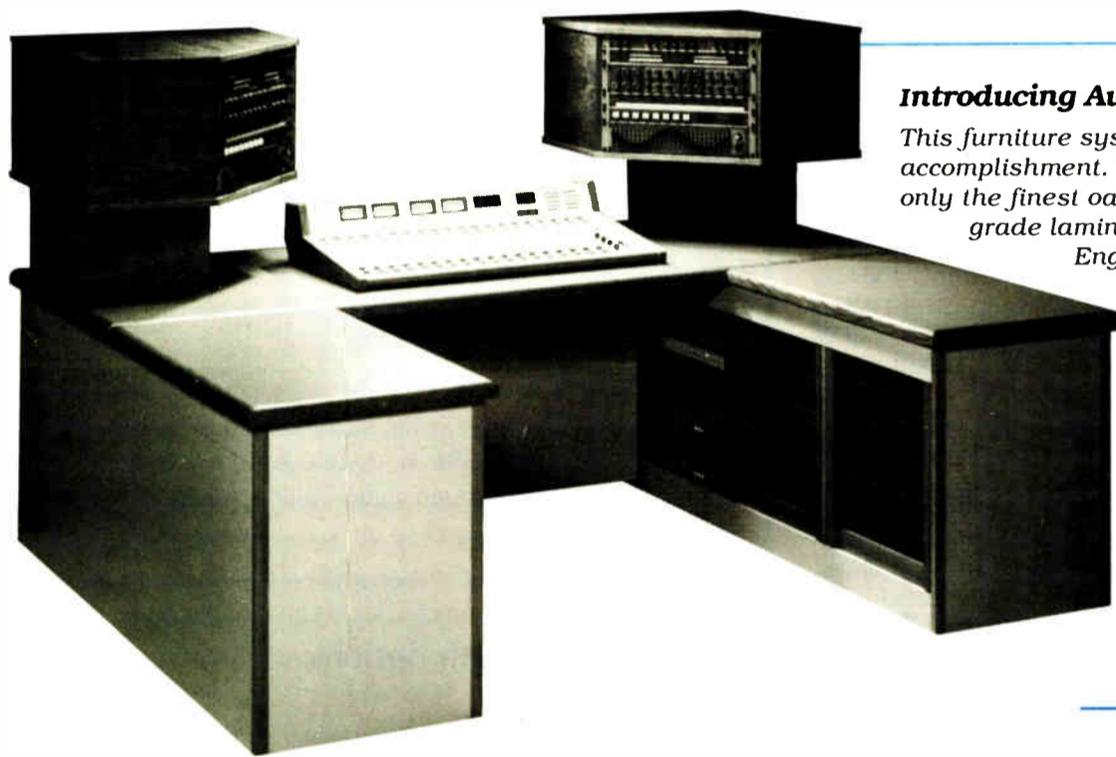
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Innovations in STL, Remote and Telco

by Paul Rebmann

LAS VEGAS A number of product introductions were made in the realms of STL, remote and telco equipment at the NAB '92 convention here. As in most other product categories, digital innovations were particularly prevalent.

In the category of STLs, Dolby Laboratories showed its DSTL digital link. The Dolby STL uses the company's own AC-2 coding scheme for data rate reduction and incorporates specially designed linear RF amplifier sections allowing two program channels, one auxiliary and one voice channel to be transmitted within a 250 kHz occupied bandwidth. The auxiliary channel

STL system and a set of the selected codecs. The DMM-92 will accommodate four channels of up to 256 kbps (kilobits per second) plus a 9600 baud data channel.

Also being shown at the TFT booth was the IF interface STL system, which places the station's FM exciter at the studio. The FM output is fed into the IF interface transmitter and is then upconverted to the desired frequency in the STL band. At the transmitter site the TFT Reciter is used to return the STL signal to the broadcast frequency.

TFT also introduced two new analog STL systems. The 9100S composite STL features a broadcast-quality FM stereo generator and audio processing on one card

ter as a standard feature.

There are several other products which allow digital transmission over telco T-1 circuits. New this year was the Intraplex solution, with flexible configurations depending upon the type and number of circuit cards used. The Intraplex unit has a PC interface to allow remote access of status monitoring and control of the system.

QEI was again showing the Cat-Link T-1 digital system, which can transmit a composite stereo signal, as well as discrete audio and data channels.

For situations where the transmission path is less than three miles and fiber-optic cable can be used, Lester Laboratories has the DAS-2000 which can be configured to transmit up to 64 high quality audio channels and receive up to 16 channels. Channel capacity is added in eight channel blocks, each audio channel having a bandwidth of 10 Hz to 21 kHz.

Softpatch remote

The DAS-2000's softpatch remote controller allows inputs to be switched to different outputs, and various switching configuration can be stored for fast setup. Lester plans to have a smaller DAS-500 with a maximum capacity of 16 channels available this fall. The DAS-500 will also accept AES/EBU digital as well as analog and MIDI signals.

Harris-Allied, meanwhile, is now distributing the T-Tech fiber-optic system for STL applications.

Remote control

Remote control systems, where microprocessors made some of their first entries into broadcast equipment, were largely unchanged this year, with the familiar companies simply making improvements to existing products. One new entry into the transmitter remote control field was the PalTex RF Manager.

The RF Manager is a PC-based system which uses off-the-shelf hardware and user-configurable software. The system uses any

standard PC-compatible computers, one at the transmitter with another at the remote control point, outfitted with third party analog/digital interface cards. The Basic/32 system provides 32 command channels, 16 analog metering and 16 digital status channels. The RF Manager can be expanded to 128 channels in multiples of the basic system.

Potomac showed both the RC16+ and the newer 1500PC remote control systems, with several added options available for the 1500PC this year. The RC16+ system uses factory-set EPROM operating program and is specifically for complex AM directional array applications.

The 1500PC is designed as a universal



The Telos 100 Delta (top) and the Telos ONE plus ONE

can be either 7 kHz bandwidth audio or 9600 baud data, while the voice channel can be configured as 3 kHz audio or 2400 baud data. The Dolby DP5500 series system costs \$15,500 outfitted with the optional digital stereo generator.

Moseley again showed its DSP-6000 digital transmission system, which can be used with a composite 960 MHz STL or other link such as T-1 to provide the benefits of digital. The Moseley system places an encoder before the STL transmitter and a decoder after the receiver to create the digital system, which can relay up to four audio channels of either 15 kHz or 7.5 kHz bandwidth and two data channels.

The DSP-6000 uses the apt-X digital audio data compression system and the occupied bandwidth depends upon the channel configuration used. Each DSP unit costs \$3,000, making the total cost of the Moseley system \$6,000 plus a new or existing composite STL.

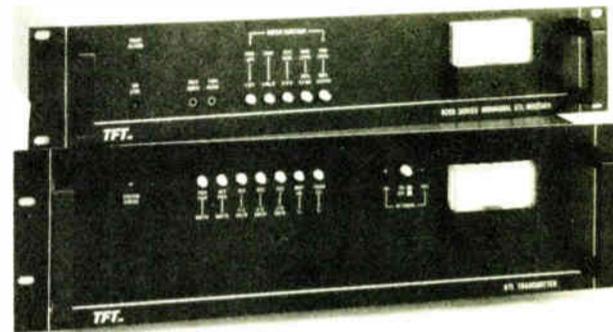
A new digital product this year for Moseley was the Digimux, which allows transmission and reception of multiple channels of user-defined bandwidth between 3 kHz and 15 kHz over a radio or T-1 link. Also in the Moseley booth was the new PCL-6060, which was described as the venerable PCL-606 repackaged to match the current style of Moseley products, plus an improved front-end on the receiver to improve performance in congested and interference prone areas.

TFT's entry into the digital STL market, the DMM-92 spectrally-efficient digital STL modem, was introduced at the NAB show. The DMM-92 allows the use of any of the popular data coding and compression systems; MUSICAM, apt, Dolby, OKI and others. The TFT unit is placed between a digital audio encoder and the STL transmitter, with a companion unit between the STL receiver and a digital audio decoder. The TFT digital modems sell for \$1,600 for either an encoder or decoder; one of each is required to be used with a composite

in the STL transmitter. An optional stereo decoder is available for the receiver in the event left and right audio outputs are also desired at the transmitter site. The 9200/9205 series monaural STL units allow user setup of carrier frequency and can operate on channels as close as 75 kHz from each other.

All of the digital STLs provide broadcasters with a system much more tolerant of interference and without the audio degradation exhibited under severe signal fading conditions.

Marti promoted its Plan A, whereby multiple sites are linked with bidirectional microwave systems to transmit program and other audio as well as data for control and monitoring. Plan A is designed as an economical system for simulcast or LMA situations where several stations are operated out of one location. Plan A uses Marti STL-10s, which this year include the peak reading modulation me-



The TFT STL transmitter and mono STL receiver

controller allowing user flexibility and can now be remotely controlled by a PC using 1500-CAS software, either in addition to or instead of the 1510ST studio unit. Another new feature this year is the option to expand the number of channels for control status and/or metering to 32. Potomac also showed its 1900 series of digital antenna monitors.

Burk Technology had its ARC-16 remote control system in a unique display controlling a model railroad. The system, which can be configured for multiple sites, is basically the same as last year, although there have been some minor improvements in the Autopilot software, which allows a PC to control and monitor all of the transmitters connected to the system.

The Autopilot can perform daily power changes and transmitter power adjustments

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Circle (135) On Reader Service Card

World Radio History

STL, Remote and Telco Progress

► continued from page 27

as well as programmed sequences to restart a transmitter or switch an auxiliary transmitter failure. Both the remote control and computer setups are easy and versatile allowing customizing for each particular installation.

Moseley also introduced improvements to its Taskmaster 20 software used with the MRC 1620 system. First is a time-based command set to allow a PC to issue commands based on the time of day. The second new feature allows MRC 1620 multi-site configurations, with up to eight sites on a dedicated control basis.

The National Supervisory Network premiered its new VISION service, which adds program transmission to its station monitoring via satellite service. Designed for small groups operating several stations from one location or LMA'ed stations where microwave might not be feasible, the VISION service can transmit 20 kHz stereo audio using a ComStream ABR200 Audio Broadcast Receiver incorporating MUSICAM digital audio. The VISION service can also relay commercials, news, sports and weather to the outlying stations and feed into a hard-disk automation system.

Hallikainen & Friends introduced the DRC200 programmable multisite transmitter control system. The company also displayed the TELI71 digital telemetry adaptor for the Moseley TC-15A, and the ITOI77 computer interface for the TELI71. The DRCI90 multisite transmitter control system was also shown.

Telco

Telephone interfaces have also seen an influx of digital technology in remote units that take advantage of recently available Switched 56 telco data lines to transmit high quality audio, and in hybrids that use digital circuitry to improve two-way telephone conversation quality.

Comrex showed the Talk Console, which incorporates two self-adjusting telephone hybrids into a small portable two-channel console for less than \$2,000. The Talk Console can be used when taking talk shows to remote locations, or in studios where a mix-minus bus may not be available.

One input is for the host mic and input channel two can switch between a microphone, line or tape inputs. The two telephone lines are fed from separate mix-minus circuits to allow hearing the other call without feeding back themselves. The Talk Console also has built in switches to provide contact closures to activate external equipment such as a tape recorder and an obscenity dump device.

Comrex was also featuring its Digital Audio Codecs, which provide 7.5 kHz digital audio transmission over 56 or 64 kbps circuits. The Comrex codecs are available in portable (DXP) or rack mount (DXR) configurations. The DXPO has an adjustable headphone output and the input is switchable between microphone and line levels, while the DXR has line level input and output.

Another manufacturer of digital audio codecs, Corporate Computer Systems, showed the CDQ2000, which can provide stereo 20 kHz audio on a pair of 56 kbps lines or a fractional T-1 circuit. If only one data line is available, or if one of the lines drops out during a stereo transmission, the system will provide a mono signal of reduced bandwidth.

The CDQ2000 uses the MUSICAM digital audio coding and has XLR connectors

for the audio as well as multiple data I/Os for various digital interfaces. Corporate Computer Systems was also showing their Micro56+ digital audio codec for transmitting 7.5 kHz audio on a single 56 kbps line.

Telos Systems introduced two new products, the Telos 100 Delta and the Telos ONE plus ONE. The 100 Delta is the fourth generation improvement of the Telos 100 telephone hybrid. It employs digital technology including dynamic digital EQ, exclusive Telos feedback suppression, digital logarithmic dynamics control and a proprietary fourth-generation digital hybrid processor.

The ONE plus ONE is a unit combining

two Telos One digital hybrids in a single rack unit chassis. An internal mix-minus matrix cross-couples the outputs of the two hybrids, allowing the use of a single mix-minus signal from the console. The ONE plus ONE has all of the features of the Telos ONE and is priced at \$2,180.

Gentner was featuring the Digital Hybrid I, an economical version of the Digital Hybrid II. The new Gentner unit was described as a low cost (under \$1,000) alternative for users who want high quality telephone audio but do not need the enhanced operational features of the Digital Hybrid II.

A Spanish company based in Madrid was introducing American and other broad-

casters to its digital hybrids. Aplicaciones Electronicas Quasar (AEQ) makes the model THE-02 in either single or dual line versions. The dual line version of the AEQ THE-02 includes an internal mix-minus bus to allow full multiplex communication between the studio and the two telephone lines.

AEQ also exhibited the Systel-3000, a PC controlled multiline digital hybrid. The Systel-3000 allows conferencing of up to nine lines as well as providing output for broadcast or recording.

Miwtrionics displayed its MCS system at the Broadcasters General Store booth. The MCS is a multiline coordinating and one-on-one phone line interface system for managing phone-in contacts, tallying surveys, listen lines and other phone connection requirements. The MCS is a rack mount card cage system allowing outfitting for each particular use with the various cards available.

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New Applications Fly High for Antennas

by Thomas R. McGinley

LAS VEGAS Antenna, tower, and transmission cable manufacturers were out in force at NAB '92. Probably because it is hard to reinvent a smooth-running wheel, very few brand new products were unveiled here. Instead, new applications and refinements for existing products were the order of the day.

In the FM antenna arena, Electronics Research Inc., Jampro, Dielectric, Shively Labs, LDL, Tennaplex, Cablewave/RFS, and SWR all showed impressive displays of their respective existing lines of element type and panel antennas.

With the new translator rules, renewed interest in low power FM CP antennas prompted most of these manufacturers to showcase their low-power antenna designs for translator or booster applications.

Low power series

Jampro and Scala unveiled new low power circularly-polarized models specifically for such low power uses. The Scala HDCA series CP version marries a pair of five- or 10-element straight yagis at right angles to form a cross or "X" configuration and are rotated 45 degrees for mounting with minimal coupling to the mast. The Jampro JY series yagis are available in the same kind of configuration.

Cablewave has added RFS to its name (RF Systems) to better identify its broadcast antenna and cable division product lines. This company has geared up to better serve its an-

tenna customers by adding a computer-based full facility test range for quarter-scale pattern testing and proofing for both FM and TV directional antennas.

Dielectric Corp. has also added to its existing test range facilities with the completion of its indoor anechoic measurement chamber, for more precise FM directional pattern proving, at its Raymond, Maine plant. Dielectric showed a full-scale model of the TCB circularly-polarized FM/TV panel antenna it announced last year, and introduced new motorized coaxial switches in the 7/8-inch and 6 1/8-inch sizes.

Electronics Research (ERI) unveiled its integrated antenna optimization program, in which every aspect of the overall system design, fabrication, installation, and proof of performance is done by the company, including not only the antenna itself, but the tower or pole it is mounted on as well. No longer will you have to guess at what the tower itself is doing to distort your FM coverage pattern.

Micro Communications of New Hampshire also introduced FM interdigital bandpass filters and constant impedance bandpass combiners.

Polarized antennas

Systems With Reliability (SWR) showed its Posi-Lock waveguide system, as well as its line of high and medium power circularly-polarized FM antennas, featuring copper tubular radiating elements and support stems.

In the RF transmission cable area, both

Dielectric and Andrew Corp. introduced *inners only* replacement for aging rigid line. Andrew's Macxline is available in 3 1/8-inch or 6 1/8-inch EIA sizes. Dielectric's inners come in all sizes from 1 5/8-inch through 9 3/16-inch. Inner conductors can be purchased and replaced at a fraction of the cost of replacing the entire rigid line system.

Andrew also introduced DRYLINE membrane-type line dehydrator pressurizing equipment, which sets new standards for drying performance and reliability with microprocessor control.

Dielectric also showed its compressor dehydrators Models 600/850.

For RG-58 and RG-59 size cables, Trompeter Electronics introduced its new portable, hand-held, powered coax cable stripper kit. At the other end of the size spectrum, Myat Corporation unveiled 12-inch 50 ohm aluminum rigid line for super power applications.

Gepco International introduced the Series GEP-5524 low-cap 100 ohm digital audio cable. The company also displayed cable assemblies, breakout boxes, custom panels, direct boxes and cable reelers.

Rohn introduced solid steel leg models of their venerable 45G and 65G sizes. Solid leg construction is now widely preferred over pipe legs in high moisture and/or cor-

rosive environments at essentially comparable pricing.

Towers on budget

Stainless showed a new G-36 design which reduces tower production costs, making the company more competitive in sales of towers under 600 feet.

Will-Burt Company showed several new products after introducing the popular 25-foot "Hurry-up" extension mast for RPU applications last year. The Stiletto mechanical composite telescoping mast is a 115 V powered big brother to the "Hurry-up"; it is available in free-standing heights from 30 to 60 feet. For mobile microwave antenna positioning, Will-Burt introduced the LPAP-12V antenna positioner designed for 12 VDC operation for mast top mounting.

LEA, Lightning Eliminators and Consultants again showed their dissipation array systems, Chemrod ground systems, and the more recently introduced Grounding Augmentation Fill. Available in 50-pound bags, "GAF" is an economical low resistance fill material to facilitate low resistance grounding in high resistance soil.

Cortana Corporation, another company in this field, showed its Stati-Cat system components, including the CN-1 Crow's Nest for tower top mounting, the SC-1 Stati-Cat for smaller towers, the SC-3 Stati-Kitty for guy wires, and the SC-4 Stati-Tomcats for side tower mounting.

Tower lighting and control has entered the

continued on page 34 ▶

Data Services Are Timesavers

by Barry Mishkind

LAS VEGAS It's no secret that the process of upgrading facilities has been made more difficult in recent months. As markets grow, locating the best transmission sites gets harder and harder. New, stricter protection requirements make the process even more difficult.

For that reason, many stations will find value in the computer programs and services that were demonstrated at the recent NAB '92 convention. Calculations that used to be done by hand and took forever now take seconds, allowing easy comparison of several sites and coverage patterns.

If you're at the start of a search for a frequency or coverage pattern, a good place to start might be the new series of map books from Dataworld. These display the contours of every AM and FM station in the country.

Customized maps

On the other hand, you may only be interested in your station's current coverage map. Dataworld can supply it to you in your choice of sizes.

Communications Data Services (CDS), like Dataworld, provides a wide range of information services and reports, either fully printed or instantly—via modem connection. If you need up-to-date FCC information, these are the best places to get it. Both companies expend a lot of time and effort to keep up with the hundreds of changes coming from M Street each week.

CDS has also gone out into the field and developed a highly accurate database that is used to produce Real World Propagation™ coverage predictions. CDS explains that this makes site analysis and signal prediction much more accurate.

If you have a lot of different markets or many sites in one market to survey, a com-

pletely packaged Real World Propagation workstation is also available from CDS.

Doing it at home

Group engineers, consultants, and stations that send out lots of remote units would find that having programs in their computer saves time and money. These computer programs can calculate paths and coverage and protection contours, as well as "what if" predictions for site evaluation.

Vernier Software and EDX Communications were both displaying their programs at NAB. Everything from STL path analysis to a 3-D display of an area is possible from one or another of the offerings.

Doug Vernier's latest effort in this area is the INTERDLG program, a "big brother" to his INTERCHK program for FM allocation studies and coverage prediction. INTERDLG adds many map overlays from the U.S. Geological Survey to display not only roads and political divisions, but railroads, rivers, lakes, shorelines and 65,000 cities.

Over at EDX, the latest versions of SHDMAP™ will provide terrain-sensitive coverage studies with a wide variety of international database formats, in addition to U.S. databases. Further, SHDMAP can do the calculations using one of six different propagation models. With the huge increase in broadcast facilities in Europe and elsewhere, this is proving to be a popular product.

□□□

Barry Mishkind, aka RW's "Eclectic Engineer," has been covering NAB conventions ever since RW started covering them. When not hobnobbing with NAB folk, he hides out in Tucson, Ariz. He can be reached at 602-296-3797, or 325-9883 on MCI Mail, or "barry@coyote.data-log.com" on Internet.

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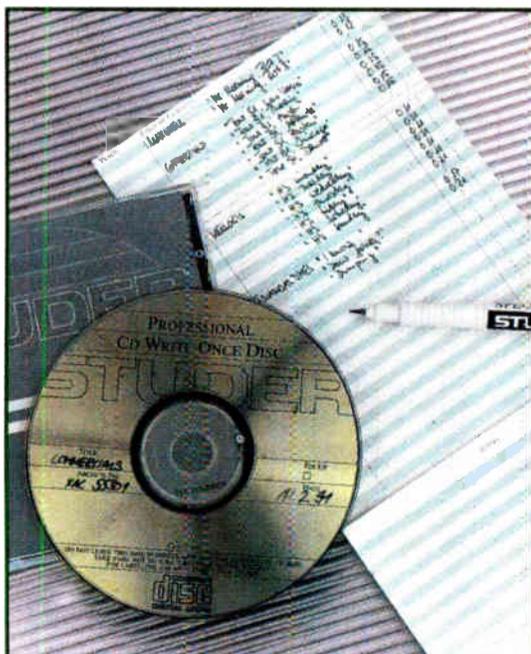
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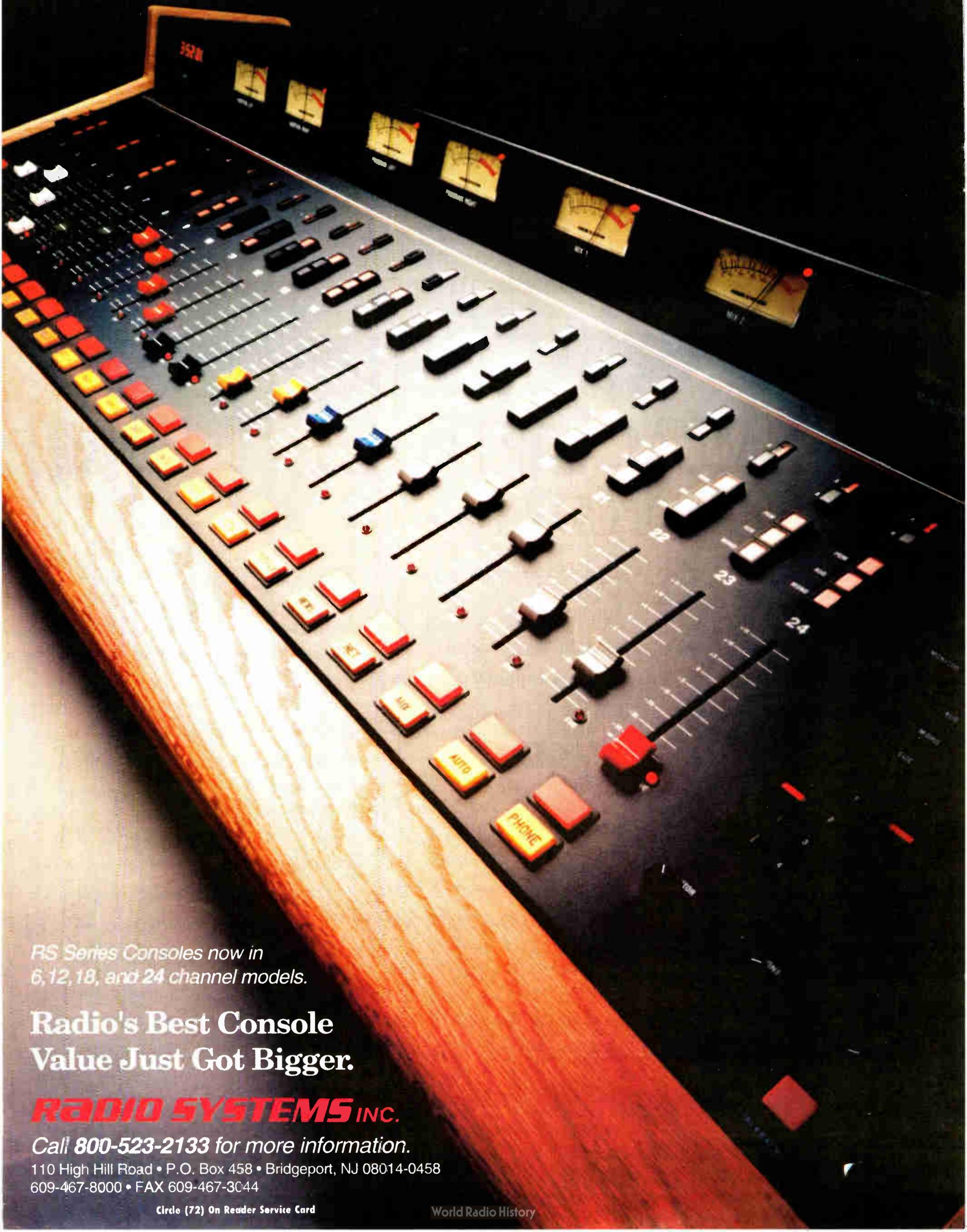
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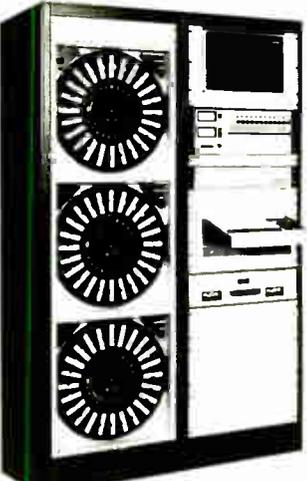
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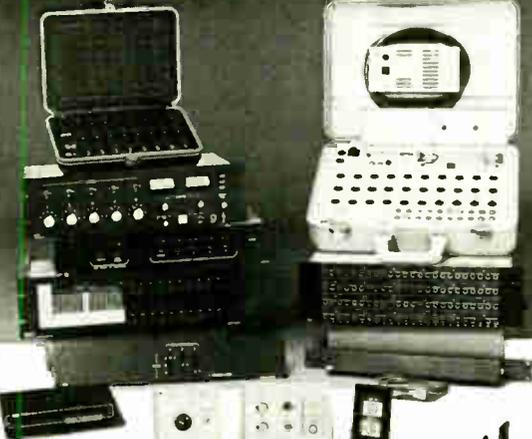
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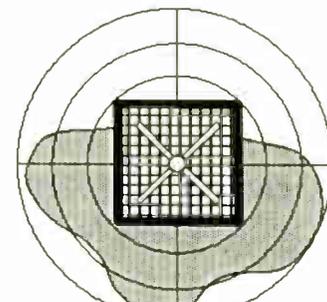
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Test Equipment Enjoys Revitalization

by Dennis J. Martin

LAS VEGAS Test and monitoring equipment—like other areas of broadcast—is enjoying a major revitalization. Rather than merely supporting existing products, manufacturers are developing new devices that continue to push technological limitations beyond the visible horizon.

The norm for equipment today is an increased reliance upon some form of digital technology, including microprocessor control. The result is higher accuracy, more features, often smaller size, and all at competitive prices.

At the Belar Electronics exhibit, two new

products were receiving their share of attention: the Wizard for AM and the RFA-4 FM RF amplifier.

Modulation wizardry

The Wizard is an AM digital modulation analyzer that is controlled by a microprocessor to provide highly accurate measurements. It features digital readouts of both negative and positive modulation levels, adjustable peak modulation indicators and positive peak weighting, automatic carrier level adjustment, loss-of-program alarm, carrier shift alarm, and more.

The Belar RFA-4 frequency agile RF amplifier is also microprocessor controlled,

and is designed to be used with the company's line of FM monitors. It offers 10 non-volatile memory presets including call letter display, selection of any standard FM frequency (in 50 kHz increments), AGC, and a four-step input attenuator. The Belar RFA-4 can also be operated remotely, when used with the Wizard FM and an optional interface module.

QEI is showing a new option for the model 691 stereo modulation monitor and the model 695 FM broadcast exciter: VPDTO (Variable Peak Duration Test Option). The option provides a variable peak-weighting function for both the models 695 and 691, which is adjustable from 100 to 1000 μ S. QEI has designed VPDTO to be simple to operate, and easy to install in the field.

On display at the TFT booth were the 753 AM modulation monitor, the 884 and 844A FM stereo modulation monitors, and the 845 FM SCA monitor. The TFT 886/887 is an AM/FM EBS system that includes the receiver, decoder, and generator in a single unit. The 886/887 feature two LED displays that show the number of days since the last EBS transmission and reception.

Using digital technology, the Mod-Minder from Modulation Sciences measures, analyzes, and displays peak FM deviation. Typical modulation monitors are said to have an accuracy of -5 percent, but ModMinder is rated at -1 percent, with 0.5 percent resolution. One minute count tally, overmod, peak weighting, and audio failure indicators are included.

Off-air signal analysis

It's no longer necessary to guess how your station's sound compares to the competition. Inovonics demonstrated how its new Sentinel

evaluates off-air and line signals. This single device simultaneously displays total modulation: level of the left, right, L+R, L-R, and QDM monaural channels; CBS loudness level; dynamic range; stereo balance; stereo image, and program symmetry.

A four-band, real-time spectral profile display shows relative level in bass, body, presence, and brilliance ranges. The receiver section offers 24 AM/FM presets, expanded AM mono and C-QUAM stereo, FM and FMX stereo, plus all analog and digital SCA/RDS subcarriers. A rear-panel RS-232 connector interfaces with compatible computers to allow long-term analysis of selected signals. Built-in 10 W amplifiers permit monitoring via headphones or external speakers.

The QA-100 quantaural audio program analyzer, from Potomac Instruments, includes VU, peak, average, quasi-peak, and aural-intensity meters. Also on display was the AG-51 audio generator and AA-51 automatic audio analyzer.

Always a popular exhibitor, Delta Electronics was showing its broad line of test and monitoring equipment including RF ammeter systems and operating impedance bridges. The SNG-1 is a stereo noise generator that provides white, pink, and USASI noise; the AMA-1 is a four-channel audio monitor amplifier; and the SM-1 is an AM splatter monitor, useful for verifying FCC compliance.

New audio test set

Amber Electro Design was proudly demonstrating the new Model 7000 low frequency measurement system. Described as a precision audio measurement device, the Amber 7000 combines audio and digital hardware to form a high-performance audio analyzer. The analog generator covers a frequency range of 10 Hz to 100 kHz with a THD residual of less than 0.0005 percent (50 Hz to 10 kHz); output level exceeds +26 dBm.

continued on page 36 ►



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Antenna Applications Soar

► continued from page 30

microprocessor age with Flash Technology's FTS 2100 SMART system (System Monitoring And Reporting Telemetry). SMART uses the FTC 121 controller to comprehensively monitor and control strobe obstruction lighting systems.

Smart controller

It monitors, anticipates, diagnoses, stores, and communicates system events with no human intervention. The controller continually polls each light for adequate intensity, initiates status codes and issues alarms via telephone modem.

Another high-tech entrant in this arena is Eagle Eye Technology's RADMOS-1100 (Remote Analog/Digital Monitoring and Operating System). Developed by ICT Systems, the RADMOS-1100 is a modular, stand-alone controller which monitors and controls the tower lighting and outage detection.

Any beacon outages encountered at a site are logged immediately and automatically called to the ICT Systems central office for notification to the FAA. Automatic systems such as these will become more attractive to broadcasters as the FCC steps up its tower lighting enforcement and more fines are levied.

Another brand new product in the tower lighting field unveiled this year by two companies was a dual red-white medium intensity obstruction strobe beacon in one package. EG&G Electro-Optics introduced the Flashguard 3000 which eliminates the need for two separate beacons and tower

obstruction-type painting.

It utilizes flash tubes for both colors with inexpensive acrylic beacon flashhead covers that are FAA-certified and unaffected by sunlight's ultra-violet rays.

Hughey and Phillips also introduced its version of the dual red-white medium intensity strobe beacon—tentatively known as the "Frogger." H&P and TWR Lighting both showed their respective full lines of tower lighting fixtures and control equipment, including both red incandescent and white strobe units.

AM phasing

In the AM antenna phasing equipment arena, Kintronic Labs, Harris-Allied, and Phasetek each had displays of the tried and true phasing hardware. This equipment has changed very little over the years, except for state-of-the-art computer modeling design and bandwidth optimization now being routinely offered by these firms.

Phasetek, the successor to CSP and Vector Technology, displayed a new spring loaded "quick tap" tubing clip for 3/8-inch and 1/2-inch tubing inductors.

Kintronics displayed a sample of its computer-optimized AM multiplexing equipment. This equipment should be of interest to stations moving to the expanded band to maintain five years of simulcasting and for stations losing their antenna sites and needing to move in with one of their neighbors.

□□□

Thomas McGinley is the director of engineering for Cook Inlet Radio Partners L.P.

Exploring Hot Topics in RF Gear

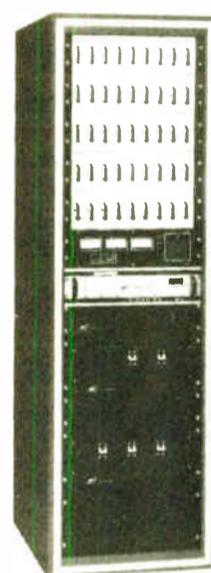
► continued from page 25

BEXT displayed its line of programmable FM exciters and solid state broadband amplifiers. The PJ series of broadband amplifiers has power outputs ranging from 100 W to 1 kW. BEXT LCR-FM and LCR-STL composite receivers are ideal for feeding an exciter in order to form a complete booster or translator station.

Radio with words

A new aspect of FM transmission for U.S. broadcasters is the radio data service (RDS). Already a proven technology in Europe, the system employs a 57 kHz subcarrier to send a data stream to RDS decode-capable receivers.

RE America exhibited its full line of RDS products. The RE533 "slim profile" encoder stores up to 16 different data records. The RE531 encoder has the same functions as the RE533 in addition to offering stations with paging capability the advantage of RDS as a paging system. The RE331 is a modular RDS decoder that can display and monitor transmitted RDS information, as well as monitoring phase, level and frequency of signals involved in RDS transmission.



OEI's OSS-10000 solid-state FM transmitter

Also on display at the RE booth was the RE530 test generator, which can vary RDS phase and frequency for R&D design applications. The RE650 codec was also on hand. This device inserts a data channel in the 15 kHz audio signal from the studio to the transmitters, which eliminates the need for modem lines to activate RDS transmission.

Rohde & Schwarz was on hand, displaying its RDS coder along with the rest of its product lines, including

test equipment and television transmitters. Access USA Corp. has placed orders with Rohde & Schwarz for a number of RDS coders to facilitate the creation of a U.S.-wide radio paging network.

The British firm VG Electronics displayed its VGE 1076D/ND slimline RDS coder and the VGE 1078M RDS monitoring decoder. The coder allows access to all presets—including phase and level controls—via front panel display. A lower cost version without front panel display is also available.

The VG decoder provides comprehensive data monitoring using a baseband multiplex input signal from a monitoring receiver. Decoded data may be displayed on a VT 100 or compatible display terminal.

Sage Alerting showed its SAGE I alerting system, which uses RDS technology to provide emergency information. The company is marketing the system as a practical successor to EBS.

Modulation Sciences displayed a different approach to RDS coding than any of the other entrants in the race. The

company has developed a card that can be installed in a station's computer.

Even some transmitter manufacturers have taken an active interest in RDS technology. Itelco, an Italian firm, has RDS

cast arrangements.

College broadcasters have long recognized LPB to be the leader in providing low power AM transmitters in carrier-current applications. The TIS (Travelers Informa-



The RE531 RDS encoder, from RE America

encoder modules that can be inserted into the company's transmitters.

Plan of attack

Broadcasters looking to consolidate the operations of their station with others in nearby markets were shown "Plan A," devised by Marti Electronics. Known for products in the RPU and aural STL fields, Marti has shown how the STL-10 transmitter/receiver combinations can be used to link stations engaged in LMA or rebroad-

tion Service) makes extensive use of LPB transmitters, which can now be linked in a synchronous fashion by fiber optic cable.

Support services

While some attendees were in the market for new transmission equipment, let's not overlook those companies who support existing installations. Econco is an established company in the business of tube recycling. A cost-effective alternative to purchasing new power tubes is to have them



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For new tube purchases, PCB-free capacitors, semiconductors and other parts, Richardson Electronics is a good source for your servicing needs. Richardson also supplies vacuum capacitors for AM and FM transmission equipment, CRTs and RF transistors.

When it comes time to test your transmitters, a dummy load is often required. You'll need one for FM direct power measurements, and Altronic Research is a good source for both high power and low power air-cooled loads.

RF trends are towards solid state FM, AM stereo, digital transmission and high reliability products. New developments are happening every day. NAB' 92 was a great opportunity to explore both new technology as well as the companies who support the needs of broadcasters both present and future.

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By John F. Schad, President
SMARTS Broadcast Systems

Those of us who have been in the radio industry 30 or more years can't help but shed a tear for the radio that used to be. But we also know that the one thing that we've always had to deal with in radio is constant change.

The era of the big studios and the live big bands, the half hour comedy shows, Amos and Andy, Our Miss Brooks and Jack Benny, gave way to smaller operations featuring disk jockeys and their record libraries, news directors huddled over their police monitors, and "air personalities" working fairs, shopping malls and other remote locations.

But radio continues to evolve. Broadcast stations are popping up in smaller and smaller communities. Outside influences such as cable television, the death of the ma-and-pa main street merchant, the growth of the discount store, have all contributed to a decline in the available revenues to radio stations and the labor intensive operations of the 50's, 60's, 70's and 80's are beginning to give way to yet another kind of radio. A radio industry that is more compact, more streamlined, more efficient and much less labor intensive. Our company, SMARTS Broadcast Systems, is dedicated to the service of these newly emerging operations. SMARTS provides the answers to many of the big, and the small problems facing the broadcaster, not just in the form of equipment and computer services, but in ongoing support and help in day-to-day operations.

That's why we now offer some of the best deals in the industry, in features, price, and creative financing.

If you are a live station with no intention to automate, but have aging cart machines that are a maintenance headache, check out the SMARTKIT FOR JUST 995.00! The SMARTKIT converts your present computer to a digital audio device that emulates a multiple play (12 deck), record playback cart machine.

If your's is the simple operation—just local breaks and a music satellite feed, you can use monaural audio on your spots, and don't need a lot of bells and whistles—we can equip you with the SAT-PAC SMARTCASTER—simple, easy to operate, but does what you need to do to automate a satellite feed—THE SAT-PAC goes for just 4,995.00.

If you need a system but dollars are just too tight, let us help you pay for it out of cost savings. We have a new rental plan that allows you to rent a unit. It's totally flexible so you can buy later, give it back to us, or rent it for another rental period! RENT-A-SMARTCASTER is here and makes our products available to everyone!

How do our services stack up? Read on for some unusual broadcast stories.

Some of our clients don't fit the profile of the typical radio station, but have found ways to make radio work in the toughest of times and the smallest of communities.

We have a man and wife running a radio station in Northern Georgia. That's the whole staff—the man and his wife. The station is run by a SMARTCASTER CD system. The station operator tells us his SMARTCASTER saved his radio operation, and he has been an operator for more than 40 years.

We have another station in Texas. Those folks have had to weather some pretty tough times, but have done so successfully with their SMARTCASTER. At one point the station had one full-time employee, and a couple of commissioned sales reps, yet stayed on the air. Things improved, and the station is doing great now, but they still have their operation revolving around the SMARTCASTER.

We have three stations, all running from one building in Eastern Missouri. On weekends, one caretaker makes sure production is done, live programming aired, and technical requirements are met, but three SMARTCASTERS run the operations. The cost efficiency is enormous.

In Southern Georgia we have an innovative broadcaster that uses a SMARTCASTER to talk to the traffic along the interstate. The unit has been running for more than a year now, a solid 24 hours a day, programming commercials for the business at Exit 10 on Interstate 75.

Give us a call, and we'll put you in touch with any of these people, and many more who have SMARTCASTERS...We now have 300 units in the field.

As good as it is, SMARTCASTER is only a part of the picture. The SMARTS billing, accounting, and traffic system has been working for years in radio stations around the country. This module of the SMARTS system handles all the office paperwork, from order entry through logs, billing, co-op, sales reports, management reports and much more. The logs flow to the SMARTCASTER, so there's no programming needed at that level. You'll find our SMARTS

office package easy to work with and innovative in its approach to radio billing and traffic.

Of course general ledger and payroll modules round out the office package and produce timely income statements and balance sheets, so you know right where your business stands.

Tie your SMARTCASTER to any satellite network, to a reel-to-reel automation system, or to one of our two new CD systems. The Jock-In-The-Box CD system integrates the final subsystem into the comprehensive picture, a complete music library, and music rotation program that builds a playlist to your specifications, allows you to look it over, then transfers the playlist to the SMARTCASTER. With as few as 3 decks, you can have a full weekend's walk away time. Each deck holds 18 CDs.

When you have questions about your system, or trouble of any kind, call our toll free number. As broadcasters ourselves, we know that you need access to help 24 hours a day, 7 days a week.

We at SMARTS always have the philosophy that we are selling solutions to the problems encountered by broadcasters, not just broadcast equipment. This philosophy is echoed in our products and in our dedication to service. You never feel out on a limb when you are working with us.

If you want to know more about our family of products, including the SMARTCASTER digital audio systems, give us a call. You can reach us toll free at 800-747-6278.



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WORKBENCH

Little Things Mean a Lot

by John Bisset

FALLS CHURCH, Va. Remember that time-worn saying, "Good things come in small packages"? This month, in conjunction with the rest of *RW*'s wrapup of the NAB show, I thought I'd focus on some of the smaller booths and smaller items that seem to get lost in the shuffle of the giant transmitter or studio displays.

We'll start our mini show tour at the Clark Wire and Cable booth. Susan Clark displayed some inexpensively-priced slotted metal cable holders. There are three sizes, and they are color coded, depending on the size cable each holder will accept. At \$15 each, you can't go wrong organizing your cables with the Clark holders.

Susan also displayed a variety of audio and small diameter coaxial cables, which have some unique features. The cables are marked off in 12-inch increments, making cable run lengths easier to calculate.

Audio wire can be purchased in a fused red/lavender pair (where the letter "R" in red stands for *right*, and the "L" in lavender stands for *left*). This stereo pair means you'll never get channels reversed again, and since each cable is jacketed, the problem of heat shrinking and protecting exposed wires—as is found with two-pair/one-jacket type cables—is eliminated.

Clark's wire can be ordered in any of 10 jacket colors. If you're considering a studio or multiple wiring run, Clark now does cable termination to the customer's specifications. For more information on Clark Wire and Cable, circle **Reader Service 143**.

Susan was also handing out entry forms for her Unofficial Official BBROYGNBGW Contest. As a female, the old standby rhyme for determining the resistor (or in this case, wire) color code, was driving Susan nuts. Her contest is designed to come up with a better (and less archaic) BBROYGNBGW phrase.

Susan's putting her money where her mouth is—first place gets \$200, second place will receive \$100, and the third place winner will get \$50. She's looking for humor, politically- or broadcast-motivated.

The contest deadline was originally May 10, but Susan has extended the entry deadline to the end of the month, so *RW* readers can participate. Since there's not much time left, call or fax Susan Clark for your entry form. Her number is 708-272-9889, fax: 708-272-9564. We'll announce the winner in *Workbench*.

★★★

If you decide to wire your facility yourself,

or if you terminate a lot of XLR-type connectors, you may want to invest in a cable tester. The Wireworks Corporation displayed its Model TE-3, a mic cable tester, that lists for \$99.

This company also manufactures a line of mic splitters (using Jensen transformers) that are compact and affordably priced. **Reader Service 188** will get you more information on these products.

★★★

Neutrik has done it again. One of its featured products was a combination XLR/tip-ring-sleeve jack. This jack looks like an XLR-type, with a hole in the center. The terminal pinouts can be wired separately, or combined—meaning the jack can serve two functions.

A custom-made remote kit could use such a connector, permitting either XLR- or phone-type mic connectors to be used. The dual function jack reduces your chances of not having the right cable connector, mounts in the same size hole as a standard XLR, and will be close to the price of a standard XLR jack. For information on Neutrik's *combo* connector, circle **Reader Service 177**.

★★★

If building studios seems to be your livelihood, you'll want to invest in one of the calculators or scalers manufactured by Calculated Industries. If you read many blueprints, or other drawings that show dimensions, the Scale Master will make your life simpler.

Held like a pencil, the Scale Master has a rotating wheel that you roll over the drawing. The Scale Master will automatically calculate square footage, total the number of studs, joists, or electrical outlets, and even make the measurements in metric if you like. The Scale Master can be switched to read any of 42 different scales, or any custom scale that you set yourself.

The Construction Master II is a hand-held calculator that adds, subtracts, multiplies and divides in feet, inches and any fraction. Conversion to tenths of an inch or hundredths of an inch is not necessary. The calculator also converts to metric, inches, and yards, and can be used as a regular calculator.

The Scale Master lists for \$129.95, and the Construction Master II is priced at \$69.95. These prices include shipping. For more information, circle **Reader Service 46**.

★★★

Cal Switch displayed a resettable fused circuit protector. Manufactured by Poly Switch, and sold by Cal Switch, these devices look like disc capacitors. They are designed for low-voltage operation, and are used extensively in IBM and Apple computers. They

are also found in ATT Merlin and Spirit telephone systems.

When a short circuit is sensed, the device opens like a fuse. As it cools down, it closes, restoring operation. In an overload condition, as the current rises, so does the heat, effectively limiting current flow.

Dangerous overcurrents caused by distortion, clipping, or over-driving the speaker can damage the high frequency tweeter. When the ROE or RXE Series are installed, the speaker is protected from these dangerous currents. For more information on the Poly Switch Circuit Protector, circle **Reader Service 174**.

★★★

Remember the old Russco turntable? Well, a 1990 model exists, and is being sold today by the company located in Fresno.

The MA75 is a 75 W stereo amp, listed for \$700. It features a dual front panel power output meters, will accept either balanced or unbalanced inputs, and has compression terminals on the fused outputs. It fits in 3 1/2 inches of vertical rack space. A 25 W version is also available. For more information, circle **Reader Service 70**.

★★★

The Carpel Video booth reminded me of one of my first jobs in radio. I was given the task of scraping off the old labels from the carts in the production room. I can't remember how many hours this took, but it was a painstaking and—armed with a

single-edge razor blade—dangerous job.

Too bad today's interns can't have the same fun! They've been saved from this drudgery by Carpel-o-peel. An eight-ounce bottle of this odorless liquid costs less than 10 dollars. When painted on a stubborn label, and allowed to soak in for a minute or so, the label and gummy residue just peels right off.

Carts treated with Carpel-o-peel aren't gummy or greasy, and don't have to be washed. Circle **Reader Service 112** for more information.

★★★

Atlantic Representations displayed a sleek, modular, all-metal CD storage system. A 25-CD storage rack costs \$25. A CD tower will hold 60 CDs, and can be combined with other towers and a swivel base to create a CD "carousel." These metal frames are drilled with rear mounting holes, to permit attachment to a studio wall.

Before you buy CD storage racks, send off for information on this patent-pending design. It's sleek, it doesn't take up a lot of space, and the price is right. Circle **Reader Service 23** for information on the CD, cassette, and VHS storage racks from Atlantic Representations.

□□□

John Bisset is a principal with Multiphase Consulting, a contract engineering and projects company. He can be reached at 703-379-1665.

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Circle (53) On Reader Service Card

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Test Equipment Enjoying Revitalization

► continued from page 34

The analog analyzer has a frequency range of 8.5 Hz to greater than 500 kHz, measures signals from less than 10 μ V to 100 V RMS, and has a residual THD+N of less than 0.001 percent (50 Hz to 10 kHz, 20 kHz bandwidth).

Introduced at the convention was AS03, a PC software package from Neutrik, designed to complement its A1 audio test and service system. Using the new software, all A1 functions can be controlled by a PC. Since the A1 and the PC communicate bi-directionally over an RS-232 interface, operation from either end is possible.

The AS03 software also enhances the performance of the A1 by offering such features

as fixed range measurements; amplitude, time, and table sweeps; tolerance curves; and calculation of tolerances. Using the new Neutrik AS03 software, the A1 audio test set can now automatically test and document devices with minimal operator intervention.

The NAB convention marked the introduction of a new product line for Sescos—hand-held test equipment. Eight models comprise the line and include the ASG-2 low distortion audio generator, THD-2 distortion analyzer, SFG-1 sweep function generator, FM-1 frequency meter, AVM-2 audio voltmeter, and LSI-1 loudspeaker impedance checker.

The model AT-1 is an audio tester that combines an audio oscillator, AC voltmeter,

and a power amplifier that feeds an internal speaker. The OSC-1 flat oscilloscope uses a Sony flat screen two-inch black and white monitor to create a sampling oscilloscope to display audio-band waveforms.

Digital audio interface tests

In an effort to address the growing demand for digital audio test equipment, t.c. electronic of Denmark was demonstrating the TC8201 AES/EBU interface analyzer and test generator, and the new Microsoft Windows-based software. The TC8201 supports AES/EBU, SPDIF, and optical interfaces, and tests for conformity to AES/EBU and EIAJ CP340 digital audio transmission standards.

The unit displays frame rate, channel status, and user data information, and supports frame rates from 28K to 53K. The TC8201 also generates sine, square, triangle, pulse, captured, and downloaded waveforms. The t.c. electronic TC8201 interface analyzer and test generator will allow users to quickly identify digital audio interface problems, analyze differences in level, and simulate fault conditions.

Testing a broadcast audio channel commonly ranges from difficult to impossible, especially when it is in use 24 hours a day. To solve this and other time-restrictive test challenges, Audio Precision developed *FAST*-test, a multi-tone test signal. In as little as one or two seconds, frequency and phase response, total distortion, and noise can be measured.

As Audio Precision demonstrated, 15 to 30 simultaneous tones provide good resolution. If high definition is required, 60 or more tones can be used. *FAST*test will operate with any System One that is equipped with DSP.

On display at the Sound Technology booth was the RTA-4000, a real-time program/acoustic analyzer. One feature that seemed to impress exhibit visitors the most is its RRC, or response mode. Using this feature, the difference in frequency response between any two sources can be accurately detailed.

Tektronix demonstrated the 760A stereo audio monitor. The 760A couples a graphic CRT display of the stereo audio signal with bar graphs for peak indication of the left and right channel signal levels. A third bar graph displays L+R, L-R, or aux signals. Peak hold and automatic or manual scale gain functions are included.

Simple phase measurements

Wohler Technologies introduced the TDM-1, a module designed to measure the time delay between two audio channels. Using a proprietary clocking circuit, the TDM-1 detects and quantifies inter-channel delay and displays the result on a 10-segment LED bar graph that is switchable between one and 10 mS full scale.

In addition, a second LED indicator displays which channel is leading. Although the TDM-1 will show the phase difference between any two audio sources, it is especially suited for satellite facilities where propagation delays between channels is common.

Unveiled at the ESE exhibit were the ES-ACM7 and the ES-215. The ES-ACM7 is a multiplexer that allows seven audio channels to be encoded on the video track of a VCR. Providing a response of 20 Hz to 3 kHz, the ES-ACM7 allows a facility to simultaneously record itself and six competing stations. During playback, you can easily switch tracks to evaluate the competition.

The ES-215 is a new audio level indicator that is a horizontal version of the popular ES-

214. The ESE ES-215 uses 14 LEDs in three colors to display level from -25 to +4 dB. Rise time is less than 250 μ S in peak mode, less than 25 mS in fast averaging mode, and approximately 300 mS when emulating the VU meter standard. The input is transformer isolated, balanced bridging, and accepts input levels from -16 to +30 dBm.

Dorough Electronics was demonstrating the model 380-A console mount stereo meter. Using gate array technology, the model 380-A offers dual elements per meter with a selectable peak-hold function. The meter is self-powered and accommodates input levels from -25 to +20 dB.

Body current checks

Meeting the need to measure non-ionizing electromagnetic fields, Holaday Industries was exhibiting its line of isotropic broadband field strength meters. The HI-3012 has been recently upgraded and includes new probes that adhere to recent ANSI standard changes.

Introduced was the Holaday HI-3701, an induced body current meter, that verifies compliance with the recently-published IEEE/ANSI C95.1-1992 standard. The Holaday HI-3701 features full-scale ranges of 3, 10, 30, 100, and 300 mA, and operates over a frequency range of 3 kHz to 100 MHz.

AVCOM of Virginia, which is known for its spectrum analyzers and satellite receivers, showed several new products. The NASA-1000A is an affordable, integrated network and spectrum analyzer. When used as a network analyzer, it will make swept measurements of devices like filters and duplexers over a range of 1 to 1000 MHz, with a dynamic range of greater than 90 dB.

As a spectrum analyzer, the NASA-1000A covers the same frequency range, but with a sensitivity of -95 dBm. Options include an FM demodulator and AM detector. Also new is the AVCOM SCPC-2000E single channel per carrier receiver, the SCPC-3000E agile demodulator, and the AVCOM SCPC-500-70 single channel per carrier downconverter.

A hot new product line available from Jensen Tools is the Fluke 90 Series scopemeter. The three models available are the 93, 95, and 97. All feature 50 MHz bandwidth, integral DMM display and functions, and are dual trace.

Logging miniaturized

At the Eventide booth was the VR240 Digital Broadcast Logger. Using a single, low-cost DAT cassette, the VR240 will record 252 hours of audio, which equates to 10 1/2, 24-hour days. The system can be supplied with one or two transports and an optional label printer.

In addition to the model CMR digital antenna monitor and model CEB EBS encoder/decoder, Gorman-Redlich was highlighting its model CRW weather receiver. The CRW is designed to receive National Weather Service transmissions in the 160 MHz band. It features 0.28 μ V sensitivity, excellent interference rejection, and a 1050 Hz "alert" tone detector.

Knowing that disaster can occur at any time, Sage Alerting exhibited the SAGE I system. The SAGE I utilizes the 57 kHz radio data system (RDS) FM subcarrier to transmit emergency information including the nature and location of the emergency.

Leitch showed its 880 Series audio distribution amplifiers. Modularly constructed, two different frames provide eight mono or four stereo outputs. A versatile audio tone generator module is also available.

Considering the myriad of test and monitoring equipment available, it seems unnecessary to ask whether a particular product is made. Rather, in the competitive broadcast marketplace, the question is: Which of these high-quality products shall we choose?

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USER REPORT

WXTR Ups Coverage with Stainless

by **Chip Fetrow**
Director of Engineering
Radio Ventures I, L.P.

WASHINGTON When Radio Ventures bought WXTR in April 1990, one of our top goals as the new owner was to improve

the signal. The station was operating from a 500-foot tower 10 miles south of the Washington Beltway with 50,000 W at 500 feet height above average terrain (HAAT). The previous owner had gotten FAA approval for a 768-foot tower and had secured the CP from the FCC.

At one time there was an FAA Determination of No Hazard 60 feet higher. We considered going back to the FAA for more height, but decided to build it as is, but extendable for at least another 100 feet.

The first order of business was to determine the losses and thus the number of bays

needed to reach the new effective radiated power (ERP) of 22,000 W without buying a new transmitter. Increasing power by buying a new plate transformer was considered and dismissed once it was determined that we could make ERP without changing the total power output (TPO) with a six-bay half-wave spaced antenna.

We decided to go with Stainless Inc. of North Wales, Pa. as our tower fabricator. We also decided to act as our own general contractor. I would not advise this if you have never built a tower before. Test borings, supervised by a geologist, were completed and it was determined that caissons were needed. These were bid and installed.

Meanwhile, Shively was selected to supply the antenna. Since the tower is extendable, we will ultimately want to use this new antenna as an auxiliary. This means it will remain side mounted.

Anyone who just side mounts an FM antenna without running a pattern study is taking an unscientific gamble. We wanted to make sure we were as omnidirectional as possible on the large-faced tower. Shively ran the patterns and then Stainless and Shively made sure the antenna would mount on the tower properly.

What occurred next made me certain that I had chosen the right vendors. Faxes were flying between Shively and Stainless. They made sure that there were no mechanical interference problems between the tower and the antenna, the matching section or the transmission line.

The Stainless G-5 tower is a five-foot, wide-face "knock down" tower. "Knock down" means the sections are assembled on-site rather than welded at the factory. Welded towers do not need to be assembled on site, but cost more to ship, especially in large face widths, and are harder to modify to accommodate larger loads in the future.

We specified our G-5 to handle very large loads—including many two-way antennas, an LPTV antenna and many microwave dishes—in addition to the two FM antennas and two 950 MHz STL antennas.

Northeast Towers was selected to erect the tower. They arrived one day ahead of the tower to get set up. The tower arrived on schedule and was unloaded and checked. Assembly started a day later. Even with a week delay for weather, the tower was up and we were on the air a day ahead of schedule.

The new signal is much better than the old one; we gained the three things important to FM stations—height, height and height. The half-wave spaced antenna limits the signal to the neighbors, and the carefully spaced tower bays do not cause problems with the antenna pattern. I need to thank Jim Mack, broadcast salesman at Stainless for all of his help.

□□□

In addition to his title as director of engineering for Radio Ventures I, L.P., Chip Fetrow is a partner in Skyline Antenna Management Inc. He also is the chairman of the Society of Broadcast Engineers Washington Chapter.

For information on Stainless Inc., contact Jim Mack or H. William Guzewicz at 215-699-4871; or circle Reader Service 186.



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World Radio History

INDUSTRY ROUNDUP

Evaluating the Design of Antenna Arrays

by **Marvin Crouch**
President
Tennaplex Systems

NEPEAN, Ontario How do you evaluate an antenna design?

Antenna arrays are a specialized art, and as such, the strengths and weaknesses are not common knowledge throughout the industry. I will try to shed a little light on the subject.

Any antenna that radiates from several driven elements must have particular timing (phasing) in order to produce a wanted pattern. Both the mechanical and the electrical arrangements influence that timing. Indeed, even the structure on which it is mounted can influence timing, if the antenna is expected to radiate through the structure. The timing horizontally around the antenna and likewise vertically up and down the antenna also influence the pattern.

Volume shape

The pattern of an antenna is a volume shape, but for convenience it is broken down into two components: the horizontal pattern and the vertical pattern. Together they constitute the volume pattern.

If the volume shape was a sphere, the gain would be 1 dB or 0 dB relative to an isotropic (point source), or -2.15 dB relative to the volume pattern of a dipole. All professional antennas use the dipole pattern shape as the reference to quote gains so that the word

"gain" means the same thing to everyone.

There are two fundamental types of radiating elements—resonant and broadband. The broadband type is engineered to achieve a match in impedance over a broad range of frequencies, while the resonant type is a single-channel device. Either one

Antenna arrays are a specialized art. Their strengths and weaknesses are not common knowledge.

can have reflecting elements or screens to direct the radiation in a particular direction or to avoid the unknown influence of the mounting structure on the pattern.

Broadband radiators are less susceptible to weather effects that change the match in impedance. Modern design allows these types to work in all weather conditions without the need for de-icers or massive radomes.

Feed systems

Vertically, there are two types of feed systems: the sequentially-fed and the parallel-fed antenna. Sequentially-fed systems are very narrowband regardless of the radiator type because there is only one fre-

quency where the timing vertically is correct. Parallel-fed elements work well over a broad range of frequencies because all elements receive the information to radiate within the same wavelength.

The common design is to have the same number of elements in each vertical level of the array. The vertical pattern and the horizontal pattern then can be evaluated separately.

There is, however, another design—one in which you do not have a common number of elements in each level and the vertical pattern changes with azimuth. This type has to be evaluated by a volume or 3-D plot of the pattern. The shape (peaks and valleys) and the gain can only be determined this way. The gain is always less with this type of design.

A good practice is to evaluate the feed system power handling capabilities. A safety factor of 30 percent should be used over the manufacturer's maximum ratings.

Materials are another area where one needs to be observant. Hot-dipped galvanized steel inside and out is about the best for a good 25-year life expectancy. Installation must be inspected to see that elements are where they should be and feed systems are well protected from falling ice or future climbers.

When all the foregoing meets with your approval—then it is time to look at the price.

□ □ □

For information from Tennaplex Systems, contact Marvin Crouch at 613-226-5870; fax: 613-727-1247; or circle Reader Service 129.

TECHNOLOGY UPDATE

MCI Coax Switches Minimize Downtime

by **Dennis Heymans**
Sales & Marketing Manager
Micro Communications Inc.

MANCHESTER, N.H. Today's broadcaster is always looking for ways to improve his transmitter site. With the introduction of coax switches, the tedious job of manually manipulating coax to make a transmitter changeover has almost become a thing of the past.

Micro Communications Inc.'s (MCI) family of coax switches (five standard EIA sizes) are designed to minimize the downtime usually attributed to a manual transmitter changeover.

The MCI 61102 7/8 EIA four-port coaxial transfer switch is a new addition to the existing line. What is unique about MCI's coax switches is that all of the four ports of the switch lie in the same plane. For most installations, this permits a more compact layout and reduces the number of coax elbows required.

The use of any size coax switch is common when one wants to switch automatically between two transmitters and one antenna (known as a main/standby configuration). A second application is to switch one transmitter between an antenna or a test load for maintenance purposes. Using coax switches makes any of these applications easy and cost effective.

MCI switches consist of a housing, a rotor and a drive mechanism. The housing for the larger models is built from a precision aluminum casting. The housing for the two smaller models, 7/8 and 1 5/8, is machined from solid aluminum block. Chromate conversion process is applied to both housings.

The rotor contains an isolation plate, which divides the interior of the housing into two separate paths. Attached to this isolation plate is the inner conductor, which transfers the RF energy from port to port. All internal contacts are gold plated.

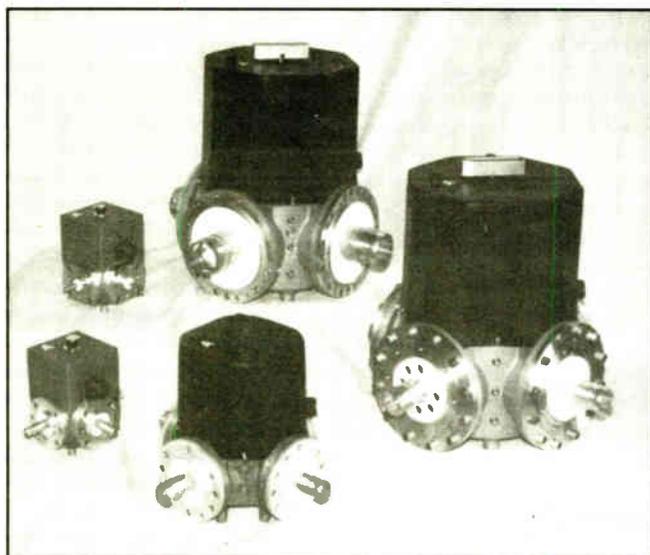
The remaining internal parts are made of either brass or dielectric material.

Rotor motion is controlled by a commercially available gear motor. A manual override is built into the drive mechanism in case of loss of power or motor failure. Drive voltage for the motor is 120 VAC. Control of the switching can be done by manual

operation or by using command control from the transmitter.

Voltages available for command control are either 6, 12, 24 VDC, or 120, 240 VAC. Switching motion is a 900 clockwise or counter-clockwise rotation. Internal stops prevent the isolation plate from traveling beyond 900. Switching time for the gear drive is typically one to two seconds. Actuation of the switch from its fixed position is done with the transmitter(s) off. Safety interlocks are provided in each position to ensure proper operation and eliminate switching under power.

All internal wiring is brought to a common connector. Customer interface to the switch is easily accomplished via pin codes on the connector.



MCI's family of coax switches are designed to lessen the downtime usually attributed to manual transmitter changeover.

All of the coax switches may be mounted in any position without affecting its operation. Mounting tabs and hardware are provided for ease in the mechanical installation. All ports of the switch are standard EIA flange (male).

All MCI coax switches are designed to provide ease of use and reliability.

□ □ □

For information on the MCI product line, contact Dennis Heymans at 603-624-4351; fax: 603-624-4822; or circle Reader Service 15.

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TECHNOLOGY UPDATE

A Line on Rigid Transmission Wire

by Joseph A. Zuba
Director

Broadcast Sales/Marketing
Dielectric Communications

RAYMOND, Maine Rigid transmission line is one item no supplier can overdesign. Sometimes, however, the superiority of one line over another is not obvious until after a period of service during which one line has failed.

A single failure can wipe out the price advantage of "cost saving" line obtained by cutting corners in design and manufacture. What is sometimes forgotten are the many factors that affect the performance and life of transmission line.

It begins with the quality of the copper. Conductivity rating affects efficiency and power handling. What "high conductivity" copper really means depends on the type of alloy used.

Dielectric Communications uses CDA Alloy # 110, which has an IACS conductivity rating of 101 percent. Other commonly used alloys 101, 102 and 122 have conductivity ratings of 99 percent, 100 percent and 85 percent respectively. The 122 Alloy, typically referred to as "water tube," is 15 percent cheaper than Alloy 110, and has a power rating of 7 percent less.

Dielectric's decision to heliarc weld all outer conductor flanges resulted from the failures of silver soldered line. Any flux remaining imbedded in soldered line can break down and cause gas leaks during stress and flexing on the tower. The tremendous heat required during silver soldering tends to anneal or soften the line near the flanges, making it vulnerable to dents and distortions, which can cause poor electric and mechanical performance. Heliarc welding requires no flux and confines heat to a very small area.

Captive insulators within elbows, and disc insulators within straight line sections provide superior mechanical and electrical stability over other type supports. The disc, although more expensive, gives better long-term service, especially in wind and vibration.

In Dielectric's "magniform" process, inner conductor insulator undercuts are "magnetically formed," rather than rolled or welded. This allows use of both continuous inner and disc-type insulators, without crimping or welding inner sections together, nor drilling holes for pin supports.

Thermal expansion and contraction of transmission line requires a time-proven connector design with meticulous attention to workmanship and quality control to ensure long life. Dielectric's "watchband" expansion joint was developed some 35 years ago and has a track record of trouble-free performance.

In addition to EIA flange line, Dielectric offers a premium "Unibolt" alternative, using the same high-quality components and construction techniques as EIA, the Unibolt line has a unique "goof-proof" coupling. Sexed flanges meet only when fully mated, preventing misalignment during installation.

O-rings are captive in the male flanges, allowing riggers the best advantage in assembling line with no chance of the O-ring being squeezed to cause a leaky joint. Furthermore, all joints swivel, making it unnecessary to match the position of the other line sections during installation or maintenance.

While a superior line may initially be more expensive, we think it represents a very worthwhile investment for the broadcaster.

□□□

For information on Dielectric Communications' transmission line, contact Jay Martin, manager of FM systems, at 800-341-9678; fax: 207-655-7120; or circle Reader Service 109.

USER REPORT

Will-Burt Mast Takes to the Street

by Jack Layton
Engineering Manager
KDKA Radio

PITTSBURGH As a kid I can remember sitting in my dad's car parked across the street from Sam's Furniture Store. Dad had left the radio on to entertain me while he went into the bank.

There in the store window was a guy doing an actual on-air broadcast on a local radio station. The sign in the window said, "Listen to Art Miller on Radio 800."

Excitedly I fiddled with the tuning dial until I found the station. Sure enough, there was the voice of the disc jockey, bigger than life, coming out of the dashboard speaker.

Magic of radio

Here I am, many years later, still held in awe by the magic of radio, but now expected to be the magician.

Every magician must have the tools to create the tricks of his trade. One of the tools in a modern-day radio station is the VHF or UHF remote pick-up system. A low-power transmitter can be set up on-site at a moment's notice to provide a studio-quality audio link for both voice and music. The receive antenna for the RPU system can be high up on a tower or on the roof top of a tall downtown building.

The only trick left is getting the transmitting antenna a reasonable distance above ground. Enter now a Will-Burt pneumatic mast.

Installed in the Rainbow Machine, the 26-foot custom-built recreational vehicle (RV) that houses the KDKA studio on wheels, the Will-Burt device is a compressed air-operated 30-foot retractable antenna mast.

On it is mounted a pair of five-element 450 MHz yagi antennas that develop a gain of about 13 dB. The mast, when fully retracted, places the bottom of the elements of the vertically-polarized side by side mounted yagis about six inches above the roof of the vehicle. The mast consists of five side-by-side mounted yagis about six inches above the roof of the vehicle. When its five telescoping sections are fully

extended, the mast places the radiation center of the antenna system about 30 feet above ground level.

Operation of the Will-Burt mast is quite simple, using a small air compressor, powered from the 12 V vehicle battery.

Pressure sensing switch

The pressure sensing switch in the output of the compressor causes it to run, filling the telescoping sections with compressed air. It takes about 25 PSI to fully extend the mast. When this pressure is reached, the compressor is automatically turned off by the pressure sensing switch. The entire erection process takes about two minutes.

The mast is turned manually from inside the vehicle for proper orientation of the antenna. Rotation of the mast can be inhibited either in the extended or retracted position by finger tightening two large paddle head screws.

A pressure interlock switch can be wired to disable the ignition circuitry of the vehicle, to preclude starting the vehicle while the mast is extended. As an alternative, the switch can be wired to illuminate a large flashing red warning light when the ignition switch is on and the mast is extended.

Coax to the antenna is enclosed in a preformed spiral-wound plastic conduit. The conduit and cable extend in the appearance of a spring around the mast as it is raised.

With the Will-Burt mast extended to its full length, stereo remotes up to 25 miles from the receive site have been successfully accomplished even over the hills and valleys of south western Pennsylvania.

The pneumatic mast is an integral part of the RPU system—one of the tools in the magician's bag—that can bring the sounds of the county fair or the noise of a fast-breaking news story to the ears of thousands of listeners.

The mast, the compressor, all of the accessories mentioned, along with complete installation, are available through Will-Burt.

For information on Will-Burt equipment, contact Donald Barlow at 216-682-7015; fax: 216-684-1190; or circle Reader Service 138.

USER REPORT

KUDL Upgrades To Shively System

by Chris Ostrander
CE, KUDL/WHB Radio

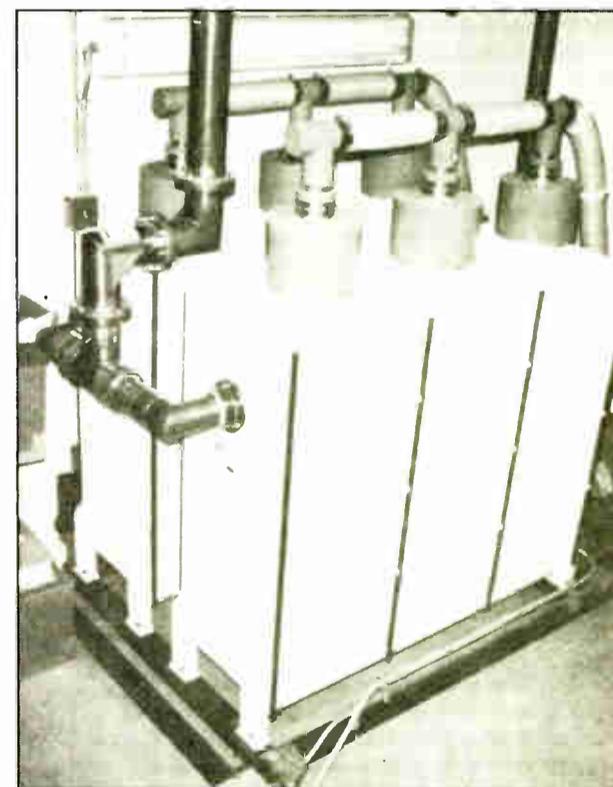
KANSAS CITY, Mo. During the frantic times leading up to the deadline for FCC docket 80-90, we were able to move KUDL-FM's transmitting facility to a taller tower, thereby securing our Class C status.

At that time we installed a Shively antenna and used the company's 4 1/16-inch rigid transmission line (over-kill for 32 kW TPO). The thought was that someday we just might end up diplexing with another station. A year later, that's exactly what happened. We were approached by KCFX, who at the time had a marginal signal over the Kansas City metro area. It had just signed on to carry Kansas City Chiefs' football and needed to improve coverage.

Once the details of our agreement were completed, it was time to choose the equipment. Since we were already using a Shively six-bay 6810, it was natural for us to go back to Shively for the entire diplexing system. Once we delved into the specifics, we realized the antenna would have to be replaced with one that could handle more power and was broadbanded enough for two FM stations 3 MHz apart. Shively's 6814 was the logical choice.

Pattern study

There is another station with a Shively 6810 on the tower, which has two radiators interleaved with two of ours. This made it extremely important that a pattern study be done to ensure the existing coverages weren't changed by the replacement of our antenna. A trip to Bridgton, Maine, was made and the Shively miniature scaled test range worked accurately to find the proper mounting configuration.



Shively manufactured KUDL/WHB Radio's combiner, part of the station's six-bay antenna set-up.

After we went on the air, we found that the "real world" pattern reflected the accuracy of the model range work done. The investment of the trip was well worth it and was actually encouraged by Shively.

The other major part of a diplexed system is a combiner. The Shively branched combiner really is a work of art. The most impressive thing about its physical appearance is the small footprint. Imagine receiving a combiner completely assembled, ready to plug in. That's just how it came. It only takes up about a 6'x4' area on the floor.

continued on page 46 ►

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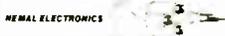
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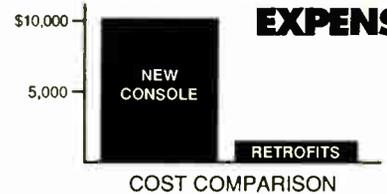
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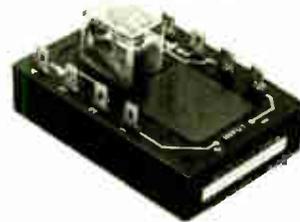
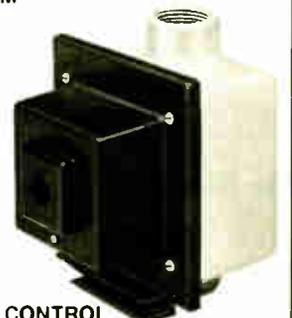


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TECHNOLOGY UPDATE

Jampro Prolow Series Offers Low-Power Antenna Options

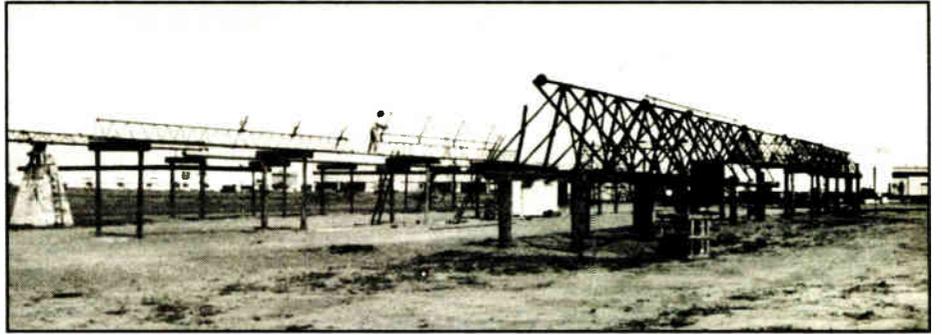
by Al Jason
FM Sales
Jampro Antennas Inc.

SACRAMENTO, Calif. Jampro Antennas has been manufacturing quality antennas for both FM and television stations for more than 30 years. Now that expertise is being used to develop an entire new line of low-power antennas—the “Prolow” series of broadcast antennas.

JLST-FM is designed as an omni-

directional low-power translator/booster antenna. The JLST is circularly-polarized and designed for a maximum of 500 W input. Its simple two-bay design allows the user to stack an additional two bays with an optional stacking harness, giving variable amounts of gain for the translator site.

The JLHP-FM antenna was designed for FM translators and boosters that require only horizontal polarization. Much the same as the JLST, the JLHP horizontal an-



Jampro Antennas' factory tuning field

tenna will handle a maximum of 500 W. It is available in two-bay arrays with optional stacking harnesses for additional gain.

JYA-FM/TV antennas answer years of requests from our customers for a complete line of yagi antennas. They are available in H-Pol, V-Pol and Circular for FM, UHF and VHF frequencies.

Radomes also are available for the JYA antennas so that the performance of the antenna is unaffected by ice and snow. The JYA is available in all standard configurations, and custom options are available.

The “Prolow” series of antennas is now available from Jampro, and all of Jampro's authorized dealers throughout the world.

As the requirements of the industry change and grow, so do Jampro's designs and products. It is due to this growth that Jampro Antennas has seen the need for a change. In an effort to become more efficient, Jampro Antennas has moved its manufacturing facility into a custom-designed plant in Sacramento, Calif.

The new facility was designed to increase productivity, thus ensuring quicker delivery and more cost-effective manufacturing. Full array assembly and factory tuning is done behind the plant with permanently mounted tuning towers ranging from 12 feet face down to six-inch poles.

All data is then transmitted to a central building located in the middle of the tuning field and transmitted directly to engineering via the computer. This allows Jampro to factory tune every antenna to a minimal VSWR and maximum bandwidth before it is shipped.

For more information, contact Al Jason at Jampro Antennas Inc. at 916-383-1177; fax: 916-383-1182; or circle Reader Service 154.

KUDL Goes With Shively

► continued from page 44

The antenna's combiner has six cavities that are just a little bigger in size than “banker's boxes” on end. There are three of these filters for each input. The outputs of each set are impedance matched and combined at a common 4 1/16-inch junction.

Blower system

Due to the small size of this system, it can't naturally dissipate its heat as larger combiners do. The way Shively handles this is to use a blower system that feeds air down a duct and rail to the three cavities. The outside of the combiner is warm to the touch and ours has been running without a single problem for close to two years.

The fan blowers (one per channel) are not that big in size. They are much smaller in size than a blower used in a large transmitter. Their blowers have a paddle-style interlock switch that can be used to protect against overheating. We have it set up so that it drops our transmitter power to 10 kW and immediately alarms our remote control in case of a combiner blower failure.

The actual specs on their boxes are impressive. Along with the transmission line and antenna, I feel that the Shively combiner's performance proves we made the right decision. It truly was a “Plug 'n' Go” install. Low maintenance and transparent operation are just two of the many benefits in using a Shively System.

For information on Shively Antennas, contact Jonathan Clark at 207-647-3327; fax: 207-647-8273; or circle Reader Service 43.



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USER REPORT

Belden Offers Two New Wire Options

by Mark Persons
M.W. Persons and Associates

BRainerd, Minn. For many years, Belden 8451 shielded pair wire has been a standard in the industry for radio broadcast studios.

Now Belden has introduced a new cable with the "brilliance" trademark. I asked for samples recently and immediately started comparing. The Belden 1503A literature says its miniature size occupies one-half to one-third less space than standard cables.

However, if you compare it to 8451, it is 1/100th of an inch larger. Personally, I couldn't see any size difference. More importantly, the new cable retains the same smooth outer jacket texture that al-

lows it to be pulled easily through conduits and around corners. Other brands of cable have a "ribbed" outer appearance from the shape of the twisted pair inside. This makes it more difficult to install and to write on with a felt tip pen, as is my habit.

Foil shield

Both cables have a 100 percent foil shield and both have 22-gauge 7x30 tinned insulated copper twisted pair conductors. The new cable uses a 24-gauge drain wire instead of staying with the same 22-gauge size of the twisted pair. This smaller drain wire should not be a problem in most instances, especially if it is not connected at both ends of the cable run.

Stripping the cable and removing the foil shield seemed easier with this new cable. Soldering to the new cable also is better, with less shrinkback of the insulation on each conductor.

The Belden specifications show 56 percent more capacitance conductor-to-conductor per foot and 64 percent more capacitance conductor-to-shield. For audio work around the studio, this should not be a problem. It could, however, be a factor in high frequency rolloff on long runs.

Honestly, I did not find a lot of difference between the traditional Belden 8451 single pair shielded cable and the new Belden 1503A cable. If you like colors, you might prefer the new cable. 8451 comes with only a gray or black outer jacket. The new 1503A comes in black, red, green, yellow or blue, but not gray.

Interestingly, the new cable comes in 1,000-foot and 2,000-foot putups in unreel boxes only. You cannot buy it in 100-foot, 250-foot and 500-foot rolls, as in the past. List price of the new Belden 1503A cable is \$128 per 1,000 feet. The 8351 has a current list of \$159 per 1,000 feet.

Stereo shielded pair

Belden also has introduced a new stereo (two-pair) shielded pair that is definitely a change and improvement. Out of the same Brilliance series, the product number is 1504A. Let's compare it to Belden 8723, which has been an industry standard for a long time.

First, 8723 is really two Belden 8451 cables with a single outer PVC jacket. Colors for one pair are red-black and the other are white-green. There is a single drainwire.

The new Belden 1504A cable is actually two shielded pairs, each in its own PVC jacket joined like I20 VAC zipcord. It also has the outer appearance of many consumer stereo audio cables that you see connecting CD players and cassette decks to stereo speaker amplifiers.

The exciting part here is that stereo audio runs to balanced or unbalanced audio equipment can be made with a single run of this cable. Once at the desired location, the two shielded pairs can be easily sepa-

rated by pulling them apart for several inches and then terminating each shielded pair individually. To keep them from pulling apart further, I recommend a tie wrap at the point where the unseparated meets the separated.

Each shielded pair has the same outside diameter as the previously mentioned Belden 1503A. Again, I could not tell the difference between a piece of Belden 8451 and each shielded pair of this new cable. Of course, the two-pair shielded is twice as wide, being that the pairs are joined like siamese twins. The jackets are smooth for easy pulling and one jacket has a blue lengthwise stripe to differentiate one pair from the other. Both pairs have the traditional red and black colors.

What also sets this cable apart from the others is the configuration of the
continued on page 52 ▶

TECHNOLOGY UPDATE

Advantages of Folded Unipole Solve Engineering Dilemmas

by Ron Nott
President
Nott Ltd.

FARMINGTON, N.M. Now that the AM rules have been rewritten, AM radio stands on the threshold of many new responsibilities. The field of antenna engineering is no longer restricted.

Low profile antennas, with their inherent economies, can now come into their own.

The folded unipole has several features that make it a natural for new antenna applications. First, short antennas usually have a low radiation resistance, making them inefficient, but the folded unipole has the capacity to transform the low resistance upward to a value often near 50 ohms to greatly improve the antenna system efficiency. The multiple conductors of the unipole make it look like it has a large diameter, which improves the bandwidth over the typical small antenna.

The folded unipole is inherently stable with varying environmental conditions. As an example, when KINY in Juneau, Alaska, installed a new solid state 5 kW transmitter, its engineers realized that the station's self-supporting antenna located in the tidewater area changed impedance drastically with variations in the tide level.

Converting the series-fed antenna to a folded unipole diminished the impedance swings to a very small value that the transmitter would easily accept. Salt water makes a wonderful ground plane, but when it shifts up and down some 20 feet, the antenna reflects it to the transmitter.

The tapered steel pole, in conjunction with the folded unipole, occupies very little real estate. The pole needs no guys, so it looks like one of the poles that we see at freeway intersections.

In one instance, where real estate for a conventional radial ground system is just not available, we are looking into utilizing a 40-foot electrolytic ground rod. The ground loss resistance will be more than with a radial system, but the radiation resistance of the unipole can be transformed up to a larger volume, which would result in a good ratio of radiation resistance to loss resistance, mak-

ing an efficient antenna of one that otherwise would not be acceptable.

Top loading of short antennas utilizing the folded unipole works very well. When the guyed tower of WVWI in the Virgin Islands was blown down by Hurricane Hugo, the island had eroded so badly that no room was available for guys. A self-supporting tower was built, which incorporated a folded unipole and a capacity top hat. Even though electrically short, the antenna far outperforms the original series fed tower.

It performs so well that WGod built a virtual duplicate of it when the station installed its AM station.

At Nott Ltd., we are ready to work with you in your special antenna or detuning needs. Every antenna system is custom designed and fabricated to suit the specifics of the station, so we're ready to do pioneering in antennas.

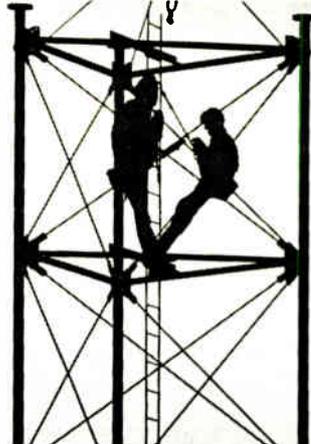
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For information on Nott antenna systems, contact Ronn Nott at 505-327-5646; fax: 505-325-1142; or circle Reader Service 169.



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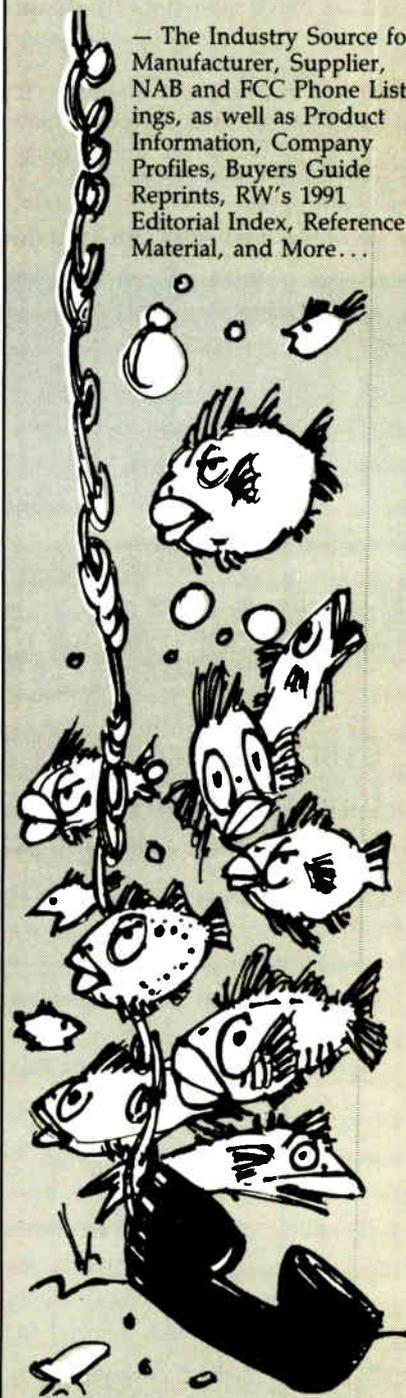
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USER REPORT

KFRC Opts for ERI Half-Wave FM Antenna

by Phil Lerza, CE
KFRC Radio

SAN FRANCISCO With the number of choices available in a world comprised of extreme competition and government regulation, choosing an FM broadcast antenna can be a real challenge.

When KFRC in San Francisco was searching for the right antenna for our particular application, we considered the half-wavelength spaced antenna. We ended up choosing an Electronics Research Inc. (ERI) Model 6AC-SP.

Although half-wave antennas are nothing new in the world of antenna design, the concept seems to be garnering some interest and notoriety in our field. They are a variation of the well-known full-wavelength spaced array and are available in various configurations and power levels.

Unpredictable variations

KFRC's antenna is a six-element, half-wave spaced high-power array, mounted on a three-section tower assembly. Our existing four-bay full wave ERI antenna was placed into service approximately 11 years ago. Although it has provided reliable service, the original installation was side mounted on a three-leg self-supporting tapered tower. At the 110 foot level, the tower face is about 10 feet wide. This arrangement generates unpredictable variations in signal penetration.

It is becoming a well-publicized fact that

antennas do not exhibit a non-directional pattern when mounted on broad tower sections. In our new installation, we wanted to address this issue. The top of our 137-foot tower originally supported a UHF-TV broadcast antenna that was relocated a couple of years ago. The vacated space provided us with a natural platform to extend the overall length of the tower, enabling us to raise the antenna height.

With the complexity of purchasing an antenna and also facing a structural modification to the existing tower, we decided to use ERI for two reasons. The company not only had an excellent track record with high power antennas—ours included—but it was able to offer services in the structural engineering area.

This convenient marriage was not only appealing, but in the end worked out to be a good arrangement for KFRC. Design criteria and specifications on the existing tower were obtained and furnished to ERI. From there, the additional three-piece tower section was designed.

A four-foot base transition section provided an interface to the existing bolt holes on the top of our self-supporting tower. From there, two additional 20-foot sections were employed for a total of 44 feet from the original tower top plate.

Ready to install

The antenna purchased from Continental Electronics was obtained under separate cover, manufactured at ERI and shipped to

our transmitter site. The additional tower sections came directly from ERI. When the riggers arrived on a Monday, all of the pieces, including the transmission line, were ready for installation.

The project, slated to take between five to seven days to complete, went virtually without a hitch.

Due to the extremely broad bandwidth that half-wave spaced antennas exhibit, we were concerned with potential cross products from other FM stations located nearby. San Bruno Mountain, because of its desirable location and height, supports several other stations' transmitter facilities.

The first bit of good news came when we switched to the antenna at 10 percent power and didn't see any obvious problems. As we approached a value close to our licensed power level, VSWR was so low that at first we questioned the meter. The threat of cross products diminished when we were able to finally read reflected power at 7 W. Our TPO will be 22.5 kW for a total ERP of 40 kW. Cross product energy and spurious emissions measured on the spectrum analyzer were well below 85 dB.

The antenna seems to be living up to its expectations. Initial field measurements in many areas were improved.

Signal symmetry

What we were really looking for, however, was not only an improvement in coverage, but an improvement in signal symmetry through a reduced order of multipath—especially in the downtown San Francisco area. As a result of our efforts, KFRC is exhibiting a cleaner sound with respect to multipath. Additionally, we are penetrating areas further out, most likely due to the increased height above average terrain authorized in the construction permit.

Also, the half-wave configuration in even number element arrays tends to increase the energy in our 1 mV contour, filling in previously troubled areas. The elevated level on the tower is seemingly manifesting an overall improvement.

Another advantage derived from the half-wave antenna spacing is in the area of human exposure to RF fields. We all are being made aware of our responsibilities both morally and legally with respect to RF radiation. The phase difference between the elements of a half-wave configuration produces a reduction in downward radiation levels, which drastically diminishes RF levels at the base of the support structure or tower.

For information on ERI, contact Dave Davies at 812-853-3318; fax: 812-858-5706; or circle Reader Service 99.

TECHNOLOGY UPDATE

The HI-3701 Monitors RF

by Dave Baron, PE
Holaday Industries

EDEN PRAIRIE, Minn. Holaday Industries recently developed the model HI-3701 Induced Body Current meter, which measures the current induced in the human body and flowing through the legs and feet to ground when exposed to radiofre-



Holaday Industries HI-3701

quency (RF) electromagnetic fields.

Research has indicated that free-field RF measurements in the frequency range below 100 MHz do not necessarily predict possible worst-case energy absorption or exposure.

Operation of the HI-3701 is simple: Place the instrument on the floor or ground in the operator's normal location and have that person stand on the meter. The induced current is read directly as RF fields are applied.

A recorder output is available for input to a chart recorder or data logger. An optional fiber optically-coupled remote readout allows for remote monitoring of current levels without affecting the applied fields. The fiber optic link also can connect through a serial data link to a PC.

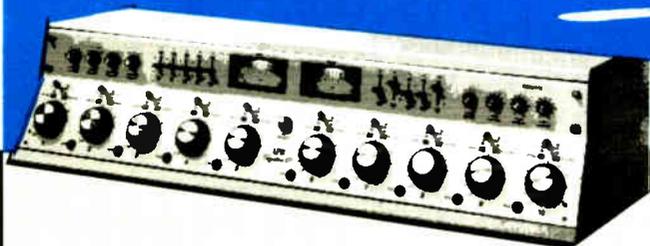
Body current measurements do not replace the need to monitor electric and magnetic fields around RF generating devices. These measurements provide additional information on exposure to possible hazards.

Holaday Industries has provided electromagnetic field measuring instruments to the health and safety professional for more than 25 years.

□□□

For information, contact Dave Baron at Holaday Industries at 612-934-4920; fax: 612-934-3604; or circle Reader Service 74.

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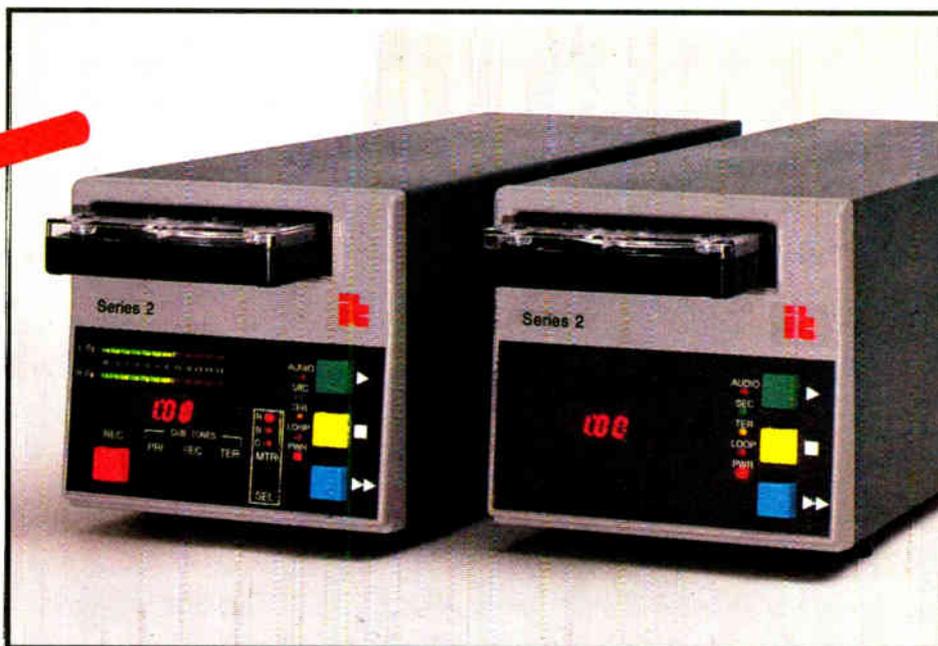
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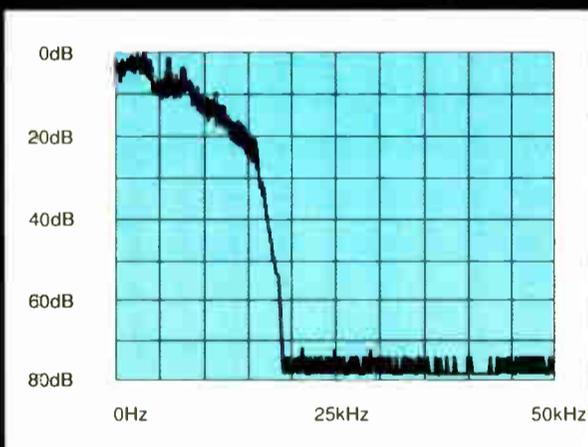
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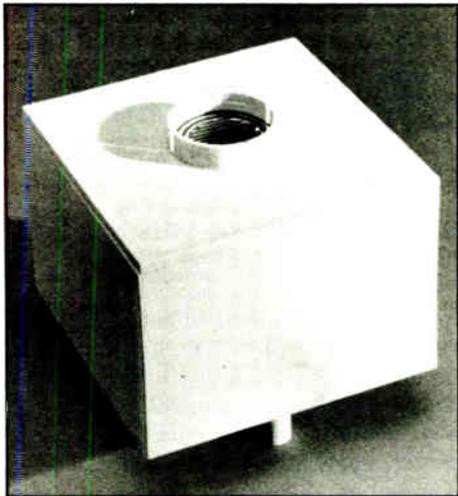
Power spectral density at the 4000's output using "maximum peak hold" measurement. (10kHz/div. horizontal; 10dB/div. vertical)

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BUYERS BRIEFS



SOUTH BEND, Ind. Environmental Technology Inc. has developed the low-cost LCD-3S Snow Control for automatic antenna de-icing heater control. This patent-pending product reduces power costs when compared to thermostat or manual control.

The LCD-3S operates de-icing heaters during snow, sleet or freezing rain at temperatures between 18 and 38 degrees Fahrenheit and for one hour thereafter. Continuing heater operation melts any residual snow and ice.

The 18-degree limit prevents heater operation at temperatures too low for effective de-icing. The LCD-3S regulates heater power based upon temperature for added efficiency. Other LCD-3S features include power-on self-test, foolproof override switch and power foldback at temperatures above 44 degrees Fahrenheit for safe heater testing.

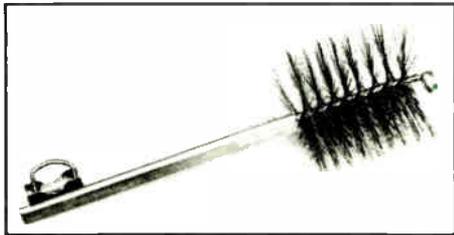
The LCD-3S directly controls heaters for up to 1.8 meter antennas. Supply options accommodate domestic and foreign power sources. The LCD-3S also employs a white UV-stabilized housing.

For information, contact John Petty at Environmental Technology at 219-233-1202; fax: 219-233-2152; or circle Reader Service 30.

FORT WORTH, Texas FWT (Fort Worth Towers) has designed custom communications products for more than 30 years, growing and changing with the demands of a changing marketplace. The company manufactures towers, communications buildings and power systems for numerous applications throughout the communications industry.

Tower offerings include guyed towers, engineered with either all-welded or bolted construction; and self-supporting towers, for use in heavy or moderate loading conditions and heights up to 1,000 feet.

For information, contact Roy Moore, FWT vice president, at 817-457-3060; fax: 817-429-6010; or circle Reader Service 82.



CEDAR, Mich. Electron Processing offers the Lightning Reducer model LRU-1, which prevents the buildup of high cloud to tower voltages responsible for lightning strikes.

Static charges are discharged into the air via hundreds of pointed discharge spikes on the LRU-1 before they can build up enough voltage to produce lightning.

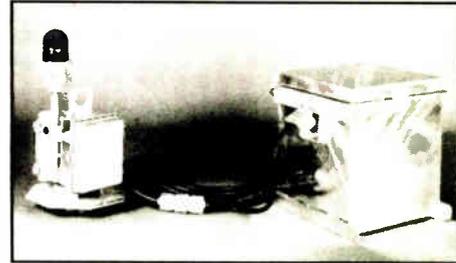
Each unit consists of a six-inch diameter discharge head mounted on a 12-inch long bracket with a U-bolt for mounting on masts (or tower legs) up to two inches in diameter.

For information, contact John Martin at Electron Processing at 616-228-7020; or circle Reader Service 144.

SIMI VALLEY, Calif. Two new temporary obstruction lights are available from Hughey & Phillips, Inc.

The Model OB-30 features an FAA L-810 steady burn obstruction light with controls, lifting eye and mounting plate; 200 feet of 10/2 cable with twist connectors and weatherproof boots; a 24 VDC, 90 Ah battery bank with sealed, low-maintenance batteries and an automatic three-stage charger connected to a permanent 110 male outlet with weatherproof cover. Batteries can power the Model OB-30 for approximately 30 hours per charge.

The Model OB-28 features a non-FAA flashing Xenon strobe with power supply; lifting eye and mounting plate; and the same cable and battery bank accessories as above. Batteries can power the Model OB-28 light for approximately 200



hours per charge.

For technical and applications information, contact Diane Hardy at Hughey & Phillips Inc.: 805-581-5591; fax: 805-581-5032; or circle Reader Service 179.

FARMINGTON, N.M. The Stati-Cat Lightning Prevention System from Cortana Corp. works through the principle of charge dissipation, providing a continuous low-resistance discharge path for the static electric charge found on all tall structures. The Stati-Cat system reduces the high voltage gradient between cloud and tower that eventually leads to the sudden, massive discharge known as lightning.

The Stati-Cat System has been on the market for nearly 10 years, and has proven to be reliable, affordable and rugged. The materials used are approved for corrosive atmospheres.

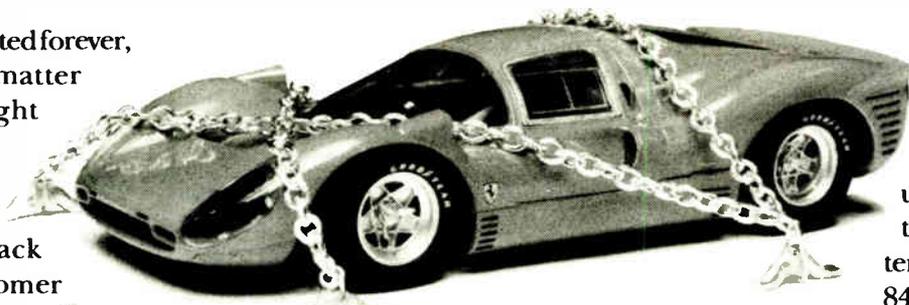
Cortana Corp. will design a system for your installation, at no cost or obligation.

For information on the Stati-Cat system, contact David Stockmar at Cortana Corp.: 505-325-5336; fax: 505-326-2337; or circle Reader Service 35.

What happens when you buy a "high performance" product from a low performance company?

If electronics lasted forever, it wouldn't matter where you bought your next exciter, amplifier, STL, translator or transmitter. Track records of customer frustration would be of no concern as you simply chose the box which suited you.

Since failures not only occur, they usually take place at the worst possible time, it's a good idea to go into the purchase knowing exactly what the manufacturer will do if you need help. Will they handle your need themselves? Will they take action? Will they follow up to see if you're okay?



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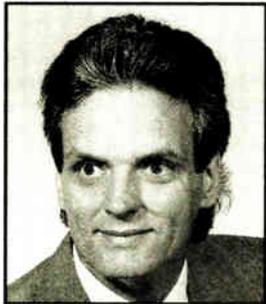
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TECHNOLOGY UPDATE

The Right Cable Choice Saves Money for Stations

by **Robert Leonard**
Product Manager,
HELIAX Products
Andrew Corp.

ORLAND PARK, Ill. Class B1, Class B and Class C2 FM stations customarily have been designed using 3 1/8-inch rigid line or three-inch coaxial cable for transmission line.

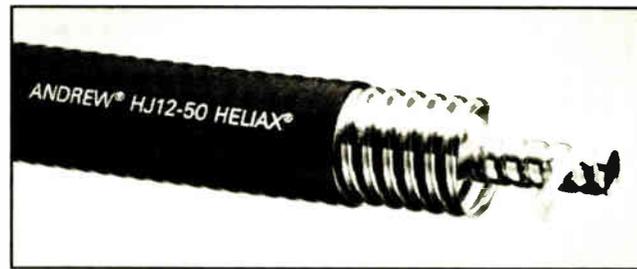
Certainly, three-inch line or cable has resulted in good service over the years. But, depending on the specific application, continued specification of three-inch cable may be real design overkill, potentially wasting thousands of dollars that could be put to

rating for 2 1/4-inch cable.

The average power rating for 2 1/4-inch HELIAX cable at 100 MHz is 20.6 kW (21.9 kW at 88 MHz and 19.7 kW at 108 MHz). Of course, this needs to be derated for the VSWR of the FM antenna, which can range from 1.1 to as high as 1.5 (based on derating factors found in the Andrew Corp. catalog No. 35, page 423). Even with a 1.5 VSWR FM antenna, the average power rating at 100 MHz is 17.5 kW—a comfortable margin.

Class B or C2 stations

For Class B or C2 stations, however, selection of cable for transmission line is less clear cut. A station using five antenna bays at 85.6 percent transmission line efficiency requires transmitter output power of 21.5 kW—too much for 2 1/4-inch cable. With six antenna bays, 17.7 kW is required at 85.7 percent efficiency and 18.3 kW at 83.0 percent efficiency.



Andrew Corp.'s 2-1/2" HJ12-50 HELIAX coaxial cable

better use in the control room.

The introduction of 2 1/4-inch HELIAX coaxial cable with 3 1/8-inch flanges makes these savings possible. At 100 MHz, it is rated for 20.6 kW average power, compared to 37.0 kW for three-inch HELIAX cable. This is ideal for Class B1 applications, and sufficient for all Class B and C2 configurations with seven or more antenna bays. Yet, 2 1/4-inch cable costs more than 20 percent less than three-inch cable.

Standby transmitter run

Ron Turner, CE at WTMX 102 FM Skokie, Ill., needed a 150-foot run of transmission line to power a 10 kW standby transmitter. He decided that three-inch HELIAX cable would be wasteful—he did not need the power handling capacity. For WTMX, broadcasting at 101.9 MHz (Channel 270), HJ8-50B HELIAX cable has an average power rating of 36.6 kW, exceeding what would ever be needed.

On the other hand, 1 5/8-inch cable seemed to be undersized.

While it would work for now (average power for channel 270 at 1.0 VSWR is 14.3 kW), it provided an insufficient margin in the event WTMX received approval to increase power in the future.

Ron concluded that 2 1/4-inch cable offered the most cost-effective solution. The added loss posed no problem; for WTMX, it was only 0.044 dB total (VSWR 1.0). Margin was available for the future, since the average power rating was 19.9 kW. Yet Ron was able to purchase 2 1/4-inch cable from Harris Allied for about \$900 less than three-inch cable.

Let's take a look at the details. For Class B1 stations, maximum effective radiated power is 25 kW. With a typical manufacturer's most commonly requested antenna/transmitter combinations, the required transmitter power output for 88 percent transmission line efficiency—the worst case for 2 1/4-inch HELIAX cable—does not exceed 13.3 kW, regardless of the number of antenna bays. This is well within the

If the VSWR of the antenna is 1.1, 2 1/4-inch cable is acceptable, but for higher VSWRs, it is marginal at best. Stations with seven or more antenna bays should experience satisfactory performance at any frequency or antenna VSWR condition likely to be encountered.

These average power ratings are specified for an ambient temperature of 104 degrees Fahrenheit (40 degrees Centigrade).

□□□

For information on Andrew products, contact the Andrew Customer Support Center at 1-800-255-1479; fax: 708-349-5444; or circle Reader Service 48.

Belden Offers Cable Options

► continued from page 47

conductors. They are 19×34. That's right, 19 strands of tinned copper wire in each conductor to help keep the cable flexible and improve reliability when flexing occurs. This cable takes solder well with a minimum of insulation shrinkback.

One part that I really like about this cable is the way Belden bonded the foil shield to the outer jacket. This means the foil is removed automatically when the jacket is tripped off. This in itself is a huge time saver.

Conductor-to-conductor capacitance and conductor-to-shield capacitance is higher than with Belden 8451 or 8723 and is similar to the 1503A. Putups are in 1,000-foot and 2,000-foot unreel lengths only. List price is \$286 per 1,000 feet, as compared to \$243 for Belden 8723 two-pair shielded cable.

I plan on buying and installing some of this new cable soon. It looks like a good step into the future.

□□□

For information, contact Bill Hayes at Belden Wire & Cable at 317-983-5200; or circle Reader Service 90.

Broadcast Equipment Exchange

"Broadcast Equipment Exchange" accepts no responsibility for the condition of the equipment listed or for the specifics of transactions made between buyers and sellers.

AMPLIFIERS

Want to Sell

BE EP-1 phono preamp, clean, \$75. B Glenn, KOTY, 830 N Col Ctr Blvd, Kennewick WA 99338. 509-783-0783.

Ampex (2) R/P. D Morgan, KNZZ, Box 969, Grand Junction CO 81501. 303-241-9230.

Mac tube, MC275, 75/75, 60, 240, C-22; Marantz 7C, 9S, 1S #2. Yun, Sleeping Beauty, 1129 S Robertson Blvd, Los Angeles CA 90035. 310-274-1921.

Crown Microtech 1000 (4), will reduce price for purchase of all, excel cond, \$590 ea. G Fern, Best Audio, POB 2366, Van Nuys CA 91404. 818-763-2378.

WE FM pwr, 80 W, 88-108 MHz w/pwr supply, \$250. J Cunningham, KEOR, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

Audiometrics (2) dist amps, \$160 ea. R Dees, KARX, 3507-A Van Tassel, Amarillo TX 79121. 806-355-4554.

Ward (6) modules & pwr supply in cage. D Morgan, KNZZ, Box 969, Grand Junction CO 81501. 303-241-9230.

Amplidyne (2) controls, \$50 ea; Gates M6108, monitor, \$50; Macintosh 30 W; ADC Sound-shaper 1 EQ, \$75, all in gd cond. B Williamson, 914-858-2941.

Crown Micro Tech 1200 stereo, 320 Wch 8 ohms, 495 Wch 4 ohms, 1315 W mono 4 ohms, new, 3 yr xfer warranty. B Fisher, KPCK, Box 829, Bowman ND 58623. 701-523-3883.

Viking RP10-22 (2) tape head preamp to 600 ohm bal line, solid state, like new, \$35 ea. E Davison, 217-787-0800.

Crutchfield CR2x30 car stereo amp, 30 W/chnl, excel cond, \$50; Shure M-64 line amp w/tape, line/phono EQ switch, \$40. R Hardy, Richardy Prods, 3239 S 90th E Ave, Tulsa OK 74145. 918-627-2937.

RCA, Altec tube mic pre's & tube amps & mixers; Langlevin AM-16's, sale or trade. Tracy Eaves, 615-821-6099 (evenings before 10PM EST).

Want to Buy

Rane, Furman, other headphone amp for rcdg studio application. W Dougherty, WLD Rcdg, Music Valley Rte 1, Mill Spring MO 63952. 314-998-2377.

ANTENNAS & TOWERS

Want to Sell

ERI G5CPS-8 on ground Santa Fe NM, 955 FM, BO, J Curtis, KFRO, POB 4299, Longview TX 75606. 903-663-3700.

Potomac AMM-19-D 6-tower dig monitor, excel cond, \$2500. M Turner, WYIC, 7641 Camberwood Dr, Indianapolis IN 46268. 317-872-3004.

ERI 425 isocoupler, tuned to 95-105 MHz, 3800'; D Kiker, WTKX, 8084 N Davis #138, Pensacola FL 32514. 904-478-6011.

ERI single-bay, rototiller type, tuned to 104.9, \$1000/BO. E Coffman, KEZU, 7007 Riviera Dr, Ft Smith AR 72903. 501-782-0361.

RCA MI-27791D-1A 20' lengths, 3" universal 50 ohm trans line, excel cond w/accessories, 9" also avail, \$250 per length/BO. N Jeweller, US Tower Svcs, 5263 Agro Dr, Frederick MD 21701. 301-874-5885.

Dielectric DCVS-6B FM w/radomes, 9 yrs old, BO. R Cleveland, Radio One Ltd, 206 Rockwood Ave, Fredericton, NB, E3B 2M2, Canada.

Nems Clarke phase monitor, analog for 4-tower amateur array on 3.5 MHz, K Ericson, Cellular One, 1001 16th St, Denver CO 80265. 303-573-3261.

Large collection of AM phasing capacitors & inductors, great prices. T McGinley, WPGC, 6301 Ivy Lane, Greenbelt MD 20770. 301-441-3500.

dbx F900-A player w/(3) 902 de-essers, para-EQ & (3) 904 noise gates, \$2000; (2) dbx-160x comp/limiters, \$225 ea; Symetrix 525-dual gates comp/limiter, 7 mos old, \$250; Aphex type B aural exciter, \$200. D Crepps, IBS, 225 W Lockerman St, Dover DE 19901. 302-678-4420.

Belar Audio Sentry Silence Sense, \$275; Burwin 1201A proc, \$150; (2) EV Sentry 1A spkrs, \$300 ea; Mod Sci Stereo Maxx enhancer, \$1800; Orban 111 reber, \$500; Ramko DA 1658R/E dist amp, \$150. B Williamson, 914-858-2941.

Urban 622B parametric eq, rack mount, stereo, excel cond, \$850/BO. F Morton, KMGZ, POB 7953, Lawton OK 73506. 405-536-9530.

dbx 224x type II noise reduc unit, rack mount, new, \$105. B Dombrowski, WhirlWind Prods, 10356 W Warren Ave, Dearborn MI 48126. 313-584-4038.

Ampex 1000 one master maker, 10-chnl. E Kazmark, KAZZ, POB 1369, Deer Park WA 99006. 509-276-8816.

Want to Buy

Sports headset gd cond, prefer Sennheiser. Telex. Budd, 413-783-4626.

AUTOMATION EQUIP

Want to Sell

MW Persons 3-A prog w/unltd sequential rotation of up to 4 sources & manual; Microprobe Elect 24-station 8-source auto controller, nds repair/spare parts w/remote control switch pad, \$100. R Chambers, KSUE, 3015 Johnstonville Rd, Susanville CA 96130. 916-257-2121.

Schafer 903E 4 racks, 4 Carousels, brain, cart PB unit, 200 Audiopak A-2 carts, gd cond when removed from svc, spare parts, extra heads, \$3200. K Brown, KTRZ, Box 808, Riverton WY 82501. 307-856-2922.

Schafer 903 (7) 24-tray Carousels, IO cards, cables, racks. D Widmer, KTEL, 112 NE 5th, Milton-Freewater OR 97862. 503-938-6688.

Schafer 800 auto controller w/25 Hz detector in rack, \$300. E Stanley, KBTO, Box 12, Bottineau ND 58318. 701-228-2483.

Harris SC-90 (4) 42-tray Go-Carts, (1) 72-tray Go-Cart, (1) 12-tray mono Instacart, (4) Scully 270, stereo, all in excel cond. R Fess, WLRR, 119 W Carroll St, Macomb IL 61456. 309-833-5561.

SMC ESP-1 '82 w/DS-20A switcher, PDC-5 clock, (3) 350 Carousel, works terrific, \$5500; SMC DP-2 w/DS-20 switcher, PDC-5 clock, (2) 350 RSB Carousels, (2) SMC racks, works great. B Christie, Grande Radio, POB 907, LaGrande OR 97850. 503-963-4121.

SMC RP1000 prog w/PDC-3 clock, pwr supplies & DS-20 switcher, \$300. E Stanley, KBTO, Box 12, Bottineau ND 58318. 701-228-2483.

SMC (3) cabinets, (3) #350 circ Carousels, (4) 750-series R-R decks, (1) LT-5 Brån, \$5000. T Steel, WMRX, POB 1513, Midland MI 48640. 517-631-1490.

Format Sentry FS 12C w/UPS system, Tandy 1000 TL/3 computer, CM-5 color monitor, both w/2 yr warranty, 6 mos old, \$3500; (3) IGM 504D dual 25 Hz detectors, excel cond \$125 ea/\$300 both; Conex 25G Tone Gener, 2 mos usage, mint, \$250. Pegi, Global American, 1768 Coral Way N, Vero Bch FL 32963. 407-231-4800.

Insta-Cart 48-tray w/Sentry interface, recently recond w/manual, \$2600/trade. Ron, KPIK, 108 Dewitt Henry Dr, Beebe AR 72012. 501-882-3331.

Schafer 7000 control unit w/Audiophile source cards in racks, \$3000; IGM Instacart (2) 48-tray mono units in rack, \$2000 ea/\$3500 both. F Burke, WKRM, POB 308, Bath ME 04530. 207-443-6871.

SMC TG-25 tone gener w/manual, \$30. J Feasel, W64BG, 13549 Morse Rd, Pataskala OH 43062. 614-927-2592.

Cetec 7000 w/4 ITC R-R, (9) Audiophiles, (2) Beehive terminals, all options, gd working cond. C McCarthy, 916-244-9700.

Sonomag TS-25 (2) 25 Hz dual sensors, \$180 ea/\$350 both. B Tidwell, WAFT, POB 338, Valdosta GA 31603. 912-244-5180.

Automated Bdct Control tone gener, \$150; Gates time pulse mod, \$75; Gates ATC logging encoder, \$75; Sonomag 250 (3) cart Carousels, \$200; ATC cart player, parts, \$50. B Williamson, 914-858-2941.

SMC auto control unit: DAS 6/12 dig audio switcher, MSP-12, ch4 programmer, computer mon, BO, P Berger, WNAM, POB 707, Neenah WI 54957. 414-727-2040.

Cetec 7000 w/brain, 3 Audiophiles, 250 & 350 Carousel, Cetec load & dump unit, (4) video monitors, \$5500/BO/trade, you pick up. P Ware, 805-947-3107.

Schafer, old, BO, J West, 406-388-3337.

IGM (2) Go-Carts, 24-tray, 1 42-tray, rack mounted w/Harris interface cards, gd cond, \$1700. G Falus, WZMX, 10 Exec Dr, Farmington CT 06066. 203-677-6700.

Schafer 903 controller w/4 decks in 2 racks, works gd, BO, P Delaney, WOSX, Box 921, Marshfield WI 54449. 507-895-2065.

BUSINESS OPPORTUNITIES

Want to Sell

Systemation Quik Disk computer auto system w/hard drive, R/PB, 2 yrs old, excel cond, \$6000. D Brook, WNLB, POB 602, Rocky Mount VA 24151. 703-483-7011.

CAMERAS (VIDEO)

Want to Sell

Fujinon S10X73 for Sony WV555, BRM-4 1:14/7.3-73mm, never used, \$1000; Sony WV-555 svc manual, \$30; Quick Draw Portabrace case for Panasonic WV-890, never used, \$100. D Christian, Pacific Lutheran, Univ Adm 207, Tacoma WA 98447. 206-535-7265.

Panasonic WV-555 Nighthawk 3-tube Newvicon w/Fujinon zoom lens, 1 batt & chrg & mounting plate for tripod, \$1200/BO. A McPeck, 615-272-4827.

Hitachi FP-50 (2) studio w/Fujinon A10+11 WCU, cable, viewfinder, 200m, focus grip w/control cable & manual, \$3000 ea/BO. Frank, KCEA, POB 2385, Atherton CA 94027. 415-321-6049.

CART MACHINES

Want to Sell

BE 2100 RP mono, excel cond, BO; Tapecaster 700-RP/delay, gd cond, \$300 ea. B Brintzer, WDNC, 1000 Park Forty Plaza Ste 120, Durham NC 27713. 919-361-1051.

ITC delay & rec & PB, mint; (3) Tapecaster 700's, J Phillips, WZOM, 408 1/2 Clinton, Delaware OH 43512. 419-784-1059.

Tapecaster 700, \$150. E Stanley, KBTO, Box 12, Bottineau ND 58318. 701-228-2483.

ITC Series 99 w/ELSA stereo R/P, nds work, BO, J Curtis, KFRO, POB 4299, Longview TX 75606. 903-663-3700.

Abko 300 (2) lazy susan-type storage rack, holds 300. BO, T Webb, WZQK, POB 150, Coeburn VA 24230-0150. 703-395-3997.

ITC 3-D stereo triple-deck R/P w/remote start control box, \$1200. R Reeves, Voice At Large, 5080 Bainbridge Ct, Lilburn GA 30247. 404-925-8868.

Nortronic cart heads premium laminated, dual 1/2-trk, rear/no mount, new, \$20 ea. K Crosthwait, WTNN, 13206 Buttermilk Rd, Knoxville TN 37932. 615-531-2297.

Pacific Recorder Micromax mint cond, stereo, in rack-mountable pairs w/manuals & orig boxes, \$1800 pair/\$5200 for 3 pairs. K Rosato, Sound Bdctg, 303 Webster Ave, New Rochelle NY 10801. 914-235-5939.

ITC 3D mono 3D0003 all cue tones, new heads, bearings & pinch rollers, quiet, clean w/new IB, \$1000. Pegi, Global American, 1768 Coral Way N, Vero Bch FL 32963. 407-231-4800.

Fidelipac CTR-12, (3) PB only, size A cart, 3 cue, desk mount wrack, plug in circuit boards; (1) CTR-14 PB & rec, size A, 3 cue, desk mount, plug in circuit boards; (1) ESD-10 eraser/splice locator; (115) 380-25 40-second carts; (60) 380-44 70-second carts; (10) 380-63 100-second carts; (10) 380-94 2.5-minute carts; (5) 380-207 5.5-minute carts. BO, T Webb, WZQK, POB 150, Coeburn VA 24230-0150. 703-395-3997.

Audicord DL series (2) PB, D Brook, WNLB, POB 602, Rocky Mount VA 24151. 703-483-7011.

Tapecaster 700-RP R/P w/push button release & secondary 150 Hz cue tone gener & detector, new cond, \$595. R Franklin, Franklin Studios, 1004 Dekalb St, Norristown PA 19401. 215-646-7788.

ITC RP mono single-deck, new heads, motor, rack mount, gd cond, \$450. B Fogal, KDBX, 57400 S Morse Rd, Warren OR 97053. 503-397-0337.

ITC Omega mono player, \$800; Premium mono recorder, \$850; WP mono player, \$500. B Williamson, 914-858-2941.

RCA (4), old & rec amp, OK cond, BO; Harris Criterion compact, stereo, BO, R Wells, KSRO, POB 1598, Santa Rosa CA 95402. 707-545-3313.

ITC-SP (3) stereo/1 tone, recently refurbished, \$525 ea/\$1300 all; Dynamax CTR-100 R/P mono, D Crepps, IBS, 225 W Lockerman St, Dover DE 19901. 302-678-4420.

Gates mono recorder, \$75; (2) players, \$75 ea; ATC player, \$750. B Williamson, 914-858-2941.

ATC (2) mono players, \$75 ea; Collins recorder, \$750. B Williamson, 914-858-2941.

Fidelipac CTR 100 Dynamax rec w/tones, splice find erase function, gd shape, stereo. G Brown, WJBM, 1010 Shipman, Jerseyville IL 62052. 618-498-2185.

Telex/Viking NAB mono players, \$50 ea; Sony TC228 8-trk R/P w/16 blank carts, clean & working, \$50. E Davison, 217-787-0800.

ITC RP (2) excel cond, wrack mounts \$15 extra, \$800 ea. F Lauerman, WNAM, POB 609, Mannette WI 54143. 715-735-6631.

Fidelipac 292 (3) & (1) 294 stereo cart w/3 tones & rapid cue, new, trade for 5/6 mono machines of similar value. R Wells, KSRO, POB 1598, Santa Rosa CA 95402. 707-545-3313.

CASSETTE & REEL-TO-REEL RECORDERS

Want to Sell

Otari MX5050BII 10 1/2", \$1195; tiltable floor stand for Otari, \$95; Scotch 8206 1" tape on 10 1/2" NAB metal reels, \$15 ea. G Wachter, FYI, 6312 N 1st Ave, Phoenix AZ 85008. 602-258-6161.

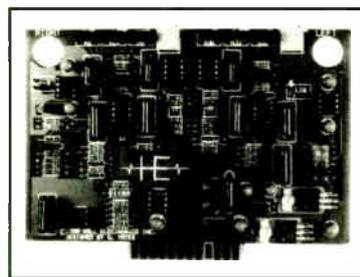
Ampex 440. T Wortmann, WJAG, 309 Braasch Ave, Norfolk NE 68701. 402-371-0780.

Otari 5050B 1/2", 4-trk w/case & remote, very gd cond, \$4250. G Fern, Best Audio, POB 2366, Van Nuys CA 91404. 818-763-2378.

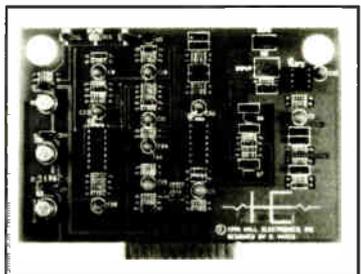
TEAC A2300S, \$175. E Stanley, KBTO, Box 12, Bottineau ND 58318. 701-228-2483.

Ampex 602/601 (4) w/cases, BO; 440 (2), 1 mono, 1 stereo, very gd cond, BO. B Brintzer, WDNC, 1000 Park Forty Plaza Ste 120, Durham NC 27713. 919-361-1051.

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CASSETTES . . . WTS

Telex 6120 high-spd cass duplicator master & 3 slaves, \$2500; Telex/Viking RP110 & RP112 transports & elects, several sets in various conds, \$100 set. Katherine, Linden, 229 N Henry St, Alexandria VA 22314. 703-549-4424.

Scully 2813-8 8-trk 1", 3/4 to 30 ips, made w/VS-76 variable spd, less than 100 hrs use w/manuals, BO over \$4000. T Sherry, Rcdg Cons, 1412 Clarity Ave, San Jose CA 95130. 415-969-3030.

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Nashville, TN. 37203 (615) 244-6892

Otari ARS 1000, 2-chnl, 1/4-trk-1/2-trk w/25 Hz tone sensor & cue tone relays & manuals, very clean, \$875. R Chambers, KSUE, 3015 Johnstonville Rd, Susanville CA 96130. 916-257-2121.

Ampex ATR700 mint cond, \$800; TEAC A3340SX, 4-chnl, 4-trk, new cond, \$800; TEAC 3300SX (2) like new, \$350 ea; Pioneer RT701, like new, new heads, \$300. J Parsons, 2781 Fayson Cir, Deltona FL 32738.

GX77 clean, gd shape, \$250. J Parsons, 2781 Fayson Cir, Deltona FL 32738.

Otari ARS1000 stereo, play, excel cond, \$900/BO; ITC 850 (2), fair cond, BO. B Brinitzer, WDCN, 1000 Park Forty Plaza Ste 120, Durham NC 27713. 919-361-1051.

Dictaphone (2) logger/recorder, slow spd w/manuals. J Phillips, WZOM, 408 1/2 Clinton, Defiance OH 43512. 419-784-1059.

MCI JH110A 1/2", 9 yrs old, 7 1/2, 15, 30 ips, heads in gd cond, analog meters w/manuals, \$2500 inclc s/h. T Sherry, Rcdg Cons, 1412 Clarity Ave, San Jose CA 95130. 415-969-3030.

JVC R431 (7) R/P, bi-directional wired for remote start/stop w/Henry Match Box Interface, 2 mos usage, mint, \$200 ea/\$1200 for 7. Pegi, Global American, 1768 Coral Way N, Vero Bch FL 32963. 407-231-4800.

MCI JH110A (6) 2-trk, most need heads, w/ consoles, many spare parts, \$500; (2) w/roll-around consoles, \$500. T Nelson, WCAL, St Olaf College, Northfield MN 55057. 507-646-3328.

Otari MX 7308 1" 8-trk, 15/30 ips, low hrs, excel cond w/remote, \$3900; Ampex 300/440 motors & parts, \$150 & under; Studer Revox PR99 2-trk, 7 1/2 & 15 ips, low hrs, excel cond, \$1950; Technics 1500RS 2-trk, 15, 7 1/2, & 3 1/4 ips + 1/4-trk PB head w/remote, excel cond, \$950. L Wagner, ARN, POB 1788, Orlando FL 32802. 407-299-1299.

Radio Systems RS-1000 DAT R/P w/updated software, PROM installed, low hrs, excel cond, \$1500. P Temple, Carson Radio, 120 Beechwood Trail, Exeter RI 02822. 401-846-8141.

Otari ARS 1000 stereo reel player, \$750; same nds nubs & pr, \$650; same nds hubs, \$700. B Williamson, 914-858-2941.

Marantz PMD 221 port, 3-head, mono w/AC pwr supply, excel cond, \$200; Ampex ATR-700, 1/4", 2-trk, 3/7.5 ips, rack mount, excel cond w/new 10" reel hubs, \$850. B Fogal, KDBX, 57400 S Morse Rd, Warren OR 97053. 503-397-0337.

ITC R/P Mono Premium Series. . . \$385 EA. . . Good operating condition. . . Warranties and rebuilds available. Mark O'Drobinak, 619-598-3311.

MCI JH-110 2-chnl transport & elect in roll around console, nds work. Bill, WBMJ, 1409 Ponce de Leon #420, San Juan PR 00936. 809-724-1190.

Ampex 350 stereo recorder w/cab, \$400; mono w/cabinet, \$300; 601 portable mono, \$150. B Williamson, 914-858-2941.

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350 N. Eric Drive
Palatine, IL 60067
708-358-4622

Scully 270 (2), fair cond, \$200. FOB. A Crane, Desert RF Eng, 2099 Chip Dr, Lake Havasu AZ 86403. 602-453-3546.

Scully 280 for parts. R Robinson, 203-469-4465.

AKAI 17221I portable stereo, \$175; B & H, \$50; ITC 750 stereo, \$475; Omnilib, \$75; Omnilib (2) 4-trk recorders, \$100 ea; Pioneer RT909, \$200; Revox A77 (2) recorders, 1 stereo, \$250 ea. B Williamson, 914-858-2941.

Tape-A-thon RR (2) bi-directional players, 3.75 ips 1/2-trk, auto rev, port 7" & 10 1/2", 1 rack mount 10 1/2", all working w/spare parts, \$50 ea. E Davison, 217-787-0800.

Otari MX-5050 MKIII-8 1/2" 8-trk recorder, low hrs, \$3000; Soundcraft 200B 16x4x2, very quiet, low hrs, \$1800. C Lallo, PYR, 465 W Anderson St, Hackensack NJ 07601. 201-646-0277.

TEAC 1230, \$175; 7030SL recorder, \$200; X-3 MK II stereo reel, \$150; X300, \$150. B Williamson, 914-858-2941.

Metrotec 400 logger recorder, 4-trk, works. BO. R Wells, KSRO, POB 1598, Santa Rosa CA 95402. 707-545-3313.

Schafer AL330 logging, 10 1/2" 1/6"-1/3"; BO; Tapesonic 70-TRS 10 1/2", rack mount, stereo, BO; Revox A-77 for parts, BO. J West, 406-388-3337.

Akai CR 80D-SS quad 8-trk cart rec. BO/trade for other audio equip; BE Spotmaster 505, mono fair cond, BO/trade. J Roper, Imperial Sound, 383 N Studio St, Terre Haute IN 47803. 812-877-2663.

Sony PCM-F-1 dig proc w/Apogee 944G filters in & out, \$1250; Sony SL-2000 port BETA, \$350. J Vanore, Acoustical Concepts, 708 Ashland, Eddystone PA 19022. 215-328-6772.

Technics RS1500 2-trk; Sony/MCI JH110C on roll around metal cabinet, both excel cond; Dynaflex NR system D2B. J Gelo, 813-642-6899.

Want to Buy
Cash for tube type R/R, Ampex, Roberts, Magnecorders, Reagertones. J Schramm, 205-826-0390.

Otari MX-5050 MKIII-4 in gd physical/elect cond in roll around cabinet. J Glass, WROK, 3901 Brendenwood Rd, Rockford IL 61107. 815-399-2233.

Sony TC-D5M parts. J O'Leary, O'Leary Tech Svcs, 1717 Euclid St NW, Washington DC 20009. 202-332-8377.

Otari 5050 gd cond; Sony ECM 50 mic, \$1000 both/BO. G Macsai, 202-223-0663.

Otari MX 5050 (2), B series preferred. R Wells, KSRO, POB 1598, Santa Rosa CA 95402. 707-545-3313.

Scully '100' recorders, record/play amplifiers, 8, 16, 24 track heads. Sequoia Electronics, 1131 Virginia Ave, Campbell CA 95008. 408-866-8434.

Ampex ATR100 taperecorders for parts. Circuit cards, heads, motors, machine parts, or electronic parts. Call 818-907-5161.

MCI/Sony capstan & reel motors, any cond., recdg heads, most migs, machines, new, used. Relapped then sold. Amp Services, 224 Datura St No 614, W Palm Beach FL 33401. 800-826-0601, in FL 305-859-4805.

CD's

Want to Sell
Denon 950FA (2) players, perfect shape, \$600 ea. V Richardson, WTKT, POB 12890, Lexington KY 40583. 502-863-1580.

Denon DN-950FA (3) player w/desk mount stack shelf; (150) CD carts that hold CDs for DN-950FA player, BO. T Webb WZQK, POB 150, Coeburn VA 24230-0150. 703-395-3997.

Audiometrics AMCDs-1000A (4) jukeboxes, holds 100 CDs, program via RS-232 port, very gd cond, \$2000 ea/BO. R Irwin, KSAC, 1021 2nd St, Sacramento CA 95814. 916-446-2294.

COMPUTERS

Want to Sell
Commodore VIC 20 & peripherals; Heath/Zenith H90 & disk drives. T Wortmann, WJAG, 309 Braasch Ave, Norfolk NE 68701. 402-371-0780.

Comtel CBC 3000 (2) w/pripter & Akai R/PB cass decks, \$2000. S Kozak, 216-871-5897.

Apple 2E w/bdct software, \$500. E Stanley, KBTO, Box 12, Botineau ND 58318.

Wang terminal, CPU, hard drive, ran CBSI w/Control Data printer, works, BO. M Martindale, KVON, 1124 Foster Rd, Napa CA 94558. 707-252-1440.

ALR-SX16 1 meg RAM, 44 meg hard drive, 5/25/35 disk drives, VGA video interface, mon extra, \$695. D Crepps, IBS, 225 W Lookerman St, Dover DE 19901. 302-678-4420.

CONSOLES

Want to Sell

Sony MX16 8 in, 4 out, gd shape; Pyramid PR8800 Echo, 8 in, 2 out w/new Echo in box, \$400. J Parsons, 2781 Fayson Cir, Deltona FL 32738.

Gates Statesman 5-chnl stereo, fair cond, \$450/BO; LPB/RCA 10-chnl stereo, great shape w/clock & timer, 40 inputs & full documentation, remote starts, some spare parts, \$2000/BO. F Morton, KMGZ, POB 7953, Lawton OK 73506. 405-536-9530.

Yamaha PM-2000 24-chnl, pwr supply & road case, excel cond, 2nd pwr supply avail w/manuals; 1516 & 916, both w/cases, excel cond, \$13500 all. G Fern, Best Audio, POB 2366, Van Nuys CA 91404. 818-763-2378.

Shure SE-10 gated mixer-compressor, excel cond, \$150/BO. B Laughlin, L-Pad Elect, 753 Ruth Ln, Hurst TX 76053. 817-282-9033.

Ramko DC5RA 5-chnl board, fair cond. J Phillips, WZOM, 408 1/2 Clinton, Defiance OH 43512. 419-784-1059.

Opamp Labs 20-input, 8 subs+stereo mix out, gd prod board, \$2500. L Wagner, ARN, POB 1788, Orlando FL 32802. 407-299-1299.

Ward Beck R2200 (2) in svc, 1 w/16 mods, 1 w/17 mods, 1 w/dual pwr supply, avail 7/92, gd cond. BO. J Shadle, KMEO, 3719 N 32nd Ave, Phoenix AZ 85017. 602-279-5577.

Harris Dulux 80 8-chnl, gd cond, mono, \$900/BO; BE Spotmaster, 8-chnl, mono, gd cond, \$800/BO. B Brinitzer, WDCN, 1000 Park Forty Plaza Ste 120, Durham NC 27713. 919-361-1051.

Radio Sata Octopus 2408 24-chnl in, line out, 250 W out, 10 W cue, talk back, aux & RF out, subgroup & more, \$22000 inclc s/h. A Branch, KYAY, 2402 Woodridge Dr, Decatur GA 30033. 404-325-7847.

RCA BC-19/A 4-pot stereo board w/ or w/o plug-ins. M Harris, KDOK, POB 1330, Tyler TX 75710. 913-393-1519.

Ramko XL41S 4-chnl, stereo, 16 inputs, 2 yrs old, wired to custom punch block, works fine w/manual & amp. \$800/BO; 11-chnl, mono w/rack mount, I/O amps & pwr supply, no control cable, BO. M Martindale, KVON, 1124 Foster Rd, Napa CA 94558. 707-252-1440.

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Gates Studioette, \$75; Shure M68 mixer, \$100; Sony MX-650 6-chnl mixer, \$100; Collins 21221 portable, \$175; Shure 675, \$125. B Williamson, 914-858-2941.

Sparta (2) EQ mods, \$150 ea; Centurion II frame w/p, \$600; Centurion IV frame, \$300. B Williamson, 914-858-2941.

Langevin AM-301 (3), 2 in gd cond, 8-slider, dual mono, BO; Ramko custom 16-pot rotary mono, in 2 sections, BO. R Wells, KSRO, POB 1598, Santa Rosa CA 95402. 707-545-3313.

Wheatstone/Audioarts A-50 12-chnl stereo bdct, prepared w/XLR cables, 8 mos old, \$5000. D Crepps, IBS, 225 W Lookerman St, Dover DE 19901. 302-678-4420.

CCA Futura Six mono audio, nds work, 1 stereo pot. Erway, KKSB, 1330 Cacique, Santa Barbara CA 93103. 805-568-1444.

RCA BC-19/A 4-pot stereo board w/ or w/o plug ins. M Harris, KDOK, POB 1330, Tyler TX 75710. 913-393-2519.

Tascam M-320 20x4x8x2 configured, great cond, w/Calzone case, \$2199. S Wytas, SWP, 165 Linden St, New Britain CT 06051. 203-224-1811.

Gates Gatesway refurb, 10-chnl w/Q on all faders, new paint, Opamp labs & color pic, \$800; Gates Stereo Yard less pots, clean, gd parts, \$250. B Mayben, WKXJ, POB 71, S Pittsburg TN 37380. 615-837-5544.

LPB Signature III 6-chnl mono, new, 2 yrs old w/books, \$1500+s/h. D Kasey, WROD, Box 991, Daytona FL 32115. 904-252-0677.

Shure M67 4-input mixer, \$250. E Davison, 217-787-0800.

Want to Buy
Langevin AM4A w/documents. J Gangwer, 942 32nd St, Richmond CA 94804. 415-644-2363.

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Want to Sell
JBL 4911 (2) speakers, never used, BO; TFT EBS1 rec (94.7) & encoder; Micro-Trak audio DAs 7215; dbx 900 mainframe, BO. B Brinitzer, WDCN, 1000 Park Forty Plaza Ste 120, Durham NC 27713. 919-361-1051.

Gas moving coil cart preamp, black rack mount, excel cond, \$195/trade; Leak Point One stereo tube, hi-fi preamp, 1959 mdl, \$150/trade; Pultec HLF-3C, excel cond, \$250/trade. J McLane, Oddeo, 115 W Gutierrez, Santa Barbara CA 93101. 805-963-3941.

EV DL 15X (4) spkrs, removed from baseball park system, nds new cones, \$400/BO. B Mayben, WKXJ, POB 71, S Pittsburg TN 37380. 615-837-5544.

Community CSX 57 pair of mobile DJ spkr cabinets w/dual 15" woofers, Titanium mid-horn & Piezo tweeter, carpet covered, as new, 5 yr warranty. B Fisher, KPOK, Box 829, Bowman ND 58623. 701-523-3883.

dbx 120XDS sub harmonic synthesizer, gd cond, BO. S Wytas, SWP, 165 Linden St, New Britain CT 06051. 203-224-1811.

Soundcraftsmen TG-2209-600 graphic EQ, stereo, IO band, rack mount, balanced in/out, excel, \$100; Aphex C aural exciter #103, rack mount, excel cond, \$100. B Fogal, KDBX, 57400 S Morse Rd, Warren OR 97053. 503-397-0337.

DJ & sound reinforcement system & pro light show w/mixer, strobes & spec lights, tri-amped Peavy DH 2's & 3's, 24-chnl Peavy mixer, effects, EQ & more; CD's, cass, turntables, mics & cords, road cases+150' 16-chnl snake for live sound reinforcement, perfect cond, \$25000/BO. E Miller, WZZY, POB 427, Winchester IN 47394. 317-584-2800.

SuperSonic C1 dual-chnl compressor, self-contained, compress/recover active controls w/full data, \$175; Q1 dual-chnl semi-parametric EQ, 4 controls per chnl splits spectrum in 2, sweepable overlapping bands per chnl, \$195, both w/active balanced in/out, 1 owner, like new, black rack mount & full data. H Davis, 803-276-0639.

Symetrix SE-400 2-chnl 4-band parametric EQ, light use, \$175; Aphex Type C aural exciter, 2-chnl, light use, \$165; dbx 118 (2) compressor/expanders, unbalanced, stereo & dbx 119, \$60 ea/BO. J O'Leary, O'Leary Tech Svcs, 1717 Euclid St NW, Washington DC 20009. 202-332-8377.

ROH card cage w/p, \$75; 201/218TA mainframe w/mods, \$300; Tapco 2200 stereo EQ, \$200; Tascam RS20 spring reverb, \$100; UREI 533 (2) mono EQs, \$200 ea; UREI 533 (2) EQs in rack mount, \$400 ea. B Williamson, 914-858-2941.

Want to Buy
Altec A-5, A-4 components, 515 woofers, 288 B/C/16-G/8G, multicell horns, good/bad; EV patricians, any mdl, the pat IV, 600, 700, 800 or components CX-2825, 828, 25A, T-250 or T-350. Yun, Sleeping Beauty, 1129 S Robertson Blvd, Los Angeles CA 90035. 310-274-1921.

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Orban 8000A pulled from svc 1/92, rehipped, \$1600. D Christien, KPLU, Adm 207, Tacoma WA 98447. 206-535-7265.

CRL PMC-450 meets NRSC, installed 1990, removed due to AM going dark w/manuals & in orig box, \$1000. T Nelson, WCAL, St Olaf College, Northfield MN 55057. 507-646-3328.

Orban 8100A/ST studio chassis for 8100A, BO; CRL SEP-400B (2), low mileage, BO. B Brinizer, WDNC, 1000 Park Forty Plaza Ste 120, Durham NC 27713. 919-361-1051.

Optimod 8000 and 8100 Buy-Sell-Trade
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FXR Psychoacoustic proj, like new cond, BO. F Morton, KMGZ, POB 7953, Lawton OK 73506. 405-536-9530.

Optimod 8000A gd cond, \$2300. K Smith, WNCG, Box 66, Clyde OH 43410. 419-547-8792.

CBS 410 FM Volumax auto peak controller, \$175/trade; CBS 400 Volumax auto peak controller, \$150/trade. J McLane, Oddeo, 115 W Gutierrez, Santa Barbara CA 93101. 805-963-3941.

Audio & Design Xpress FM stereo compressor/expander, gd cond, \$100; dbx 142, stereo noise-reduction system, new. \$75. B Glenn, KOTY, 830 N Col Cir Blvd, Kennewick WA 99336. 509-783-0783.

Gates Solid Statesman, BO. D Morgan, KNZZ, Box 969, Grand Junction CO 81501. 303-241-9230.

Harris M-6543 Solid Statesman FM w/manual, \$150. T Rosen, KBLI, 1129 Acacia Ave, Bakersfield CA 93305. 805-871-6094.

Howe Elect 2100 working cond, 4-5 yrs old, Phase Chaser, \$2000; Mod Sci MYB-2 Stereomax in working cond, 4-5 yrs old, \$2100. E Swanson, WZTR, 520 W Capitol Dr, Milwaukee WI 53212. 414-964-8300.

Altec 436 B compressor, tube type, working, BO; CBS 4440 compressor, Audimax, BO; CBS 4000 limiter, volumax, BO; CBS 450 dynamic presence EQ, BO. R Wells, KSRO, POB 1598, Santa Rosa CA 95402. 707-545-3313.

CBS 400 Audimax, \$150; CBS 444 Volumax, \$150; Gates Solid Statesman, \$350; Harris MSP-90 AGC, \$600; UREI LA 3H (2) compressors, \$175 ea. B Williamson, 914-858-2941.

Gregg FM, \$4500; AM proc, \$3500; Optimod 8000A, \$1500. C Haynes, WJMI, 1850 Lynch St, Jackson MS 39203. 601-948-1515.

UREI 1178 dual peak, little use, \$500. B Fogal, KDBX, 57400 S Morse Rd, Warren OR 97053. 503-397-0337.

Want to Buy

Orban 8100A gd & clean w/zero card. T McGinley, WPGC, 6301 Ivy Ln, Greenbelt MD 20770. 301-441-3500.

MICROPHONES

Want to Sell

Telex FMR-50 hand-held wireless mic & rcvr, \$295. G Wachter, FYI, 6312 N 1st Ave, Phoenix AZ 85008. 602-258-6161.

Shure SM61 (2), excel cond, gd for announcer, remotes, sports, \$75 ea/\$140 both/trade for EV RE20 or headphone amp. W Dougherty, WLD Rcdg, Music Valley Rte 1, Mill Spring MO 63952. 314-998-2377.

Alan Gordon Sonic #312 fish pole mic boom, new, \$105. B Dombrowski, WhirlWind Prods, 10356 W Warren, Dearborn MI 48126. 313-584-4038.

AKG D-900 (2) dynamic long shotgun, \$125 ea; (1) CK-9 long shotgun capsule, \$125; (1) N46E 2-mic, AC, pwr supply, \$75. E Toline, Audio Etc, 525 W Stratford Pl, Chicago IL 60657. 312-975-8598.

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B+K 2801 tube-type condenser, pwr supply, BO/trade for Sony CP-3 pwr supply. J Roper, Imperial Sound, 383 N Studio St, Terre Haute IN 47803. 812-877-2663.

RCA Velocity Jr bi-directional ribbon, chrome & black, very gd cond, \$350. R Franklin, Franklin Studios, 1004 Dekalb St, Norristown PA 19401. 215-646-7788.

Sennheiser MD421 U-5 w/case & clamp, excel cond, \$200. B Fogal, KDBX, 57400 S Morse Rd, Warren OR 97053. 503-397-0347.

AKG D110 lavalier dyn, new, \$35; (2) metal screen #W17 windshields that also fits Altec M20, new, \$10 ea; Altec 169A shock mg, new, 78" dia mics, \$20; Mdl 571 lavalier, new, \$45; Shure SM56 & 546, mint, \$65. E Davison, 217-787-0800.

Shure SM-7 (4), 7 mos old, \$250 ea/\$900 all; (2) EV-RE-18's, \$125 ea/\$200 both; EV-635A, \$75. D Crepps, IBS, 225 W Lockerman St, Dover DE 19901. 302-678-4420.

RCA & others, 44A, 77-DX, SK76, 88, Aerodynamic & many others, gd cond, \$1 list. R Franklin, Franklin Studios, 1004 Dekalb St, Norristown PA 19401. 215-646-7788.

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Production/personality exper, skilled, talented & creative, countless voices & accents, solid & conversational, seeking gd home in Madison WI. Scotty Matthews, 615-526-7099.

1 yr & 2 wks exper on the air + 1 month prog dir. Gary, 914-266-1173.

CE w/big prod voice & over 15 yrs hands-on engrg exper seeks CE pos w/prod or air shift in competitive top 100 mkt. G Morgan, 704-563-8676.

Novice announcer looking for pos in San Antonio TX area, any format/shift. Tracy, 512-654-7530.

PD/MD w/1000 CDs designed for AOR interested in helping you, any mkt. N Shearer, 817-387-8090.

DJ seeks pos in LA, CA area, any shift/format except rap/R&B, prom & prod skills, fun, friendly. M Hart, 4107 Conrad Rd, Alexandria VA 22312.

Talented unemployed morning man, newsman, copy, PD, prod, 23 yrs exper, team player, prefer mgmt post, limited announcer duties. Larry, 717-653-2500.

Univ of MD campus celebrity Gary Allen graduates soon, over 2 yrs at WMUC, currently hosting live remotes & taping parodies. 2126 Hagerstown, College Pk MD 20742. 301-314-4590.

College grad seeks employment, CH/URBAN/CHR radio/recrds, comm major, resume, ref, outgoing, will work & relocate. T Stein, POB 1498, Central Pella IA 50219. 515-628-7523.

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Gentner (4) pre-wired patch panels, great cond, \$190 ea. R Dees KARX, 3507-A Van Tassel, Amarillo TX 79121. 806-355-4554.

Weather radar Raytheon color 4804C, 60 mile range, \$3500/BO. M Berry, KGWY, POB 1179, Gillette WY 82716. 307-686-2242.

TIE E300C 10-button phone, TT dial, new, \$50; WE field phones, magneto w/modern handset, excle cond, \$50 pr; music on hold interface to 1A2 phone systems up to 5 lines, \$25 per phone; Plantronic mini operators headsets (2) w/289B DBL plug, \$25 ea. E Davison, 217-787-0800.

SEDAT card to fit Fairchild DART rcvr; West Elec 24 V pwr supply, heavy, bulky and may blow-up. R Wells, KSRO, POB 1598, Santa Rosa CA 95402. 707-545-3313.

Motorola 1410 (2) C-Quam AM stereo mod, tuned to 1240 kHz, \$3000/BO. R Irwin, KSAC, 1021 2nd St, Sacramento CA 95814. 916-446-2294.

McMartin SCA TR 66C; TR 55A; TR 55C. T Wortmann, WJAG, 309 Braasch Ave, Norfolk NE 68701. 402-371-0780.

Sony SRF-A1 Walkmans, \$100 ea. C Fox, WOLF, 4853 Manor Hill Dr, Syracuse NY 13215. 315-468-0908.

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Patch bays (4) 2x24 2-conductor (tip & sleeve 1/4" w/solder blocks & w/normal thru contacts. David, Prod House, 6130 S Dehmel Rd, Frankenmuth MI 48734. 517-652-6863.

ESE ES-400 10-min dig timer, modified for remote test, \$30. R Hardy, Richardy Prods, 3239 S 90th E Ave, Tulsa OK 74145. 918-627-2937.

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MONITORS

Want to Sell

TFT 753, \$400. R Chambers, KSUE, 3015 Johnstonville Rd, Susanville CA 96130. 916-257-2121.

Want to Buy

Any older McMartin mod monitors. C Goodrich, 11435 Manderson, Omaha NE 68164. 402-493-1886.

MOVIE PROD EQUIP

Want to Sell

Bell & Howell 1500 several 16mm projs, 1 auto-feed, ea w/extra lamp. Katherine, Linden, 229 N Henry St, Alexandria VA 22314. 703-549-4424.

Bach Auricon MA-11 all-transistor Filmagnetic high Fidelity sound on film amp w/AC pwr pak in fitted case w/cables, BO/trade for Ampex R/R. W Rudd, 205-826-0390.

AM STEREO RECEIVERS
 Portable, Home/Studio, Auto
RRADCO GROUP
 708-513-1386

Avcom ACPC 3000E freq agile SCPC rcvr & Avcom 500-70 downconverter, both rack mount, in svc 7 mos, \$2100 both. D Crepps, IBS, 225 W Lookerman St, Dover DE 19901. 302-678-4420.

Kerwood 599 twrns, matching xmtr & rcvr + spkr w/Hamtronics/VIC 20 for RTTY, high spd code, TX uses 2-6146 in final, \$300. B Mayben, WKXJ, POB 71, S Pittsburg TN 37380. 615-837-5544.

SCA decoder, high quality micro-miniature 6792 kHz, prewired & ready to install, \$15. D Jackway, Background Music Eng, 5742 Fairoak, Springfield MO 65810. 417-881-8401.

REMOTE & MICROWAVE EQUIP

Want to Sell

Moseley TR215 xmtr unit, 10 yrs old, \$250. J Randolph, WHIR, Box 1230, Danville KY 40422. 606-236-2711.

TFT 7700 series composite STL w/hot standby xmtr & rcvr w/T601 remote, BO. L Dupree, KQID, 1115 Texas Ave, Alexandria LA 71301. 318-445-1234.

Moseley TRC15AW 15-chnl remote w/2nd control panel, spare relays, works great, replaced due to FM relocation, \$450. T Nelson, WCAL, St Olaf College, Northfield MN 55057. 507-646-3328.

Marti RPT2 & RPT15 161.67 MHz w/Bearcat rcvr, new, J Phillips, WZOM, 408 1/2 Clinton, Defiance OH 43512. 419-784-1059.

db PE/GHz & CV5 GHz STL link, 950-1000 MHz, 0-8 W, synthesized freq on both w/2 alum 1.2m dish & supports, A Branch, KYAY, 2402 Woodridge Dr, Decatur GA 30033. 404-325-7847.

Marti 450-455 MHz RPO (2) RP125 xmtrs, (2) RPT 2 W portable, (2) R-R rcvrs, 2 rcvrs, all dual freq, BO, M Berry, KGWY, POB 1179, Gillette WY 82716. 307-686-2242.

Micro Controls RCR/RCT-9 system, wireline, gd cond w/manuals, \$1000/BO. F Morton, KMGZ, POB 7953, Lawton OK 73506. 405-536-9530.

Circle (38) On Reader Service Card

Telefunken U-47, Neumann U-67, KM-54 mint; RCA ribbon mics (2) KU3A's 10,0001, (3) 77-DX, (1) 44-BX, (2) BK-5; Altec tube mics M-11, M-20, M-30; 639 film version mic ect. Trade or sale. Tracy Eaves, 615-821-6099 (evenings before 10PM EST).

Patch panel ADC-J341 harnessed w/Belden shielded cable to ADC PJ106 conn block, BO/trade for R/R ATR. J Schramm, 205-826-0390.

Keith Monks or similar record cleaning mach. R Thompson, ASCO, Rt 1 Box 268, Timberville VA 22853. 703-896-8148.

West Elec REP-111C telco repeat call, R Yaw, KOJM, Box 7000, Havre MT 59501. 406-265-7841.

UTC LS type xformers. R Robinson, 203-469-4465.

2-Meter type photo light controllers. D Morgan, KNZZ, Box 969, Grand Junction CO 81501. 303-241-9230.

111-C coils, \$35 ea/23-A EQa (8 kHz), \$25 ea. (2) 11-C & (1) 23-A, \$85 both, we pay s/h. W Florian, WNIB, 1140 W Erie, Chicago IL 60622. 312-633-9700.

AKG R-25 remote control, BO/trade for Tascam remote. J Roper, Imperial Sound, 383 N Studio St, Terre Haute IN 47803. 812-877-2663.

Antique bdctg equip from 30s-70s, \$1 list. R Franklin, Franklin Studios, 1004 Dekalb St, Norristown PA 19401. 215-646-7788.

Deep racks (2), \$50 ea; 36" table top rack, \$25; McMartin TG-2 EBS tone gener, \$375; WE KS19645-L2 (2) recorder couplers, \$50 ea. B Williamson, 914-858-2941.

Dielectric 2410 dummy loads, (10kW FM) air cooled w/3-1/8" input, Dielectric 5 kW w/3-2/8" input/1-5/8". Bird 1000W w/N input, Bird 2500W/UHF input, Bird 1200W/3-1/8" input. Goodrich Ent, 11435 Manderson, Omaha NE 68164. 402-493-1886 FAX 402-493-6821.

Combiner, Shiveley FM high pwr xmtr combiner, excel cond, Electro (20 kW) FM air cooled dummy or reject load. Goodrich Ent., 11435 Manderson St, Omaha NE 68164. 402-493-1886.

Want to Buy

Capacitor new 6 MFD & 5 kV, no PCBs, BO. F Morton, KMGZ, POB 7953, Lawton OK 73506. 405-536-9530.

Software R/S TRS 801 word proc, cassette-based; Apple II E. E Stanley, KBTO, Box 12, Bottineau ND 58318. 701-228-2483.

Schematic for Western Electro condenser mic complement (pwr supply). R Robinson, 203-469-4465.

Harris AM 80. T Wortmann, WJAG, 309 Braasch Ave, Norfolk NE 68701. 402-371-0780.

TFT 753 AM w/TFT 755 preselector option, mint, removed from svc due to AM going dark, \$1000. T Nelson, WCAL, St Olaf College, Northfield MN 55057. 507-646-3328.

McMartin AMR 1 (2) AM tuners, 770 kHz, \$275 ea; STR400 SCA rcvr on 101.5 & 104.7, \$50; TBM 2500B RF amp, \$75; TBM 2200A stereo, \$650; TBM 3500B FM, \$650; TBM 4500A stereo mod, \$1100; TR 66 SCA rcvr, \$40. B Williamson, 914-858-2941.

RECEIVERS & TRANSCEIVERS

Want to Sell

Motorola 2-way radio RPU equip, 161 MHz; Micor 110 W mobiles, 450 MHz; Micor 7045/75 W mobiles, 161 MHz; 15 & 45 W Motrac, Mocom 70 & 30 mobiles & base stations, 450 MHz; Micor & Motrac 1275/90 W repeaters, 161 MHz. D Davis, KMBA, 5000 Marble NE, Albuquerque NM 87110. 505-262-1866.

MISCELLANEOUS

Want to Sell

Texas Instruments mdl 700 printer. T Wortmann, WJAG, 309 Braasch Ave, Norfolk NE 68701. 402-371-0780.

Gates (3) meters in panel, PA voltage, amps, ant current amps. D Morgan, KNZZ, Box 969, Grand Junction CO 81501. 303-241-9230.

Attn Country stations: mid-60s Gretsch Atkins Country Gent guitar autographed by Chet Atkins w/case, great promo giveaway, \$1000. A Peterson, 203-350-6697.

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20 kW FM	1974 RCA BTF 20E1	1 kW AM	1978 Harris MW1A
25 kW FM	1988 TTC 25,000	2.5 kW AM	1982 CCA 2500D
30 kW FM	1981 BE FM-30	2.5 kW AM	1976 McMartin BA2.5K
		5 kW AM	1968 Harris BCSH
		5 kW AM	1972 CCA AM5000D
		5 kW AM	1977 RCA BTA 5L
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TRANSMITTERS . . . WTS

Harris 2.5K gd cond, \$13000. K Smith, WNCG, Box 66, Clyde OH 43410. 419-547-8792.

Moseley TRC-15 (2) 15-chnl remote controls, excel cond, BO. B Brinizer, WDNC, 1000 Park Forty Plaza Ste 120, Durham NC 27713. 919-361-1051.

B-910 FM exciter, \$1000 plus shipping. M Benson, KWTY, 916-893-8737 or 619-764-2564.

Collins 20V1 1 kW AM. T Wortmann, WJAG, 309 Braasch Ave, Norfolk NE 68701. 402-371-0780.

Gates/Harris FM-10B, 10 kW FM, partially rebuilt, 230V single phase power, BO/will trade, will deliver west of Rockies. M Benson, KWTY, 916-893-8737 or 619-764-2564.

RCA BTA183 1 kW on 1110 kHz, \$2000. M Turner, WYIC, 7641 Camberwood Dr, Indianapolis IN 46268. 317-872-3004.

db DC/EM synthesized repeater FM, fixed input freq, synthesized FM chnl out, mpw audio, unused, \$2600. A Branch, KYAY, 2402 Woodridge Dr, Decatur GA 30033. 404-325-7847.

Gates BC1F & BC1T (2) AM, \$600/\$700. J Randolph, WHIR, Box 1230, Danville KY 40422. 606-236-2711.

2500 W AM w/cutback, 1979 w/spares & manuals. J Phillips, WZOM, 408 1/2 Clinton, Defiance OH 43512. 419-764-1059.

Gates FM1B manual. D Morgan, KNZZ, Box 969, Grand Junction CO 81501. 303-241-9230.

Bendix TDD-5 25 W AM tube-type w/instruction book, on your freq, excel cond, \$320. J Cunningham, KEOR, Rt 2 Box 113B, Stonewall OK 74871. 405-265-4496.

WE BUY MOSELEY PCL-303, 505, & 606's 414-482-2638

Moseley DRS 1, \$2000/BO; DLS 1 logging system, \$1000/BO; RCA BTF 40 E1, gd cond, BO. R Dees, KARX, 3507-A Van Tassel, Amarillo TX 79121. 806-355-4554.

RCA 250 W BTA 250-L on 970 kHz w/new tubes, \$1500; tuned & tested at your freq w/new tubes, \$2550; various rblt rectifiers. D Jones, WRCC, 2052 Watson Blvd, Warner Robins GA 31099. 912-922-2222.

Harris MW-1A gd cond, nds some repair, \$13000. B Kidd, Airwaves Co, 510 W 2nd, Rayville LA 71269. 318-728-4574.

B-910 FM, \$1000 + s/h; Gates-Harris FM-10B 10 kW FM, partial rebuilt, 230 V single phase pwr, BO/will trade. M Benson, KWTY, 916-893-8737.

Sparta 625 25 kW removed from svc 12/91, \$27500 + frt. K La Rue, Gen Comms, 2171 Ralph Ave, Stockton CA 95206. 209-462-6059.

McMartin B-910 reg mod reg & PA mods, works, 92.1 MHz, stable, BO. J Houts, KAAA, 2534 Hualapai Min Rd, Kingman AZ 86401. 602-753-2537.

Gates M-6095 FM exciter, 88.1 w/manual, 10 W, \$300. T Rosen, KBLL, 1129 Acacia Ave, Bakersfield CA 93305. 805-871-6094.

Harris 3.5 K, excel cond, spare final, tuned to 92.3 in ND. R Frisch, CERM Bldg, 6300 Variel Ave #D, Woodland Hills CA 91367. 818-887-4246.

Spares for RCA BTA5H. G Wilson, WWTC, 5501 Excelsior, St Louis Pk MN 55416. 612-926-1280.

Collins 20 V-3 1 kW, nds reconditioning, \$1500 + s/h. Erway, KKSJ, 1330 Cacique, Santa Barbara CA 93103. 805-568-1444.

Dielectric 2410 dummy loads, (10kW FM) air cooled w/3-1/8 input, Dielectric 5 kW w/3-2/8 input/1-5/8. Bird 1000W w/N input, Bird 2500W/UHF input, Bird 1200W/3-1/8 input. Goodrich Ent, 11435 Manderson, Omaha NE 68164. 402-493-1886 FAX 402-493-6821.

Harris FM-20 kW transmitter, 1981-82, excellent condition with MS-15 exciter. Being sold by station owner. Call Mr. Clayton at 314-721-1247.

RECTIFIERS: molded replacements and open assemblies available. Upgrade kits for older transmitters. DEALERS WELCOME. Repairs on open assemblies. Plastics Technology Inc, 205-633-6277 or FAX 205-633-3202.

Combiner, Shiveley FM high pwr xmtr combiner, excel cond, Electro (20 kW) FM air cooled dummy or reject load. Goodrich Ent., 11435 Manderson St, Omaha NE 68164. 402-493-1886.

Used Transmission Line, many sizes & lengths, many like new. 816-635-5959.

Complete LPTV equipment for sale, reasonable, channel 13. For information call evenings (517) 321-1763.

Want to Buy

AM any, need 250 W for night pwr; 3K-5K FM tuned to 100.7 MHz, would consider 10 kW needed. B Barnett, KIMP, 4110 McKnight Rd, Texarkana TX 75501. 903-832-5532.

Collins 30K5 250 W AM 300 CW shortwave. W Reese, KPH, Box 630, Bolinas CA 94924. 415-868-1403.

McMartin AM/FM xmtr, any model, exciter or stereo modules. Goodrich Ent., 11435 Manderson, Omaha NE 68164. 402-493-1886.

TUBES

Want to Sell

Driver shell w/socket unit 1A8 for MW-50 Harris. D Morgan, KNZZ, Box 969, Grand Junction CO 81501. 303-241-9230.

Eimac 4CX250B (3) new, \$270/\$100 ea. R Swan, Wroy, 101 N Church, Carmi IL 62821. 618-382-4161.

Many, small tubes. D Morgan, KNZZ, Box 969, Grand Junction CO 81501. 303-241-9230.

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Eimac 5 CX 1500 B new w/warranty, \$825. P Delaney, WOSX, Box 921, Marshfield WI 54449. 507-895-2065.

3CX1500A7, 4CX5000A, 6146B, 4CX250B, 4CX3000A & more. We carry large inventory all major brands, Eimac, Amperex, RCA, etc. Call Stew 1-800-842-1489.

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Want to Buy

RCA 6161/6181 used in TTU-1B, no shorts but weak. N Davis, TV24, POB 5180, Defunak Sprgs FL 32438. 904-892-4038.

TURNTABLES

Want to Sell

Rek-o-Kut B12H 3-spnd w/S120 tonearm & 2 head shells, \$100. J Parsons, 2781 Fayson Cir, Deltona FL 32738.

Technics SP15 & SP10 w/A+I tonearm & base, preamps, BO. B Brinizer, WDNC, 1000 Park Forty Plaza Ste 120, Durham NC 27713. 919-361-1051.

Technics SP10 MKII electronic, gd cond, \$400. B Glenn, KOTY, 830 N Col Cir Blvd, Kennewick WA 99336. 509-783-0783.

Technics SP-10 (2) w/Obsidian base, Audio-Technica tonearm & Stanton 310 preamp, \$950 ea/\$1750 both; Henry Engrg controller for 2, excel cond, \$100/BO. F Morton, KMGZ, POB 7953, Lawton OK 73506. 405-536-9530.

Audio Technica ATP-12 tone arm, excel cond, \$150. R Franklin, Franklin Studios, 1004 Dekalb St, Norristown PA 19401. 215-646-7788.

Technics SP-25 2-spnd direct drive, excel cond, \$250. R Franklin, Franklin Studios, 1004 Dekalb St, Norristown PA 19401. 215-646-7788.

Audio Technica ATP-12 tonearm w/681 cart, \$225; ORK rim drive, \$75; Sparta/Microtrak/Stanton (2) 500 carts, \$300 ea; Technics SP25, \$225. B Williamson, 914-858-2941.

Want to Buy

16" & tonearm. G Moor, Bromo Comm, POB M, St Simons Island GA 31522. 912-638-5608.

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VIDEO PROD EQUIP

Want to Sell

Remax/CMX paper punch system; GVG room console for parts; Ampex 50V batt pack chgr; Ampex TBC I; Sony TT-10 tuner timer VHF/UHF, BO/will trade. W Rudd, 205-826-0390.

VIDEO TAPE RECORDERS

Want to Sell

Sony U-Matic 5000 3/4" play w/RM 580 remote control, mint, 25 hrs head time, \$1500. Pegi, Global American, 1768 Coral Way N, Vero Bch FL 32963. 407-231-4800.

Panasonic NV-9600 edit 3/4"; (2) NV-9240 3/4" source decks; (2) NV-A500 editing control units w/3 cables; (1) NV-8500 VHS deck w/on-panel shuttle & edit capability; (2) Bretford rack stands on wheels for decks, \$4500/BO. A McPeck, 615-272-4827.

Sony RV-8 (RP) upper drum assembly for VO-4800, \$100; VO-4800 (2) portable, need repair, \$500 ea; AC-340B w/AC pwr & adapter for VO-4800, \$75; svc manuals, \$30. D Christen, KP LU, Adm 207, Tacoma WA 98447. 206-535-7265.

Solution to May 6 puzzle

U	P	X		S	K	I	L	L	D	R	A	M							
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P			C		O	P	T	I	M	O	D	A	G	A	I	N			
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