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# Radio World

Focus On  
Transmission:  
See pp. 29-43

Vol 17, No 13

Radio's Best Read Newspaper

July 14, 1993

## AT&T Algorithm Vital To Three DAB Systems

by John Gatski

**MURRAY HILL, N.J.** With its millions of research dollars, AT&T has its eye on U.S. digital audio broadcasting (DAB).

Seeing potential to license technology to equipment manufacturers, the telephone company giant is putting money into in-band, on-channel; in-band, adjacent channel; and satellite DAB technologies.

Although the AT&T system has not been widely publicized, extensive computer modeling and tests of individual pieces of hardware have been conducted at the corporation's various facilities, according to the company.

At press time, AT&T said it would be testing a closed-loop version of the in-band, adjacent channel system in late June or early July. Plans also included over-the-air testing at WPRB in Princeton, New Jersey, in July and August.

Nikil Jayant, head of AT&T's advanced audio department, said the key to the company's DAB involvement in three different DAB proposals is its audio compression scheme, Perceptual Audio Coding or PAC, which is said to provide "transparent" CD audio at 128 kilobits per second data rate. Audio compression schemes (actually they are data reduction systems) are necessary for DAB systems because of limited bandwidth for satellite and terrestrial transmission.

"Here is a technology (PAC) that is really matched to U.S. broadcasters," Jayant told *RW* editors during a recent tour of the AT&T research facility.

Of the five DAB transmission proposal systems slated for testing by the

Electronic Industries Association (EIA) Digital Audio Radio Subcommittee (with oversight by the National Radio Systems Committee), the PAC algorithm is involved in AT&T's own in-band, adjacent channel system; the AT&T/Amati in-band, on-channel system; and the NASA/VOA satellite system. The EIA tests are scheduled to begin in October.

Other systems slated for testing are USA Digital's in-band, on-channel system, the front runner so far; and the European-developed EUREKA 147 new band system that is being implemented in Canada and being considered in some European countries and Mexico. Both use the MUSICAM compression scheme.

### Critical listening

According to Jayant, critical listening during the recent Swedish Radio Tests revealed that PAC was "transparent," even at 128 kilobits per second.

He said that at 96 kilobits per second, PAC is good enough to provide "transparent" 15 kHz audio for an AM DAB system. Jayant called AM DAB an

continued on page 7 ▶



**RDS For Sale:**  
The Denon DCR-730R is among several RDS receivers now available. See story below, related story p. 36.

## RDS Proponents Confident

by John Gatski

**CHICAGO** With another successful demonstration under their belts at the Consumer Electronics Show (CES), RDS (radio data systems) technology proponents believe the "datacasting" medium will succeed in mainstream radio.

According to RE America, it has placed more than 75 encoders at stations across the country (some encoders have been loaned out, given as promotional gear, as well as purchased). Other manufacturers including Modulation Sciences, CRL, Rohde and Schwarz, and Teli already are selling or are ready

to ship RDS encoders, too.

RDS (also called RBDS, which is the U.S. standard name for RDS, based on the European-developed system) is a 57 kHz subcarrier that enables stations to provide datacasting to receivers, including call letters, slogans, phone numbers, station selection and scanning by format, automated emergency alerting, and automatic switching from one transmitter to another of a network or station. Other RDS uses also are possible, such as scrolling advertisements and interactive functions.

RE's John Casey said radio stations, consumers and consumer audio retailers are now aware of RDS. "People are now coming to us looking for the stuff," Casey said after the CES show.

Modulation Sciences, which was to begin shipping products later this month, said there have already been 40 orders placed for its RDS card/software combination that works with IBM-compatible computers.

Jim Hauptstueck of Harris Allied said interest in RDS is increasing, but a lot of station GMs still don't know what the technology can do. "So far, it is looking real good. Needless to say, however, there is still a long way to go. I see a lot of education that still needs to be done," he said.

A dozen stations went on the air with RDS for the CES in Chicago. The stations were given RE encoders by Harris Allied for a 60-day trial period. Stations also were loaned Delco radios for monitoring purposes. Similar demonstrations were held at the winter CES and NAB convention in Las Vegas.

Most station installations are easy and compatible with most SCAs that broadcasters have on the air, according to Casey, whose company sells a basic encoder for \$2,500. (However, two stations at the CES demo were running 67 kHz data SCAs that interfered with the RDS 57 kHz subcarrier. Casey said the problem was caused by the older

continued on page 3 ▶



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World Radio History

# NEWSWATCH

## Vriesman, Fox Elected To NAB Board Posts

**WASHINGTON** Wayne R. Vriesman, vice president of Tribune Broadcasting's Radio Group, has won a two-year term as chairman of the National Association of Broadcasters' joint radio-TV board. He was elected during the association's annual summer board meeting late last month.

Vriesman, who has served as NAB radio board chairman for

the past year, succeeds LIN Television Corp. President Gary Chapman in the joint-board slot.

Meanwhile, a tight race for the open radio board chairmanship was settled after balloting that took up most of the morning during one day of the four-day meeting. Robert L. Fox, chairman and CEO, KVEN(AM)-KHAY(FM) Ventura, Calif., won in the fifth ballot over Bayard H. Walters, president of The Cromwell Group, Nashville.

Fox has as radio board vice chairman for the past year.

## ABC Names Donnelly New Engineering VP

**NEW YORK** ABC Radio's General Satellite Systems Manager Robert Donnelly has been promoted to vice president of engineering.

Donnelly, who joined ABC Radio in 1966, will now be responsible for all ABC Radio technical operations including

studio facilities in New York, Dallas, Washington, Los Angeles and Chicago.

## SBE Show Set for Miami

**INDIANAPOLIS** Possibly the last national SBE convention on its own, the 1993 show is scheduled for September 29-October 2 at the Miami Beach Convention Center in Miami, Fla.

The show will be held in conjunction with the Radio Television News Directors Association convention and will feature NEWSTECH, the joint collaboration of the two groups. The annual Ennes Workshop for

engineers, as well as the normal schedule of technical sessions, also are scheduled.

The Miami show could be the last SBE national convention because the SBE is negotiating with NAB to take over the technical sessions at the spring NAB convention.

For more information, contact the SBE at 317-253-0122.

## DCR Expands Potential Subscriber Base

**SAN FRANCISCO** With the availability of Digital Cable Radio (DCR) to 825,000 of Time Warner Cable's subscriber base, the upstart premium audio service will be accessible by three million homes in the U.S. by the end of the summer.

Time Warner will roll out the 57-channel DCR service in 13 of its Cable Systems this summer including Birmingham, Ala.;

continued on next page ▶

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# Low Funds May Affect FCC Services

by Randy Sukow

**WASHINGTON** Despite a serious funding shortfall, the FCC has been able to maintain most of its processing and enforcement operations without any serious delay.

But if Congress does not grant the commission its long-sought \$12 million supplemental appropriation this summer, radio broadcasters and all other FCC licensees are certain to feel the effects of stalled rulemaking proceedings (including RF radiation and Emergency Broadcast System proceedings), slower station-transfer and facilities-change processing and, perhaps, even cutbacks in rules enforcement.

So far, the most significant sign of hard monetary times at the FCC has been its controversial decision early last month to delay enforcement of the 1992 Cable Act's rate-regulation sections from June 21 to October 1.

Interim FCC Chairman James Quello has been roundly criticized from some corners of Capitol Hill for that decision. But Quello and Mass Media Bureau Chief Roy Stewart have gotten high marks from other lawmakers and Washington communications lawyers for their maintenance of a functional FCC during the money crisis.

"It's a critical situation because the commission was given an enormous amount of work and virtually no new personnel and money," said Jeff Baumann, executive vice president and general counsel, National Association of Broadcasters. But so far NAB has not detected a sharp increase in broadcaster complaints over the FCC's work pace, he said.

Further complicating matters has been an on-going federal hiring freeze. "I think Roy Stewart has done a really amazing job in dealing with gradual losses of people. He's really just a very

## RDS Products

### Now On Market

► continued from page 1

technology of the 67 kHz SCAs, which can be remedied by better filters.)

Receiver availability is likely the determining factor for broadcasters in making a decision to add RDS. Many companies showed actual production and prototype tuners at CES.

In a major announcement, Delco detailed its plans to offer RDS radios in early 1994. "This new radio receiver will be available through GM's dealer distribution network next spring," said Bill Jenkins, marketing and sales manager for audio at Delco.

Denon already sells two RDS car receivers: the DCR-930R (\$600 list) and the DCR-730R (\$450 list). It also plans to ship a home RDS-tuner, the TU-650RD in September. Onkyo will ship its home tuner, T-450 RDS (\$349 list), in September as well. Blaupunkt, Sony and other companies showed products that are planned for dealer shipment in early 1994.

GoldStar, the bargain-price Korean electronics giant, showed a RDS-receivers with high quality display, listing for \$175. No word on availability.

good manager," said Richard Waysdorf, of the Washington law firm of Waysdorf and Van Bergh, who serves as co-chairman of the Federal Communications Bar Association's Mass Media Practice Committee.

"But I think if October rolls around and there isn't more money, there's going to be some serious problems," Waysdorf said.

#### Help on the way

During a mid-June hearing on the FCC's 1994 and 1995 reauthorization, House Telecommunications Subcommittee Chairman Edward Markey (D-Mass.) promised that the \$12 million supplemental appropriation was on the way.

The FCC anticipated the need for additional 1993 funding at least one year ago. In June 1992, then-Chairman

## NEWSWATCH

► continued from previous page

Shreveport, La.; Monroeville, Pa.; San Diego, Calif.; Jackson, Miss.; Lima, Ohio; Troy, Ohio; Portland, Maine; Bakersfield, Calif. Savannah, Ga.; Hampton, Va.; Raleigh, N.C.; and Fayette, N.C.

DCR also has introduced its universal song remote "The Maestro, which not only controls the DCR tuner, but other components of home audio/video systems.

Besides Time Warner, DCR's partners include Jerrold Communications, Cox Cable Systems, Time Mirror Cable, and subsidiaries of Sony Software and the Warner Music Group.

#### Equipment Authorization Video Available from FCC

**WASHINGTON** The FCC has produced a video that explains common problems found in equipment authorization applications.

The video explains how to avoid common administrative and technical deficiencies in applications, and how to assemble an application to facilitate review. The video also discusses importation and marketing rules.

To obtain the video, contact Telespan International, Inc., 8201 Corporate Dr., Suite 600, Landover, MD 20785; phone: 301-731-5355. Request the "FCC Equipment Authorization Video."

#### RF Hazard Courses Offered

**NEW BRUNSWICK, N.J.** A three-day short course on electromagnetic energy hazards including RF will be held October 12-14 at Rutgers University Cook College.

The program is designed for individuals whose responsibilities demand awareness of technical issues and policy implications concerning electromagnetic hazards. The course is relevant for government officials, telecommunications/broadcasting engineers and managers, scientists, medical personnel, industrial safety personnel, military personnel and environmental safety officials.

For information and registration materials, contact Cook College Office of Continuing Professional Education at 908-932-9271.

Alfred Sikes wrote to House and Senate leaders to warn that the cost of Cable Act's rate-regulation enforcement "would have a negative impact on the ability of the FCC to do its job in all areas."

Sikes estimated the first year's price tag at between \$22.5 million and \$54.7 million, or the equivalent of 17-44 percent of the commission's 1992 budget.

Soon after the Cable Act passed last October, several influential Congressmen, including Markey, House Energy and Commerce Committee Chairman John Dingell (D-Mich.), Senate Commerce Committee Chairman Ernest Hollings (D-S.C.) and Senate Communications Subcommittee Chairman Daniel Inouye (D-Hawaii), promised to secure additional FCC funding to pay for drafting and enforcement of the act's provisions while maintaining the commission's current functions.

In spite of its backing, the supplemental appropriation got off to a rocky start when it was turned down by the House Appropriations Committee last spring. But early last month, the Senate approved the funding and the House was expected to agree to it in conference.

"The check is in the mail," Markey said. "It will be there (at the FCC) by the end of the month or early July." (Markey's prediction had not yet come through as RW went to press in late June.)

With the money apparently on the way, Markey pressed Quello, a witness at last month's reauthorization hearing, to restore the June 21 implementation date for enforcement of cable rate regulation. Quello's blunt response: "No way."

#### Administrative chaos

The interim chairman agreed to consider moving the rate-enforcement implementation up from the currently planned October 1 to as early as August 1, if and only if the supplemental appropriation were approved quickly.

Had he not announced the delay, "it would have been anarchy. It would have been just chaotic and I think we did the honest thing," Quello said.

FCC Commissioner Ervin Duggan backed up Quello's statement. "Papers and boxes would be piling up in the halls at the FCC" if the Commission started accepting cable rate complaints before having adequate staff to process them. The result would be "administrative chaos" and "contempt for our processes" from the public and licensees, Duggan said.

Quello outlined the agency's current manpower problem in written testimony to the subcommittee. In 1984, the commission employed a total 1961 workers. Over the next several years, the FCC took on several new projects—high-definition television development, new radio ownership rules, TV syndication rules and others—while a series of Congressional budget cuts reduced the commission's workforce to 1745 by 1992.

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# AT&T Invites a Closer Look at PAC

If you haven't already, I'd urge you to read News Editor John Gatski's article on AT&T's digital radio system and PAC algorithm on the front page of this issue. He wrote it after a road trip we (myself, John, RW Technical Advisor Tom McGinley and RWI Managing Editor Charles Taylor) took to Murray Hill, N.J., to the AT&T Bell Labs research facility.

(I must confess that Chuck got one right, much to his glee and our dismay).

Those of you with a penchant for industry history will know that this is not AT&T's first foray into radio. It was in fact one of the early pioneers in the business—AT&T's WEA(AM) New York aired the first radio commercial back in 1922. The company decided a short time later that the money was in the telephone business and got out of the broadcast business.

Now AT&T sees a potentially lucrative opportunity to license technology to equipment manufacturers. And it has placed its eggs in more than one basket—its system is in three of the five DAB transmission proponent systems slated for testing by the Electronic Industries

on all five systems, the best from each would be taken and melded into the perfect digital radio system. Sound naive? Maybe. Is it technologically feasible? I don't know. But I can only hope so for the benefit of the industry. In the interim, we'll keep tabs on everyone's progress.

NAB's Spring convention happened roughly three months ago, but I have one last snippet of news to report from that gathering. RW's Dream Team II did in fact meet and play, and, Sean Bowers reports, "A great time was had by all." (I confess. No pictures were taken of this great time because I slept right through my 5:30 a.m. wake-up call at the hotel.)

But the Dream Team regulars did show: Frank Foti, Don Bird, Ric Ferguson,

Details on the Dallas get-together will be forthcoming. And I promise, I'll stay up all night if I have to—just to make that early morning photo shoot.

★ ★ ★

Our heartfelt condolences go to RW columnist Al Peterson. His mom died on June 19 of complications following open heart surgery. She was 68 and an avid RW reader. Al's column will resume in August.

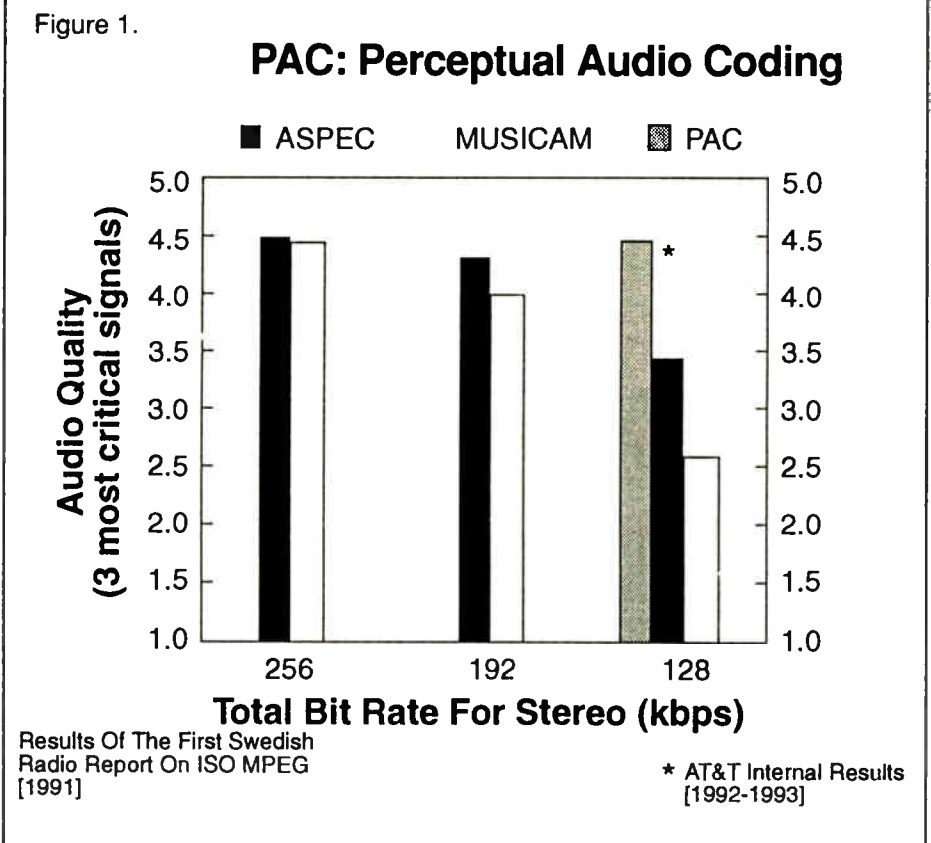


It's the very same AT&T Bell Labs where the transistor was developed in 1947 and the very same place where scientists have won at least one Nobel Prize. (A good lesson in humility is to stroll through this beautiful campus' cafeteria and see these great minds hanging around munching on sandwiches and playing chess).

Lately these minds have been looking at digital radio. Think about it: All that AT&T money backing all those IQs spending all that time thinking about radio.

As you can see in the chart, AT&T claims its compression algorithm is transparent at 128 kbps, just about the rate broadcasters need for FM transmission, and right about the point where MUSICAM's and ASPEC's compression algorithms begin to break down. AT&T scientists already are hard at work on the AM scheme.

Real-world testing will prove whether this is a feasible system. It looks good on paper and sounds good in the lab. So good in the lab, in fact, that your team of correspondents failed seven attempts to pick out the compressed sample from the source sample in an impromptu laboratory test we were dumb enough to request.



Association (EIA) Digital Audio Radio Subcommittee (with oversight by the NRSC).

In an ideal world, once testing is done

Scott Beeler and Sean. The team added three new players: Ted Lantz and Tim Beeler from BE and Jamey Miller from Harris Allied.



Tore B. Nordahl and Media Touch Systems Inc. have gone their separate ways after Nordahl's consulting president assignment contract expired at the end of May. Both parties agreed that there was not enough common interest to make the relationship permanent.

Nordahl will continue to provide management, marketing and acquisition consulting services and to evaluate investment opportunities in the professional digital audio areas, particularly in the software intensive system arena. He can be reached at 203-775-8098.

Ron Frillman has been named Manager of Marketing Communications for Harris Allied. Frillman will be responsible for all division advertising, media relations, trade show management and market research.

Bob Munger reports that Audisar is alive and well. The company is currently accepting product orders, and will maintain its existing product line for the present time.

Audisar has moved to new manufacturing facilities in Bellevue, Wash. Munger can be reached at 206-454-2040.



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# READERS FORUM

If you have comments for Radio World, call us at 800-336-3045 or send a letter to Readers Forum (Radio World, Box 1214, Falls Church, VA 22041 or MCI Mailbox #302-7776). All letters received become the property of Radio World, to be used at our discretion and as space permits.

## Data-reduction stacking

Dear RW:

In response to your "compression stacking" articles (May 26 and June 9), thanks for turning attention to a potentially widespread problem.

However, one critically important point needs to be emphasized. The systems discussed are not in fact data compression systems, but data *reduction* systems. The two terms are emphatically not interchangeable.

A bona fide compression scheme eliminates "uninformative" data for transmission or storage, allowing full reconstruction of the original data. This is what computer file-compression routines do. The digital audio systems you are writing about permanently discard real information which the respective algorithms identify as "sonically irrelevant."

The supporters of the various data reduction schemes frequently promote them as compression systems, either out of ignorance of the distinction or in an attempt to mislead consumers. I think it is very important to maintain and explain the distinction.

Don Stepka  
Director of Engineering  
Sound Engineering  
Rochester, N.Y.

## Helping hands are welcome

Dear RW,

Thank you for your coverage of my NAB '93 technical presentation on resolving broadcast-related interference to consumer electronics equipment in Edwin Bukont's "Coordination Makes good RF Neighbors" (May 26). I would, however, like to correct a few significant inaccuracies.

The article reports me as advising stations receiving consumer interference complaints to "only assist in identifying causes of interference and advise on corrective action" and that "in no case should station personnel or contractors

disconnect, adjust or modify a resident's equipment," and further, "to do such work at a resident's premises can expose the station to litigation." The article also states that stations may supply the materials to potentially cure an interference problem, but "allow the resident to perform (the installation) or hire someone to have the work done."

I did not make these statements during the presentation, nor do they appear in the paper published in the "NAB Proceedings."

On the contrary, we suggest that station technical personnel adjust equipment controls and connections accordingly, to help diagnose and cure the problem, provided that the resident's permission to do so was received in advance. We encourage station technical personnel to take an active role in providing direct assistance to residents experiencing broadcast-related interference.

During our involvement in a related project, we found that most residents we visited were pleased to have some help resolving the interference.

Stanley Salek  
Hammett & Edison  
San Francisco

*Edwin Bukont responds: Stan Salek's comments on handling RFI in consumer gear were incorrectly paraphrased. Mr. Salek did advise that stations should "take an active role in providing direct assistance...be responsive to complaints...but make no internal equipment modifications." It is proper to make external remedies such as installing filters or adjusting equipment provided you have the homeowner's permission. The warning about litigation was added from the author's own experience.*

## Historic interest

Dear RW,

I read Les Paul's account of the arrival of the tape recorder in the U.S. with a great deal of interest, especially his reminiscences of Richard Ranger and the Rangertone tape recorder ("Studio Sessions," May 26).

Richard Ranger was one of the great personalities of the electrical engineering profession. Early in his career he worked as a researcher for both RCA and GE, working with such figures as the famous inventor Ernst Alexanderson. At RCA, Ranger was the developer of an early form of radio facsimile, which transmitted photographic images between New York and London in demonstrations during the early 1920s. Ranger served in the Signal Corps in World War I where he began to develop the network of professional acquaintances that would eventually make him one of the best known engineers in the field.

In the inter-war period, Ranger formed his own company, Rangertone Inc., to manufacture an electronic organ of his own design. The Rangertone organ has been cited by music historians as perhaps the first commercial all electronic organ, predating the more famous Hammond organ by a few years.

When Ranger re-joined the Army Signal Corps in World War II, an in-depth

## FCC Looks Out for Broadcasters

This space is rarely reserved for tribute to the FCC, but it seems appropriate to thank Interim Chairman James Quello and his fellow commissioners for maintaining a functional agency in the face of Capitol Hill pressure to compromise the FCC.

Quello raised some Congressional hackles last month when he cited the FCC's chronic money shortage as the reason for delaying implementation of new cable TV rate regulations, mandated by the 1992 Cable Act.

House Telecommunications Subcommittee Chairman Ed Markey (D-Mass.) called the delay "simply unacceptable" and pressed Quello to reverse the decision.

"No way," was Quello's response.

He was right. Congressional leaders knew well over a year ago that passing the Cable Act would place an enormous burden on the FCC and that more funding would be needed and quickly.

Granted, early this year Markey and other powerful House Democrats put in a good word for a proposed \$12 million supplemental appropriation. But in the final analysis, they dropped the ball. The money did not get into Quello's hands in time to justify the June 21 start-up date and at press time still had not been approved.

Without the supplemental appropriation, the FCC will furlough some of its already thin staff in the fall. If the commission had not delayed cable rate regulation, all its other functions would have suffered, affecting all communications industries.

Several radio-related projects would have come to a virtual standstill, including rulemakings on AM stereo, new EBS rules and RF radiation exposure. Processing of license transfers—including those creating duopolies—and local marketing agreements as well as everyday chores like facilities and call-letter changes also would have come to a dead stop.

Critics say the FCC could have accepted cable rate complaints and acted on them when it had the money. The FCC correctly declined that alternative in anticipation of the avalanche of paper it would have caused.

FCC detractors also complain that delaying rate regulation will cost an estimated \$250 million in consumer savings. That is an impressive-sounding number, but anyone with a pocket calculator will quickly figure that it comes to an average savings of \$4.48 per cable subscriber.

Quello and company can be forgiven for concluding that \$4.48 per subscriber is not worth turning themselves into the Federal Cable Rate Regulation Commission.

—RW

investigation of German electronics technologies, such as the new capacitor and resistor manufacturing techniques, would change the direction of his life's work. He was intensely interested in a tape recorder, the "Magnetophon," manufactured by a German company, AEG.

In 1944 or 1945, Ranger and a friend, John H. Orr, made an informal agreement to manufacture tape recorders and recording tape in the U.S. Ranger returned to his Newark factory and began tooling up to make the Rangertone recorder, while Orr began to produce magnetic tape in a tiny facility in Opelika, Ala.

Rangertone Inc. was overshadowed by the phenomenal success of Ampex, Magnecord and others, but the company did not simply fade into oblivion. Ranger developed a synchronous sound system for the motion picture industry, which earned him accolades in Hollywood and a technical Academy Award in the mid 1950s. To this day Rangertone produces magnetic recording equipment for the motion picture industry.

David L. Morton, Jr.  
Graduate Student  
Georgia Institute of Technology  
Atlanta

almost 200 miles to the south.

The 1938 "Broadcasting Yearbook" (p.290) indicates WIXER was a high frequency (apex) station operating with 500 watts on four simultaneous frequencies in the kilocycle range, but by late 1938 it was assigned 42.3 megacycles. In January 1940, Major Edwin Armstrong conducted his famous FM transmission demonstration in Yonkers, N.Y. It was picked up by W2XMN in New Jersey and relayed to Sheperd's WIXOJ in Paxton, Mass., and bounced to WIXER atop Mount Washington (which reported reception absolutely clear).

The Yankee Network received authorization to begin commercial operation from Mount Washington on Oct. 29, 1940, with call letters W39B.

In 1943 the station became WMTW(FM) and in 1947 its city of license became Portland, Me. The station closed on the last day of 1948 as the Yankee Network deemed it too expensive to operate at such a remote location.

The New Hampshire Association of Broadcasters (NHAB) is writing a book on the history of radio and television stations here. We hope to be in print by the end of 1993.

Ed Brouder  
NHAB History Committee  
Bedford, N.H.

Dear RW,

Having followed the recent letters on early FM pioneers with interest, I offer the following information about New Hampshire's FM heritage.

In November 1937, advancing winter weather halted construction on WIXER, on the summit of Mount Washington, N.H., the second highest point east of the Mississippi and renowned site of the world's worst weather. WIXER was actually licensed to John Sheperd III owner of the Yankee Network in Boston,

## Correction:

The location of Studio Technologies Inc., which introduced the StudioCom digital audio workstation during the NAB convention last April, was erroneously reported in the May 26 RW. It is located in Skokie, Ill.



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Next Issue of  
Radio World  
July 28, 1993

# NAB to Offer RF Guidance

## Contractor Will Create Non-Measurement Methods

by John Gatski

**WASHINGTON** With a new radio frequency (RF) radiation exposure standard on the horizon, the NAB has commissioned a study to develop new techniques for broadcasters to comply with the new regulations.

According to NAB Staff Engineer Kelly Williams, the contractor that is finally awarded the bid for the project will be asked to come up with "non-

Bulletin 65, listed only one exposure level, and did not deal with body current absorption.

"NAB wishes to develop non-measurement-based techniques for determining compliance with the FCC's proposed new guidelines," the NAB's request for bid proposals said. "These techniques would be used as a first step toward demonstrating compliance (i.e., an alternative to actual measurements) in the same manner as the existing tables and charts contained in OST Bulletin No. 65."

Once made available, Williams said the NAB package will be an easy way to determine compliance without having to resort to measurements, if possible. "A broadcaster can open a book and check in the chart and say, 'hey, I'm in compliance.'"

However, there are circumstances when a broadcaster may have to use a consultant to

determine compliance, he added.

The contractor will be required to study the impact of the new regulations on the compliance methods already used by broadcasters in OST 65. "Specifically, determine what modifications are required for existing charts and tables contained in the appendices of the bulletin. Develop any new charts or tables that may be required to demonstrate compliance with MPEs in controlled and

uncontrolled environments," the NAB proposal said.

In the area of body current absorption, (a very controversial area that may not be easy to standardize, Williams said,) the contractor will also be required to "develop charts, graphs or tables that can be used to demonstrate compliance with the FCC's proposed guidelines."

Williams stressed the importance of broadcasters meeting RF radiation

guidelines, especially as public awareness of the issues continues to grow. Broadcaster groups believe that without reasonable guidelines and compliance, state and local laws governing RF exposure may be overly strict, resulting in conditions a broadcasters could not meet, such as having to move a tower site.

The NAB expects to sign a contract with the accepted bidder by July 9.

## NAB wishes to develop non-measurement-based techniques for determining compliance with the FCC's proposed new guidelines.

measurement techniques" for broadcasters to use as a basis for compliance with rules.

The new FCC standard, when adopted later this year, will be based on the ANSI/IEEE C.95.1-1992 voluntary standard that set a two-tier exposure limit (one for public exposure and one for workplace exposure) as well specifying limits on current for body absorption. The old FCC standard, known as OST

## CCBE Convention Set for Sept. 28-30

**TORONTO** The Central Canada Broadcast Engineers Technologists and Technicians Association (CCBE) is holding its annual convention and exposition in the Skyway Trade and Conference Center in Toronto, Ontario, Canada, September 28-30.

The CCBE has contributed to the education and advancement of its members for over forty years. Three days of papers and seminars are planned, with exhibits.

The 1993 convention theme is "Focus on Computers and Multimedia." CCBE officials said computers are becoming ever more important in the technical operations of radio and television stations as more systems become available that are replacing the older analog on-air and editing operations.

The following is the draft agenda for the 1993 CCBE Convention and Exposition:

### Monday Sept. 27

8:00 a.m. to 12:00 p.m.	Exhibitor Setup
11:00 a.m. to 5:00 p.m.	CCBE Registration-Skyway
6:00 p.m. to - 8:00 p.m.	Exhibitor/Delegates Buffet-Skyway

### Tuesday, Sept. 28

8:00 a.m. to 12:00 p.m.	Exhibitor Setup
8:00 a.m. to 6:00 p.m.	CCBE Registration-Skyway
9:00 a.m. to 12:00 p.m.	CCBE Papers Sessions
12:00 p.m. to 6:00 p.m.	Exhibits Open-Skyway

### Wednesday, Sept. 29

8:00 a.m. to 6 p.m.	CCBE Registration-Skyway
9 a.m. to 12:00 p.m.	CCBE Papers Sessions
12:00 p.m. to 1:00 p.m.	CCBE Business Meeting

### Thursday, Sept. 30

8:00 a.m. to 3:00 p.m.	CCBE Registration-Skyway
9:00 a.m. to 12:00 p.m.	CCBE Papers Sessions
12:00 p.m. to 5 p.m.	Exhibits Open-Skyway
7:00 to 8:00 p.m.	CCBE Reception
8:00 p.m.	CCBE Awards Banquet-Delta Hotel

The CCBE is making a concentrated effort to ensure the success of this year's convention on behalf of the members of the CCBE and the suppliers. An advertising blitz is in progress to encourage more exhibitor and member participation, and the group also is targeting a wider audience by including multimedia and computers in this year's program.

Members are encouraged to make copies of their registration forms and to ask their manager to distribute them to members of their staff who would benefit from the program. The CCBE Convention is a very economical way for station management to assist their staff in keeping up with the ever accelerating changes in technology.

Gary Hooper, 1993 Papers chairman, will present the following program:

### CCBE 1993 Papers Sessions

The focus of this year's convention is "Computers and Multi-media in Broadcasting." Papers will offer material in the digital technology area for radio and TV. As well, there are select presentations in other fields of interest, some of which are outlined below.

Digital radio is a much discussed topic these days. Steve Edwards of Roger Broadcasting will provide a technical update and inform us of the current status DAB.

There will be a "power quality" sessions with Rhonda Wright, P.E. of Ontario Hydro who will provide insight into the gremlins and glitches that cause power related problems with computers, studio equipment and transmitters.

"Q matching" is a new term. Broadcast Electronics' Jerry Westberg will share his method of AM diplexing and illustrate how "Q matching" works.

"Harnessing the Power of Satellite for Power and Impact" will be the subject of a paper by Donald Witzel of Novanet Communications.

Chris Ruscica will outline the process of determining if digital automation/digital audio is for your operation, and how to choose a system and options which best suit your needs.

Leonard Hull and Geretan Petrovic of McCurdy Telecommunication Products will speak on digital audio transmission theory. There is a planned digital workshop of all aspects of digital equipment, LANS, audio and video compression will be discussed. For more information, call 514-352-4038.

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# Funding Imperils Services

► continued from page 3

To cope with the new 1993 workload, Quello has been forced to take staffers from the Field Operations Bureau, the Office of Plans & Policy, the Common Carrier Bureau, the Office of Legislative Affairs and the General Counsel's office, and reassign them to the drafting of various cable regulations.

"Even with this emergency reallocation of resources, attorneys in the Mass Media Bureau's policy division have worked on nothing else since last October but Cable Act-required rule-makings," Quello said.

Regardless of the manpower shortfall, Markey and other House Democrats tried to pressure Quello into reinstating the June 21 implementation startup, claiming a delay until October 1 would cost cable subscribers nationwide \$250 million-\$300 million in rate savings.

The delay is "surprisingly convenient" for the cable industry, Subcommittee Member Jim Cooper (D-Tenn.) said.

But Quello had a powerful friend in Dingell, a fellow Michigan native who has been the interim chairman's chief Congressional supporter. The delay was, "I think, a sound decision—the way a difficult task, very much unenviable, should be done," Dingell said. "I want to see these (cable) matters dealt with, but I can't quarrel with your decision."

## Long term

Congress hopes to allocate enough money to spare the FCC of future funding crises. The reauthorization bill currently under consideration would clear up to \$146.6 million in 1994 appropriations and up to \$215.8 million in 1995.

Whether the FCC is to be funded entirely by the U.S. Treasury or partially by alternative means, such as licensee user fees or spectrum auctions, is still an open question. The House's 1992-93

FCC reauthorization bill would have granted the Commission the ability to collect up to \$70 million—over 50 percent of its current budget—through user

fees. The fee schedule, however, was blocked in the Senate.

"(The fee) proposal made sense two years ago, and it makes even more sense today," Markey said. Dingell and Markey are expected to again insert user-fee language in the FCC's reauthorization when it is marked up later this

year. But Senate Democrats, led by Hollings, are still said to be solidly opposed to fees.

Spectrum auctions appear to be on a steadier track. House and Senate auction bills have cleared committee and were awaiting votes by both full bodies at deadline last month. However, the two plans are different enough so that some form of reconciliation will be necessary, either in conference or by acceptance by one house of the other's plan.

Neither plan involves broadcast spectrum auctioning. Both appear to be aimed at the allocation of frequencies for personal communications services, the futuristic upgrade of current cellular telephone service. The Senate recently estimated that its auction proposal would net \$7.2 billion over four years (1994-98).

# AT&T Enters DAB Fray Using PAC Algorithm

► continued from page 1

"intriguing possibility." USA Digital already has shown a promising digital AM system using the MUSICAM algorithm.

Technically at least, Jayant said AT&T believes that the in-band, adjacent channel (or interstitial) solution will work best for U.S. FM broadcasters because of the additional spectrum provided. Other technical features of the AT&T system include a four PSK modulation scheme.

## Using diversity

Jayant explained that its error protection system coupled with a two-antenna diversity-type receiver (an extra 6 dB advantage) can nearly eliminate the effects of multipath in the in-band systems.

Diversity FM receiver systems, however, have not had a strong presence in the U.S., where auto manufacturers have not embraced the concept because of cosmetic concerns. Jayant said DAB proponents would have to work with car manufacturers to convince them of diversity's merits.

A problem for the adjacent channel system, however, may be broadcaster reluctance due to potential allocation

problems. Areas such as the Northeast section of the U.S. could have problems with short-space requirements if an adjacent channel system is adopted, according to industry observers.

Jayant said allocations would have to be addressed under such a system.

If allocation concerns hinder in-band, adjacent channel technology, Jayant said the Amati in-band, on-channel system also is promising. Unlike the USA Digital system, which places the digital signal about 30 dB down in the main carrier, the Amati system places the digital signal in the side lobes of the signal, he said.

When asked why AT&T had jumped into the DAB fray so late, Jayant said PAC had not been developed when DAB first became an issue in the U.S. in 1990.

Initially, the NAB threw its weight behind the European-developed EUREKA 147, new-band DAB system. The broadcasters organization, however, shifted its support to an in-band solution when it realized such technology was at least theoretically possible, and when broadcasters expressed a preference for a solution that would not severely disrupt the U.S. FM allocation scheme.

**"Here is a technology (PAC) that is really matched to U.S. broadcasters."**

—Nikil Jayant  
AT&T

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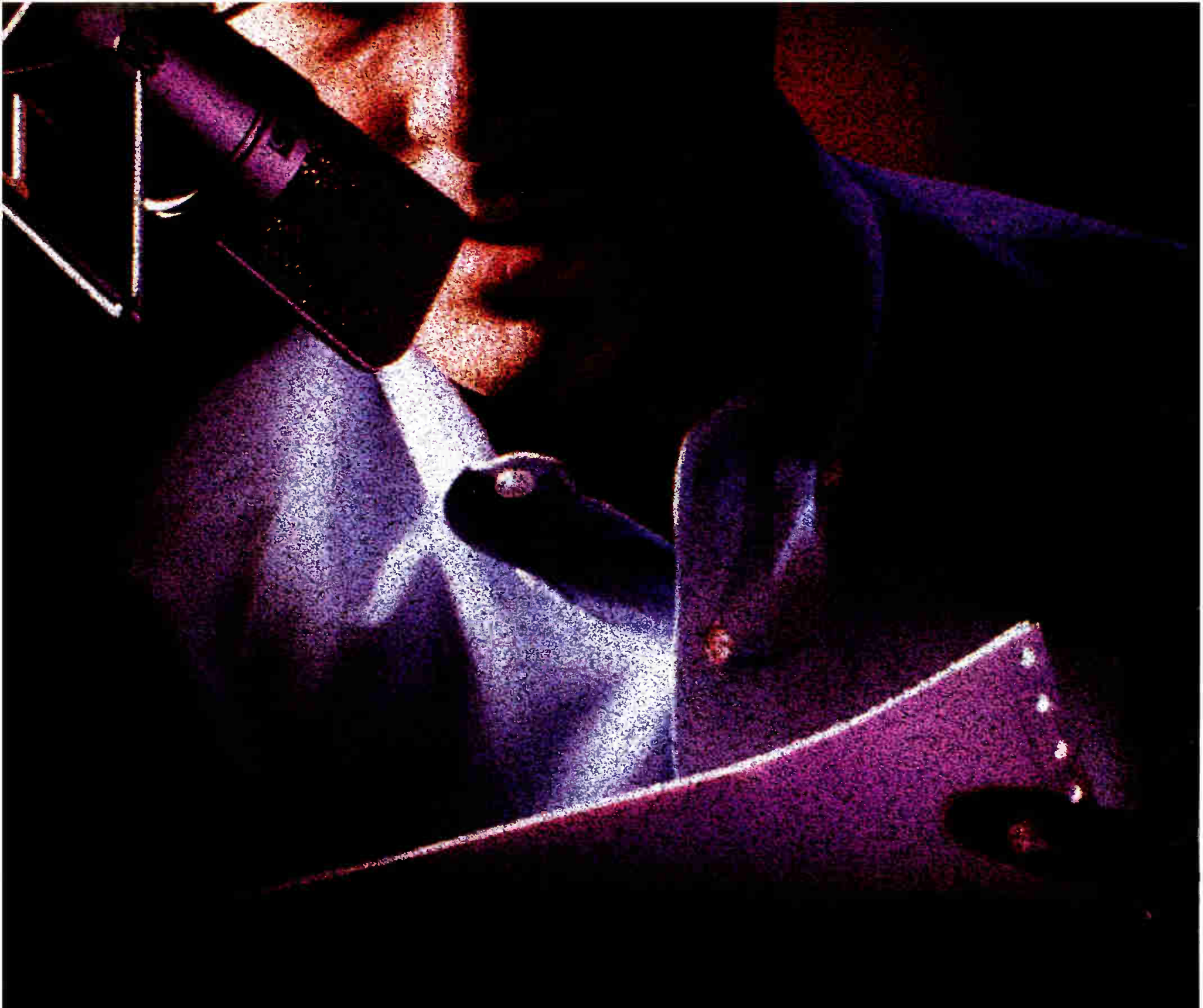
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**Technology:**  
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**page 13.**

## News Future Is Digital, Menu-Driven

by Lucia Cobo

**WASHINGTON** As the radio business continues to move to define its role in a multimedia world and reinvent itself to fulfill that role, the radio news service/network business is changing to keep pace.

Associated Press (AP) Vice President/Director Jim Williams says the news provider is continually formulating plans and developing technology to better serve its clients.

Said Williams: "We are a service company and we are here to meet the needs of the market. On the horizon is putting in digital audio cards in the AP NewsDesk—because once it is digital, it is data." AP is developing software, he added, to make it possible to send an audio cut from Moscow as digital data to Los Angeles, be captured on the AP NewsDesk, and converted to CD-quality audio. "We have to develop the software, the capturing capability for the audio," he said.

AP NewsDesk is installed in 1,500 stations, said Williams, meaning that AP can eventually offer the upgrade at very low cost because the NewsDesk infrastructure is already in place.

As part of its plans, AP is moving to SATCOM 5 and converting its entire system to Scientific Atlanta's SEDAT.

United Press International (UPI) is moving aggressively to reposition itself after years of ownership turnover and financial turmoil. It announced that it will restructure editorial operations in the U.S. into six regional profit and loss centers (New York, Chicago, Los Angeles, Dallas, Miami and Washington).

Steve Geimann, executive vice president and executive editor, UPI: "Each regional office will be run by a general manager responsible for the sales, marketing, newsgathering and customer service of his/her region."

UPI also announced that the restructuring will include a technical move. The service is planning to turn its radio network to an all-digital format. "We are going to provide digitalized equipment for UPI Radio," Geimann said. "The move will improve the fidelity of the network and make it much more flexible—both in the U.S. and in the rest of the world."

A recent entry into the field of radio news providers is StandardNews. The service went on the air New Year's Eve, explained Managing Editor John Rodman. Broadcasting from an all-digital radio news facility in Washington, the service provides stations with Washington-based news product without a brand label. "Our service is designed to be flexible," Rodman said. "We provide building blocks of newscasts (1-5 minute segments) so that stations can construct any package they want, on a market exclusive basis."

Westwood One and Unistar Radio

Networks both have recently reconfigured their respective networks.

The commercial affiliations of Unistar's networks have been reshuffled and renamed, the company now offers advertisers the ability to buy CNN+, Power Network and Super Network. Rich Rieman, Unistar Radio News and Sports vice president: "We are very

encouraged right now. Sales are up substantially from last year at this moment."

Like its counterparts, Unistar is trying to provide affiliates with a greater degree of choice and flexibility. "There is a demand for more custom, format-specific product," he said. To serve that need, Unistar has added "Entertainment Newscall" to its product offerings.

The network also serves affiliates with the best technical products it can produce. "We went with the DAWN system, all-digital storage and playback," Rieman said. "We are planning to standardize transmission (using SEDAT). We are working with IDB to install SEDAT equipment—to prepare us for the nineties and beyond."

Effective August 30, 1993, Westwood One will meld Westwood One News and Entertainment Network (WONE)

continued on page 17 ▶

## Sat Business Booming

by Nancy Reist

**SAN FRANCISCO** Though many segments of the radio industry are still struggling economically, the satellite delivery business is prospering. Paul Manuele, Manager of Advertising and Public Relations for GE American Communications (also known as GE Americom)—which operates a fleet of five C-band and two Ku-band satellites and handles the bulk of the radio traffic—said the satellite-delivered radio business is growing steadily. "The number of network affiliates that are currently receiving programming off GE Americom Satellites last year was somewhere over 5000. The latest figure this year is over 6000."

Bill Sepmeier, Vice President of Research and "Installer Guy" for National Supervisory Network (NSN),

said it is very practical to use satellites to consolidate the efforts of a group of stations. "When you look at it, this is a technology that lets broadcasters really save a lot of money.

"If you're running a group of stations with common formats and you can really honestly deliver a localized format to different markets via satellite and replace a lot of expenses in outlying areas in some of your smaller markets by making use of some of your larger market talent that you've already got in place, it makes sense to do that," Sepmeier said.

One of the issues faced by broadcasters interested in using digital satellite delivery is whether or not to use a compressed system to increase efficiency. Manuele said he does not believe this is really necessary for radio. He explained that GE Americom's Digital Audio

Transmission Service (DATS) is not compressed.

Kent Malinowski, vice president Broadcast Radio and Data Systems for Scientific-Atlanta, considers compression to be an important asset for digital satellite technology. Scientific-Atlanta's SEDAT technology is a compressed digital system used by ABC, CBS and other networks.

"Compression technology increases the number of channels available on the satellite. In fact, the ABC transponder with the new system that we're putting in for Satellite Music Network will enable them to transmit as many as 102 channels in a transponder," Malinowski said.

The use of digital compression for satellite delivered radio services may have some drawbacks however. There is growing concern that the signal may degrade significantly if different data compression schemes are combined once the signal reaches the station,

continued on page 17 ▶

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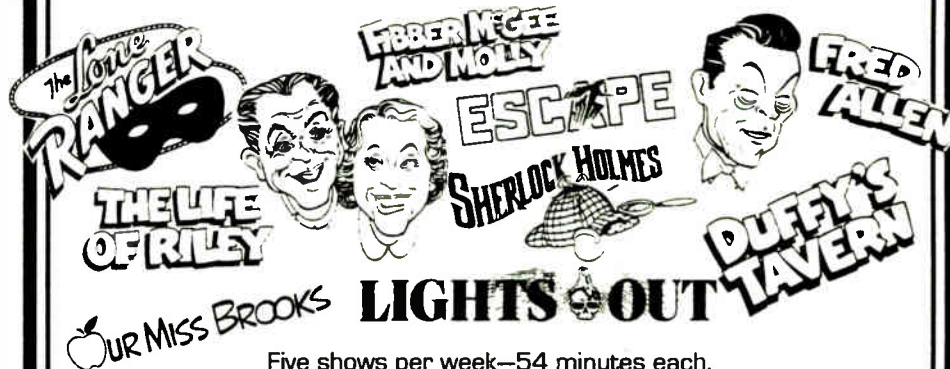
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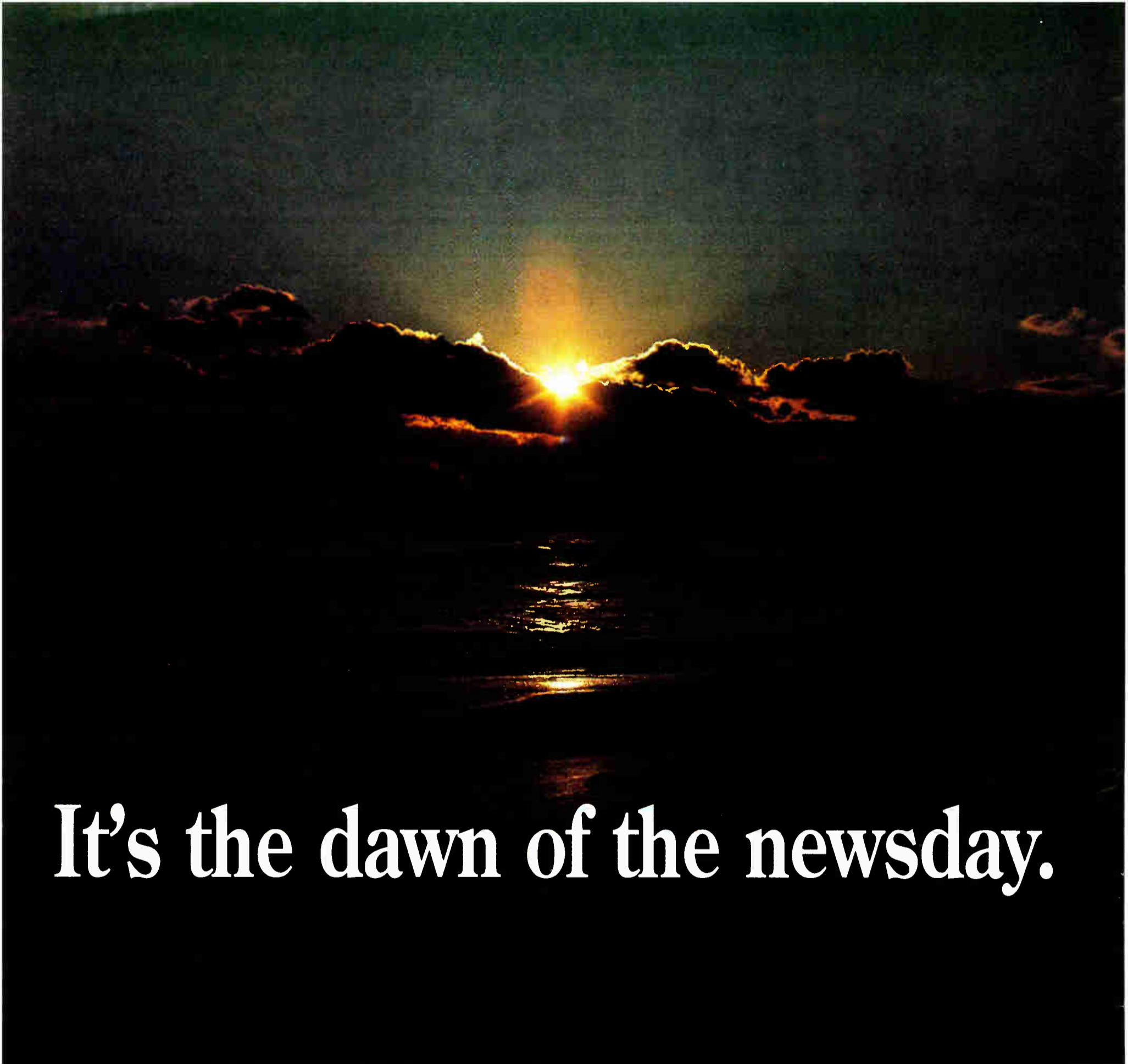
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## UPLINK

# What to Demand from Remote Monitors

by Karl Baehr

**ALBUQUERQUE, N.M.** If the FCC were to walk into your radio station tomorrow, would you pass muster, or are you like many satellite broadcasters, running the risk of huge fines unnecessarily by operating unattended? Let's talk about remote monitoring.

With the proliferation of PC-based satellite controllers, it is no longer necessary to have an operator standing by in your radio station every hour of the day and night, or is it?

I spoke with Leo Cirbo, staff engineer at the FCC field office in Denver. You will find references to specific FCC Regulations throughout this conversation where appropriate.

**RW:** First let's clarify the difference between 24 hour telemetry and 24 hour control. Is continual telemetry necessary in order to have a legal remote operation?

**Cirbo:** 24-hour telemetry may have advantages for some broadcasters, but it is not required. Any monitoring service must have the ability to directly access transmitter monitoring and control equipment and EBS systems at any time. In order to meet the commission's requirements, that remote service must be able to receive EBS tests and alerts and respond. This does not require 24-

hour telemetry, but does require the ability for the remote control service to be contacted immediately and take the appropriate action. (Sections 73.1400, 73.1410 Remote Operation and Authorization.)

**RW:** Let's define the term walkaway. What is appropriate with regard to staffing for satellite stations which employ remote monitoring services?

**Cirbo:** Stations need to realize that they are still required to have a main studio within their principal community contour. This includes a fixed control point. The commission has published a policy statement that is an interpretation of "Main Studio," and the suggested management and staff presence in the community. (Section 73.1125 Main Studio Requirements.)

**RW:** So programming your remote to call your car phone when something's wrong may not cut it?

**Cirbo:** Probably not, no. Paging systems, having the local answering service or another 24-hour business act as control point is not really a good idea.

**RW:** What about LMAs and such? Can Station "A" assume the monitoring and control of its automated or satellite sister, Station "B"?

**Cirbo:** Yes it can, provided the duty

operator is not hampered in their ability to respond to the transmission and EBS system requirements of each station. (FCC 880194 4460 Clarification of The Commission's rules pertaining to broadcast station transmitter remote control operation.)

Perhaps the thing to keep clear in your mind as you explore various satellite, telephone and local remote monitoring arrangements is that it all comes down to you as station owner or manager to take the appropriate action.

Is it worth the risk of a fine to proceed on an assumption that programming your transmitter to call your car phone will be alright? I've personally heard of fines up to \$3,000 leveled against stations that are not in compliance with remote control of their operation.

To this end it is suggested that you shop around. There are plenty of options for this type of service now, not just one or two. Keep in mind that these various companies do not all offer the same level of service. What may sound adequate and cheap, might just be cheap. Tack on a fine and it's not so cheap.

Always ask questions and document the answers. Get it in writing from the monitoring company. Make sure that whatever company you decide to go with will provide an acceptable level of service. The easiest way to make sure of this is to

make sure you are clear on what you are shopping for, what you really require for adequate service.

Remember, it's ultimately your butt on the line.

Use your head. Get clear answers from the start. If it sounds a bit unclear as to how the system works (how the company handles "emergencies," EBS, technical malfunctions), before you sign up, how responsive do you think that company will be when you're an affiliate?

"There are some services out there that do not provide the level of response they should in order to comply with our policies. I strongly urge a station to check out each service carefully and not assume that they are doing it right just because they're doing it." said Leo Cirbo.

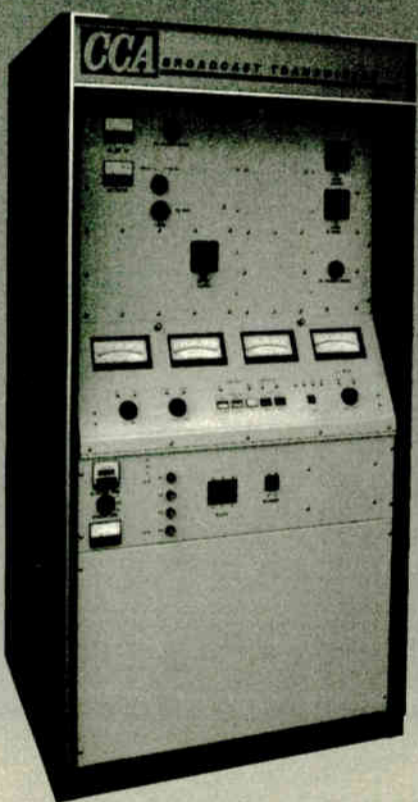
I agree with him, and to that end the second part of this series on remote operation will deal with the two most popular types of service, satellite and telephone. Next time out we'll talk with Ray Reich, president of Southern Communications, a telephone-based service, and Muffy Montemayor, general manager of the National Supervisory Network, a satellite system.

□□□

Karl Baehr is president of KBE "Broadcasting By Design" a radio consultancy that provides support services for satellite radio stations and produces the Actual Radio Measurement (ARM) electronic survey system. He can be reached at 505-828-0488; fax: 505-821-4226.

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# Cable Radio Proves a Serious Player

**Cable Radio Provides Variety and Quality at Homes; But Service Is Not Mobile Like Radio Stations Yet**

by Charles Taylor

**WASHINGTON** Send popcorn. I'm never leaving my living room armchair.

Since hooking into cable radio via my local cable television carrier, I have more music at my fingertips than any local radio dial in the nation could offer. It is uninterrupted by chatter, by commercials or by static. And with the hand-held remote, I can instantly discover a selection title, the artist and what disk it is taken from.

Cable radio is nothing short of a revolution.

The press already has covered the business and engineering aspects surrounding the technology—and criticisms are hard to come by. As a consumer who is shelling out \$9.95 a month for Digital Music Express (one of two U.S. companies offering similar but competing cable radio services), I offer the same deduction: cable radio, with few exceptions, outdoes and outdates FM radio.

## Painlessly installed

The service is painlessly installed by splitting the already-existing wire coming into my apartment for cable television. It hooks into a sleek 10-x2-inch

black box terminal manufactured by Scientific Atlanta, which controls Digital Music Express (DMX) power, channel selection and volume. An accompanying hand-held remote allows the same

## Cable radio offers more than the FM and AM dials of even the best markets.

options, as well as information about song selections.

From the box, a wire connects to my living room hi-fi, allowing me to select DMX along with traditional sound options such as CD, tuner or phono.

At present, the service offers 30 diverse digitally transmitted format channels. Not just classical, but your choice of Symphonic, Chamber Music and Opera. There's Lite Jazz, Classic Jazz and Big Band/Swing; Latin Ballads and Latin Rhythms; Show Tunes and Contemporary Christian.

Among popular music formats, there are modern and traditional country; R&B; Hottest Hits; three rock formats; four oldies formats; and urban offerings

such as Soul Ballads; Blues; Reggae and Rap.

DMX also includes stereo audio simulcasts of five cable television channels: Music Television and VH-1 video channels; and The Disney Channel, Home Box Office and Cinemax movie channels.

(Digital Cable Radio, DMX's primary

competition, also offers 30 formats, but is set to expand service to include up to 250 audio channels.

## Not served by FM

The applications of DMX are far reaching, whether you're an obsessive music fan trying to keep up with the hits or a discriminating classical music fan in one of the many radio markets not served by such an FM station format.

My roommate and I call on DMX whenever we host company. If it's a party, we offer cheese and crackers, daiquiris and the Dance channel. If it's dinner, we serve veal, wine and the Great Singers channel. For casual visits, it's soda and Alternative Rock.

The point is, cable radio offers something for every taste at any time—more than the FM and AM dials of even the most resourceful radio markets.

Those of us accustomed to the anemic selection of music on Washington radio are amazed at the choices on any of the cable radio popular music channels. I am finally able to hear the music I see on the charts. Truly, there is hardly a day that passes that I resist a few moments on the sofa to sample the choices available at will.

But alas, therein lies the single shortcoming of cable radio. The service is limited by its inherent lack of mobility. We all are used to carrying radio through the daily tasks of our lives: we sing along as we shower, we catch the weather while we dress, we hear the news with our coffee. And on the road, radio is our companion.

So far, DMX and Digital Cable Radio cannot be packed up to accompany us through our daily activities. It is a wonder, yes, but only in its place.

Still, I am convinced that cable radio (or, in some parts of the world, satellite radio delivering original programming) is the next chapter in music delivery. Digital Audio Broadcasting remains a promising but bureaucratically restrained technology in the States. In all nations, it is years in the future and even then, faces consumer resistance to purchasing costly radio receivers.

Cable radio is here today, increasing its presence every day. It is inexpensive and uncompromising in quality and programming. Sounds like the future to me.

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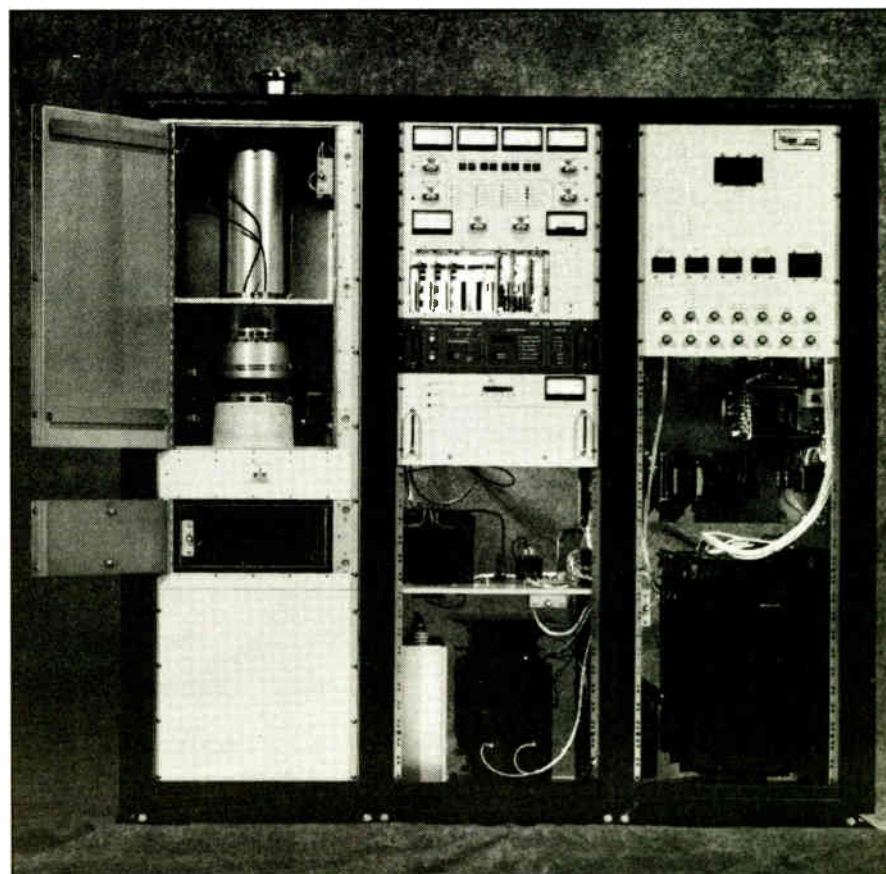
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## PROMO POWER

# Reap Advantages of Technology for Promos

by Mark Lapidus

**WASHINGTON** Using the proper tools makes a significant difference in your product. A man with a shovel can't possibly obtain the same results as a man with a plow. While this seems obvious, many radio station managers are reluctant to supply their promotion and programming people with the necessary tools of the trade.

It's a very slow process, plowing your market armed only with a ribbon typewriter, a cassette deck and a one-line phone system. Let's focus on a few devices that will save you time and free you up to plant more seeds around your city.

## Tools of the trade

Cop a computer. For those of you who already have one, you're probably thinking that this suggestion is so elementary that it's silly. I can't tell you how many marketing people I've spoken to that either don't have access to a computer or haven't taken the time to learn how to use any programs.

If you're writing promos and liners every day on a typewriter, you're living in the stone age. A simple word processing program allows you creative flexibility in rewriting drafts and calling up old copy to re-use. Memos and newsletters are a breeze.

Computer pop art permits you to create good looking point-of-purchase displays at no cost. With spread sheets you can alphabetize winners lists, create data bases, do expenses and plan budgets. Most marketing managers do not have secretarial assistance and need to minimize time spent on administrative functions; this is impossible to do without a computer and programs which they are comfortable utilizing.

Just the fax: Most radio stations now have a fax machine for business purposes, but many are still lacking one dedicated strictly for listener requests, contests and feedback about the station. If you want to communicate with your audience at work you must have a fax machine. Many listeners who would never dream of going to the hassle of writing you a letter will communicate with you via fax.

Your next step is to tie in with one or several computer bulletin boards like CompuServe so that you can receive Electronic Mail (E-Mail). Make sure that one person on your staff is assigned the responsibility for retrieving either faxes or E-Mail and responding if necessary.

## Get the message out

Now that you're set up for receiving faxes, how are you set for sending? It's no longer necessary to spend time printing out letters and faxing them manually. There are several programs available for less than two hundred dollars which turn your computer into a fax machine. Many allow you to fax in groups. This means that if you're sending out a press release to all the local television and newspaper outlets, you simply set up "groups" that enable you to do it all with the press of a key.

In fact, you could even split it up so you've got newspapers in one group, television in another and trade press in a

third. When faxing by computer, your system will keep trying busy numbers. Talk your boss into buying you one of these programs and you'll never spend another afternoon attempting to get your press releases delivered.

Vote for voice mail: If your phone rings as much as mine does you're getting between fifty and a hundred calls a day. These calls are divided between promotional partners, clients, vendors trying to sell you something, and your own staff. Voice mail is the best solution.

An entire system is very expensive and

many stations are not yet ready to make an investment. However, there are many companies (including your phone company) that will rent you a voice mail box at very reasonable price. Even if nobody else on the staff has it, promotion people should strongly consider using it not only because of the volume of your activities, but because you can pick up your messages from a touch tone phone from any location. Make sure that your voice mail number is on your business card.

Listener Telephone Hotline: Now that we've solved your internal communica-

tion needs, let's move on to how you deal with calls from listeners. Many stations still have one telephone line on a cart machine for a concert/entertainment line.

## Handle more calls

At most, a one line system in use twenty-four hours a day, seven days a week can handle around four hundred calls. With a computer-based five-line system you'll be able to handle over four thousand calls weekly! Unfortunately, this is

continued on page 14 ►

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# Understanding the Art of Delegation

by Sue Jones

**BURKE, Va.** If you are suddenly hospitalized for a life threatening emergency for the next two weeks, will your department head and staff know who will have approval authority for routine daily business functions of the station? If they were in doubt about who had check signing and contract approval authority, do they have a policy/procedure manual for reference that lists the authority levels for each management position?

Ask yourself the same questions about your department heads. If one of them had a two week medical emergency, would all of the departmental decisions and routine signature approvals flow up to the general manager level increasing your workload and slowing/delaying work for the other staff members? What would happen to the interim approval authority if one of your department managers resigns?

## A gaping hole

All organizations have to deal with the missing manager (and all other staff members) at some point during the year when he/she takes annual leave. The summer months are more susceptible to this problem because of the greater number of staff members taking annual leave.

Typical thoughts of delegation of authority usually center around the chain of command, organization charts, and who reports to whom. However, delegation of authority is much more involved and is an integral part of the station's operational guidelines. If delegation of authority is carefully thought through, it will be the backbone of the station's management infrastructure.

To evaluate your current structure or develop delegations of authority, start by evaluating your organization chart. Do you have everyone in the station directly reporting to you? If you have more than ten staff members, you should have them

grouped into organizational functions with an appointed manager who reports to the general manager.

Each department manager should have a reasonable span of control. A good average is no more than five subordinates for each manager/supervisor. When a manager has more than five subordinates, the supervisory tasks can consume the entire working day. If any of your departments is large enough to have more than five or six people, consider creating supervisory or senior staff positions. This will help develop the subordinate staff for additional responsibilities and free the department manager for management, administrative, and planning tasks.

When you have evaluated the organizational chart and have well defined positions that relate to functions, you are ready to evaluate the authority levels of each position.

## Who can do what?

A good place to begin the analysis is to consider the types of authority you will give to each management level in the human resource area. For example, would you give your department heads hiring authority, leave request authorization, pay/promotion increases, and/or overtime pay approval? Perhaps you prefer to give department heads clearance approval and you as the general manager will have the final signature authority for certain decisions.

Other human resource related decisions involve requests for seminars/conferences, station paid memberships in professional organizations, corporate credit cards and expense report reimbursements. Will you give your department heads signature approval authority on all of these items or part of them? You may want to give full authority for some functions and less authority that you think should have the general manager's second review and approval.

Another major area of delegation of authority is administrative matters. These include budget development/management and purchasing levels. Do you require your department heads to develop their own annual general and administrative and capital budgets that are submitted to the general manager for final approval? What purchasing authority levels will be delegated to them?

You could also assign dollar amount purchasing authorities to department heads. For instance, a department head would have signature approval on any purchase up to \$500, \$1000, or \$5,000 depending on your station's operating funds and the levels you may wish to delegate.

Other administrative levels of authority include media inquiries. You may delegate one department head (promotion director) to handle all media inquiries. All other staff members should be aware that any media inquiries should be directed to the designated department head.

Another administrative function is management representation letters, commitments and contractual agreements. You might require department heads to review all letters and contracts related to their departments and pass them to the general manager for signature authority.

## Who should spend?

Accounting functions are another major area of consideration for delegation of authority. The most common function is accounts payable (invoices). Department heads should review and approve every invoice that is charged to their department. In addition, you may want to require the general manager's signature on the invoice behind the department head's signature before it is sent to accounting for payment.

Your department heads should advise the station staff who will have their approval authority during the time they will be on annual leave. This could be a

senior member on their staff and is an excellent way to develop supervisory experience and talent.

This list is not all inclusive. You may have other areas that would require some type of management approval. However, you should think through this list and make a decision about what positions have specific authority. When you have made those decisions, it is vital that you communicate this delegation of authority to the department head level and possibly the entire staff.

This can be done simply by developing a chart with the business functions on the left side and the position level across the top. Indicate the approval authorities for each function and department head with a check mark or definitive words such as "review authority" for department heads and "signature authority" by the general manager on some of the functions.

You may wish to delegate some approval to the department head level. An example would be the engineer approving an invoice under \$500 and forwarding it to the business manager for payment. The general manager would not be involved in that approval process since the guidelines had been established and the staff is following them.

A well developed delegation of authority system can streamline your operations and provide a framework for your department heads to function smoothly. It can also be the backdrop for grooming junior staff for greater management responsibilities. It is worth the time and effort you put into it.

□□□

*Sue Jones is a senior manager for Computer Data Corporation Inc. in Rockville, MD. She can be reached at 703-323-0491.*

## Technology Benefits

► continued from page 13

one item that will cost you.

A sophisticated multiline unit with voice mail capability (for requests, comments and contests) ranges from twelve to sixty grand. There are a few smaller systems on the market for a few hundred dollars, but they're not capable of handling the volume of traffic that most radio stations generate.

If cost is a problem, consider selling or merchandising your system. For example, we have beers sponsoring our concert and sports lines. A major insurance company sponsors our traffic line (which is updated by a traffic service).

"Remotes 'R Us': If your station isn't doing remotes then somebody else in the market is probably more visible than you are. We've talked before about how every appearance you do doesn't have to be a remote broadcast, but there are those magic moments when your station should be on the air live from a site. If you're unable to afford some sort of remote gear or lease lines, consider using cell phones. Sure they sound different, but that can work to your advantage when listeners immediately understand that you're live from someplace other than your studio.

□□□

*Mark Lapidus is promotion director for Group W's WCPT(AM)-WCXR(FM) Washington. He can be reached at 510 King Street, Alexandria, VA 22314.*

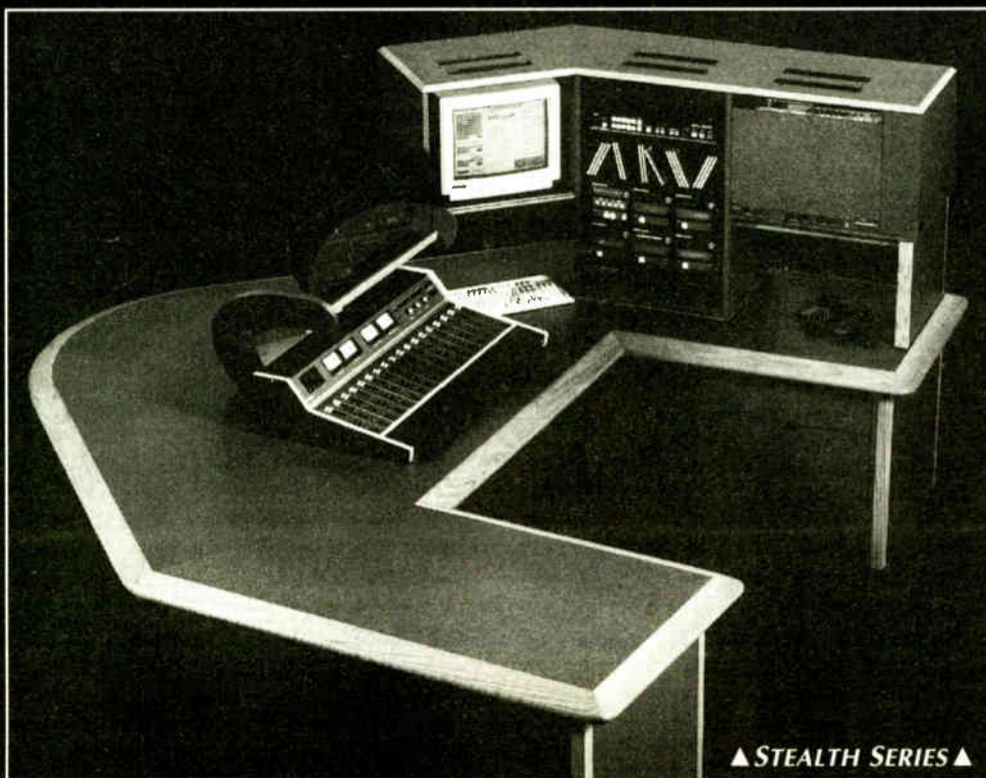
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## MARKETING &amp; MANAGEMENT

# How to Compile a Relevant Database

by John Cummuta

**ALGONQUIN, III.** Last time we discussed reasons why a business should segment its customer database. This month we'll talk about the information you might want to capture and track on each customer.

Your database should be more than a "Who and Where" list. If all you have is the names and addresses of your customers, you're losing most of the strength that database marketing offers. Let's examine some of the additional facts you should be gathering about your customers.

## Relevant target audience

If you're about to have a sale on cookware, doesn't it make sense that you'll probably get the best response from people who have already purchased some cookware items from you? Suppose you went further than just notifying them. What if you had a special day or evening, when just your "Good Cookware Customers" would be invited to view your new items or line. Sound familiar? Many businesses are beginning to offer "Preferred Customer" type sales.

The results of such targeted marketing include dramatically higher closing ratios, and a much lower marketing cost-per-sale. It's just a lot more efficient, and the results are trackable and quantifiable.

When did they buy last? This is pretty straight-forward. You should capture and record in your database the date of a customer's purchases. The reason for this is that research has proven that the more recently a person purchased something from you, the more responsive they would be to an offer to purchase something more from you.

How often do they buy from you? If you have software designed for database marketing, you will be able to track the frequency of your customers' purchases. The reason for tracking this is that people who buy most often are more likely to buy something additional from you than people who buy less often.

How much do they typically spend on a purchase? The average monetary amount of customer's purchases tells you approximately what price ranges of products or services he or she might be responsive to in the future.

## Recency, frequency, amount

If you look at just the last three points—recency, frequency and monetary amount—it becomes obvious that the person who has bought most recently, who also buys most frequently, and who spends the highest average amount, should be considered your optimum prospect for future purchases.

How do they pay? You should be tracking whether a customer pays with cash, a check, or a credit card. Their preferred method of payment can dictate which customers would most likely respond to different kinds of sales and special offers.

Credit card customers might be more responsive to a quick, mail order type offer, while cash customers would probably be more responsive to a "Cash and Carry" inventory clearance sale. Credit card customers are, on average, probably more impulsive in their purchases, there-

fore more responsive to pricey but attractive personal items.

Why do they respond to your advertising? Many business operators have no real idea why their customers are their customers. They're not sure why these people came into their store, or responded to an ad, or called on the phone. When such businesses succeed, it's by accident, and more a tribute to the resilient American buying public than to the operator's individual business savvy.

Your customer can simply tell you, if you ask, why he or she is your customer. They can share with you what they like

and what they don't like about their experiences with your business.

You record this information in your database, in fields designed to hold "Preference" information, and in the future you can send them only those proposals that they will find most interesting.

## Elicit a response

What advertising medium are they most responsive to? You'll find that some of your customers are more responsive to your print ads, while others are triggered by your through-the-mail offers. Still

others might call from a radio or TV commercial.

In reality, the best 20 percent of your customers may well be different for different products or services you offer. That's why some of the data we discussed capturing included "What" they bought and "How" they paid. This data will allow you to further segment and tightly target offers based on product, price, convenient payment method and so on.

□□□

*John Cummuta is an independent Marketing and Management consultant, and the author of the Sales Machine database marketing course and Sales Machine PC database marketing software. He can be reached at 708-658-9107.*

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# Satellite Delivery Business Is Prospering

► continued from page 9

particularly when small speakers are used (see "Compression stacking Mars Audio," RW May 26).

Malinowski said that Scientific-Atlanta has been aware of this potential problem for a long time and has proposed an interface, SEDAT OSI, which could solve these problems if it were adopted by the industry.

Station managers or programmers interested in using satellite technology also need to determine whether or not they need to use one of the bigger satellites which reach more stations. Malinowski said that many of the networks are congregating on GE Americom's SATCOM C5 which carries the bulk of the radio satellite traffic and thus has many receivers pointed at it. Programmers thus have the potential of reaching a maximum number of stations very efficiently.

Some of the larger networks also provide satellite time. Robert Donnelly, vice president engineering of ABC Satellite Services, explained that several other networks and syndicators put programs up on ABC's satellite channels both on a

regular and occasional basis. "We have a transponder on SATCOM C5 and we have excess capacity on that transponder. We have 57 channels currently. We're going to expand that to another 20 channels at least.

"Because not every one of those channels at a given moment is filled up with ABC product, it provides us with the opportunity to allocate these channels when they're available to other services.

He said that multi-channel capabilities allow stations to use single receivers to pick up more than one program simultaneously.

IDB also provides channels on the SATCOM C5 satellite. Julie Spira, vice president audio, explained IDB operates the West Coast uplink in Culver City, Calif., and also provides channels from GE's New York uplink. In addition, IDB has the Sports Satellite Interconnect (SSLI) which connects most major league sporting cities and provides both point-to-point communication and network distribution for several sports networks.

The Public Radio Satellite System provides programming for public stations, but also leases excess satellite space and

ground capacity to commercial users. Pete Loewenstein, vice president distribution at National Public Radio, said they serve over 250 programming sources, including NPR, with 23 fixed uplinks and 350 downlinks in public stations around the country.

Currently, NPR has two transponders on Galaxy 6 satellite. Loewenstein said they plan to relocate to two transponders on the new Galaxy 4 within the next couple of months which should double their capacity. He said they also hope to gradually switch from analog to digital signal delivery.

"You can get to the point where you can do some amazing things with network radio and not even sound at all like a network delivered station."

## Digital Is News Future

► continued from page 9

into WNBC (NBC Radio Networks) and WMBS (Mutual Broadcasting System). All elements of WONE will be reported in RADAR under the two networks.

Larry Cooper, vice president, CBS Radio News vice president, says the network is not sitting still. "We are considering a number of things—how we present the news, or do we find other completely different ways to present the news," said Cooper. "Radio is facing increasing competition from the telephone and from PCs. Soon we have to respond to that; we are seriously assessing the future and what we need to do to meet the demands."

CBS is not ready yet to publicly announce what its plans might be, Cooper said, but look for the news company to make a move soon, he said.

In many ways, Jim Hood's Zapnews led the way in news service innovation. The company, launched roughly three years ago, pioneered the notion of a news menu option for stations.

"We sort of started the menu option," Hood said. "Now everyone is getting in on the act. That is good for business because it allows stations flexibility. As various news services become better, stations do a better job programming news."

ABC Radio Networks has been on the leading technical edge of digital radio for years. Jim Farley, News Director, ABC Radio Networks: "It is very much a part of the strategy, we see ourselves as an electronic tool box. We also see ourselves as the best tool locally, for a radio station, because of the variety of options we offer."

By the end of this year, ABC will have implemented the previously announced upgrade of its entire system to the next version of SEDAT. The company will then have 114 discrete channels.

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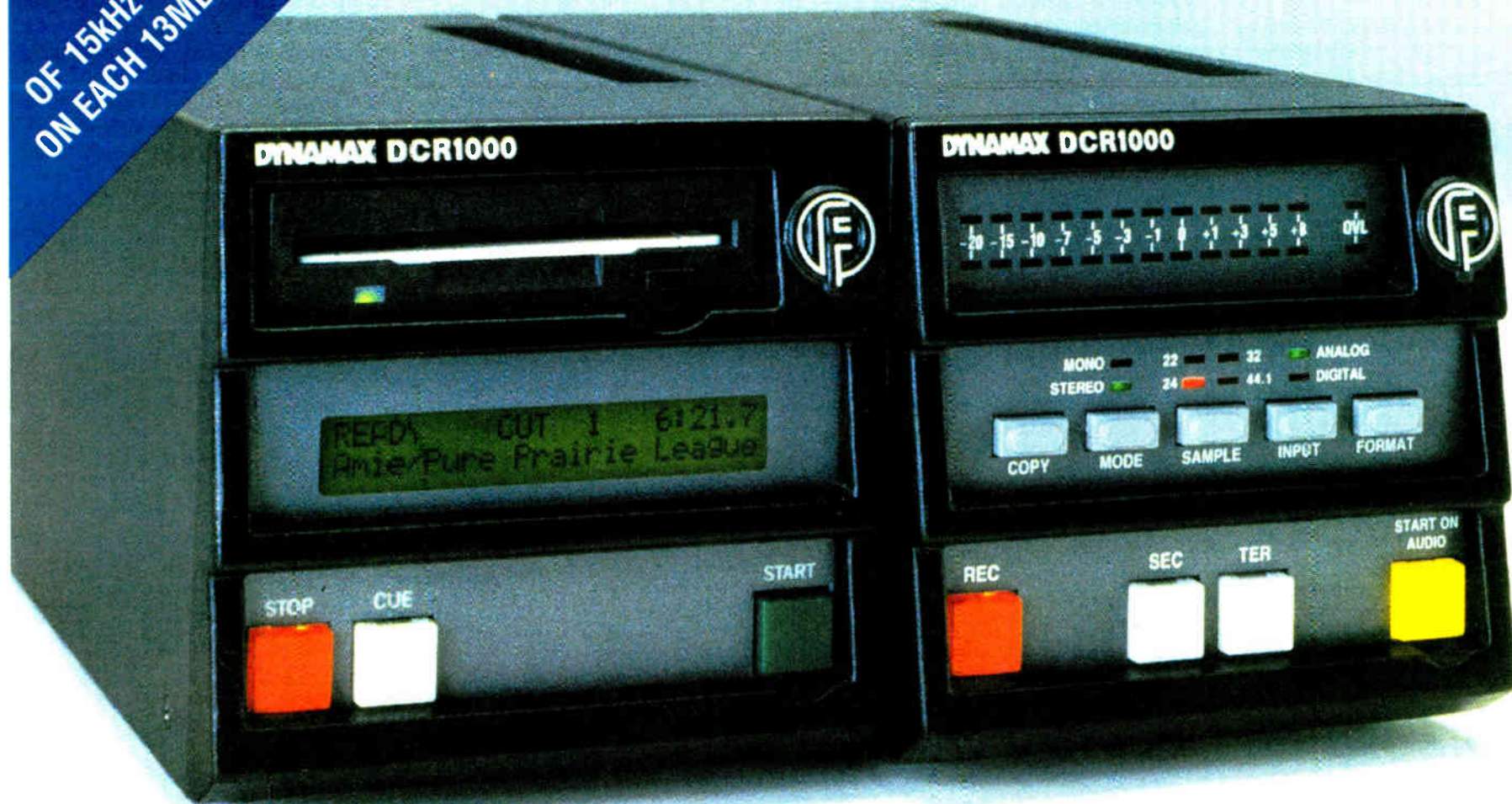
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# STATION SERVICES

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## A-Ware Software Inc. Releases CloseLine

**WAUKESHA, Wis.** A-Ware Software released the latest version of CloseLine, a computer system that organizes school and business closings for broadcast and is now available to all stations.

CloseLine automatically assigns a specific number and password to each organization to prevent prank notifications. CloseLine profiles may hold contact names, phone numbers, type codes, and priority levels.

For information, contact Tom McCarthy at A-Ware Software in Wisconsin at 414-521-2890; FAX: 414-521-2892; or circle Reader Service 110.

## Motor Sports Radio Rights Acquired by Soldiers Radio/Announce "Race Talk" And "Radio-Road-Test"

**JOHNSON CITY, N.Y.** Soldiers Radio Network acquired exclusive non-commercial broadcast rights to Motor Sports Radio, a division of Sportscom. SRN broadcasts information programming to soldiers and their families at 20 Army stations, posts, and camps across the U.S.

Sportscom also announced satellite distribution of its Motor Sports Radio programs "Race Talk" and "Radio Road Test"; both are five minute programs, hosted by Sports Radio News Director Paul Kaminski, and were launched on June 17th.

For information, contact Paul Kaminski at 607-770-9165; or circle Reader Service 33.

## Premiere Offers Mornings To Country Stations

**NASHVILLE** Award-winning country radio personality and long-time WSIX-AM-FM morning show host, Gerry House, will be available on a national basis beginning August. "Gerry House and the House Foundation" is available to country-formatted stations via satellite on a market exclusive basis from Premiere Radio Networks. It will be available on a cash or barter basis.

"Gerry House and the House Foundation" will air daily from 6 a.m. - 10 a.m., ET, and use an interactive computer technology that will allow the local personality to interact with House during the show. The digital technology has been in development for a year, according to Premiere, and allows the audio to be fed as data to the computer and transformed back into audio by the PC at the station. The PC will alert the local host ahead of time of the program contents coming up—including exactly what House is going to say.

For information, contact Ed Mann at 818-377-5300; or circle Reader Service 210.

## Two Men and a Cat Talk about Travel

**SCHILLER PARK, Ill.** Award-winning travel writer, Stan Barr, and "Uncle" Phil, a travel broadcaster on radio WOR in New York City have teamed up with a talkative cat named Tiddles to launch "Travels with

Tiddles", a live call-in radio show about destinations, resorts and cruises around the world. "Tiddles" airs weekly via satellite on Peoples Network Inc. in White Springs, Fla., and Highes Communications Inc.

Broadcast times are 3-4 p.m., PT, and 6-7 p.m., ET. The Ritz-Carlton Hotel San Francisco will be one of the more frequent sites for the live broadcast.

For information, contact Stan Barr at 707-964-7821; or circle Reader Service 169.

## Family Commentary Program To Be Broadcast

**COLORADO SPRINGS, Colo.** Focus on the Family is pleased to announce its decision to "go national" with the "James Dobson Family Commentary," currently one of the most popular shows on KNX Radio, Los Angeles. This ninety-second "byte" of Dobson's characteristic wisdom, wit and professional insight is designed for daily airing, and touches upon nearly every family related subject imaginable from potty-training to marital communication to the problems of aging.

The themes of "commentary" are in fact quick distillations of the content of Dr. Dobson's syndicated daily half-hour program, "Focus on the Family," which is now carried by more than 2,000 broadcast facilities nationally, and around the globe by the Armed Forces Network.

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# WORKBENCH

## Putting Extra Effort into Customer Service

by John Bisset

**FALLS CHURCH, Va.** By now, you are probably aware that Symetrix has discontinued its popular TI-101 telephone hybrid. Actually, Radio Systems Inc., Bridgeport, N.J., bought the manufacturing rights and is now building and shipping the hybrid. I spoke with Walt Lowery, Symetrix's customer service manager, who gave me some useful service notes for the TI-101.

When removing the circuit board from the chassis, the 5/64-inch allen screws used on the front panel must also be removed along with the circuit-board screws.

Before you pull out the printed circuit board, you should notice that the board is also secured by the XLR connectors. These connectors have a locking screw that must be released before the body of the connector will slide out of the shell. You will locate the extra hole as you look at the connector from the "connection" side.

Give the locking screw a quarter turn counter-clockwise with a 1/8-inch "greenie" flat-blade screwdriver. The connectors will slide out of their shells when the board is removed.

Walt also said the signal-to-noise performance of the TI-101 can be improved 15 dB by relocating the power transformer. If your power transformer is mounted on the bottom of the chassis, its field induces hum into the caller output transformer.

Remounting the power transformer to the side of the chassis corrects the problem. This rotates the transformer 90 degrees and eliminates the hum induction.

This modification does not require removal of the printed circuit board. Remove and save the transformer mounting screws. Unplug the power connection to the circuit board, but do not cut the connection from the fuse or the AC cord.

Next, drill two 11/64-inch holes 2-1/3 inches apart, half way up the side of the chassis. The new holes should be drilled to remount the transformer in approximately the same location, except now it will be mounted to the side of the chassis. Re-use the original mounting bolts to re-mount the transformer and power cord grounding connection.

The output level of the TI-101 can be increased about 8 dB by changing two resistors. Resistor R75 should be 27K ohms; R62 should be 270K ohms. Check the values before you remove the board. Many older units already have these values in place.

A "holding coil" is often suggested for the interface to the telephone system. Microtran Co., Valley Stream, N.Y., manufactures the #T4415, 2 Henry holding coil, which can be purchased from the Robert E. Priebe Co. in Seattle (206-682-8242).

Microtran publishes an engineering application bulletin on telephone coupling transformers, written by the company president. Circle **Reader Service 121** for a copy.

Walt's tips for TI-101 customers are really appreciated. Usually, such inside information never makes it to the users in the field.

Workbench salutes Symetrix for collecting this valuable, nuts-and-bolts information and making it available to readers, even though the company no longer manufactures the product. It demonstrates their commitment to their customers. For information on other Symetrix products, circle **Reader Service 64**.

★ ★ ★

Jon Hall of Hall Electronics, Charlottesville, Va. (which repairs, buys, and sells used broadcast equipment and offers a full line of new broadcast equipment), offers a warning based on his years of repairing Tascam 32 reel-to-reel machines.

It seems the motors on the machines can become magnetized, causing the reel motors and/or the capstan motor to stop working.

The solenoids on the old silver-front Otari MX-5050 suffered from the same problem. Their symptom was not letting go. The plunger would become magnetized, and the solenoid would remain engaged, even though no voltage was present on the coil.

I've also heard of degaussing solenoid plungers that suffered from this problem. Holding the plunger as if it were a cart, the degausser is rotated around the length of the plunger several times, then slowly pulled away—just as if you were bulking a cart.

I understand this procedure was used successfully on Sony/MCI JH-110B machines, but I have no personal experience as to how effective it may be. We'd appreciate hearing from any readers that have tried this technique with success.

★ ★ ★

Speaking of magnetism, Jon Hall is distributing a very useful magnet that affixes to the door of your transmitter.

The magnet lists Jon's company name and phone number, space to write in nominal transmitter readings. It also provides plate current, voltage and TPO blanks and a box for a contract engineer, the transmitter field repair/parts service office or some other emergency number. If you'd like one, circle **Reader Service 109**.

★ ★ ★

Jon also passed on a tip for Tascam 122B cassette deck users. When the glass heads on older machines go bad, they may look as though they're fine—no wear marks or scratches on the glass.

The problem manifests itself in muffled or poor audio or a response that can't be EQed flat, using the on-board controls.

Replacing the head corrects the problem. Don't be fooled, or waste time searching for problems elsewhere.

The newer Mark II machines have not exhibited this problem; it has only been observed on the 122B machines which went out of production in the late 80s.

□ □ □

*John Bisset is a principal with Multiphase Consulting, a contract engineering and projects company. He can be reached at 703-764-0751. Fax Workbench submissions to his attention at 703-998-2966.*

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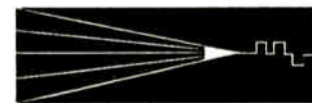
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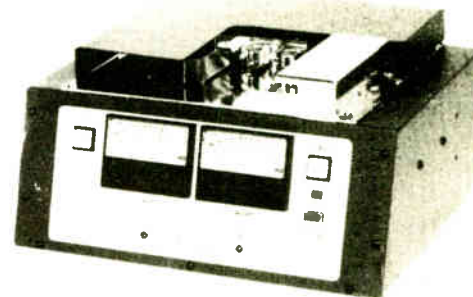
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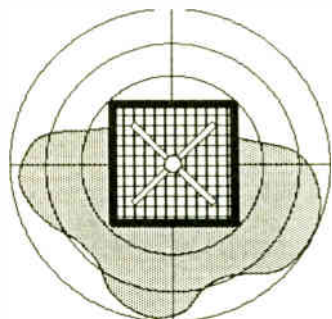


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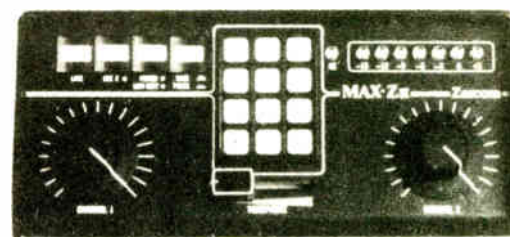
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READER SERVICE NO. 166

# Weber Studies Ushered in New Era

by George Riggins

**LONG BEACH, Calif.** The last *Old Timer* installment included a background of the terms "gauss" and "weber" (RW, May 12) with a few biographical facts about the 19th Century scientific developers, Wilhelm Eduard Weber and Johann Friderich Carl Gauss.

The two worked together for years with extremely limited finances, but their collaboration laid the groundwork for others who later built electronic communications.

Ironically, Gauss was said to have been frightened by the thought of worldwide communication. He was a mathematician first, trying to explain his world in absolute terms of mathematics. Weber, on the other hand, was a physicist interested in reaching findings that others could duplicate.

velocity depends on depth and noted the difference between capillary and gravity waves. They also studied the way oil on water affects wave action.

These studies led to work on sound waves. Weber observed the effect on a tone's pitch as various air pressures were pumped through a coupling of a reed organ's tongue and air cavity.

Weber's most significant work in the development of communications was his study of the effect of temperature on magnetism and his development of galvanic and magnetic instruments. He constructed and designed a portable magnemometer that worked by electromagnetic induction. He is also credited with construction of a dynamo.

In yet another paper, Weber summarized the results of his various geomagnetic observation points that he,

electromagnetic unit of current as it affected the deflection of the magnetic needle of a tangent galvanometer in an 1840 study.

In 1846 he introduced the electro-dynamometer, an instrument that was used to measure the electrodynamic unit of current. The response of the device depended on the square of the current, thus making it suitable for the measurement of sound. The unit the



instrument measured was defined in the terms of the force between two current elements, using Ampere's law—a magnitude of the square root of two greater than the electromagnetic unit.

Weber retired in 1870 but continued to research and publish his findings until 1875. He died on June 23, 1891. The term "weber" was officially adopted internationally as the practical unit of magnetic flux in 1935.

Some of Weber's theories were proven by others after his death. But other researchers were not always in agreement with him. During Weber's lifetime he had strained relations with

Hermann von Helmholtz. Later columns will deal with Helmholtz's contributions.

★ ★ ★

A few weeks ago I received an invitation to attend a lunch meeting of the ROTC. It was not the ROTC that promised us a commission in the armed forces after we graduated college. This one is the Radio Old Timers Club. The locals here in Southern California meet twice a year and say they have been around for 25 years.

Add this group to the Telephone Pioneers, Quarter Century Wireless, Old Old Timers Club (amateur radio), Pacific Pioneer Broadcasters and a few others and I could spend all waking hours at gatherings of the retired set. But there's lots of good eating and a guaranteed enlargement of the waist line.

Amateur radio operator Bill Orr (W6SAI), wrote in an April 1993 article for "CQ Magazine" (an amateur radio publication) regarding the Apex broadcast system, which was in limited use prior to World War II. As Bill says, there is not very much existing literature about Apex. Perhaps someone who is still active remembers this service and can tell us more about the pros and cons. Bill Orr can be reached at 48 Campbell Lane, Menlo Park, Calif., 94025.

□ □ □

*George Riggins has experience in radio and electronics dating back to the 1930s. He is also a licensed ham operator and has had his own broadcast sales and service company, Riggins Electronic Sales, for over 20 years. He can be reached at 213-598-7007.*

## (Gauss and Weber) laid the groundwork for others who later built electronic communications.

Weber's early work was in acoustics and standing waves. One study concerned the distribution of sound around a tuning fork. He and one of his brothers are said to have used narrow channels with glass walls to observe the waves in mercury. They observed that

Gauss and others established to draw lithographic maps showing the Earth's magnetism. The same paper contained Weber's first work on extending the idea of absolute units, as originally proposed by Gauss several years earlier.

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## Q-TIPS

# Never-Ending Modulation Adventures

by John "Q" Shepler

**ROCKFORD, III.** Doc Michaels slouched in the seat of a rented Mercury Sable. From his vantage point atop Lookout Hill he had a panoramic view of the city lights. In the distance he could make out the red beacons from a clump of transmitting towers.

Doc reached down and picked up a device that looked something like a large version of a child's Etch-A-Sketch drawing toy. Sliding the power switch up, he watched as the screen burst into

an eerie white glow. A multitude of instrument windows came to life and a string of vertical bars danced to the music on the radio.

He was satisfied that the device was working properly.

"Ready for a little action, Denny?" he asked his partner sitting in the driver's seat.

"You bet, Doc," came the reply.

Dennis King was chief engineer of K99 and normally the one who made adjustments like this. But tonight he was eager to see what Doc, his group consultant and mentor, could do with the station's sound.

K99 had spent the better part of a week and most of the year's capital budget installing the new digital processing equipment. The device in Doc's lap was the remote tuning pendant. It controlled the station's audio processing from a notebook-sized computer connected to the equipment racks at the station via cellular phone.

## The big moment

Doc turned the car stereo up a little louder and pushed a button on the pendant, next to the legend "AUTO INITIATE." The sound quality changed within a half-second. It seemed a little louder and a lot more transparent. Doc nudged the trackball with his thumb to bring the modulation right up to the

limit.

"Nice to be out from under that tower. Let's see how we stack up to the competition," Doc said as he began to scan the dial using the preset station buttons of the car radio.

Dennis' were eyes riveted to the pendant display as Doc stopped to listen to each station, a few seconds each.

"Not so bad, partner," Doc said after completing the scan. "We're head and shoulders above the pack, except for Rockin' 101. They've still got us and I'm not sure why."

"Aren't they 50,000 watts?" Dennis asked.

**"You can spy on their processing?"**  
**"Yeah. Ain't it great?"**

"That's true, but it shouldn't matter. We're well away from the near fields of any stations," Doc said. "As long as there's enough signal to drive the receiver into full limiting, the RF strength won't help or hurt the audio."

Doc pushed a couple more buttons on the computer display and created two instrument windows, one for K99 and another for Rockin' 101. The displays showed modulation, spectrum and data

such as density, separation, distortion and control bands.

"You can spy on their processing?" asked a surprised Dennis.

"Yeah. Ain't it great?"

Doc had a wide grin and an explanation: "This system analyzes and synthesizes. We can look into our own processing to see what is happening to the audio compared to what we are tuning for. It also takes a receiver feed for a second channel. With Rockin' 101 on channel 2, we can do head to head comparisons and even let the computer tell us what the differences are."

"Don't we need to put tones through or something?"

"Nope. But to do a really in-depth analysis we do need to sample the same material on both signals."

## Tweaking

Doc glanced at his watch. "Ah, it's just 8 p.m. now. We'll sample their song at the top of the hour and compare it with ours."

Following the ID, Rockin' 101 led off with the week's top hit, "Killer Lover." K99 started the same song a few seconds later. Doc pushed the sample capture buttons so that the start points were roughly the same. "I had the night guy primed for this," Doc said, now gazing even more steadily at the screen.

The computer was drawing some strange 3-D charts. "Frequency versus amplitude versus time," Doc said even before Dennis could pose the question.

Doc's eyes lit up. "I think I've got it. Their system is pushing harder in the band around 2600. They're also more dense on the real low end. Probably trying to get those kick-in-the-gut drums as well as some presence. So, let's see. I'll do a little fiddling with the parametric equalizer and maybe a touch more reverb on the low end. What the heck, let's take another dB or two off the dynamic range too."

Dennis was having great fun watching the master. The instant feedback from adjusting the processor to comparing stations on the audio system added to the excitement.

Over the next half hour they tweaked nearly every parameter to move themselves distinctly into the top sound on the dial. Then Doc switched the pendant's screen switch off and laid it back on the floor of the car, satisfied with his night's work.

"That should get us through the book tomorrow with no trouble. Next time I want to work on the AM and maybe try to tune each day part. I'm also in the pipeline to get a disk with the new final limiting algorithm that might give us a touch more loudness."

"Sounds great Doc," Dennis cheerily as he turned the car back toward K99.

A Bronco kicking up a lot of dirt passed the Sable about halfway down the hill. "Those guys are in a big hurry aren't they?" Doc said. "Looked like the little guy in the passenger seat was having trouble holding onto his laptop computer."

"I don't know him," Dennis said, "but the big guy with the beard is Rockin' 101's chief, Jim Weston."

Almost simultaneously, Dennis and Doc groaned: "Oh, no."

□ □ □

*John Shepler is an engineering manager, writer, and longtime RW columnist. He can be reached at 5653 Weymouth Drive, Rockford, IL 61114 or on Prodigy Email as GJMS86A.*



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## OFFBEAT RADIO

# RDS Envisioned as City Traffic Solution

by Dee McVicker

**MINNEAPOLIS** Motorists of the near future may be able to steer clear of traffic jams with the help of electronic maps and their car radios.

That's one of the RBDS (Radio Broadcast Data System) applications being tested by KBEM-FM Minneapolis, well known in the Twin Cities area for its extensive traffic coverage.

Several months ago the 3 kW noncommercial station, working with the Minnesota Department of Transportation (MNDOT), began pilot testing the video road map and two other applications using the RBDS FM subcarrier system, that soon is expected to give radio stations the ability to display call signs and consumers the ability to scan formats on "smart" radios.

Although still in development stage, said KBEM-FM Chief Engineer Wayne Selley, RBDS shows promise in a number of imaginative traffic-advisory applications.

## Natural partnership

KBEM-FM's RBDS experiments began with the purchase of an RE America RBDS encoder and MNDOT's purchase of 10 prototype RBDS Delco receivers. MNDOT had already begun investigating Intelligent Vehicle Highway System (IVHS) technology.

MNDOT has an established open-door agreement with KBEM-FM to allow station announcers to set up a drive-time post at the state's traffic management center, a sophisticated facility that monitors traffic patterns with computerized ramp meters and over 100 video cameras. KBEM-FM drive-time traffic alerts are broadcast from the center at intervals of 10 minutes or less.

DynaGuide, a video traffic monitoring technology, is currently being tested at KBEM-FM. Seven specially equipped Volvos are being tested in various traffic conditions in the Minneapolis area.

"The video screen has a freeway overlay map of the Twin Cities programmed into it," Selley said. "The radio feeds information to this video screen, and by using TMC—Traffic Message Channel—location coding on the RBDS signal, displays icons on various portions of the freeway system where there is a problem."

Another system, Ford Motor Co.'s Indikta, is designed to warn motorists within a few blocks of an accident of any traffic slow-down.

The system transmits location-specific messages to RBDS radios. Intersections or location points with electronic addresses

near a major pile-up are flagged by a computer and the signal is relayed to affected drivers. The signal is automatically screened from other drivers in the area, not near enough to the accident site to be affected.

The hardware requirements for the Indikta project have been completed. The station is preparing for testing in October.

## Global positioning

RBDS could also be used to track a specific car, truck or any

other vehicle anywhere on the planet.

Currently, civilians using the military Global Positioning System (GPS) cannot get accurate longitude, latitude and altitude readings on their decoders. The military degrades the GPS signal for national security reasons. Military receivers are accurate to within one meter. Civilians can do no better than 100 meters with current technology, Selley said.

RBDS radios, however, can

improve accuracy to within three meters by reading a differential signal. The surveyed global position of a fixed object is compared to the GPS signal to determine a correction factor. A computer "takes the information of where it is versus where the GPS says it is.... This correction factor is transmitted by RDS to a mobile receiver, your car receiver," Selley said.

RBDS for global positioning has even greater implications for motorists. The possibility

exists that cars can someday be put on automatic pilot to preprogrammed destinations. This application is a ways down the road, but KBEM-FM is planning to move full speed ahead with it as well.

"We are talking about entering into a pilot program with a company in town that is into vehicle location and navigation systems," said Selley. "That's real preliminary, but that's one of the things we're playing with."

□□□

Dee McVicker is a freelance writer and regular contributor to *RW*. She can be reached at 602-545-7363.

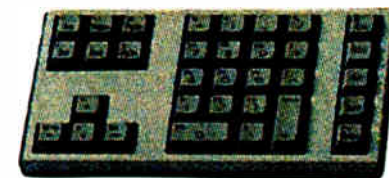
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## **Digilink performs ALL types of automation...**

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## **Digilink is engineered and manufactured by Arrakis...**

Digilink is not simply a hardware package assembled from parts built by *other* computer manufacturers and run under our software. Arrakis is the *only* manufacturer to build nearly all parts of the digital system in-house. We build our own *Arrakis* DSP board, SCSI board, I-O board, switcher board, cabinet, and cabling. Because Arrakis builds the system and doesn't simply mark up someone else's hardware, Arrakis can offer you Digilink with broadcast features and performance unmatched by anyone *and* at a truly remarkable price !!!

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Printer Support- IBM compatible, parallel port

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Freq Response- (+)(-).5dB 10Hz-15kHz

### Physical Specifications

Dimensions- 19" Rack mounted- 19"W x 5 1/4" (3RU)H x 16"D  
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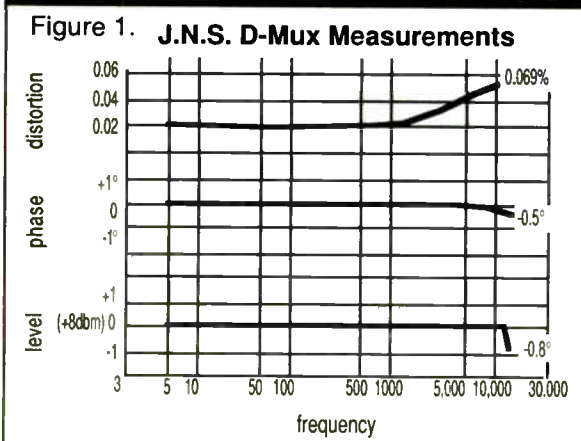
Circle (162) On Reader Service Card  
World Radio History

# FOCUS ON TRANSMISSION

## J.N.S. D-Mux System Shines Down Under

by Frank Wilcox  
Chief Engineer, 3MMM-FM

**MELBOURNE, Australia** Melbourne's 3MMM-FM was the last area commercial FM station to change to a 1.5 GHz digital link.



There were several reasons for this, not the least being that I did not want to change until I could hear a marked improvement in the clarity and definition of the sound of the station.

Another main concern was to have an effectively "straight wire with gain" system. I also wanted, if possible, to purchase a locally made system for the obvious advantages of service and spare parts.

The major components in any linking with a digital bitstream are the analog-to-digital encoders, the multiplexer, and the digital-to-analog decoders.

Triple M has quite a lot of Australian-

made electronics in the system, including a significant amount of J.N.S. equipment, so when I heard that J.N.S. was bringing out its 15-bit linear D-Mux system, I decided to wait and try it out.

Our D-Mux system was delivered in two, single-rack-unit frames. Each frame contains two A-to-D or D-to-A (or a combination if you want return lines) converters, a multiplexer and a main power supply, giving two 15 kHz stereo lines at 2.048 Mbits. It is much smaller than the competition, with the advantage of a built-in power supply. The boards are constructed up to the usual J.N.S. standard, excellent.

The next step was to connect the units together on the bench and start doing some A-B tests against a piece of wire, not only with standard test equipment, but with the most important test gear of all, human ears.

The results were very pleasing and, as the graph indicates, were repeatable whether the units were joined by coaxial cable or the N.E.C. 1.5 GHz links (Figure 1).

The tests were done with a programmable Tektronix SG 5010 oscillator and AA 501 Distortion Analyzer (with 30 kHz low-pass filter before it). The system was +0, -0.8 dB from 10 Hz to 15 kHz. Worst-case distortion was 0.67 percent at 15 kHz (a bit high, probably because of the filter) and the crosstalk was -85 dB. Signal-to-noise ratio was better than 85 dB, which

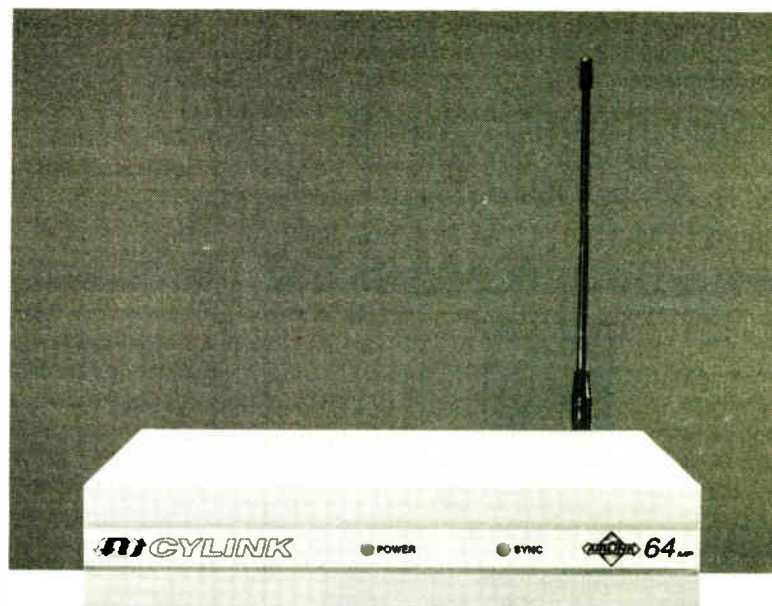
was at the limit of our test equipment. Phase response was exemplary at 0.5 degrees from 10 Hz to 15 kHz.

The complete system was then tested, with a non-programmable oscillator. The frequency response was almost identical, with the only difference being at the bottom end due to the filter. Distortion was slightly higher at 15 kHz, probably because we were not totally sure that the

frequency was exact. The system measurements were taken in a worst-case situation, with received level being -90 dB, whereas in practice it is -45 dB. Crosstalk and signal-to-noise measurements did not change.

The ultimate test is, of course, when the system is put on-air. The clarity of the signal was noticeably improved. The signal's "openness" was improved so much that I had to reduce the processing. Compression artifacts that had been unnoticeable before were now audible.

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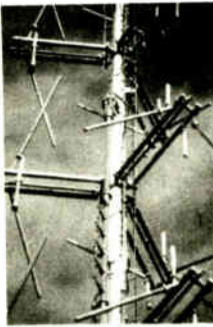
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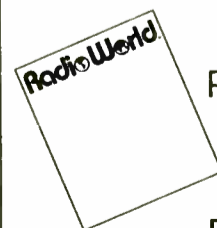
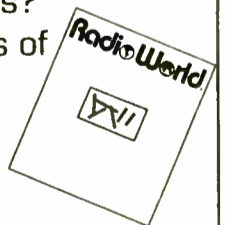
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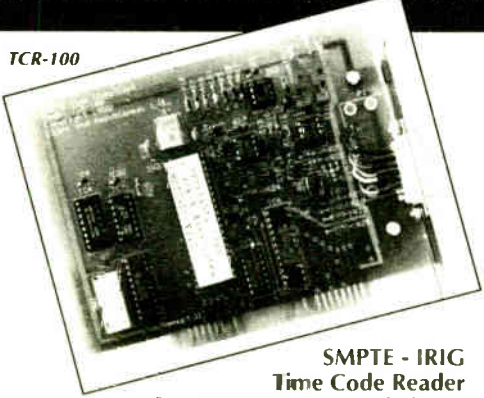


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Obstruction Lamp Alarm Relay  
SCR490D

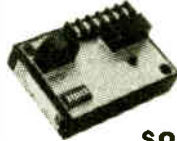


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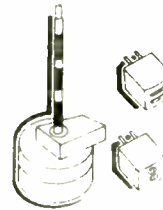
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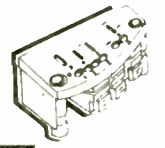
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# BURK TECHNOLOGY

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# Transmission Line Measurements

by Fred W. Greaves

**YORK, Pa.** It is useful to establish reference measurements for existing sample and transmission lines. They will lighten the task of taking repeat measurements when trouble someday develops.

You can establish reference measurements by determining the resonant frequency of the lines and converting that information into the actual phase lag in degrees at the station's operating frequency.

Equipment needed includes an RF generator/detector, such as the Potomac SD-31, and an operating impedance bridge or a GR-type bridge. You should note the test equipment used (including serial numbers) next to any measurements recorded. (This author assumes that the reader is familiar with the setup and operation of this type of test equipment.)

As you may recall from study of transmission-line theory, if a line is cut to 1/4 wavelength or a multiple thereof (3/4, 5/4, etc.) and open-circuited at the far end, it will exhibit zero reactance at the sending end. Conversely, a transmission line cut to 1/2 wavelength or a multiple thereof (1.0, 1.5, etc.) and short-circuited at the far end, will exhibit zero reactance at the sending end. A transmission line cut to 1/2 wavelength or a multiple thereof (1.0, 1.5, etc.) and short-circuited end, will exhibit zero reactance at the sending end when excited with its resonant frequency.

When measuring AM sample lines, it becomes obvious that if toroidal pickups are used, it is very easy to make both open-circuit and short-circuit measurements. If, however, you have sample loops hundreds of feet in the air on half-wave towers, only short-circuit measurements can be made easily.

When possible, make both open- and short-circuit measurements on a given line and average the results of both measurements. This tends to smooth out any errors in the measurement procedure.

### Open-circuit measurement

The first step is to estimate the length of line to be measured in order to calculate the approximate frequency to exhibit a 90 degree, 1/4 wave resonance. Assume we

know this line is approximately 600 feet long and that it is Andrew LDF-4-50, which has a velocity factor of 0.88. We can determine the approximate starting frequency as follows:

a. Determine the approximate electrical length of the line.

$$E = P / F = 681.8 \text{ feet, where}$$

E = electrical length of line (feet)  
P = physical length of line (feet)  
F = velocity factor of line (percentage)

b. Determine the approximate 1/4 wave frequency at which the line will resonate.

$$Fr = (K/E) / 4 = 0.361 \text{ MHz, where}$$

Fr = resonant frequency (MHz)  
K = constant of 984

You now know what frequency to adjust the RF generator to start the measurement. From this point, adjust the generator until you achieve exactly zero reactance on the bridge. Record this frequency and the small amount of resistance as indicated on the bridge.

For the sake of argument, assume the measured resonant frequency shows .384 MHz, and your station operates on 910 kHz or .91 MHz. We can determine the phase lag of this line at the operating frequency as follows:

c. Determine the actual electrical length of the line.

$$E = (K/Fr) / 4 = 640.6 \text{ feet.}$$

d. Determine 1.0 degree length of line at the operating frequency.

$$X = (K/Fo) / 360 = 3.004 \text{ feet, where}$$

X = 1.0 degree in feet at operating frequency.  
Fo = operating frequency in MHz.

e. Determine the phase lag of the line at the operating frequency.

$$PH = E/X = 213.2 \text{ degrees where}$$

PH = phase lag at the operating frequency (degrees)

### Short-circuit measurements

Short-circuit measurements are made the same way, except the formulas in (b) and (c) have a divisor of 2 rather than 4. To determine the 1/2 wave frequency of the same line we have been discussing, proceed as follows:

f. Determine the approximate 1/2 wave frequency at which the line will resonate.

$$Fr = (K/E) / 2 = 0.722 \text{ MHz}$$

Assume that when the line is actually measured it shows a resonant frequency (Fr) of 0.770 MHz.

g. Determine the actual electrical length of the line.

$$E = (K/Fr) / 2 = 638.96 \text{ feet}$$

$$PH = E/X = 212.7 \text{ degrees}$$

Now  $(213.2 + 212.7) / 2 = 212.95$ , or 213 degrees. This is our reference measurement for phase lag at our operating frequency for this particular piece of transmission line.

There is one problem with using these measurements as a reference for future trouble shooting. Suppose you take them in the summer and your problem develops in the winter. The electrical length of a transmission line varies with temperature. When working on a directional AM array, measure on all lines under the same weather conditions.

Suppose the measured line is the sample line for the reference tower (#2) in a three-tower system. You make similar measurements on the other two towers' sample lines and come up with the following:

Tower	Phase Lag
1	-421
2	-213
3	-465

We now have a relationship between the three measured lines that is repeatable regardless of weather differences. Subtracting the reference towers phase lag from all three lines results in the following:

Tower	Phase Lag
1	-208
2	0.0
3	-252

This is the same relationship between lines that your antenna monitor sees when it is measuring your towers. Although the amount of lag on each individual line will vary with temperature, the differences between the reference tower line and the other two towers theoretically should not vary (with stabilized line) by more than 1/4 of a degree. In reality don't expect to see more than one degree of difference.

Depending on the number of towers in your antenna system, these measurements can be very time consuming. But when trouble develops—and it will—you will be far better prepared to find the source of the problem.

□ □ □

Fred Greaves is assistant director of engineering, Susquehanna Radio Corp., York, Pa. He can be reached at 717-848-5500.

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World Radio History



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World Radio History

# Wireless Modem Expands Radio's Reach

by Edwin Bukont

**GREENBELT, Md.** A common concern when investing in new technologies is what are the limitations of a device's application. If you recently purchased, or are considering the purchase of remote production gear, you are no doubt aware of the many products available. You may need to buy multiple systems to accommodate your various production needs.

For those who require both wireless 'RPU-style' and wired systems, there are few products that serve both purposes. A new product, the CYLINK "AIRLINK" series of wireless modems addresses that concern by using, in the wireless

domain, the same digital codecs used for wired connection via ISDN or Switched-56.

AIRLINK does not require access to the digital telephone network, but transmits at 1 W between two points on L-band spread spectrum frequencies of 902-928 MHz allocated by the FCC under the Part 15 rules and thus does not require licensing.

With the proper combination of codec and wireless modem, you can send high-quality duplex (simultaneous passage of data in each direction) communications for many miles. Many present systems, wired or not, cannot provide a return link to the remote venue. AIRLINK even interfaces with ISDN circuits for long haul communication.

## Multipurpose device

The AIRLINK series was introduced at the 1993 National Association of Broadcasters convention at several radio and TV booths. It began with an SST voice modem about four years ago and evolved into the present data-supportive product.

An AIRLINK system, in its basic configuration, requires two transceivers, one for the remote end and one for the destination. The system is commonly used to transport data over a few hundred feet for indoor links and 10-30 miles outdoors with a line-of-sight path. Direct sequence spread-spectrum technology makes the AIRLINK signal virtually immune to terrain and near- or on-channel interference that troubles other systems.

Typical users are broadcasters, computer networks, emergency communications and remote and other various remote-link users in hard-to-access places where wired service is impractical.

Each device requires an appropriate antenna which may be a short omni 'whip' as used in portable cell phones or higher-gain directional Yagi and parabolic dish antennas. Your needs will determine what additional gear is neces-

sary for converting audio, video or data for delivery.

Four models are available. An analog voice-only model (AIRLINK VF) with RJ-11 connectors for interfacing with telephone systems includes hook-switch signalling and ringdown. The remaining three digital models (AIRLINK 64, AIRLINK 128 and AIRLINK 256) can interface with codecs to digitize analog programs. Specify the data rate (64, 128 or 256 kb/s) and standard data connector (V.11 34-pin Winchester, RS-232 or EIA-530) when ordering.

The digital models can provide from mono 7.5 kHz to wideband stereo audio or multiplexed audio/video/data depending upon the data rate and codec used.

For video applications, Picturitel Corp.'s codec combines slow-scan color video, data and 7.5 kHz voice for transmission via AIRLINK 256. Higher data rates of 384 kb/s and 512 kb/s are in the R&D or beta-testing phases. The RF bandwidth occupied increases with the data rate used. Lower data rate units

the sites of a mock disaster staged in Salt Lake City. Comrex Corp. used the system to connect various areas of downtown Boston to a receive site at the Prudential Tower.

## Spread spectrum edge

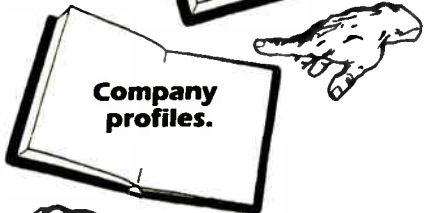
Previous research in digital audio broadcasting has shown that the wide-bandwidth of spread-spectrum technology can overcome the affects of multipath degradation in urban areas and will effectively 'wrap-around' terrain blockage. Radio broadcasters may find the AIRLINK useful for relaying programs between sites indoors, from indoors to an outside production center, from a stadium or arena to the studio or local ISDN interexchange center for delivery to a studio hundreds of miles away.

Two important aspects make AIRLINK particularly useful for remote coverage. It is bi-directional (unlike traditional systems), so you can return high-quality audio from the studio to the remote venue, a useful feature for AM talk radio stations that could generate revenue with evening shows but cannot receive a desired signal after sundown.

For concert events, FMs could link

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**For those who require both wireless 'RPU-style' and wired systems, there are few products that serve both purposes. The CYLINK "AIRLINK" addresses that concern.**

offer a choice of center frequency that denotes the portion of spectrum to be occupied.

The video and audio versions are currently being used by state and national highway authorities to visually monitor traffic over wide expanses of roadway and control highway signs where traditional wiring or microwave systems are less practical.

The Federal Emergency Management Agency (FEMA) recently used the AIRLINK and Picturitel codec to connect

directly to the studio or the remote vehicle without the safety or budget concerns usually encountered at such venues.

AIRLINK also offers the system in repeater, Multipoint 64 MP and networked FTI Access Radio (ARU) configurations that operate on L-band, S-band (2.4 GHz) or C-band (5.8 GHz) frequencies. Such a system can be useful for networking computer systems or remote control systems between studio, office and transmitter sites.

You might consider using AIRLINK for telephone service at a remote site or as a backup STL system. The system requires an external 110 or 220 VAC power from which is derived  $\pm 12$  vdc and +5 vdc power supplies. Development of a DC/DC converter for vehicle operation is underway.

## Pricing

AIRLINK prices (with power supply) start at just over \$3,000. Codecs, such as those made by Comrex or CCS, start at just under \$2,000. Prices usually compare favorably to the cost of traditional approaches. A bi-directional mono audio channel at 7.5 kHz, with the purchase of AIRLINK-64s, codecs, power supplies and antennas costs approximately \$12,000.

Remember, you can use the same codec for many other types of digital audio transmission, including ISDN, Switched 56, T-1, satellite and microwave relay.

CYLINK may be contacted at 408-735-5800. For technical advice, ask for Mark Wurfl in engineering.

□ □ □

Edwin Bukont is the chief engineer at WPGC-AM-FM Morningside, Md. (Washington). He can be reached there at 301-441-3505, ext. 8213; address: 6301 Ivy Lane, Suite 810, Greenbelt, Md. 20770.

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# Purdue U.'s WBAA-FM Goes High-Tech

by Fred Baumgartner

**WEST LAFAYETTE, Ind.** Purdue University's WBAA(AM) was Indiana's first radio station, operated by the school since 1922. Purdue is still making firsts and leading broadcast engineering with its recent design of an innovative, high-performance FM operation.

WBAA's 70-year run has been as a stand-alone regional AM on 920 kHz. Thanks to a monetary gift from the class of 1942, however, WBAA-FM was able to begin broadcasting this year on 101.3 MHz with 5 kW.

The WBAA philosophy has always been to buy or build the best equipment it could afford and take care of it. The AM's studio, located in the basement of Purdue's Elliot Hall of Music, with its stone columns, high ceilings, massive doors and art deco "On Air" lights (rather different from today's closet studios), exhibits a fascinating mix of radio eras.

Racks of meticulously clean Macintosh tube distribution amplifiers and a half-century-old, entirely passive, homebrew mixing board are still the heart of WBAA(AM). CD players operate in the same room with high-quality, modern turntables mounted in the Presto bases that once held turntables more accustomed to playing 18-inch, 78 RPM transcriptions.

## The new WBAA-FM

WBAA(AM) has always featured NPR programming and classical recordings. WBAA-FM follows the same programming path, building on the AM's high-quality CD/LP/DAT/digital-PCM library.

The FM studio (larger than the AM's next door) is built around a Harrison Air-7, 28-channel mixing console. A Broadcast Electronics "Vault" and digital automation system, six Beta machines with PCM encoder/decoders are also available. Put it all together and the audio leaving the studio couldn't be better or closer to the digital source.

The problem is getting that broadcast quality to the transmitter nine miles away.

Maurice Mogridge, WBAA-AM-FM's chief engineer, knew that the weak point in a typical FM transmission system is the STL. He selected a TTC-8090X exciter and TTC solid state transmitter, but then had to determine how to realize the full quality of the TTC exciter.

It made little sense to place an STL transmitter and STL receiver in the path between the high-end studio and the high-quality exciter because the audio quality could never be any better than the modulator and demodulator of the STL equipment.

A digital STL is almost immune to noise and interference, but was ruled out because current technology requires digital compression in order to fit into the FCC RF spectrum mask.

## IF solution

Maurice chose instead to place the FM exciter at the studio and to use an IF (intermediate frequency) interface STL system with no modulators or demodulators.

The TTC-8090X exciter is the only

modulator in the entire WBAA-FM broadcast chain. The STL link (Figure 1) takes advantage of an IF STL transmit-

20 dB pad installed between the exciter and the IF interface. In an emergency, the full power of the exciter could be

routed to a roof-top antenna. The IF interface STL upconverts the FM exciter output to 950 MHz and amplifies it to 6 W, which feeds the STL antenna.

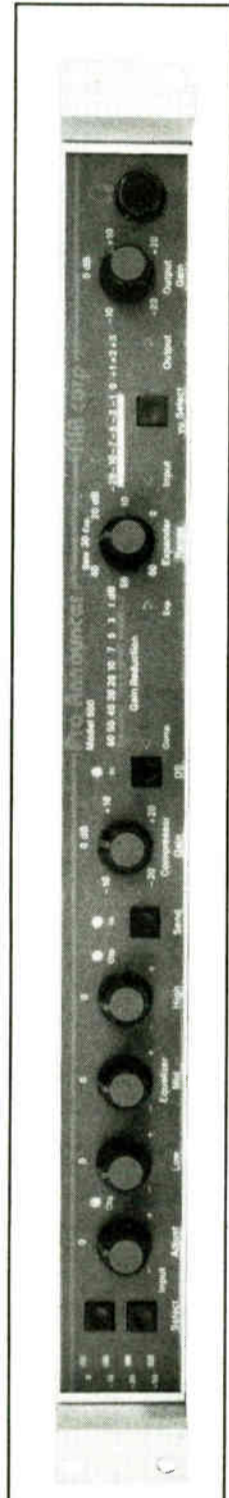
At the transmitter, a TFT Reciter takes in the 450  $\mu$ V signal (300  $\mu$ V is the recommended minimum) and downconverts the signal back to 101.3 MHz, an exact replica of the

**The proof was in the performance: less than 0.1 percent distortion,  $\pm 0.1$  dB frequency response.**

ter, and the TFT Reciter is to preserve the audio quality of the exciter.

The IF STL transmitter takes only 10 mW of the exciter's 101.3 MHz output. The exciter power is turned down and a


continued on page 43 ▶



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Circle (42) On Reader Service Card

# RDS Proves Valuable Tool for Radio

by Joe Sands

**LAS VEGAS** With the mass blitz of publicity surrounding RBDS, most in the broadcasting industry know by now that it stands for Radio Broadcast Data System. But few broadcasters realize the technology's great potential.

RBDS is a data subcarrier that resides at 57 kHz in the FM baseband. Some engineers have had negative subcarrier (SCA) experiences in the past and may tend to avoid RBDS because of potential detrimental effects to their primary FM signals.

My first thought was: "Oh... there goes the neighborhood." With the stereo sub-

channel right next door, at 23 to 53 kHz, what effect would a data subcarrier have, screeching out data?

My fears were unfounded. The two systems merged perfectly. RBDS requires very little injection (or loss of loudness for any PDs or GMs reading this). Typically 3 to 4 percent injection is all that is required for good operation.

Remember, the FCC allows a station to recoup 50 percent of the "lost modulation," so the net loss to a given FM is about 1.75 percent modulation. I wonder how many of you can claim a monitoring system accurate enough to even miss that amount of modulation.

Shortly before the Winter 1993 Consumer Electronics Show (CES), John Casey of RE America and I worked together and installed five of the RE RBDS "coders." None of these installations suffered crosstalk, birdies, whistles or squeals. Other engineers at the remaining five RBDS stations in "RBDS City" had similar success.

## Preparing the demos

The RBDS coder requires a 19 kHz pilot source, from which it phase locks and generates the required 57 kHz signal. Older coders required a source of 19 kHz from either the composite signal or from a stereo

monitor. The latest-generation units loop through the composite so that a separate 19 kHz source is not required.

None of the five stations were able to use injection with an SCA monitor tuned to 57 kHz, which would have been ideal. A standard monitor had to do the job.

Programming the coders for the CES demonstrations was tedious. A work sheet was used to format the radio-text message. Radio text is the user-programmable message that generally provides the station slogan. It can also be used to provide the station request number or be used for advertiser messages.

Happily, by the time of the National Association of Broadcasters convention, RE America had upgraded its software to simplify the programming process. Data to the coders is now entered by means of a standard RS-232 data port. Any RS-232 device can now supply data to the system.

## Practical applications

The first promotional idea I had was an RBDS trivia contest. The jock on the air would promo the "smart radio" contest and where "smart radios" are available, the radio-text message would be generated. Listeners could call in and the correct answers could be sent out in radio text once the contest is over.

I know that the lawyers among us are probably screaming: Lottery! Lottery! But I'm sure there is a way to work in listeners with standard radios too. A station could generate RBDS clues for a regular contest requiring a number of clues to solve a puzzle.

Advertisers could be either given free radio-text messages for purchase of time on the station. Perhaps there could be commercials asking listeners to "mention this RBDS message for a free carwash." You get the idea.

The most innovative RBDS ideas I've seen interface studio CD or mini-disk players with a computer for transmission of real-time back announcing and label information while the song is airing. The radio text could read something like: "'Genesis-I Can't Dance' from the CD 'We Can't Dance,' ATLANTIC, available at Sam Goode's in the Woodfield Mall."

The PTY or "format code" can be changed for block-programmed stations or for stations with a morning-show format that differs from the rest of the broadcast day.

KFBI(FM) in nearby Pahrump, Nev., one of my client stations, runs Howard Stern's show during the morning drive and is Classic Rock the rest of the day. In the morning we program the PTY to "Personality" and the radio text to read: "To talk with Howard Stern call...."

When the morning show is over, the PTY is changed to "Classic Rock" and the radio text to: "The New 107.5 KFBI...Howard Stern all morning... Classic Rock all day..."

RBDS is easy to install, has unlimited applications and can deliver a literal data explosion. I foresee enormous potential for RBDS and the stations implementing it.

□ □ □

Joe Sands is a contract engineer who assisted in the organization and set-up of RBDS systems at several Las Vegas-area radio stations for demonstrations during the Winter Consumer Electronics Show there last January and the National Association of Broadcasters convention last April. Joe can be contacted at Sands Broadcast Engineering, 225 Seahawk St., Las Vegas, 89129, phone 702-254-5645.

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Circle (154) On Reader Service Card

# Harris Introduces a Digital FM Exciter

by **Richard J. Fry**  
Senior Engineer,  
FM Product Support  
Harris Allied Broadcast  
Division

**QUINCY, Ill.** Direct digital FM synthesis enables radio stations to broadcast the true digital quality of compact discs. This is accomplished by maintaining the digital data format from the studio source to the digital FM modulator at the transmitter. By eliminating all intermediate A/D and D/A conversions,

tal FM exciter to use these new techniques. Figure 1 is a top level block diagram of the signal paths in the exciter. A brief description of the function of each block is given below.

◆ **Digital modulator:** The digital modulator uses a 32-bit direct digital synthesis (DDS) device and supporting circuitry to digitally generate the FM carrier complete with stereo and SCA modulation. A digital "tuning number" sets the output frequency of the DDS device in the 5 to 6 MHz range. Incoming digital

RF mixing signal for the upconverter. The source frequency can be set either internally by a DIP-switch array, or externally using a 25-bit parallel data interface through a D connector mounted on the rear of the exciter.

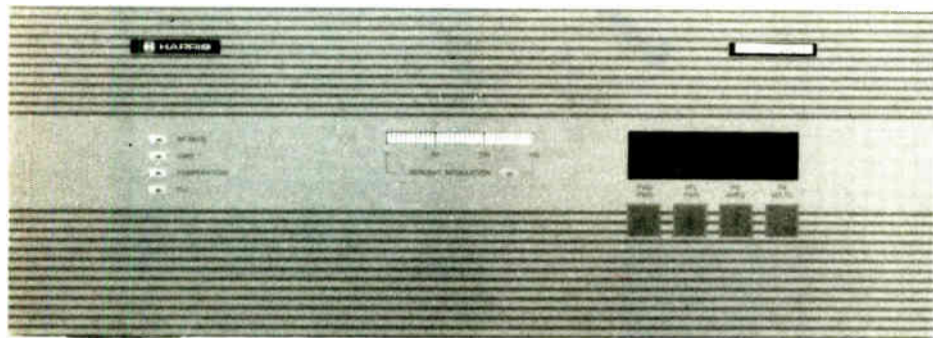
◆ **Digital/SCA Interface module:** A digital/SCA interface is planned to accept AES/EBU digital audio (discrete left and right channels, digitally encoded) and multiple RDS/SCA inputs. The digital interface will include an on-board DSP stereo generator which will feed data directly into the digital modulator.

The digital interface module will allow a direct connection from the AES/EBU outputs of the digital processors now supplied by several studio-transmitter link system manufacturers.

The digital interface module can be substituted for the analog interface module (this module is now in the design phase). This allows stations to use the digital exciter now with analog baseband sources, and then upgrade the exciter to work with an all-digital program path later, when their digital studio-transmitter link is installed.

◆ **Upconverter/bandpass filters:** Outputs of the digital modulator board and the frequency source are converted to the final output frequency in the upconverter.

▶ continued from page 42



Harris DIGIT 50 Watt Digital FM Exciter

noise and distortion added between the source and the output of the digital FM modulator is zero.

## Digital advantages

Among the advantages of digital modulation over the traditional analog voltage controlled modulated oscillator (VCO) is the elimination of additional A/D and D/A conversions which add distortion, noise and system cost. This benefit is a result of the direct interface to digital sources/STL without intermediate A/D conversions.

Perfect stereo is achieved through the DSP synthesis of stereo in data format directly into digital FM modulation. This eliminates signal degradation due to amplitude and phase limitation of analog baseband.

Low frequency tilt and overshoot for ultimate bass response is completely eliminated and digital modulation is unaffected by large transients in program sources (STL carrier squelch, etc.) due to the modulator frequency response capability to DC. This also means no off-air time for AFC/PLL overload relock.

True modulation level is read from the modulation data, allowing for exact modulation metering at any frequency.

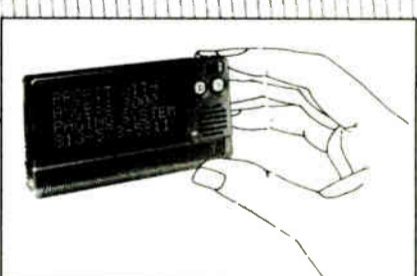
The modulation level and linearity are independent of carrier frequency, meaning that no adjustment is required when the exciter frequency is changed. This particular feature is useful in N+1 systems, which use one broadband transmitter as standby for several other transmitters at the same site. On failure of any operating transmitter, the standby transmitter is automatically set to the required frequency and program source, and replaces the failed transmitter.

Digital circuits cannot drift and do not need adjustment to meet specifications, meaning there is operational stability with absolute, digital control of carrier center frequency and deviation. Circuits work as well after 20 years as when installed.

The Harris Digit™ FM Exciter is the first commercially available, fully digi-



program data at about a 500 kHz data rate is used to offset the tuning number to modulate the output signal.

◆ **Frequency source:** The frequency source uses a crystal-referenced PLL synthesizer to generate a high quality



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World Radio History

# STL Manufacturers Embrace Digital World

by Dee McVicker

**GILBERT, Ariz.** Digital is sweeping through the telephone company and the STL microwave band, according to a number of equipment manufacturers, some of which have begun shipping digital products in record numbers for studio-to-transmitter and even studio-to-studio links.

Of the STL systems currently being sold by Moseley, the company that introduced the digital microwave STL three years ago, 70 percent are digital, according to the company's national sales manager, Dave Chancey.

"All total, we've sold about a thousand DSP 6000s worldwide," said Chancey, who has noticed a substantial rise in demand for the company's digital STLs over the past year.

TFT's Darryl Parker also reported landslides in sales, calling recent interest in his company's new digital add-on units for analog STLs "phenomenal." "We're sold out through our third production run," he said of

TFT's new DMM92, which began shipping in April.

## Demand for digital

Part of the demand, no doubt, is due to both newly formed local marketing agreements (LMAs) and duopolies and the July 1 STL deadline, by which time broadcasters were required to use only type-notified STL transmitters for compliance with part 74 of the FCC rules.

Still, said Tom Daily of Dolby, which manufactures the DSTL digital STLs, "A lot of (broadcasters) are excited that there has been a real move in the marketplace to improve the quality of STLs. I think a lot of people feel like here they are using CDs and they're buying digital workstations, and there's all this improvement in the studio but oftentimes the STL is the weak link."

Digital, he feels, has changed that perception and has substantially raised the quality of STL transmission and reception. His customers report that of the many benefits digital STLs offer, audio quality rates as one of the

most important features.

Digital STLs provide 90 dB dynamic range, and as is inherent with digital, do not vary their performance based on available carrier or signal-to-noise ratios. Digital STLs also require lower signal gain than analog STLs, and for this reason are desirable for lengthy paths.

"There are three reasons why people ought to consider digital,

rate reduction, it would occupy twice the spectrum."

Nonetheless, available spectrum for microwave links is diminishing and more and more broadcasters are looking at alternatives such as telco for STLs.

By going back to the phone company, we are actually taking a step forward," said Jeff Detweiler with QEI, which introduced the CAT-LINK for T1

## Digital innovation has changed the perception that STLs are the weak link in the transmission chain.

and that is if they need additional channel capacity, such as an LMA, or if they have co-channel interference on their STL, or they have a marginal path. Digital does offer a lot of advantages for those conditions," said TFT's Parker.

Plus, digital technology has enabled these newer STLs to put more signal into less spectrum. Bit rate reduction schemes such as G.722, MPEG/ISO and AC-2 have enabled spectrum efficiency along the lines of 250 kHz occupied bandwidth for two audio and two auxiliary channels and 400 kHz occupied bandwidth for four audio channels and two auxiliary channels over microwave links.

## Bit rate reduction

Bit rate reduction is a necessity for digital microwave links, said Daily, whose company developed the AC-2 algorithm. "Because without any type of bit

lines in 1987 and recently introduced the Q-MAX 16-bit discrete card for the product.

Digital phone circuits like T1 are less susceptible to cross talk and noise, he said. Digital telco is also coming down in price because of greater demand and availability. Typically, T1 lines are "anywhere between \$10 and \$40 a month per mile," said Detweiler, and are competitively priced with 15 kHz analog lines when comparing price and performance.

"All of the phone communications for the most part are digital at this point, where they have capacities that they are looking to market," he said. However, some areas of the country are more conducive to digital service, he pointed out, naming California, Washington, Oregon, Florida, and Georgia as just a few.

One reason for the increased popularity of T1 is its inherent full duplex capability, observed Roger Shaw with Intraplex,

which manufactures a T1 multiplexer for broadcast applications. "Typically, when you think of STLs, they tend to be one way. The functionality of T1 is full duplex so consequently when you do install (T1) you have the capability of not only STL but TSL, transmitter to studio, as well as full duplex circuits," he said.

## Options abound

ISDN (integrated services digital network) and Switched 56 digital phone services are also coming to the rescue for broadcast stations having to make interesting studio-to-studio or studio-to-transmitter hops in this new age of LMAs and creative broadcasting.

David Lin at CCS Audio Products, which manufactures digital codec products for digital telco lines using the MPEG/ISO algorithm, reported linking his company's equipment with microwave STLs, as did Lynn Distler of Comrex, which manufactures the DX digital codec for digital telco.

"We have people that are in LMA and similar types of situations where they have multiple studios, and they interconnect their studios either on switched or dedicated digital service," said Distler.

Digital also is taking on other forms for STL use. Ken Leffingwell of Wegener Communications spoke of his company's QPSK modulated product, which is typically used as a subcarrier over video or FM<sup>2</sup> networks, and is now being considered as an STL subcarrier.

As broadcasting becomes more creative, and digital becomes more advanced, it's likely broadcasters will find many other uses for digital in transporting audio from studios to transmitters and other studios.

## New Bext RF Gear

**SAN DIEGO** Bext Inc., with its HPT series of RF devices, attempts to give broadcasters the flexibility to use one single box as an exciter, translator or booster in either digital or analog operation.

The series comes in four versions: the HPT-FMR (FM exciter with built-in FM composite receiver); the HPT-STL (FM exciter with built-in STL receiver); the HPT-SGN (FM exciter with built-in stereo generator), and the HPT-EXO (stand-alone exciter).

HPT-FMR and HPT-STL are designed to break the chain between the internal receiver and transmitter sections, allowing for local audio input intervention, as well as the ability to alternate between a satellite feed and an off-air terrestrial feed. The HPT-SGN can receive separate left and right input.

Operating frequencies are programmable at the front panels. Nominal specifications fall in the range of 0.03 percent THD and 80 dB S/N. The FM receiver section is available with a narrower RF bandwidth option, which makes reception possible when there is an interfering first adjacent channel.

All HPT units include: a synchronization port for phase locking boosters; adjustable fold-back determined by either the internal direction coupler or by outside connection with the coupler of the final amplifier in the RF chain; a carrier-enable/carrier-detector sensor with squelch and RF muting; quadruple volt-

age capacity; IF monitor; TX monitor; SCA 1, SCA 2, mono and MPX out/in ports, and 20 W of programmable output power in 1 W step increments.

Bext expects to introduce future models at additional power levels.

□□□

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# Create an RFR-Safe Environment

by W.C. Alexander

**DALLAS** At stations all over the country there are work areas where the FCC/ANSI RF radiation (RFR) exposure limits are exceeded.

Somewhere in or around the transmitter site of just about every station on the air there is an area unsafe for humans because of high RF fields. It may be on the grounds at the transmitter site, in the transmitter building, in and around the tuning houses or way up on the tower (perhaps even when all stations on the tower are not transmitting).

It is the licensee's responsibility to know where these areas are and to take steps to insure that workers and the public are not exposed to unsafe RFR levels.

## Finding hot spots

In past **RW** articles, I have demonstrated how to calculate the RF power density (RFPD) at any given point. I won't go into the number crunching again, but I will remind you that the correct procedure is to plug in the total power from each antenna (H+V, aural + average visual, etc.), calculate the RFPD from that antenna at the point and figure the percentage of the FCC/ANSI limit that the calculated RFPD represents. Then add all the percentages together to find the total percentage at a particular point.

Measuring is better than calculating, but if you measure, be sure to do more than a

spot-check. Lay out the area of interest in grid, measure in accordance with the meter manufacturer's instructions at each grid line intersection and note it by X-Y coordinate. This will give an accurate and scientifically correct picture of the RFPD situation in the area of interest.

Once the grid has been measured, check for "hot spots" around potentially reradiating objects. Carefully note the location of any such high RFPD areas.

If it appears that you do have a problem with high RFPD levels at your site, it will pay in the long run to hire a professional

to make measurements, submit a report and make recommendations on dealing with the problem. With new and in some cases tighter standards evidently on the way, the consultant should make his recommendations with an eye toward the new limits as well as the existing ones.

## Posting warnings

Hypothetically assume there is a problem at your site, a mountaintop with a short tower. Also assume the area around the tower base, including the interior of the transmitter building, have RFPD levels exceeding the FCC/ANSI limit. How do you bring it into compliance and insure the

safety of the public and workers?

Start at the perimeter of the property. First and foremost, take steps to keep the public out. Fence the perimeter at a radius sufficient to keep people out of areas where RFPD is in excess of the limit. Place signs along the perimeter and at all gates indicating that high RF fields are present. This pretty well takes care of the public.

The situation is different for workers. The station engineer, the guy that keeps

the weeds cut, the HVAC service man and others occasionally have

to be inside the perimeter—some for extended periods of time. You must take steps to insure their safety.

These might include procedures that take advantage of the time-averaging provisions of the ANSI guideline when only periodic entry is required for maintenance activity. I used an example of this in a previous **RW** column, in which a typical AM station engineer had to read a base current where the RFPD was in excess of the limit. Provided he was in and out within a prescribed amount of time, there was no excess exposure.

(I must say that I got some mail on that one. Alert readers pointed out to me that

the engineer would have had to spend the remainder of the six-minute period with no exposure at all. This is true, and I should have pointed it out. I omitted it in the interest of simplicity.)

What about your mountaintop site, though? How can we insure the HVAC service man's safety?

It is unlikely that excessively high RF power densities will exist everywhere at the site. There are probably areas where reflections and natural shielding make it safe to work and operate. You must know where these areas are and mark or fence them, either with contrasting paint or signs.

You can then make up an 8 1/2 x 11 inch laminated card called the "Occupational Exposure Guide." This card should include: a description of the ANSI standard and its time averaging provisions; the significance of all markings and fences; a definition of the maximum time allowed in the marked areas; the reduced-power factors for on-tower work, and telephone numbers for obtaining additional information.

Copies of this guide should be available at the site and given to anyone working there. A copy should be posted on each exterior door and several should be kept at the studio as well. I recommend giving a permanent copy to each contractor that regularly works at the site, including the HVAC service man.

## Indoor RF

Areas inside the building just about have to be "safe zones" with RF power densi-

continued on page 43 ▶



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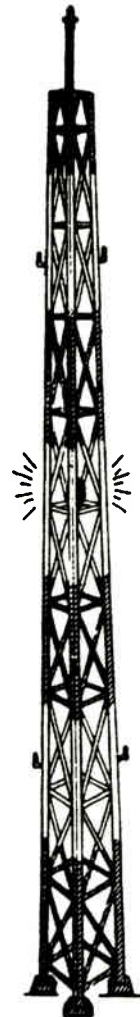
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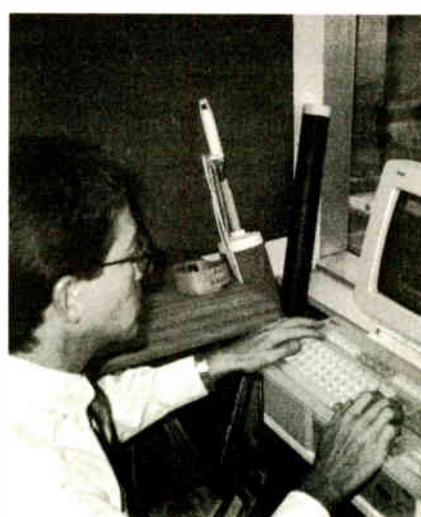
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World Radio History

# Harris Introduces a Digital Exciter

► continued from page 37

Innovative bandpass filters, which do not change the FM sideband structure, provide -80 dBc or better filtering of the FM signal. The output of this circuitry is a very pure FM signal on the assigned carrier frequency, ready for amplification by the following stages in the exciter/transmitter.

► Power amplifier: The RF power amplifier boosts the output power from the upconverter to at least 55 watts (adjustable, 3-55W) to drive the FM transmitter. The amplifier uses rugged MOS-FET devices and is self protecting for load

mismatch and overtemperature. An optional harmonic filter with RF sample port is available to use the Digit™ directly on the air as a low power transmitter.

► Analog/SCA Interface module: The analog/SCA module allows the Harris Digit™ FM Exciter to be used with analog baseband channels. It provides compatibility with the same composite baseband interface, monaural audio, and analog 57-92 kHz SCA subcarrier input ports as found on the Harris THE-1 FM Exciter, and many other analog FM exciters. This module converts baseband input signals to the

composite digital format needed for the digital modulator.

Whenever an AES/EBU program path becomes available, the digital module described above may be purchased and substituted for the analog module. This will provide an all digital path from AES/EBU inputs through the generation of the FM broadcast signal.

## Exciter performance

The performance of the new Harris Digit™ FM Exciter is highlighted in the table below. Note these measurements were made through a wideband input of the analog input module. Although this performance is excellent, some parameters are better when using the direct digital interface module.

The predicted theoretical performance of this technology is beyond current test equipment capabilities to measure accurately.

Parameter (analog input)	Theoretical	Typical (demodulator dependent)
Harmonic Distortion	0.002%	0.005% (demodulator dependent).
CCIF Intermodulation	-96dB	-94dB
TIM/DIM	0.002%	0.007%

*Stereo Separation (15kHz)	-80dB	-68dB (20Hz-15kHz)
FM S/N	-96dB	-93dB (deemph-sized, unweighted)
Asynchronous AM Noise	N/A	-65dB
Synchronous AM Noise	N/A	-55dB
Spurious Output	N/A	-90dB (≥600kHz from carrier)

\*Based on the following measured values (20 Hz-53 kHz): ± 0.003 dB amplitude response and ± 0.01 degrees phase linearity.

The Harris Digit™ FM Exciter offers broadcasters the latest advances in digital performance as well as the final link in the FM broadcast digital program chain. FM modulation is produced by all-digital means using direct digital synthesis. A choice of input modules allows an immediate benefit for stations even without a digital studio-transmitter program link, with the capability for an easy upgrade later on.

The Harris Digit™ FM Exciter is truly an advancement of "the state of the art" in FM broadcast technology.

Thanks to Edwin Twitchell, Harris Digit™ FM Exciter project engineer, for assistance in providing resource material for this article.

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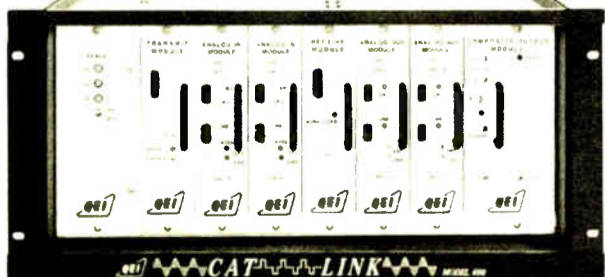
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## Create an RFR-Safe Working Environment

► continued from page 40

ties well below the prescribed limits. Radiation could originate with cabinet leakage from transmitters, phasing/coupling equipment or open transmission feeders. Promptly determine the sources of these fields.

If the fields are coming from outside, it may be necessary to screen the building. For VHF and UHF frequencies, a copper screen can be installed on the roof and bonded continuously along its edges to a wide copper strap that in turn connects in multiple locations to the station ground.

Install the screen under any roofing material if possible (directly on the decking), or it will be disturbed whenever roof work is done later. Each strip of screen should be continuously bonded to adjacent sections, not just spot welded.

Once the roof screen is in place, remeasure the RF power density inside the building. Chances are that it will have fallen dramatically, but if not you might have to screen the walls. In some cases, reflections may make it necessary to screen one or more walls in the same manner as the roof.

A copper mesh (rather than the

screen) is useful for protecting AM stations with high RF fields inside the building originating from outside. You will probably have to screen the roof and all walls, but you can spot-weld these adjacent sections.

In some situations, such as diplexed high-power operation into a single tower, the RF field is so high in the vicinity of the tower base that even time averaging won't help the guy who needs to read the base current. A remote-reading base ammeter may be the solution. Some companies can provide just about any reasonable length of coax between the pickup transformer and the meter and calibrate everything at the factory.

There are just about as many varieties of RFR protection as there are sites. I've just touched on a few, but some principles should apply universally. If anyone has creative solutions to specific problems, drop me a line. I'd like to hear about them and share them in the future.

□□□

*Cris Alexander is director of engineering for Crawford Broadcasting. He can be reached at Box 561307, Dallas 75356.*

## WBAA-FM Goes High-Tech

► continued from page 35

telemetry, subcarriers for auxiliary services could be injected into the Reciter at the transmitter site as well.

Maurice paid special attention to off-air monitoring. The station's FM modulation monitor is located on the same rack as the FM exciter, but the monitor's desired signal comes from nine miles away, not a nearby exciter.

To assure leakage from the exciter does not affect the monitor, the downconverter is located with the roof-top antenna. The monitor receives a 650 kHz IF from the roof, and thus is completely immune to the 1 W exciter's 101.3 MHz signal, even though it is on the exact same frequency as the main transmitter.

When it was all done, the proof was in the performance: less than 0.1 percent distortion,  $\pm 0.1$  dB frequency response from 10 Hz to 90 kHz and a signal-to-noise ratio of 90 dB through the exciter, IF interface, Reciter, transmitter and modulation monitor.

This kind of audio performance is what one would expect to see on a test bench, and certainly not with a nine-mile STL in the path.

□□□

*Fred Baumgartner is the new chief engineer of KDVR(TV) Denver. He recently stepped down as a project manager at TFT, Santa Clara, Calif. He assisted in the transmission installations at WBAA-FM while in his position with TFT.*

Once the stereo audio and subcarriers modulate the TTC exciter, the signal is never demodulated or remodulated until it reaches the listener's receiver. What goes into the IF interface transmitter is what comes out of the Reciter and the WBAA-FM transmitter.

WBAA-FM uses a 152 kHz subcarrier to remotely control the transmitter. The signal is above the highest frequency that the FCC permits to be broadcast over an FM channel, so it has to be moved before reaching the FM transmitter.

TFT's Reciter uses a phase-locked loop to lock onto the incoming 152 kHz subcarrier, and then subtracts this from the Reciter output, cancelling the undesired subcarrier before it is broadcast. The separated 152 kHz subcarrier is fed via a separate output to the transmitter remote control equipment.

Although WBAA-FM uses a separate TSL (transmitter-studio link) for return

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McIntosh Mc240 tube power amp. chrome & blk with manual, good condition, \$700. R Glenn, WJGR, 1718 Shannadoa, Wimauma FL 33598, 813-634-1940.

Lafayette Stereo 224, all tube preamp/amp. very quiet when w/o signal. (4) new output tubes 6GW8, \$125. H Jeschke, The Fellowship Press, 5820 Overbrook Ave, Philadelphia PA 19131, 215-879-6300.

LPB DA 1 16 distribution amp, new. J Gelo, 813-642-6899.

Crown Micro-Tech 600LX stereo power amp, \$550. Crown DC 300A power amp, \$400; South West Tech power amp, \$175; Haller P-230 power amp, \$400. D Lundy, Lundy Tape Duplicators, POB 408, Heidrick KY 40949, 609-546-6650.

Dynaco stereo 70 fact built; McIntosh MC-40 pwr amp, all documentation. L Lindstrom, WJEZ, 315 Mill, Pontiac IL 61764, 815-844-6101.

Marantz 2130 quartz locked tuner w/scope, Marantz 3250B control pre-amp, Marantz 140 amp w/VU meters, rack mount, \$695; Marantz 2270 tuner, preamp & amp, rcvr, rack mount, \$150. J Price, Price Recdg Std, 2651 Globe Ave, Dallas TX 75228, 214-321-6576.

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New 250 W solid state amp, \$1800. Call for details. Bill Hoffman, 518-583-9490.

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Scala HDCA10 10 element yagi on 102.3 MHz, \$150; 500 point stainless lightning dissipator, \$350. D Rose, KAAA, 2534 Huaiapai Mtn Rd, Kingman AZ 86402, 602-753-2537.

PLFM-100 obsolete exciter upgrade ... \$229.95  
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Collins phasor for DA-2, 10 kW in 2 cabinets & components for ATU's. E Hoehn, KFMZ, 1101 Walnut, Columbia MO 65201, 314-874-3000.

Andrew Helix 700' 1-5/8" line, in service only 6 yrs on a reel ready to ship, \$5/ft; ERI 10 bay antenna FMH-10AC circular polarized tuned to 98.9, \$22000. M Wodlinger, WIXI FM, 813-262-1000.

Kintronics 7.5 kW isocoupler at 103.1. L Lindstrom, WJEZ, 315 Mill, Pontiac IL 61764, 815-844-6101.

Jampro cir polar 4 bay on 103.1. L Lindstrom, WJEZ, 315 Mill, Pontiac IL 61764, 815-844-6101.

Phelps Dodge HFM-LP-12 12 bay H polarized FM on 104.1, just removed, \$1000/BO. M Bishop, KXYL, POB 100, Brownwood TX 76804, 915-646-3535.

Cablewave CP-1000-1 one bay tuned 105.5 MHz like new, \$750; ERI 31CP3 3 bay tuned to 105.5 MHz, \$1800. C Fletcher, WLJE, 2755 Sager Rd, Valparaiso IN 46383, 219-462-8125.

Dielectric 3-1/8" rigid line reflectometer, type 122-245-24 ser #103, \$300; Bird Thru-line wattmeter 4110 type AN/URM-182 ser #852, in case w/1990 test data, \$100. A Olean, WMPG, 96 Falmouth St, Portland ME 04103, 207-780-4424.

Kintronics Labs PS-1 AM PSA/PSSA pwr reduction unit, from 1 kW to PSA/PSSA power input; CCA Watchdog II VSWR transmission line monitor, like new w/instructions. M Rice, Contemporary Media, 222 Indacom Dr, St Peters MO 63376, 314-928-6569.

Cooper strap, 150', 0.020 thick, 4" wide, never used, \$150/BO; 60' Cable-wave 50 ohm, air, 1-5/8, never used, \$400/BO. C Scherer, WDOK, One Radio Ln, Cleveland OH 44114, 216-696-0123.

Stainless TV tower, 199', 4' face, fortified for 10-bay antenna, with guys, lighting, hdwe; channel 15 antenna & 6-1/8" line. P Durham, WVTF, Grand Pavilion, 4235 Electric Rd, SW, Roanoke VA 24104, 703-857-8900.

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Phase Linear 1000 auto correlator NR system in gd cond, \$100. R Glenn, WJGR, 1718 Shannadoa, Wimauma FL 33598, 813-634-1940.

Furman PB 40 patch bay, front 1/4" tip-sleeve jack, rear RCA, \$35; dbx 400X route switch to switch in/out processing & NR, gear in recdg chain, stereo, RCA conn, \$150; Sony PCM 501 ES pulse code mod to record digital audio & PB on any video tape recorder, mint cond, no digital output, \$450. H Jeschke, The Fellowship Press, 5820 Overbrook Ave, Philadelphia PA 19131, 215-879-6300.

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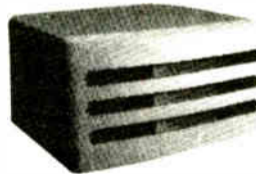
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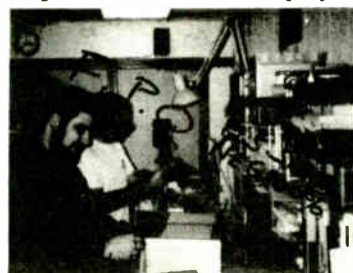
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**SAE 5000A** impulse NR system, \$100/BO; Fisher space expander, \$50. B Ladd, WNRN, 108-1/2 E Main, Bellevue OH 44811. 419-483-2511.

**Symetrix 511A** one-way NR system, 2 chnl, excel cond, \$175. D Humphreys, Masterwork, 1020 N Delaware, Philadelphia PA 19125. 215-423-1022.

**ADC TT144** patchbay, excel cond, 144 point TT bay wired to 50 pin telcos, \$110; Niche ACM 8 chnl audio automation unit controllable by MIDI, 1 rack space; Barcus Berry Sonic maximizer 402 2 chnl, needs some work, \$100/BO. S Wylas, SWP, 165 Linden St, New Britain CT 06051. 203-280-3913.

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**SMC 350 series**, stereo in wood laminated cabinet, works gd, \$450. D Koehn, KKPR, Box 130, Kearney NE 68848. 308-237-9333.

**SMC 350 Carousels** (3), \$350 ea/BO. D Quinlan, KSYC, 316 Lawrence Ln, Eureka CA 96097. 916-842-4158.

**SMC MSF-12 w/(4) Otari ARS-1000** decks, (3) 350 random select Carousels, ITC 3D cart, \$7000. R Ness, WCSJ, 1802 N Division, Morris IL 60450. 815-942-0022.

**SMC ESP1** automation w/(4) TS25 tone sensors, (2) 350 RSB Carousels, Extel printer, remote control, \$2000; SMC IC1 instacart interface, \$50; encode center, \$50. D Rose, KAAA, 2534 Hualapai Mtn Rd, Kingman AZ 86402. 802-753-2537.

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**Carousels in automation unit**, \$400 each. R Coleman, WGEN, 1003 S Oakwood, Geneseo IL 61254. 309-944-4633.

**Cotec-Schafer 7000** level 1 memory w/expansion, pwr supply, CRT, keyboard, printer, works as is or gd for parts, BO. B Dieckman, KCLN, 1853 442nd Ave, Clinton IA 52732. 319-243-1390.

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**BE5300B** 3 deck cart machine, BO; Audi-Cord 121 cart rdcr/reproducer, BO. 504-657-5249.

**ITC Delta I** stereo PB, new heads, excel cond, low use, \$2500/both. C Guglielmetti, Edgewater Co, 232 C St, S San Francisco CA 94080. 415-589-3313.

**Spotmaster stereo delay mach**, \$100/BO. B Ladd, WNRN, 108-1/2 E Main, Bellevue OH 44811. 419-483-2511.

**Harris Gates Criterion 80** stereo cart plyr w/manual, works, BO. Dave, Allmake Prod, 517-652-6863, leave msg.

Great Prices on original equipment tape heads for ITC, BE, Fidelipac, Otari, Tascam & others!



**HE Hall Electronics**  
(804) 974-6466 • FAX 6450

**Harris CCII** stereo play, new motor bearings, excel cond, \$675. P Willey, WMNB, 466 Curran Hiway, N Adams MA 01247. 413-663-3419.

**ITC ESL IV** splice finders/erasers (2), \$350/BO. C Scherer, WDOK, One Radio Ln, Cleveland OH 44114. 216-696-0123.

**Audicord R/P mono 100 Series**, \$400. D Rose, KAAA, 2534 Hualapai Mtn Rd, Kingman AZ 86402. 602-753-2537.

**ITC 99B** new in '87, in excel cond w/manual, \$3500/BO; ITC 3-deck, 15 yrs old, gd hands, play only, \$850/BO. C Mellon, WILL AM/FM, 720 Main St, Willimantic CT 06226. 203-456-1111.

**RCA RT 7A 19" mono PB** (5), \$100 ea/\$375 all. P Drake, 312-392-4618.

**Pacific Recorder Micro-Maxx** (2), new cond w/standard heads & speeds, pwr cords, rack mount, casing & manuals, \$1900/pr. K Rosato, Snd Bdctg, 303 Webster Ave, New Rochelle NY 10801. 914-645-1626.

**ITC triple deck**, working w/automation at present, \$950. R Coleman, WGEN, 1003 S Oakwood, Geneseo IL 61254. 309-944-4633.

**Spotmaster 505** mono desk top rec/PB, \$250; Spotmaster 500 PB mono desk top, \$200 or \$350/both. P Drake, 312-392-4618.

**CART MACHINES:**

For Sale: \$395 & UP  
Repairs: \$100 per deck + parts  
Recondition: \$150 per deck + parts. Call Mark @ 619-598-3311

**ITC Delta**, several new 99B stereo repro units, \$1195; ITC 99B repro, several new stereo units, \$1195. J Addie, WLTL, 708-579-3749.

**BE 5300C** tripledeck, stereo, PB, mint less than 50 hrs, BO. R Kaufman, Pams Prods, POB 462247, Garland TX 75046. 214-271-7625, after 3PM CDT.

**Tapcaster 700P & 700RP**, \$250/both. T Hodgins, KLKY, 580 Roger Rd, Walla Walla WA 99362. 509-529-7094.

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**Ampex ATR700** gd cond, lw hrs, \$700; Teac A3340s, like new, \$800; Pioneer RT1020L, lw usage, \$300; Teac A3300SX, new in box, \$450; Teac X1000R, recondition clean, \$400. J Parsons, Parsons Sound Service, 2781 Fayson Circ, Deltona FL 32738. 904-532-0192.

**Tascam 644 4 trk**, 8 chnl cassette only, 4 hrs use, \$800. D Ott Jr, Otter Bdct, POB 314, Bath OH 44216. 216-836-3896.

**Technics RS1500** 2 track, excel cond. J Gelo, 813-642-6899.

**Revox PR 99** (4), PB decks, great cond, automation ready. E Gross, KEYZ, 410 E 6th St, Willston MD 58801. 701-572-5371.

**Magnecord RP**, \$75 plus shipping; Scully RP, no case, \$75 plus shipping. J Hughey, WIZK, POB 548, Bay Springs MS 39422. 801-764-3151.

**Technics 1500US** (2) 2-trk, cherry wood sides, fair cond, \$350 ea; Technics 1520, gd cond, \$450, or \$1050/all. J Block, Production Block, 906 E 5th St, Austin TX 78702. 512-472-7875.

**Otari ARS 1000** stereo PB decks (4), \$500 ea. R Ness, WCSJ, 1802 N Division, Morris IL 60450. 815-942-0022.

**Infonics 200 series** duplicator, reel master, mono, excel cond, 7 or 10" reels, 1/4" tape, \$500. T Boddie, Boddie Recdg, 12202 Union Ave, Cleveland OH 44105.

**Tape-a-thon**, Channel Caster 6, 10" 702 bi-directional p/b system, good condition many extras, playing when taken out of service, \$1000/BO. R Swafford, 417-883-5488.

**Ampex 440-C/7.5 15"** per sec (2), 5-15 ips 1/4" w/Ampex roll around cabinets & rem cntrls, new erase, record & playback heads, excel cond, \$1395 ea. Bill 313-242-2319, 8-4 in MI.

**Studer 807 2-trk**, 2 yrs old. 3 speed shuttle whl, \$2695. D Matyis, KLTR, 10533 Richmond Ave #6937, Houston TX 77042. 713-760-0937.

**Ampex MM1200** 16 trk R-R R/P, excel cond. Mark, 619-758-0888.

**Otari ARS1000** play decks (6), \$250 ea. M Ripley, KOZE, Box 936, Lewiston ID 83501. 208-743-2502.

**EMPLOYMENT**

To place ads in this section, use the ActionGram form. To respond to box numbers write Radio World, PO Box 1214, Falls Church, VA 22041. Attn: \_\_\_\_\_

**POSITIONS WANTED**

**Radio announcer** looking for pos in top 40 or A/C format, also exper in talk radio. John, 904-663-9059.

**Exp Bdct Engr/Prod voice** w/18 yrs exper, prefer SE but will discuss other, AM/FM preferred. R Watts, Rt 1 Box 91-C, Carrollton AL 35447. 205-367-2113.

**CE w/Big Prod Voice** & over 15 yrs hands-on engineering exper seeks CE pos w/production or air shift in a competitive top 100 mkt. G Morgan, 704-563-8676.

**The popular John Benson Hillbilly Hayride**, the sounds that rocked the cradle of C&W Music is searching for a new weekend late/overnite home, Hudson Valley, North Jersey, SW CT mkt. 914-342-1930.

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**Talented AT** seeks 25-54 demo station for FT air shift, prefer Midwest Top 100 but will consider all offers, specialize in PM drive. Jack, 414-242-4357.

**General Manager** for Florida medium or large market, 29 yrs exper in sales, programming & engineering, turn-arounds or start ups, avail immed. 813-849-3477.

**Radio production** & announcing experienced under graduate degree in business & economics, plus management & sales experienced. Kevin, 515-432-1741.

**Construction/fix it engineer**, will go anywhere, anytime, avail day/week/project, excel credentials, US or foreign, call 24 hrs, 813-849-3477.

**Experienced:** strong background in sales, management, engineering, operations, construction & ownership seeks challenge in small to medium mkt. Resume/voice mail box: 803-430-3005.

**Student** of radio possessing leadership experience seeking position, all offers considered. Randy, 919-854-9073.

**Sales, management, programming**, marketing and engineering, expertise to successfully achieve turnaround for any station with good signal in decent market. 813-849-3477.

**Looking for an experienced**, affordable morning team? We're original, talented & get the listener involved. Jack, 414-242-4357.

**Tascam ATR-16-60** 16 trk w/auto locator, no more than 100 hrs use, excel cond, \$10,000. A Mauro, 972 E 88th St #002, Brooklyn NY 11236. 718-927-0926.

**Tascam 52** w/optional rack mount, excel cond w/lw hrs, \$895. C Spencer, CS Prod, 10032 Hillgreen Circle, Cockeysville MD 21030. 410-783-0737.

**Otari 5050 BII** (2), \$700 ea; Otari 5050B, \$650; (2) QUAD ESL 63, factory updates, \$1500; GAS Grandson amp (2), \$125 ea. Bob, India Navigation, 177 Franklin St, NY NY 10013. 212-219-3670.

**ITC 750/770** (4) 750 R/R stereo PB gd cond, \$300/ea or BO; (2) ITC 770 R/R stereo PB gd cond, \$400/ea or BO. D Fortenberry, Brown Broadcast-ing, 280 Commerce Circ, Sacramento CA 95815. 916-923-6828.

**Ampex 440** in gd cond, spare motors, heads in gd cond w/Ampex elect, \$750/BO. J Schloss, KICD, 2600 N Hiway Blvd, Spencer IA 51301. 712-262-1240.

**Ampex ATR-800** 4 trk, needs repair, BO. T Rusk/J Harvill, KSSN, POB 96, Little Rock AR 72203. 501-227-9696.

**MCI JH5** solid state electr w/built-in sync (8) w/cables, power sply, etc for mounting on Ampex 300 deck, \$100 ea. T Boddie, Boddie Recdg, 12202 Union Ave, Cleveland OH 44105.

**Lipps 8 trk** head stock, very little use, some cables shortened, \$100. T Boddie, Boddie Recdg, 12202 Union Ave, Cleveland OH 44105.

**Fostex 80 8 trk 1/4"**, low hrs, excellent condition, \$875; Tascam 40-4 4 trk 1/4", new heads, spare new heads, spare amp board, excellent condition, \$750. W Ahlberg, Davis & Glick Prod, 11846 Ventura Bl #306, Studio City CA 91604. 818-509-9100.

**ITC 750 R-R** stereo recorder, excellent condition, \$350; Ampex AG 440-B FT console, \$350; Ampex AG 600-B stereo, \$100. D Lurdy, Lundy Tape Duplicators, POB 408, Heidrick KY 40949. 609-546-6650.

**MCI JH-110-B-2** (4) R-R play only, BO; MCI JH-110-B-2 R-R R/P, BO; Otari MX5050BQII, 4 trk, 1/4", \$2500. C Scherer, WDOK, One Radio Ln, Cleveland OH 44114. 216-696-0123.

**Tascam MS-16 1"** 16-trk w/function dbx, excel cond, factory rack, full remote w/stand, will separately or as package w/Yamaha RM-1608 studio console, \$7000/package. J Block, Production Block, 906 E 5th St, Austin TX 78702. 512-472-7875.

**Teac A-3300SX**, 10", 3.75/7.5 ips, 1/4 trk stereo, vgc, \$250; Tascam 102 cassette deck, new in 8/92, vgc, \$275. T Backer, WXHC, POB 386, Homer NY 13077. 607-753-6182.

**HELP WANTED**

**Arizona-AM/FM** in the beautiful White Mountains of North-eastern Arizona. Wide area coverage. AM at 970 kHz; FM at 93.5 MHz. Only \$150,000. To be relocated. Will lease present site. Write or call Lou Reynolds, Century 21 Sunshine Realty, PO Box 1659, Show Low, AZ 85901. Phone (602) 537-7121. 01RW.

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3422 Old Cantrell Road, Little Rock, AR 72202  
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### CASSETTES & R-R...WTS

Tascam 32 2 trk R-R, low time on new heads, \$837. J Blodgett, WGTF, 308 Westgate Pkwy, Dothan AL 36303. 205-794-4770.

Otari MX 5050 B II, mint cond, 2 trk, \$1200/BO. S Wytas, SWP, 165 Linden St, New Britain CT 06051. 203-280-3913.

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Nashville, TN 37203 (615) 244-6892

Otari MX 5050 MK II 1/4" R/R in gd cond, \$1500/BO. K Stevens, 14241 Ventura Blvd #204, Sherman Oaks CA 91422. 818-981-8255.

Tascam 38 1/2" 8 trk w/8-chnl of dbx NR, \$1500/all, w/o dbx, \$1200. P Cibley, Cibley Music, 138 E 38th St, Nyny 10016. 212-986-2219.

Scully 270 1/2 trk stereo R/P in roll around rack, \$1000 plus S&H. J Dyer, KRAP Prod, 1140 Dixieanne Ave, Sacramento CA 95815. 916-927-4201.

16 trk 2", \$3450; Otari 1" 8 trk, \$2450; 5050 III-8, \$1950; Ampex ATR800 mono, \$750; Tascam 25-2, \$750; Tascam 52 mint, \$1200; MCI Locator III, \$1195; Ampex AG350 solid st elect, \$100/ch. W Gunn, 619-320-0728.

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Ampex MM1200 8 trk remote AL 8 chnl, dbx 208 PUTC cards, etc, \$4500; Otari MTR10-2C stereo, excel, \$3500; MCI Sony JH110B stereo big reels in console, \$2000; MCI Sony JH110A stereo in console, excel, \$1295; MCI JH110B mono, \$895. J Price, Price Recdg Std, 2651 Globe Ave, Dallas TX 75228. 214-321-6576.

Ampex ATR 700 stereo, \$595; Scully 280B mono in console, like new, \$795; Ampex 440C stereo, new heads, motors, etc, \$895; Ampex 440 transports, recon, bearings, brakes, etc, \$395; Ampex, MCI, Scully, motors, parts, 8 & 16 trk heads avail. J Price, Price Recdg Std, 2651 Globe Ave, Dallas TX 75228. 214-321-6576.

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Revox A-77, 7.5-15 ips, works great, \$395; Tascam 38 in mint cond w/dbx on all 8 chnl & new 1/2 gold master reel, \$1800 or trade for type accepted STL. T Hodgins, KLKY, 580 Roger Rd, Walla Walla WA 99362. 509-529-7094.

Otari auto rewind in automation at present, \$695. R Coleman, WGEN, 1003 S Oakwood, Geneseo IL 61254. 309-944-4633.

Tascam 38 8 trk 1/2", extra clean, low hrs, gd hds, 13 reels, Ampex 1/2" tape, \$2000/all. J Powers, Power House Prod, 338 N University Dr, Nacog-doches TX 75961. 800-388-1077.

Teac 22-4 4 chnl 1/4" w/factory tech manual, \$500. J Hunter, KBRE, Box 858, Cedar City UT 84720. 801-590-1277.

Otari ARS-1000 (4), PB only, 10.5" R-R's, gd cond, \$300 ea or \$1000/all. J Kimmel, WLFE, 102 Swanton Rd, St Albans VT 05478. 802-524-2133.

Tascam 80-8 8 trk w/varispeed, DX-8 dbx, Mod 1 line mixer, wooden case, spares, \$1800. W Slaten, Audio Intl, 424 Grant Ave, Scotch Plains NJ 07076. 908-322-4466.

Teac X10R stereo recorder dual capstan drive bi-directional, like new, \$495. J Price, Price Recdg Std, 2651 Globe Ave, Dallas TX 75228. 214-321-6576.

Otari Mark II-IV 1/2" 4-trk, multi-trk, mint, less than 50 hrs. BO. R Kaufman, Pams Prods, POB 462247, Garland TX 75046. 214-271-7625, after 3PM CDT.

Recorder heads, used Scully mono & 2 trk, \$25-50, ATR100's, 3M M79-16 & 8's, Otari 1/2" 8 trks, \$495. W Gunn, 619-320-0728.

### Want To Buy

Dual dubbing cassette deck in gd cond, RCA in/out OK, prefer used unit. P Kaminski, Sportcom, 82 Zevan Rd, Johnson City NY 13790. 607-770-9165.

Schematic for Scully 280B w/constant tension circuitry. B Bordeaux, KSLY, POB 1400, San Luis Obispo CA 93406. 805-543-6855.

Need heads, cables & addtl electronics to convert Scully 280, Ampex 351's to 2-trk stereo & upgrade tube electronics to solid state; 10-1/2" stereo machines also needed, donations accepted by new non-comm FM. M Sophos, WDFH, 21 Brookside Ln, Dobbs Ferry NY 10522. 914-693-3963.

Low-priced R/R Rec/PB compact, portables, suitable for splicing/production projects, possible quantity if suitable. H McDonald, KKJV, POB 807, Veradale WA 99037. 509-535-7535.

Pioneer CT-F950 schematic or service manual, call with cost. C Leaseur, WTBO, POB 1644, Cumberland MD 21502. 301-722-6666.

Scully '100' recorders, record/play amplifiers, 8, 16, 24 track heads. Sequoia Electronics, 4646 Houndshaven Way, San Jose CA 95111. 408-363-1646.

Ampex ATR100 taperecorders for parts. Circuit cards, heads, motors, machine parts, or electronic parts. Call 818-907-5161.

### CD's/PLAYERS

#### Want To Sell

TM Century Gold Discs, mellow AC library w/optional vocal EZ library, 110 discs, \$2500 or trade for type accepted STL. T Hodgins, KLKY, 580 Roger Rd, Walla Walla WA 99362. 509-529-7094.

Technics SL-PG300, new in 8/92, vgc, \$170. T Backer, WXHC, POB 386, Homer NY 13077. 607-753-6162.

#### Want To Buy

Gd used CD player w/rack mount, RCA out OK. P Kaminski, Sportcom, 82 Zevan Rd, Johnson City NY 13790. 607-770-9165.

### COMPUTERS

#### Want To Sell

Amstrad PCW-9512 (2) word processors, \$150/ea. G Arroyo, 407-830-0800.

Macintosh computer, upgraded, 2.5 Meg RAM, 80 Meg hard drive, (2) 3.5 floppys, 9600 baud, S/R fax modem, all programs, imagewriter printer, \$1800/all. J Powers, Power House Prod, 338 N University Dr, Nacog-doches TX 75961. 800-388-1077.

### CONSOLES

#### Want To Sell

Electro-Voice BK-2432 24-chnl mixer, vgc, \$1200. G Arroyo, 407-830-0800.

Tascam 688, Midistudio, new in 8/92, vgc, \$1500; Howe Audio Series 7000, 12-chnl stereo console, needs some work, missing 2 input modules w/manual, \$800. T Backer, WXHC, POB 386, Homer NY 13077. 607-753-6162.

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**DRAWMER DS-201-B Dual Gate \$550**  
**UREI 1176LN Peak/Limiter \$300**  
**RADIO SYSTEMS 1x8 ADA \$175**  
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Ramko Research DC 8MS 8 chnl stereo, \$1200; Shure M-67 mixer, \$100; Sony MX-6S, stereo mixer, \$45. D Lundy, Lundy Tape Dupli-cators, POB 408, Heidrick KY 40949. 609-546-6650.

Yamaha RM-1608 in excel cond, one owner, 16.8, 48V, 3-band parametric, separate power supply, avail separately or as package w/Tascam MS-16 16 trk, \$2200 or \$7000/package. J Block, Production Block, 906 E 5th St, Austin TX 78702. 512-472-8972.

Sony MX16 for parts, \$50. B Ladd, WNRR, 108-1/2 E Main, Bellevue OH 44811. 419-483-2511.

Shure PE 68 M mixer, 5-chnl mic mixer, \$25; Interface Electronics 300 mixer, 16-chnl, 16.8.2 w/book, works but needs work, \$300. A Olean, WMPG, 96 Falmouth St, Portland ME 04103. 207-780-4424.

Ramko DC5AR 5-chnl mono recondition, \$350; Altec 1592B, 5 chnl mono clean w/plug-ins, \$250; Grommes Precision M5, 5 chnl mono new in box, \$275. J Parsons, Parsons Sound Service, 2781 Fayson Circ, Deltona FL 32738. 904-532-0192.

Ramsa 8816 16.4 in vgc, 6 different effects, returns, 4 sub-mix channels, \$950 plus shpg. Ken R, 1806 Madison Ave, Toledo OH 43624. 800-451-5367.

Harris Medalist 10 chnl stereo, needs work, cosmetically good, \$1200. G Arroyo, 407-830-0800.

Sparta 20C 8-chnl mono in gd cond, new pots & rebuilt, \$850/BO. E Prendergast, KAOK, 801 Columbia Southern Rd, Westlake LA 70669. 318-882-0243.

Ampro AC8DSB stereo, 8 chnl, \$650; Ampro 10 chnl stereo, both approx 15 yrs old w/wooden ends, no books or schematics, \$800/both. J Hughey, WIZK, POB 548, Bay Springs MS 39422. 601-764-3151.

RCA BC7A in gd cond, 10 chnl stereo, BO. R Scott, GMN Inc, 1831 N Ft Thomas Ave, Ft Thomas KY 41076. 606-781-3323.

Ramko DC-5RA 5-chnl mono, dual outputs LED, VU meters, like new, have several avail, incl manual, \$250. D Fortenberry, Brown Bdcg, 280 Commerce Circle, Sacramento CA 95815. 916-923-6828.

Pacific Recorders CI-2, TI-2, TT-3 console interface units; stereo cart, (2) 3 inputs ea; stereo reel (2) one input ea; TT 2 inputs, \$150 ea/\$600 all. C Guglielmetti, Edgewater Co, 232 C St, San Francisco CA 94080. 415-589-3313.

Gates 4-chnl mixer w/power supply, XLR inputs, Dynamote 70, \$100; Gates Dualux II, stereo 8-chnl, many spare knobs, pots, spare amp modules, external power supply, vg sound, \$1000. A Olean, WMPG, 96 Falmouth St, Portland ME 04103. 207-780-4424.

Tascam M-35 8.4 mixer, gd cond, \$700/BO. W Ahlberg, Davis & Glick Prod, 11846 Ventura Bi #306, Studio City CA 91604. 818-509-9100.

LPB Monogram II 5 chnl, 2 input, gd cond, \$800. C Hicks, WEAX-FM, W Park Ave, Angola IN 46703.

Neve 5303 in vgc, avail 6-93, \$1000/BO. J Schloss, KICD, 2600 N Hiway Blvd, Spencer IA 53101. 712-262-1240.

Harris Stereo-5, gd cond, clean, \$375. G Finney, WPWB, 7137 Heather Ln, Macon GA 31206. 912-788-2124.

Soundcraft Series II mixer, 12x4x2, \$650. W Slaten, Audio Intl, 424 Grant Ave, Scotch Plains NJ 07076. 908-322-4466.

### DISCO & SOUND EQUIPMENT

#### Want To Sell

TOA SM25A powered speakers, clamp mounts, \$125 ea. L Just, Auditech, POB 2426, Secaucus NJ 07096.

JBL 4312 control monitors (2), \$600; JBL 4311-B control monitors (2), \$600. D Lundy, Lundy Tape Duplicators, POB 408, Heidrick KY 40949. 606-546-6650.

JBL D16R2405 16 ohm replacement diaphragm, JBL 2405 tweeter new in box, \$50. E O'Brien, Imperial Sound, 383 N Studio St, Terre Haute IN 47803.

Burwen/KLH TNE7000A transient noise eliminatr, exc cond, rkm, \$315; SAE 5000 transient noise eliminatr, exc cond, \$125; UREI 560 parametric EQ, mic/line in, line out (2) in rkmnt, vgc, \$250. S Hofmann, Cameron Univ Theatre, 2800 W Gore Blvd, Lawton OK 73505. 405-581-2428.

AKG R-25 remote control w/cable for AKG BX-25 reverb unit, \$50/trade. E O'Brien, Imperial Sound, 383 N Studio St, Terre Haute IN 47803.

Altec 1592B mixers (3), 5x2, \$250; Soundcraftsmen AE2000 scanalyser/dual EQ, \$550. W Slaten, Audio Intl, 424 Grant Ave, Scotch Plains NJ 07076. 908-322-4466.

Ampex ADD-1 stereo DDL for variable pitch lathe, vgc, \$500; Lang PEQ2 (2), \$1500 for pair/BO; Sony PCM-10 dig processor w/4 mod, vgc, \$450; Neuman PEV-518 EQ (4), \$50 ea. D Humphreys, Masterwork, 1020 N Delaware, Philadelphia PA 19125. 215-423-1022.

dbx 208 NR system, \$895, plus 216 & 224 systems; stereo noise scratch & pop filter for old 78 records, etc, \$125; Conn strobe tuner, \$250. J Price, Price Recdg Std, 2651 Globe Ave, Dallas TX 75228. 214-321-6576.

Teac 4-chnl recdg studio w/Teac-5 mixer, Teac A-3440, Teac X-10, Teac 550RX, Sound Workshop 242-A, Harris CB1201, Teac PB64, \$1200 FOB Springfield IL. D White, Cineco-Centril Media Prod, 2425 W Iles #2, Springfield IL 62704. 217-787-3800.

Duntech Sovereigns 2001, light oak, fine cond, local Miami pickup or buyer pays shpg/packg, \$6000/firm. Insight Prod, 7441 Wayne Ave #10-D, Miami Beach FL 33141. 305-866-6048.

JBL 4311 (2), \$500/BO pair. J Diamond, Blue Diamond, Box 102C Chubbic Rd RD 1, Cannonsburg PA 15317. 412-746-3455.

Yamaha QX-5 MDF-1 MIDI sequencer, \$125, MDF-1 disk drive also, \$100 or both/\$200; dbx 155 4-chnl Type 1 NR (2), \$200 ea or \$350/both. P Cibley, Cibley Music, 138 E 38th St, Nyny 10016. 212-986-2219.

#### Want To Buy

Studio Technologies AN-2 stereo synthesizer. D Jackson, 203-762-9425.

### FINANCIAL SERVICES

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### LIMITERS

#### Want To Sell

CRL SGC-800 audio processor, \$950. C Fletcher, WLJE, 2755 Sager Rd, Valparaiso IN 46383. 214-462-8125.

Aphex Type C aural exciter stereo processor, vgc, \$150. B Harwell, Compact Disc Jockeys, 1861 Brown Blvd #630, Arlington TX 76006. 214-407-7347.

UREI BL-40 modulimiter, \$75; Moseley TFL-250, \$100; Moseley TGR-340 AGC, \$100. D Rose, KAAA, 2534 Hualapai Mtn Rd, Kingman AZ 86402. 602-753-2537.

Orban 422 A/V compressor/limiter, new never installed, \$550; Gentner Prisms (pair), excellent condition, \$1900/pr. C Spencer, CS Prod, 10032 Hillgreen Circle, Cockeysville MD 21030. 410-783-0737.

Audiomax IIs stereo, \$200/BO. B Ladd, WNRR, 108-1/2 E Main, Bellevue OH 44811. 419-483-2511.

Aphex Dominator II 723. BO. R Scott, GMN Inc, 1831 N Ft Thomas Ave, Ft Thomas KY 41076. 606-781-3323.

Gates Solid Statesman limiter, \$100/BO. C Scherer, WDOK, One Radio Ln, Cleveland OH 44114. 216-696-0123.

Texar Audio Prisms (2), gd cond, C Tarkenton, WCOH, 154 Boone Dr, Newman GA 30263. 404-253-4636.

Modulation Sciences CP803 composite clipper, like new w/manual, \$675. J Addie, WLTL. 708-579-3749.

CBS Labs Audimax 4440A, \$150/BO; CBS Labs dynamic presence EQ 4500, \$150/BO; (2) UREI 537 graphic EQ, \$200/BO. C Scherer, WDOK, One Radio Ln, Cleveland OH 44114. 216-696-0123.

Inovonics 222 NRSC AM processor, 2 years old. L Lindstrom, WJEZ, 315 Mill, Pontiac IL 61764. 815-844-6101.

Orban 8200/U3S new digital Optimod with multiband option in pristine condition, \$7995. P Christensen, 11142 Paley Creek, Jacksonville FL 32225. 904-725-6099.

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CBS 4440A Audimax volume leveler, \$225. W Slaten, Audio Intl, 424 Grant Ave, Scotch Plains NJ 07076. 908-322-4466.

dbx 166 limiter/compressor, \$500/ BO. P Drake, 312-392-4618.

ART MDC-2001 comp/exp/de-ess/gate/aural exciter, new, \$450; dbx 163X complim, full rack mount, new \$140. T Backer, WXHC, POB 386, Homer NY 13077. 607-753-6182.

### BUY-SELL-TRADE OPTIMOD 8000 & 8100 414-482-2638

Orban 8100A Optimod, one owner, excellent working condition with manuals, \$2400. J Conesa Jr, Ponce Bldg, POB 7213, Ponce PR 00732-7213. 809-840-3160.

CRL SGC-800 audio processor, 1 year old, \$950. C Fletcher, WLJE, 2755 Sager Rd, Valparaiso IN 46383. 219-462-8125.

#### Want To Buy

Optimod 8000 in any condition for non-communication station. V Zandt, WJLU, 4295 Ridgewood Ave, Port Orange FL 32168. 904-756-9000.

Aphex Type III or C2 aural exciter, either model. D Jackson, 203-762-9425.

### MICROPHONES

#### Want To Sell

B&K type 2801 mic power supply for B&K tube-type mic systems, \$50/trade for Sony CP-3 mic supply. E O'Brien, Imperial Sound, 383 N Studio St, Terre Haute IN 47803.

Gefell Neumann UM57 tube mics, New capsules for SM2 & many others, New AC701 tubes for Neumann mics, \$275. W Gunn, 619-320-0728.

RCA 77DX & 44 ribbon mics. P Davis, 804-980-2940.

HME-WM 252 wireless w/SM58 mic, \$195; Audio Technica ATM31R condenser, \$100. J Price, Price Rcdg Std, 2651 Globe Ave, Dallas TX 75228. 214-321-6576.

Neumann UM-57 condenser with power supplies, BO. J Steele, WKBX, POB 2525, Kingsland GA 31548.

Sennheiser 441, new w/all papers & response curves, \$450. R Payne 313-786-1767.

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EV 644 sound spot mics (4), shotgun, \$200 ea. W Slaten, Audio Intl, 424 Grant Ave, Scotch Plains NJ 07076. 908-322-4466.

AKG 414's, \$695, original D12 like the Bealles used, \$295, Sony ECM54, \$150, Beyer M500 like new, \$300, Demeter 4-channel tube DI rack mount like new, \$875. W Gunn, 619-320-0728.

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Model T-10,000 rotary phase master, \$2500. R Allen, KLAD, POB 339, Klamath Falls OR 97601. 503-882-8833.

Onan 12.5JC-18R 12.5 kW standby generator, propane powered with 60 A 3 phase transfer panel & all access, \$5000. J Hunter, KBRE, Box 858, Cedar City UT 84720. 801-590-1277.

Aiphone NEM-40A 40 station intercom master & access, \$650; (2) Electrosond 100-48/200 cassette winder/splicers, \$450 ea. W Slaten, Audio Intl, 424 Grant Ave, Scotch Plains NJ 07076. 908-322-4466.

Teledyne Thermoelectric 50 W LPG fuel generator, \$2000/BO. D Quinlan, KSYC, 316 Lawrence Ln, Yreka CA 96097. 916-842-4158.

Topaz ES153 15 KVA UPS, 120V/208V single or 3 phase w/internal batts & service bypass switch, \$7950. G Wachter, KFYI, 631 N 1st Ave, Phoenix AZ 85003. 602-258-6161.

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Radio transformers by Chicago, UTC, Triad, Peerless, Freed, Sola, send list. J Gangwer, 942 32nd St, Richmond CA 94804. 415-644-2363.

Sperry Rand 104 E-14 weather radar. H Hoeflicker, KRFS, RR 2 Box 149, Superior NE 68978. 402-879-4741.

Looking for all kinds of crystals. E Prendergast, KAOK, 801 Columbia Southern Rd, Westlake LA 70669. 318-882-0243.

Ampex tube recorders and mixers. W Gunn, 619-320-0728.

Teac RC-170 remote control for 80-8. D Humphreys, Masterwork, 1020 N Delaware Ave, Philadelphia PA 19125.

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Rust SFM-19 deviation monitor, BO; Indesys mod mon, BO; Collins mod mon, BO. C Scherer, WDOK, One Radio Ln, Cleveland OH 44114. 216-696-0123.

#### Want To Buy

FM & stereo monitors, remote meter panels, RF amp, EBS rcvr/enc/ decoder, donations accepted by new non-comm FM. M Sophos, WDFH, 21 Brookside Ln, Dobbs Ferry NY 10522. 914-693-3963.

Belar AMM-2 or 3 mod mon, any cond. G McClintock, WNQM, 1300 WWCR Ave, Nashville TN 37218. 615-255-1300.

McMartin (buy & sell) any model. C Goodrich, 11435 Manderson, Omaha NE 68164. 402-493-1886 or fax 402-493-6821.

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Symetrix TI-101 telephone interface (2), \$250 ea. C Fletcher, WLJE, 2755 Sager Rd, Valparaiso IN 46383. 214-462-8125.

Marti CR-10/RPT-15 TRL link w/Racom ID, gd shpe, \$1500; Moseley TRC-15 R/C setup for subcarrier, \$500/BO. D Fortenberry, Brown Broadcasting, 280 Commerce Circ, Sacramento CA 95815. 916-923-6828.

TFT 8610/8611 (4), working in good condition with manuals, \$1200 ea; Moseley MRC-1600 (2) working good condition with manuals, \$1400 ea; Moseley TRC-15AR with Hallikainen & Friends TEL 171 digital telemetry remote terminal adapter, \$700. Jefferson Public Radio, 1250 Siskiyou Blvd, Ashland OR 97520. 503-552-6301.

Comrex PLXII & RTLX II late mdl 2-line freq extenders w/TBC-3 couplers, excel cond, \$3995. C Spencer, CS Prod, 10032 Hillgreen Circle, Cockeysville MD 21030. 410-783-0737.

QEI Cat-Link w/T1 modems w/manuals, \$5000. Dave/Mick, Brown Bldg, 280 Commerce Circle, Sacramento CA 95815. 916-923-6800.

Micro Controls 9-chnl linear remote control, \$600/BO. R Swan, WROY, POB 400, Carmi IL 62621. 618-382-4161.

Moseley MR1600 xmtr site unit only, \$500. S Minshall, KJSN, 3600 Sisk Rd, 2B, Modesto CA 95356. 209-545-5585.

Marti transmitters (2), Marti rcvrs (2), Marti 4' dish antenna, Mark 8' transmitting dish and many other misc STL items, pkg price \$9,000. J Baer, Z-91 FM, 381 E Ramsey, San Antonio TX 78216. 210-430-9052 or fax 210-340-7729.

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Telephone hybrid, Comrex TLX xmtr, Comrex PLX-II xmtr, Comrex RLX rcvr or gd used Comrex THX. P Kaminski, Sportcom, 82 Zevan Rd, Johnson City NY 13790. 607-770-9165.

Comrex TCB-1 telephone voice coupler. S Kirsch, Silver Lake Audio. 516-623-6114.

Marti used receiver, preferably 161.70 and/or 161.76 MHz, no tube types. D Moore, WDUX, Box 247, Waupaca WI 54981. 414-468-4100.

Marti 160 MHz rcvr & xmtr, old tube xmtr OK. G McClintock, WNQM, 1300 WWCR Ave, Nashville TN 37218. 615-255-1300.

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Microdyne 1100-CSR (2) prof sat video rcvrs, dual 4 GHz inputs, \$200 ea. S Minshall, KJSN, 3600 Sisk Rd 2B, Modesto CA 95356. 209-545-5585.

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Wegener 1601-24 LNB Wegener rcvr w/card for CNN, news, ready for Unistar country format w/CNN, excel cond, \$1875/shpg. C Walmer, WTHU-AM, 10 Radio Ln, Thurmont MD 21788.

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Fidelipac 300, 900-1000 avail, new, 20 sec-8.5 min, no 40's or 70's, must take all, \$.50. H Casteel, Megastar, 701 Desert La #4, Las Vegas NV 89106. 702-386-2844.

Pams Jingles ref tapes, 1951-1976, BO. R Kaufman, Pams Prods, POB 462247, Garland TX 75046. 214-271-7625.

**Want To Buy**

AC Gold library, need up-tempo hits from '80s & late '70s, carts or CD's. P Posen, KEZN, Box 291, Palm Desert CA 92261. 619-340-9383.

Any 10" tape formats from TM programming, especially stereo rock, also interested in Rick Dees weekly Top 40 records or CD's. J Egloff, TKR Cable, 5582 Rapid Run Pk, Cincinnati OH 45238. 513-922-7049.

**TAX DEDUCT EQUIP**

**Want To Sell**

W Africa educational, Christian station needs FM, AM & SW xmtrs & studio equipment. K Leatherwood, Grace Intl 2111 Griffith Ave, Terrell TX 75160. 214-503-1956.

Non-Comm Educ FM station needs any equip. B Tyson, WSSD, 11026 S Wentworth Ave, Chicago IL 60628. 312-928-8800.

**TEST EQUIPMENT**

**Want To Sell**

Hewlett Packard vector impedance meter, needs probe, excel cond, \$800. G Arroyo, 407-830-0800.

Potomac AT-51 with matching transformers, vgc, \$2995. J McPhearson, Blue Ridge Bdt Assoc, 14926 Ampstead St, Centreville VA 22020. 703-968-7492.

Tektronix 5441 storage scope w/on screen numerical display w/dual 5B42 timebase & 5A22 differential input amplifier, high gain & selectable lo/hi pass filters for audio work, \$345. G Wachter, KFYI, 631 N 1st Ave, Phoenix AZ 85003. 602-258-6161. MST.

Tektronix DC505A freq counter, \$250; Tektronix digital multimeter DM502A auto range, \$295; Tektronix digital multimeter DM501A, \$295; HP dist analyzer 333A, \$695; HP 353A, 110B attenuator, \$75; Waveform 520-A RMS/DBM sensitive volt meter, -60 dB to +50 dB, \$100. J Price, Price Recording Studio, 2651 Globe Ave, Dallas TX 75228. 214-321-6576.

Ithaco 4302 dual 24 dB/octave hi-lo-pass filter 1/10 to 1 MHz, \$295; Weston 666 multimeters, \$45; Eico 150 solid state signal tracer, \$100; Heath audio gen 1G-72, \$85; Tentelometer tape tension T2-V20, \$200. J Price, Price Recdg Sid, 2651 Globe Ave, Dallas TX 75228. 214-321-6576.

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Potomac FIM-41 AM field strength meter in gd cond. C Spencer, CS Prod, 10032 C Hillsgreen Circle, Cockeysville MD 21030. 410-783-0737.

**TRANSMITTERS**

**Want To Sell**

Gates FM 20 H3 w/exciter, gd cond, \$13500; Harris HT 3.5 kW, excel cond, \$15000. M Wodlinger, WIXI FM, 813-262-1000.

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**Broadcast Electronics FM-5B transmitter - NEW; 5.5kW TPO, 101.7 MHz; 50w exciter; remote control interface, filament voltage regulator. Export crafted. Doug Holland (305) 522-3303; FAX (305) 522-3355**

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CCA AM5000DX 1970 mdl, needs some work, BO; 50' 3-1/2" coax, new, \$500; 75' & 15' 7/8" coax, \$150 & \$30; used 7/8" on spool, BO. D Koehn, KKPR, Box 130, Kearney NE 68848. 308-237-9333.



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Continental 816R-1A well maintained, great condition, 10 kW tuned to 102.5 MHz, BO. M Murphy, KMSS, 725 Strand, Missoula MT 59801. 406-542-1025.

Harris FM20H3 late 70s mdl (2), one w/QE1 exciter, one w/TE-3, avail now, \$16,995 ea. C Spencer, CS Prod, 10032 C Hillsgreen Circle, Cockeysville MD 21030. 410-783-0737.

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Gates/Harris TE-1 FM stereo exciter, with spare stereo generator & interface panel for Optimod, good working condition, \$1000. J Kimel, WLFE, 102 Swanton Rd, St Albans VT 05478. 802-524-2133.

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RCA 10 kW AM mdl BTA-1002, tuned to 1030 kHz, needs modulation transformer, vgc, workhorse, \$10K. G Arroyo, 407-830-0800.

RCA BTF-50 5 kW FM, in service, \$5000/BO. C Binder, WZOS, 33-48 E Bridge St, Oswego NY 13126. 315-342-9600.

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TTC UST-106 on Ch 61, recently rebuilt, tuneable, \$14,000. S Kafka, 945 S 12 #4, Lincoln NE 68508. 402-477-2813.

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ITA 15000B FM power amp, complete in one cabinet, \$5000/BO. A Weiner, WHVW, 507 Violet Ave, Hyde Park NY 12538. 914-471-9500.

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Collins 30K-4 or 30K-5, 20-30 MHz xmr. J Stitzinger, 23800 Via Irana, Valencia CA 91355. 805-259-2011.

Collins 20V 1-2 or 3 buffer & driver tank cannisters, meter banks for these units also; 250 W AM transmitter that operates on 120 V like Gates BC-250A and RCA 250M. E Prendergast, KAOK, 801 Columbia Southern Rd, Westlake LA 70669. 318-882-0243.

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250-500 W FM w/wo exciter, tunable to 90.3, donations accepted by new non-comm FM. M Sophos, WDFH, 21 Brookside Ln, Dobbs Ferry NY 10522. 914-693-3963.

Tepeco/Jones/Versacount J-317, V-317 10 W single or dual output translators. J Stromquist, WNCB, 2828 Piedmont Ave, Duluth MN 55811. 218-722-3017.

5-10 kW FM w/wo exciter, for non-comm station, can pick-up. V Zandt, WJLU, 4295 Ridgewood Ave, Port Orange FL 32168. 904-756-9000.

2.5 kW AM xmr, prefer solid state. D Jackson, 203-762-9425.

McMartin AM/FM xmr, any model, exciter or stereo modules. Goodrich Ent., 11435 Manderson, Omaha NE 68164. 402-493-1886.

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Russco Cue Master (3) with Micro-trak tonearms & Stanton heads, \$100 ea; Henry Engineering Universal TT controller, \$75. D Rose, KAAA, 2534 Hualapai Mtn Rd, Kingman AZ 86402. 602-753-2537.

Technics SP-25 (2), tonearms, Stanton 310 preamps & Henry Universal controller, \$500. K Surgeon. KLIK, POB 414, Jefferson City MO 65102. 314-893-5696.

RCA MI-11833B 16" transcription disc TT & cabinet, 16" Gray tonearm & Stanton 680EL cartridge, \$300. A Olean, WMPG, 96 Falmouth St, Portland ME 04103. 207-780-4424.

Stanton 310 stereo preamp, like new, \$95; (2) Harris CB 1201 3 speed, good condition, \$100 each; Russco Fidelity Pro, stereo, like new condition, \$125. G Gibbs, KMNS, 901 Steuben St, Sioux City IA 51102. 712-239-3966.

Technics SP-25 w/tonearm, gd cond, \$150/BO. R McDaniel, KJRG/KOEZ, Box 567, Newton KS 67114. 316-283-5150.

**Want To Buy**

Need tonearm & head shell for Gates CB-500. B Abel, KOSE, 509 S Walnut, Osceola AR 72370. 501-563-2641.

Microtrak 303 cartridge shell, need several. B Hoisington, 33 John Sims Pkwy, Valparaiso FL 32680. 904-678-8943.

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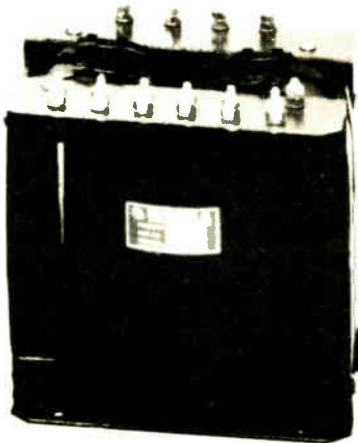
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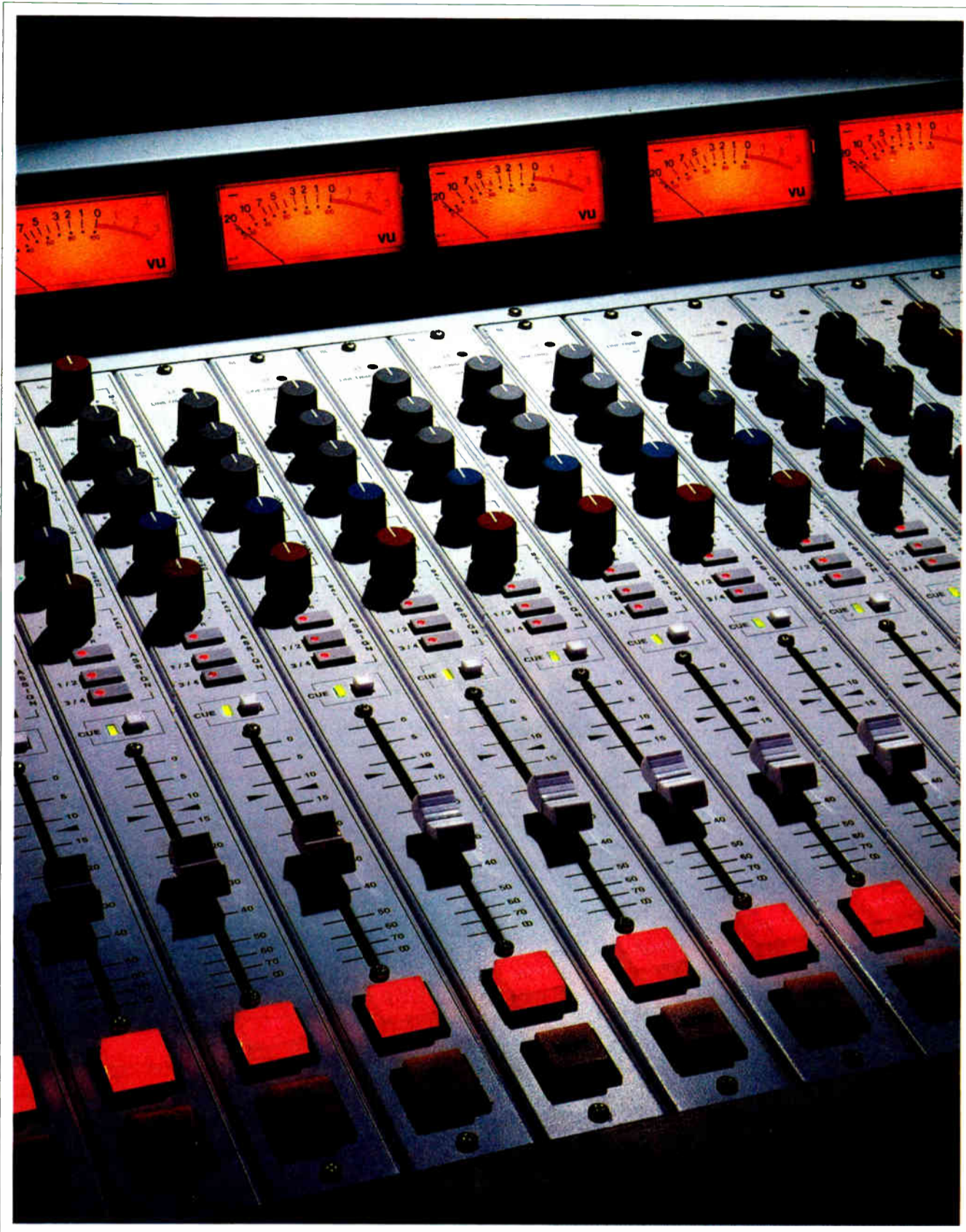
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