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# Radio World

Complete NAB  
Radio '92  
Wrap-Up Coverage:  
See pp. 11-30.

Vol 16, No 20

Radio's Best Read Newspaper

October 21, 1992

RW EXCLUSIVE

## Tuner Tests Out "Super"

by Len Feldman

**GREAT NECK, N.Y.** At long last, the NAB-commissioned "Super Tuner" has been produced by Denon and is available for purchase by interested radio stations—or for that matter, by consumers.



Denon's TU-680NAB is a high-end tuner with AMAX enhancements.

The "Super Tuner" concept arose as a result of the standards developed by the NRSC (a joint effort of the EIA and the NAB), designed to improve AM transmission and reception.

It is no secret that most makers of so-called "hi-fi" tuners and receivers have treated AM circuitry as an afterthought. Frequency response, for example, typically extended no further than to about 2.5 or 3.0 kHz! Among other improvements, the Denon TU-680NAB "Super Tuner" conforms to the new NRSC stan-

dards for AM tuners and receivers, called AMAX.

### Features

The Denon TU-680NAB is, first and foremost, a superb AM/FM stereo tuner, incorporating the universally approved stereo FM system as well as the Motorola-developed C-QUAM system for stereo AM. Two settings of bandwidth are available for both the FM and the AM bands, so that selectivity can be increased when the tuner is used in areas where stations are closely spaced on the dial. The tuner also incorporates a noise-gating circuit that significantly reduces interference on the AM band from exter-

nally generated electrical noise, such as that from fluorescent lights, electric motors, and the like. When using the FM band, noise reduction in the form of an MPX filter can be switched on.

Up to 30 channels of either AM or FM can be stored in memory for instant recall by number. A remote control, capable of handling virtually all the control functions of the tuner, is supplied. The remote also features a "Preset Scan" button that is not duplicated on the tuner's front panel. A separate AM loopstick as well as an FM indoor antenna and the usual twin audio shielded pin-plug cable also come with the product. The AM frequency band available on this tuner extends from 520 kHz to 1710 kHz, in conformance



Quality Traffic: Managers and engineers saw several new products at the NAB Radio Show. See p. 16.

with the expanded AM frequency band recently authorized by the FCC.

### Control layout

A power/standby switch is located at the extreme left of the all-black front panel. To its right is a display area that shows tuned-to frequency, tuning mode (manual or automatic), mono/stereo status and preset channel number selection. A small secondary display area further to the right

continued on page 14 ►

## DAB Mark In Dispute

by John Gatski

**NEW ORLEANS** Although the USA Digital Radio in-band digital audio broadcast (DAB) demonstration appeared to work smoothly at the NAB Radio Show, a debate over standard-setting efforts did not fare as well. One audience member called it "a war."

Representatives of the Electronic Industries Association (EIA) and the NAB expressed different views on how best to enact a domestic DAB standard.

The EIA has embarked on a DAB standard setting process similar to the stereo TV standard it developed in the mid-1980s. The DAB process would test all systems that were received for evaluation by April 1993 and select the "best" by the end of 1993.

Critics of the plan, including NAB, said the process does not involve broadcasters to the same degree that they are affected by DAB. As an example, the NAB cited the proposed allocation of only two votes to broadcasters of the total 12 votes that would be involved in selecting a system. Critics also said the EIA is pushing a standard too fast.

continued on page 10 ►

## DAB Basks at Radio '92

by Charles Taylor

**NEW ORLEANS** Digital audio broadcasting (DAB) took a major step from the drawing board to the airwaves with a live demonstration and a host of forums on

the burgeoning technology at the NAB Radio Show here Sept. 9-12.

The annual convention, held at the New Orleans Convention Center, featured fixed in-band, on-channel tests from USA Digital Radio. The company's Project Acorn digital signal was combined with National Public Radio affiliate WWNO for FM and retransmitted with WNOE for AM. A four-part Digital Radio Seminar also broke down the variables of DAB technology and offered ways that station owners and engineers can prepare for its imminent arrival.

But DAB wasn't the only happening at the show, which traditionally focuses on programming and management issues. Sessions prompted discussion on topics ranging from LMAs, EBS and RBDS (radio broadcast data system) to the direction of popular radio formats and their 1990s' hybrids. A number of forums centered on survival during tough economic times.

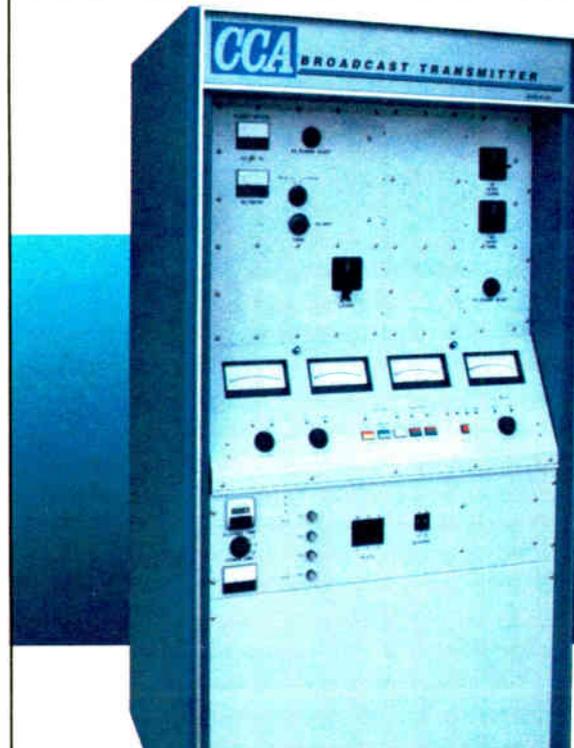
The Denon NAB TU-680 Super Tuner also made its production model debut, including a session offering a technical description and demonstration of the radio, which is fully compatible with AMAX AM standards.

Total attendance—at 6,824—took a slight downturn from last year's San Francisco show, according to Rick Dobson, NAB senior VP of conventions and exhibitions.

"Yes, attendance was slightly down, which we attribute to the downturn in the economy, but we think the show went smoothly," he said. Dobson noted favorable attendance

continued on page 11 ►

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World Radio History

# NEWSWATCH

## Continental Sells to Kuwait

**DALLAS** Continental Electronics has received a multi-million dollar contract from Kuwait's Ministry of Information to build and install two Type 320-H 600 kW medium wave transmitters and their antenna systems.

The contract was made through the S.H. Behbehani Co. and is one of the first contracts to be issued for rebuilding broadcasting facilities destroyed during the Iraqi invasion and occupation in 1990-91.

Kuwait Ministry of Information personnel will be trained at Continental, and

delivery of the equipment is slated for spring 1993.

## NRB Moves Headquarters

**MANASSAS, Va.** The National Religious Broadcasters moved its national headquarters from New Jersey to a business park in Manassas, Va.

The new 5,000 square foot headquarters is located about 30 minutes south of Washington, D.C. An NRB official said the area is a more suitable living area than northern New Jersey for NRB employees. The NRB had spent more than 24 of its 48-year existence in New Jersey.

"Since our move, we've had more people interested and able to visit the new headquarters because of its proximity to Washington," said NRB Executive Director Dr. E. Brandt Gustavson.

## FCC Moves Some Applications Processing To Gettysburg

**GETTYSBURG, Pa.** The FCC has transferred the processing of certain Mass Media Bureau applications for auxiliary services to its Gettysburg, Pa. office.

The services affected by the move include aural broadcast auxiliary station, intercity relay and microwave booster

stations, TV pickup stations, TV relay stations, TV translator relay stations, TV microwave booster stations, and remote pickup broadcast stations.

All filings applications, requests for modifications, renewals, and special temporary authority made after Sept. 21 for those services that require a payment must be sent to: FCC, Broadcast Auxiliary Radio Services, P.O. Box 358700, Pittsburgh, Pa. 15250-5770.

All correspondences and applications not requiring a fee must be sent to FCC, Broadcast Auxiliary Radio Services, 1270 Fairfield Road, Gettysburg, Pa. 17325. For more information, call 717-337-1212.

## Belar Sells Monitors To Radio Liberty/RFE

**DEVON, Pa.** Monitor manufacturer Belar Electronics has sold 23 AMM-3 AM modulation monitors to U.S. government-sponsored services Radio Free Europe/Radio Liberty.

According to Belar, the monitors were shipped in late summer and were to be used in Lisbon, Portugal.

# A Little Bit of MAGIC...



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# Plan of Action Is Key in Dealing with Consultants

by John Gatski

**NEW ORLEANS** As the trend away from on-staff engineers continues in the radio industry, stations are relying more on contract engineers and consultants. At the NAB Radio Show here, a panel of consultants and contract engineers offered advice on how to utilize their services.

The seven-member panel agreed on several basic guidelines that stations should consider when embarking on outside help. The advice included not hiring the cheapest person if the potential exists for substandard work that could cost more later. Other areas of agreement by the panel included creation of a budget for the job, developing a timetable, ensuring that the consultant knows what the project requires and making periodic checks to make sure the project is progressing as planned.

The panelists also made some personal observations. Garry Cavell of Suffa and Cavell, Fairfax, Va., told the audience to make sure that a project is beyond the capability of staff or contract engineers before a consultant is hired.

John Bisset of Multiphase Consulting, Fairfax, Va., said an initial-needs analysis enables a station to know exactly what should be done without paying for unnecessary, unplanned work.

Bisset also cautioned about non-specific agreements for the work. "Open-ended agreements can really be dangerous," he said.

Chris Imlay, an attorney for the Society of Broadcast Engineers (SBE) and a partner in the Washington, D.C. firm

of Booth, Freret and Imlay, offered legal advice on dealing with consultants and contract engineers.

Imlay cautioned against trying to reduce expenses by letting go of the station engineer then hiring him or her as an outside contractor. The Internal Revenue Service will consider the engineer an employee if most of his or her time is spent at your station, he added.

Imlay stressed the need for written consultant and contract engineering agreements to protect a station in case of an FCC fine or other legal action. The contract should spell out who should bear the loss if a station gets fined as a result of the consulting work, he said.

Chip Morgan, of Morgan Associates, Folsom, Calif., said the proliferation of consulting and contract engineers allows broadcasters to take advantage of the best talent in the country.

He noted that consultants and contractors often have specialties, and suggested that stations find those that specialize in the type of work they need.

Several audience members commented about experiences they have had with contract and consulting engineers, including stations hiring a consultant to "scare" the in-house engineer into doing a better job.

One audience member said his station has trained production personnel to do basic engineering functions such as cleaning the cart machine, which can alleviate problems when a contract engineer is not on duty. Other engineering problems that were voiced concerned the scarcity of engineers in rural and remote areas.

# Better AM Radios Needed

by John Gatski

**NEW ORLEANS** In-band DAB was not the only improvement heard for AM at the NAB Radio Show. The Denon NAB AM/FM TU-680 Super Tuner also received favorable reviews from those who listened to it.

At a booth outside the New Orleans Convention Center show floor, attendees were asked "to take the AMAX challenge," to compare wideband AM stereo against FM stereo. Most who put on the headphones were impressed by the quality of the tuner.

The Denon TU-680NAB was the subject of an entire session, which outlined the development of the unit from its inception in 1987.

The tuner is available from NAB at \$499; it will cost \$699 at consumer outlets. It meets the NRSC "AMAX" voluntary standard with attributes such as 50 Hz to 7.5 kHz frequency response, switchable noise blanking, variable bandwidth, and external antenna connection.

Members of the session panel said radio broadcasters have done their part to improve and standardize AM

broadcasts with the NRSC standard. Now the effort will turn to AMAX radio promotion, as part of the organized AMAX effort begun in late 1991.

Panel members also stressed the need for additional AMAX radios. "If only there were more out there," said Ted Snider, owner of KARN(AM) in Little Rock, Ark. and chairman of the NAB's AM Receiver Manufacturer Liaison Subcommittee.

Currently, Delco makes several AMAX quality radios for GM cars and trucks; other companies, such as Sony and Aiwa, are bringing out additional AM stereo radios. But not all of them can meet the stringent AMAX mark.

Creating portable AMAX radios has not been easy, because of such technical obstacles as designing a low-voltage noise blanking chip, panel members said. The portables need 4 V chips, while the home units require 9 V.

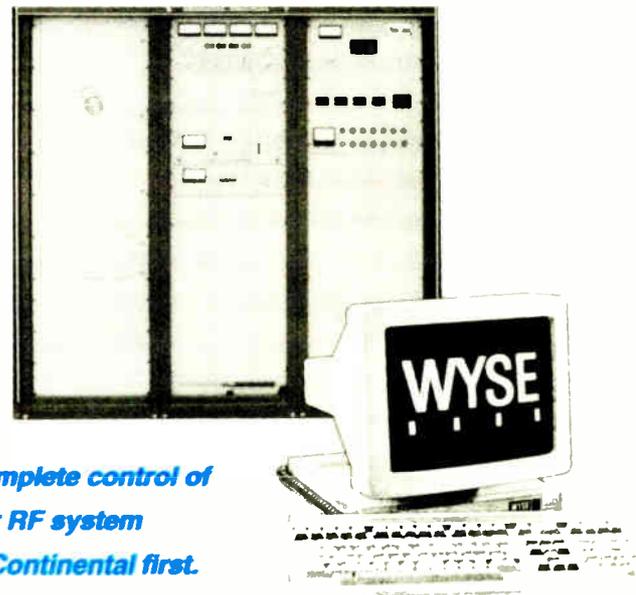
Semiconductor companies such as Motorola are reportedly designing a low-voltage noise blanker chip, but there are no production chips yet, according to Motorola.

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TECHNOLOGY

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## Drinking Hurricanes, Shooting Hoops

by Alex Zavistovich

**WASHINGTON** New Orleans is famous for a lot of things, such as Preservation Hall, the Neville Brothers, Cajun food, Mardi Gras. But as far as I'm concerned, one recent event



Clockwise, from left: Yours truly, with Margot Daly and Frank Foti of Cutting Edge; AP's Jim Williams, with Krystina Tash and husband, RW's Skip Tash; the scene of the crime; and Dave Hurst of Le Mail, hangin' loose with Clark Wire's Mike Vilches.



Jesse Walsh Communications' Keith Clark and RE America's John Casey flank the editor and Managing Editor Lucia Cobo.



times from the first day of the convention.

When we got to the bar to set things up on that now-infamous Friday night, I knew we were in for a wild time. If you've never been to Pat O'Brien's...well, let's just say it's not a big place. We rent-

coloring, or maybe cough syrup with codeine.

Now, I'm not usually a drinker, but the mood was right, and the hot, sticky night made those things go down pretty smooth. After only one Hurricane and a Cyclone, you could have been hit over the head with a phone book and not known the difference. The crowd was in high spirits (literally), and by the party's end we brought a whole new meaning to the Pink Floyd song "Comfortably Numb." Happily, everybody knew his or her limit, and the party broke up with none the worse for wear.



In fact, amazingly enough, one group of fitness fanatics even got together the next morning (at 7 a.m., no less) for a three-on-three game of basketball on the rooftop court of the New Orleans Hilton.

Yes, it was the RW Dream Team: the distributors versus the manufacturers. Broadcast Supply West, Broadcasters General Store and Harris Allied teamed up against 360 Systems and Cutting Edge Technologies for a game that, by some reports, gave credence to the movie title "White Men Can't Jump."

The outcome? Well, I don't think winning was the point, but apparently the distributors did edge out the manufacturers. But let's be fair: BSW's Sean Bowers went to college on a basketball scholarship, so there was a ringer in the crowd.

Still, as Bowers said, a great time was had by all, and the Dream Team game was voted to be a trade show ritual

has earned the right to be added to the list. The event: none other than the RW Hurricane Party, held at Pat O'Brien's in the French Quarter during the NAB Radio Show. If you don't remember being there, you probably were.

I knew things were going to be crazy from the number of folks that had promised to show up. Our broadcast friends were anticipating the good

ed the whole top floor, which consisted of two rooms and a veranda. The proprietors had set up a single bar in one of the rooms. As people started pouring in, though, it became clear that one bar was just not going to be enough. Within an hour, there was just barely enough space to squeeze through the rooms, and the line to the bar was getting dauntingly long. In a clutch decision, we had waiters weave their way through the rooms and the veranda carrying trays of Hurricanes and Cyclones, and before long the party was in full swing.

For the uninitiated, the Hurricane is the signature drink at Pat O'Brien's. As far as I can tell, it consists of a whole lot of rum and "Hurricane mix"—probably maraschino cherry juice and Hawaiian Punch. As for the dreaded Cyclone, as far as I could tell, it was even more rum and some yellow food



The RW Dream Team: Harris Allied's Scott Beehler; 360 Systems; Don Bird; Rick Forgeson of BGS; Sean Bowers of BSW; and Cutting Edge's Frank and Joe Foti. Inset: A massive hook shot from the top of the key...



from now on. Slots are still open for next year's teams.

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

*Alex*

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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.

### Composite clipping and harmonics

Dear RW,

In your Sept. 9 issue, the *Bottomline Broadcaster* article explains the "proper use of composite clipping." There are a few statements that the author, Jim Somich, should have expanded upon.

Mr. Somich mentions that the "harmonics produced by the clipping process of the stereo subcarrier will fall above 53 kHz and out of the range of audibility." While there is an element of truth to this, a simple twist of the old RF clipping scheme, there is also unwanted "baggage" to be claimed!

With respect to the harmonics that are produced by composite clipping falling above the 53 kHz passband, the author provides no explanation about what will be done with this harmonic energy. Since the frequency spectrum above 53 kHz (54 kHz-99 kHz) is used for SCA transmission purposes, the harmonic products produced from the clipping action can disrupt the operation of SCA service.

This same harmonic energy creates two additional difficulties. First, the additional harmonic content adds to the total modulation of the system since it is energy that falls within the 100 kHz spectrum of an FM channel. Remember total modulation of an FM channel is measured by calculating the energy that is transmitted within the 100 kHz passband of the transmission system. (The amount of added modulation will correlate to the amount of clipping employed.)

Second, this same energy, that will now reside in the upper composite spectrum, can create additional trouble in multipath areas. This is due to the larger modulation index of the transmitted signal. When noise from multipath is occurring in a receiver, it is in part due to the receiver trying to demodulate two of the same RF signals. Except one of them has been delayed slightly because of its multiple path travel. In attempting to demodulate these two signals, the stereo subcarrier information becomes distorted due to the

delay introduced to the multipath signal. This is how the noise and distortion of multipath is produced.

When composite clipping is employed, the added harmonic content to the upper spectrum will further exaggerate multipath noise, since there is now additional signal content that must be demodulated. Since these signals will be multiples of the stereo subchannel information, they will further add to the previously mentioned delays occurring in the demodulation process. Because of this, additional noise and distortion can be perceived in the receiver.

This does not mean that composite clipping is bad. However, if over-used, the above scenarios will take place. Also, if heavy clipping is required, a filter for the composite spectrum should be employed. It will remove all the above-mentioned problems and provide benefits.

Frank Foti, Director of Engineering  
Cutting Edge Technologies  
Cleveland, Ohio

### Spectral manipulation questioned

Dear RW,

The Sept. 9 issue included my article, "A Basic Guide to PC-Based Editing," which described the Turtle Beach 56K digital audio editor. Unfortunately, the last sentence in the article was edited out, giving the reader a false negative impression of the 56K system. As it reads, the article ends, "All these edits are destructive...and relatively time consuming." The missing sentence was, "Next time, we'll discuss playlist editing, which is non-destructive and much faster."

The same issue had an excellent article on fine-tuning your station's on-air sound. It said that equalizers can be used to change the program's spectral balance. But consider the people who make the CDs you're playing—the recording engineers, musicians, and producers. They work very hard to create a certain spectral balance on their CDs. Why tamper with it? You're second-guessing their judgment. And if you change the spectral balance of a CD, it will sound different on the air than on a CD player at home.

I realize that the idea is to give your station a distinctive sound. But if you change the balance between bass, midrange and treble, the CDs you play will sound different than intended. I'd like to hear comments on the rationale behind spectral manipulation.

Bruce Bartlett  
Crown International  
Elkhart, Ind.

*Editor replies: On one hand, I can understand your concern about changing the spectral balance of recorded music when designing a radio station's on-air sound. The artistic argument raised is similar to the one presented by opponents of motion picture colorization, and it has merit.*

*On the other hand, the listening experience is an extremely subjective thing. Music fans have never been shy of re-equalizing material to suit their tastes. For example, anyone who has pulled up alongside a car whose driver is playing house, rap or other urban music can attest to the*

## Radio 1992: More for Everyone

The NAB's Radio 1992 convention in New Orleans was decidedly positive. Attendance figures were down slightly from last year, but those present were there to conduct business and attend sessions.

Exhibitors weren't complaining about the decrease in traffic—the crowd may have been smaller but business was getting done. While the industry may not yet be ready to say it has landed on *terra firma*,

the stronger players seemed willing to participate in the show and were out on the floor looking for products and services to buy.

In the past, this page has criticized the NAB fall show for not showcasing the technical aspects of the business right along with the management and programming sides. This year's convention featured an enhanced curriculum of technical sessions, including a digital seminar.

Judging by the standing-room-only technical sessions, the move is on target. However, there is still room to do more. The NAB could further beef up the technical side of the fall show without hurting the spring convention. By doing so, it could draw in more regional engineers who may not get the opportunity to travel to the spring event.

The NAB must continue steering its members to issues of technical significance. More stations are relying on contract engineers to keep them on the air. Managers and engineers both need to keep abreast of technical developments to make informed decisions when allocating station budgets.

Engineering is the mortar that holds the programming and management bricks in place and allows for the construction of a successful radio station. A better interchange of ideas can be had if more personnel from different departments of a station attend the fall show. Managers and owners can gain a more positive understanding of how the departments of a station work together—thus fostering a team spirit that is better for stations and the industry as a whole.

The NAB did a better job of disseminating more information to more of its members in New Orleans than at previous fall radio shows. Exhibitors and broadcasters were both better served. We look forward to even further improvements in the future.

—RW

*fact that a considerable amount of spectral manipulation—usually in the bass frequencies—is going on. Ardent fans of that type of music will even outfit their cars or home stereos with high-powered amps and monster subwoofers, the better to "feel" the low end. Dance clubs routinely "bomb the bass" to accentuate the low end in songs and to bring out the instruments that carry the groove.*

*The popularity of graphic equalizers in home stereo systems also indicates that people often prefer to tailor the source material to their own listening tastes. (I must admit to re-equalizing some radio stations even when I know they are doing their own EQ manipulations.)*

*Program directors who micromanage a station's sound down to the EQ may be violating the artistic spirit of the music they air, granted. Their counter-argument, however, could be that they are attempting to set a mood—and setting and keeping the proper mood is an important subjective factor in holding an audience.*

*Anyone else care to share his or her opinion?*

### The WEAFF story

Dear RW,

I read with great interest Charles Taylor's item regarding WEAFF (RW, Sept. 9, 1992). For the benefit of the many others interested in the history of broadcasting, I recommend that they contact their local library to get a copy of the book "Commercial Broadcasting Pioneer" (subtitled "The WEAFF Experiment"). This book was written by Mr. William Peck Banning, formerly an AT&T vice president, and was published by the Harvard University Press in 1946. Being over 45 years old, copies may not be easy to find.

As many of your readers know, the first radio stations were used only to advertise their owners' products or services. A few were started only to encourage people to buy radio sets. A serious question at the time was, "Who

is going to pay for broadcasting?"

As AT&T was in the toll telephone business, they decided to try "toll broadcasting," an arrangement whereby they would provide programming and five credits to a sponsor who paid the toll. Some of the earliest performers were telephone operators or office workers who were also talented musicians. Others, such as Graham McNamee were hired to be broadcasters and went on to become very well known over the years. It was AT&T who initiated the first "network" broadcasts, too.

As an aside, the call letters were chosen because the theme of the lobby decorations at 195 Broadway in those years revolved around those first four elements: Earth, Air, Fire and Water.

George Schleicher  
W9NLT  
Deerfield, Ill.

### In search of Versa Count

Dear RW,

During the 1970s and 1980s, a company known as Versa Count manufactured broadcast equipment at its location in Elk Grove Village, Ill. Versa Count produced exciters, RF amplifiers, modulation monitors, translators and counters.

Unfortunately, the company seems to have gone out of business, and I'm sure that others like myself would like to obtain parts for equipment. My station owns a model V-322 exciter, and we are in need of part of the service manual.

We would be most grateful if any of your readers could provide us with a photocopy of the manual. Alternatively, perhaps we could be provided with instructions for reaching Al Williams, who was a principal of Versa Count. Of course, I'll be pleased to pass this information along to RW for the benefit of other owners of Versa Count gear.

I may be reached at 602-290-9797.

Paul S. Lotsof  
KAVV (FM)  
Tucson, Ariz.

# Radio World

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World Radio History

# Stations Overcome Storm's Wrath

by John Gatski

**MIAMI** The four radio broadcasters on the 1,800-foot tower demolished by Hurricane Andrew rushed to get back on the air in some fashion in the weeks following the disaster.

WMCU-FM, WXDJ-FM, WRTO-FM and WDNA-FM had antennas on the tower, owned by CBS and located in the south Dade County community of Homestead, the area hardest hit by the hurricane. Engi-

for an old standby site for WCMQ(FM), a 200-foot tower located a few miles north of Miami.

The station used a loaner ERI two-bay antenna with 15 kW of power. "We figured we got about 80-85 percent of our market

to the station, he said, and Continental shipped a new Model 816R3B 25 kW transmitter in less than a day.

WXDJ is transmitting with 12 kW ERP, covering its market adequately, Leifer added.

WRTO found a temporary home at

**ERI was very helpful in getting the loaner antenna delivered in less than 24 hours.**

—Bill Coppage,

Chief Engineer, WMCU-FM

back," Coppage said.

He said ERI was very helpful in getting the loaner antenna delivered in less than 24 hours.

Jim Leifer, contract engineer for WXDJ, said his station was able to secure tower space on WCMQ's main site in Biscayne. ERI also swiftly delivered a one-bay loaner

WSUA's old site. The fourth station on the CBS tower, WDNA—an eclectic jazz, diverse programming station—had been off-the-air when the tower was destroyed.

With the stability of securing temporary sites, the stations now are looking for permanent sites to get back to their full power levels, according to their engineers.

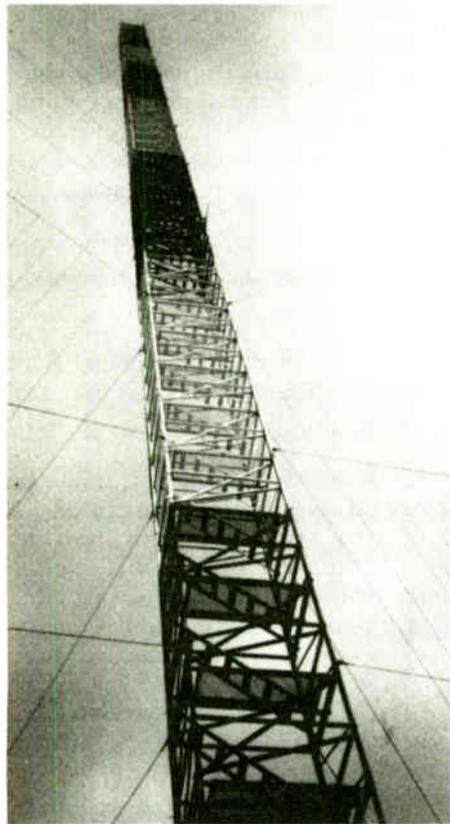
In other hurricane-related news, Lodestar Site Management found a site for several mobile communications and government communications services under a version of its Emergency Restoration Program. These users also had been on the CBS tower.

Following the hurricane, Lodestar Sales Director Frank Lee said several of those users contacted the company, which manages communications and broadcast tower sites throughout the U.S.

"There was a definite need in south Dade County for tower space," Lee said.

With enough clients ready to sign on, Lodestar found an old 650-foot government communications tower northwest of Miami, and had it operational within a week.

Lodestar is one of several subsidiary companies of the LeBlanc Group, which manufactures communications towers. LDL Communications is the marketing arm for LeBlanc towers. LeBlanc also has two other broadcast-related companies, LARCAN (transmitters) and the Alan Dick Co., an antenna manufacturer.



Lodestar found a tower for several communications services.

neers worked long hours to get the stations broadcasting again, according to WMCU Chief Engineer Bill Coppage.

Coppage was able to put WMCU back on the air within a few weeks. Most of that time was spent trying to secure a temporary transmitting site. Coppage finally settled

## Army Uses Portable AMs

by John Gatski

**MIAMI** When the U.S. Army was called in to help smooth over the disastrous after-effects of Hurricane Andrew, it put into action a communications tool used in the 1991 Desert Storm conflict: the neighborhood AM radio station.

The devastation let by Hurricane Andrew in the Miami area created a dire need to get information out to the thousands of homeless people who needed basic living items, and radio was a proven, efficient way to relay that information.

The Army put three mobile AM stations on the air, known as Radio Rescue, using a radio transmitter package made by a Kansas City Company, Video Masters Inc., for each one. Thousands of portable AM radios also were distributed by the military.

According to Tom Schulze, Video Mas-

ter's chief project engineer, the "Mobile Broadcast System" provides everything necessary to put an AM station on the air in an emergency including transmitter, antenna, microphones, cassette recorder/player, shortwave receiver, audio mixer and auxiliary power. The console/transmitter configuration can be laid out in a fairly compact module sys-

tem, weighing about 200 pounds total. The entire package, including generator, weighs 726 pounds.

The transmitter is a Nautel 400 converted into a frequency-agile unit that can deliver 25 W to 400 W, providing an omni-directional coverage area of about 30 miles maximum, depending on terrain.

"What we do is take out the frequency crystal and put in a frequency synthesizer to make it

continued on page 8 ▶

A Broadcast Industry

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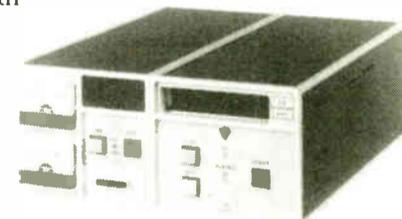
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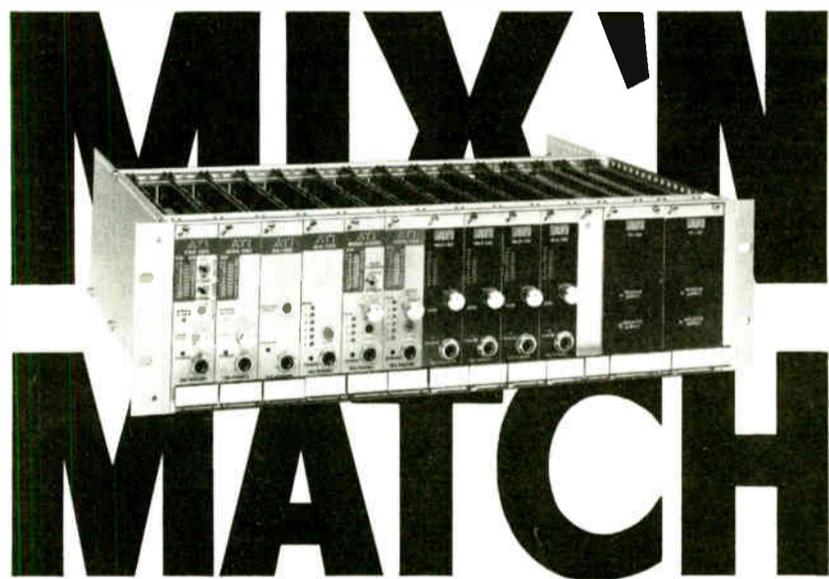


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# Canada Skeptical About In-Band DAB

by John Gatski

**NEW ORLEANS** NAB officials claim that Canadian officials are criticizing in-band digital audio broadcasting (DAB) in other countries to win favor for the L-band Eureka system—a system that Canada plans to use.

During a DAB seminar at the NAB Radio Show, NAB DAB Task Force member Randy Odenal said Canada recently downplayed the progress of in-band, the system preferred by most U.S. broadcasters, at a recent international communications meet-

ing held in Mexico. NAB Engineer Ken Springer also confirmed that Cana-

The NAB believes Canada's critical comments about in-band are an attempt

**"We believe that you are very far away from what Eureka has achieved. We are not convinced that in-band will work."**

—Michael Tremblay,  
CAB

dian officials were playing down in-band technology.

to gain favor for the Eureka system as a worldwide standard. Canada plans to

implement terrestrial L-band DAB by 1995.

Following an update on Canada's DAB efforts here, Michel Tremblay, executive vice president of the Canadian Association of Broadcasters, talked to *RW* about in-band DAB and other related issues.

Addressing NAB concerns that Canada is trying to undermine in-band, Tremblay said that any criticism of in-band is based on scientific evidence.

He said the USA Digital Radio consortium has "done some very good work" on in-band, but it will not provide the capability of Eureka because of the spectrum constraints. Canada has stated that it wants to use the Eureka system as a replacement for analog broadcasting, rather than as a supplement.

"We believe that you are very far away from what Eureka has achieved," Tremblay said. "We are not convinced that in-band will work."

Tremblay admitted that Canada is "aggressively pursuing" Eureka on L-band as a world standard, and he believes most countries will use L-band. He pointed to the WARC (World Administrative Radio Conference) earlier this year in which several countries approved L-band for satellite DAB. (There were exceptions, however, including the U.S., which voted for S-band.)

continued on page 10 ►

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Radio Station KAIR/JOY, Inc.  
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3.8 Meter Antenna Installation

## Army Utilizes Portable AM in Miami

► continued from page 7  
frequency agile from 1000 to 1620 kHz," Schulze said.

Also key to portability of the system is remote powering. The power supply is removed from the transmitter and placed in a separate module, allowing either 120 VAC generator power or 12 VDC battery power.

The antenna system includes a shortwave and an AM transmitting antenna that needs a 230-foot by 50-foot area for set up. A tuning kit also is provided to get the optimum coverage from the system, according to the company.

The Mobile Broadcast System was popular in Desert Storm, allowing military personnel to listen to music and news from their temporary desert habitats.

Schulze said the military has so far purchased five of the units for various uses, but broadcasters have not been quick to embrace the product because of its \$50,000 price tag. He noted that the product has been shown at previous NAB conventions, and is an efficient way to get back on the air in an emergency situation.

# Which type of CD player is right for your station?



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# DAB Standard Procedures Disputed

► continued from page 1

In his presentation, Gary Shapiro, EIA's Consumer Electronics Group vice president, said the standard process does include the radio industry. "We are try-

ers want digital sound, and that digital is a must for broadcasters to compete against digital cable, CDs, satellite broadcasting and high definition television.

## Representatives of the Electronic Industries Association (EIA) and the NAB expressed different views on how best to enact a domestic DAB standard.

ing to be as flexible as possible to accommodate broadcasters," Shapiro said.

### Involving broadcasters

He justified the EIA's action on the standard, citing the association's track record. He said the association's past standards work has been "fair and objective," and maintained that EIA's attempt to set a DAB standard is logical.

Shapiro also attempted to dispel what he called "myths" surrounding the DAB issue—that people don't actually care about digital quality for radio and that DAB will be a burden to broadcasters.

Shapiro cited surveys that said listen-

Shapiro downplayed the "voting bloc" aspect of the standard process, stating that until the systems are tested, "voting is irrelevant." He insisted that finding the best system is the first priority.

The proposed voting procedures would give the receiver industry four votes, broadcasters two votes, networks two votes, and one vote each for the semiconductor industry, satellite interests and software industry.

### The voting bloc snag

Later in the session, NAB Senior VP for Science & Technology Michael Rau strongly disputed Shapiro's comments on the voting issue. "I can't believe that

Gary Shapiro said that voting is irrelevant," he said.

Shapiro explained that the voting bloc allocation has to include all involved segments, and giving the majority of votes to broadcasters—or any other segment—would violate anti-trust laws.

Randy Odeneal, a member of the NAB DAB Task Force, said EIA does not need to test systems other than in-band because such a system would be easier to implement for existing broadcasters. Rau also concurred with that

opinion, calling in-band "the preferred option."

In challenging the EIA assertion that DAB is absolutely necessary, Odeneal noted that properly processed FM sounds very good. "DAB is not HDTV for radio," Odeneal said.

Prior to the NAB Radio Show, the NAB and EIA planned continuing talks on the standard. A meeting held the third week of September in Washington, D.C., was characterized by a participant as "pretty tame," with no discussion of voting undertaken.

Rau was somewhat optimistic, however. "The more we talk with EIA, the better EIA understands NAB's concerns," Rau said.

# Canada Officials Unsure About In-Band Systems

► continued from page 8

"Canada is working with other government groups to get L-band," Tremblay said. "We hope events will unfold as we want them to."

But if the U.S. ultimately does not choose L-band, Canada will not stand in the way, according to Tremblay. "We respect that (the U.S. choice of in-band)," he said. "Technically, we can co-exist."

Realistically, he added, DAB implementation will work more smoothly if all countries use the same standard.

Despite the Canadian public relations effort at portraying Eureka at L-band as technically superior, a USA Digital Radio source said that in countries that are pro-Eureka, like Mexico, officials also have expressed interest in the Project Acorn in-band system.

Tremblay also discussed potential telemetry conflicts between the U.S. and Canada. The U.S. uses L-band for military telemetry and testing, and Canada uses S-band, which could mean

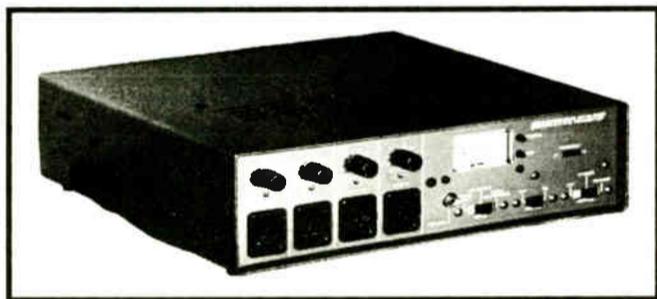
cross-border interference potential. Tremblay said an interference problem with the U.S. would exist only if Canada uses satellite DAB on L-band,

**In countries that are pro-Eureka, officials also have expressed interest in the Project Acorn in-band system.**

which it has no plans to do for several years.

Instead, Canada plans to concentrate on L-band terrestrial radio service, which is not likely to interfere with U.S. telemetry—if DAB allocations are carefully planned along the border, he said.

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# NAB RADIO SHOW 1992

## All-Digital Station Still in the Future

by Dennis Martin

**NEW ORLEANS** "How soon will it be practical to design and build the all-digital facility?" That question and others were explored during a session titled "Building the Digital Facility—Managing the Transition to the Future," during the Digital Radio Seminar at the NAB Radio Show here.

As session moderator Donald Lockett of National Public Radio observed, many stations today are a hybrid of digital and analog technologies. Yet, while digital technology is increasingly commonplace at radio stations, it is still developing. "Are the benefits worth the capital investment when considering new facilities?" Lockett asked.

On hand were panelists Steve Lyman of the Canadian Broadcasting Corp. (CBC); Tim Valley, Gentner Communications; Michael Smyth, Audio Processing Technology (APT); and Dennis Schneider of Broadcast Electronics.

### The Canadian way

For the past three years, the CBC has been experimenting with how best to digitize its facilities. Favoring an "evolutionary approach" of conversion to digital, Lyman discussed the various stages. The first step is to simply add digital devices to an analog studio; interconnections remain analog. The next progression is to build an all-digital production suite, including digital-domain interfacing. A digital workstation

and digital console would serve as the nucleus to various outboard digital sources and processors.

Beyond that is what the CBC calls "Desktop Radio." In its execution, analog audio cassettes from reporters are digitized, rate reduced, and transferred to a very large server. Thus, journalists and producers can access and edit sound files while they are working on text, all through a local area network (LAN).

To integrate the various suites and other

sources, which Lyman called "digital islands," a digital routing switcher is used. As the plant converts to digital, analog interfaces are removed from the routing switcher and replaced by digital I/O cards. The result is an all-digital facility.

Finally, coordinating such a mixed environment is the role of master control. It offers a variety of analog and digital inputs and outputs, a LAN for Desktop Radio, a synchronizer, and codecs. Lyman emphasized the need for a house sync generator

that is distributed to all suites and support equipment.

### The up side

"Digital is smaller, faster, cleaner, more reliable, simpler, easier to operate, and it costs less to purchase, operate, and maintain than analog in almost every case," reported Tim Valley of Gentner Communications. An automation system a few years ago might occupy as many as six racks and include reel-to-reels, switchers, and multiple cart players. Today, this can be accomplished in about 17 inches of vertical rack

continued on page 30 ▶

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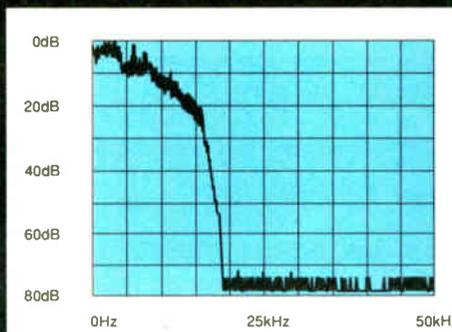
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▶ continued from page 1

at sessions, particularly those dealing with DAB technology.

Dobson added that international presence at the show appeared healthier than ever. "Having been in Montreux has made Europeans aware of what the NAB does," he said.

In fact, French vendor Dalet Digital Media Systems, which primarily does business in Europe, set up a booth in New Orleans, targeted to non-stateside visitors.

"It gives us another opportunity to demonstrate our products to Europeans," said Dalet Commercial Engineer Francois Jonchier. Numerous international delegations stopped by the well-attended booth for demonstrations of the company's on-air digital workstations, he said.

Total international attendance was predicted at 600. No actual figures were available from NAB at presstime.

Overall, 160 exhibitors showcased products on the exhibit floor. And while product introductions traditionally are reserved for the larger splash of the NAB's spring show in Las Vegas, a number of companies demonstrated new products or production models of equipment shown in prototype form this past April.

## Proponent DAB Systems Outlined

by Dennis Martin

**NEW ORLEANS** The NAB's Digital Radio Seminar session, "Technical Profiles of Proposed Systems," gave attendees a glimpse of the work being done in digital audio broadcasting (DAB), both domestically and abroad.

Randy Brunts of Delco Electronics, chairperson of the Electronic Industries Association (EIA) Digital Audio Standards Subcommittee, served as modera-

tor. Brunts questioned the expectations of a digitally indoctrinated consumer market; how to attract customers to this new technology; what should be recommended to government; and the investment required by broadcasters and consumers. Without cooperation among the affected industry segments, he said, the U.S. will be unable to remain competitive with plans developed by other world markets.

Tom Keller, a consultant to the

EIA on digital audio radio (DAR) testing, presented an overview of the group's testing procedures. The proposed FM systems fall into three groups: in-band adjacent DAR systems, in-band on-channel, and those that require new bands. Satellite and AM radio proposals, not currently included, will be added to the program.

Keller explained that the various systems will be tested for susceptibility to noise, including impulse and automotive, and multipath—

mobile and fixed. In-band systems will be examined for interference to the analog FM signal and to adjacent services.

An important issue is quality testing of FM receivers for compatibility, Keller said. It is essential that selected receivers represent products currently used by consumers to validate tests of the two in-band schemes.

### A mighty Acorn

USA Digital Radio, is a consortium of CBS, Gannett, and Group W. The tag-team presentation on the group's Project Acorn system was led by Gannett's Paul Don-

ahue. He described the FM system as in-band on-channel, offering 20 Hz to 20 kHz response, datacasting capability, and multipath mitigation. Since it operates within the station's presently-licensed RF mask, it does not create interference to adjacent channels. Using acoustic charged transport (ACT) technology developed for the U.S. military, the system is an enhancement of present analog services since no new spectrum is required.

Tony Masiello of CBS Radio described the ACT technology. The chip combines SAW (surface acoustic wave) technology and GaAs (gallium arsenide) integrated circuits and is projected to cost \$7 to \$10 in commercial quantities.

To mitigate multipath in the system, "hula" modulation is used, Masiello said. Twenty-one digital carriers are placed on each side of the analog carrier. The two sets carry redundant information and deviate with the main carrier. This scheme, Masiello maintained, solves "stoplight fade" multipath problems.

Glynn Walden of Group W discussed the in-band on-channel system for AM allocations. Designed to operate within the NRSC mask, the system offers a 96 dB SNR, 15 kHz audio bandwidth, and datacasting capability. Since most of the AM information is still proprietary, few other technical details were revealed.

### AT&T, Digital Radio Labs

AT&T has been working on its perceptual audio coder (PAC) source coding technology for several years, according to the company's Ajay Shingal. While some systems rely on 4:1 compression, AT&T was demonstrating a compression ratio of 12:1 at the show. The company is working to integrate its PAC codec with an in-band transmission system in preparation for the April 1993 DAB standard competition.

Digital Radio Labs believes that wide frequency diversity is required to solve broadband flat fades, like stoplight fades. As the company's Doug Talley described, Digital Radio Labs' system does not use multiple antennas or other impractical "crutches." Instead, 100 kHz-wide digitally modulated signals are placed in an FM station's adjacent channels.

Digital Radio Labs, which provides digital audio services to cable subscribers, has been working on its system for several years. To date, only pieces of the system have been tested.

### Eureka, Amati

Thomson Consumer Electronics is the U.S. representative of the Eureka system, and manufactures products under the GE and RCA names. Thomson's Clint Pinkham stated at the outset that Eureka 147 DAB is a wideband, out-of-band system. Pioneered by a consortium of 13 European partners, the goal of Eureka was maximum system performance. That premise led to a wideband, out-of-band system. Pinkham noted that

continued on page 25 ►

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# Switched 56, ISDN Praised for Remotes

by Tom McGinley

**NEW ORLEANS** The NAB Radio Show's technical session on backhaul alternatives for remote broadcasting featured all six panelists singing the praises of ISDN or Switched 56 (SW56) telephone services.

Moderator Carl Capista of G.E. American Communications traced the evolution of broadcast remotes first using analog telco, then line-extended telco, then satellite services including C-band and small aperture Ku-band, and finally back to earth with digital telco and SW56 along with its enhanced cousin, ISDN (integrated services digital network).

Dave Anderson, VP of operations for IDB, discussed the extensive satellite and fiber network services IDB has provided the industry since 1984, carrying over 3,600 major sporting events.

IDB has stepped into the SW56/ISDN arena and is marketing its own codec, the DAC-56, Anderson said. IDB offers turnkey remote services using whatever delivery method that makes the most sense, including SW56/ISDN.

Anderson cited the disadvantages of ISDN, including limited frequency response (7.5 kHz per circuit), poor stereo performance, and lack of network controls.

## Telco problems on ISDN

According to Anderson, telco problems will not go away with ISDN. Telco personnel are still unfamiliar with it and ISDN does not yet offer a user-friendly dial tone, he added.

Mike Schutz, manager of AT&T's Accunet, described the company's ISDN service which has been available for almost five years and provides connectivity on demand with no installation charges.

The 4ESS AT&T central office switch is separated into a voice net path and a data net path and offers data speeds of 56 kilobit (56kb), 64kb, 384 kb, and 1.5 megabit. Ten-digit dial tone service is

available in almost all of the U.S. and 20 foreign countries.

Dial 1-800-222-SW56 on the regular telco network for any information regarding Accunet services. 1-800-FOR-SW56 is the trouble number if you are using Accunet and encounter problems.

Dan Joffee of Integrated Network Corp. (INC) covered the basic hardware requirements for SW56 applications. Each end of the circuit requires a codec, which digitally compresses or decompresses the analog audio, and a CSU/DSU unit which converts the signal to the digital bitstream at one end and decodes it at the other.

Either a four-wire circuit like Accunet, which is most common, or a two-wire circuit, like Datapath, can be used, he said. INC makes and sells the SW56 CSU/DSU hardware with the CM 1056 family of units designed for a full range of SW56 applications including high quality audio remotes, video conferencing, and LAN internet working.

Joffee said each company calls its SW56 something different, causing much confusion. INC has published a guide which identifies and explains each service offered by every major telco, including costs. It can be obtained by calling 1-800-241-EASY.

## Comrex and SW56

Tom Hartnett, chief engineer for the Comrex Corporation, traced the progression of his company's telephone broadcast

equipment from the auto answer couplers and single/multiline extenders to the newest product, a codec for SW56 and ISDN applications.

The codec unit uses a 4:1 compression ratio for full duplex. Hartnett emphasized that SW56 is a system developed in the U.S. while ISDN actually originated in Europe more than 15 years ago. Comrex offers a free demo of its new codec and now has an office in the U.K.

Bob Donnelly, manager for Cap Cities/ABC Satellite Services, detailed his company's widespread use and offering of remote broadcast backhaul methods using the "toolbox" approach, taking whatever combination of different delivery systems works best in any given application.

He conceded that satellites are being used less now with the widespread availability of SW56 and ISDN, but did point out that installation and equipment costs of SWAC services are still high particularly considering the need for spares to insure absolute reliability.

## Hi-fi phone lines

Donnelly alluded to ISDN eventually evolving into the "high fidelity telephone of the future" available to everyone.

George Habel, general manager for Capitol Radio Network (CRN), discussed its widespread use of IDB and ABC services, using INC and Comrex equipment. The company has provided program origination and distribution of numerous major univer-

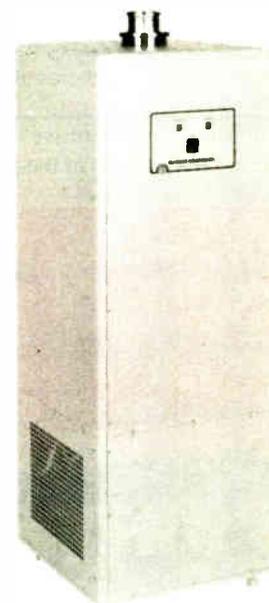
sity and professional sporting events on the East Coast.

CRN is no longer relying only on satellite for high quality backhaul and network applications. With \$7,000 initially invested in equipment costs, SW56 is now handling all network backhauling from Raleigh, N.C. to Richmond, Va. at a monthly cost of only about \$80.

A network Saturday morning garden show is now using SW56 with monthly costs of about \$200. A comparable satellite service would have been \$800 a month, he said.

Habel warned potential users of SW56/ISDN that for big-money, one-time remotes, it is still wise to use IDB or ABC. There are still too many things that can and do go wrong with the technology, he added.

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# Denon/NAB Tuner Undergoes Tests

► continued from page 1

indicates relative signal strength of incoming AM or FM signals, bandwidth selection (wide or narrow) and whether the noise reduction circuitry is activated. The right half of the panel is dedicated to push button

an auto/manual switch, the bandwidth selector button, the noise reduction button, a button that toggles between AM and FM, and "Up/Down" tuning buttons. Numbered buttons from 1 to 0 and an "Enter" button along the bottom edge of the panel com-

tuner is equipped with a bracket, into which the separately supplied AM loop antenna can be snapped. There are separate pairs of terminals for this AM antenna and for connection of an external, outdoor, or powered AM antenna. FM antenna connection is made via a 75-ohm coaxial F-type connector. Left and right phono-type output jacks complete the rear panel layout.

10kHz, amounting to little more than 1.0 dB, but overall response remained essentially flat out to 15 kHz.

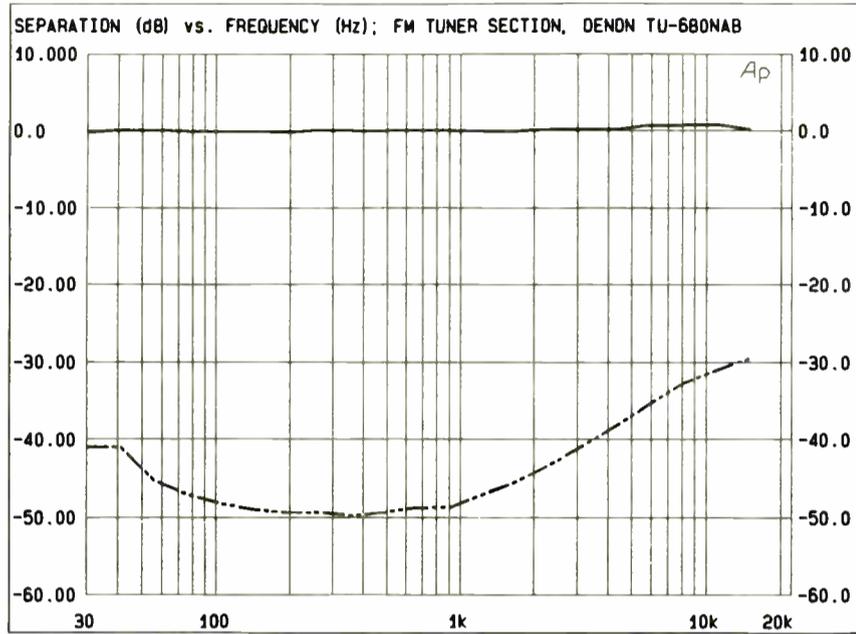
The quieting characteristics of the FM tuner section, for both mono and stereo, are a function of incoming signal strength. Input signal levels were measured in terms of dBf. For those unfamiliar with this reference term, 65 dBf is equal to approximately 1000  $\mu$ V across a 300 ohm impedance. 45 dBf equals about 100  $\mu$ V, while 11.2 dBf equals 2.0  $\mu$ V. Fifty dB quieting in mono was achieved with input signals of only 15.3 dBf, exactly as claimed in Denon's published specifications.

Stereo muting occurred somewhere below 40 dBf, by which time signal-to-noise ratio was already well above 50 dB. In fact, this is our sole criticism of the design of the tuner: The auto/manual button also controls

### Test results

While Denon and the NAB emphasize the AM performance of this product, we were equally interested in finding out just how good its FM circuitry was. After all, to be dubbed a "Super Tuner" implies that its

Figure 1.

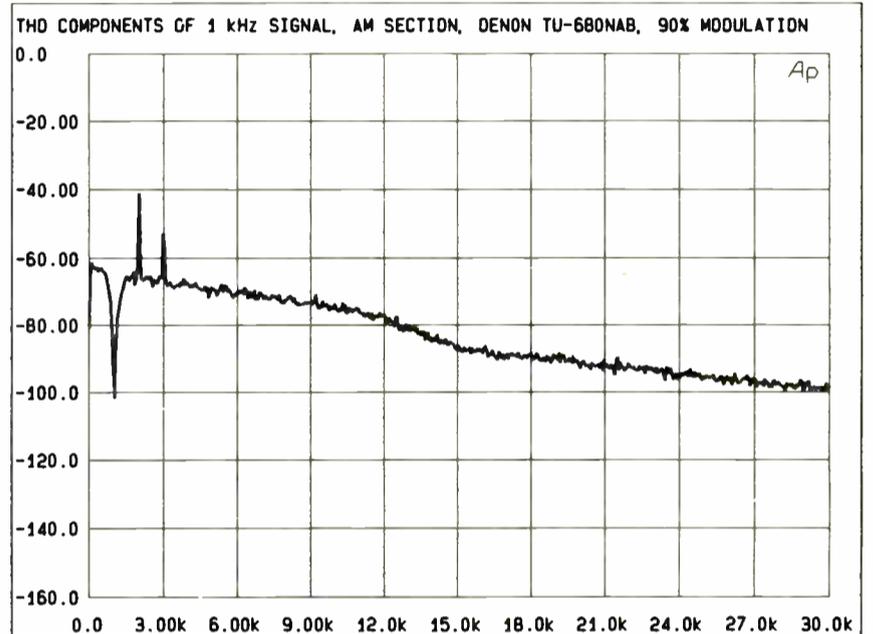


Frequency Response and Stereo Separation, FM tuner section, Denon TU-680NAB AM/FM Stereo Receiver. Solid line represents modulated channel; dashed line represents output at unmodulated channel.

controls including a "Memory" button (used for storing frequencies in the presets),

complete the front panel layout. The rear panel of the Denon TU-680NAB

Figure 2.



Spectrum analysis of harmonics of 1 kHz signal used to modulate AM section of Denon TU-680NAB tuner. Modulation level was 90%. Averaged result of 16 acquisitions, to reduce displayed noise and improve display of coherent signals. Wideband mode was used for this test.

performance is "super" in all respects. Accordingly, we measured FM performance before tackling the AM section.

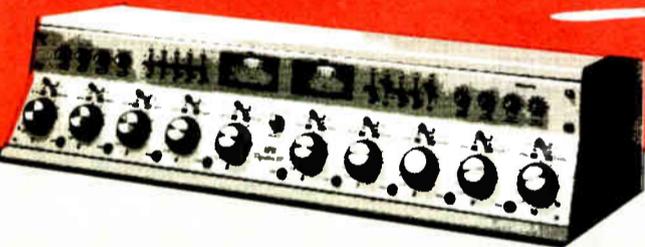
The frequency response of the FM tuner section shows a slight rise in response at

mono/stereo switching. When in the manual mode, signals can only be received monophonically. Conversely, in the "Auto"

tuning mode, stereo signals can only be

continued on next page ►

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► continued from previous page received if their signal strength exceeds the muting threshold of the tuner which, in our opinion, has been set too high.

The harmonic distortion plus noise versus modulating audio frequency was for both mono and stereo reception. In mono, THD plus noise at mid-frequencies was a very low 0.057 per-

lowest levels of distortion plus noise.

Stereo separation in the FM mode was excellent (Figure 1), reaching nearly 50 dB at 1 kHz and maintaining nearly that amount of separation at 100 Hz. At 10 kHz, stereo separation remained greater than 30 dB. A further test of stereo FM performance involved the use of spectrum analysis to analyze the modulated (left channel)

bands of the suppressed 38 kHz subcarrier (at 33 kHz and 43 kHz) are attenuated by almost 60 dB and 68 dB respectively. As for the output of the unmodulated channel, 5 kHz crosstalk was down some 40 dB relative to the reference level while other harmonic components and subcarrier components were also adequately attenuated. (Levels for the dashed-line trace for the unmodulated channel are to be read using the right-hand vertical scale in Fig. 6).

the 100 dB claimed.

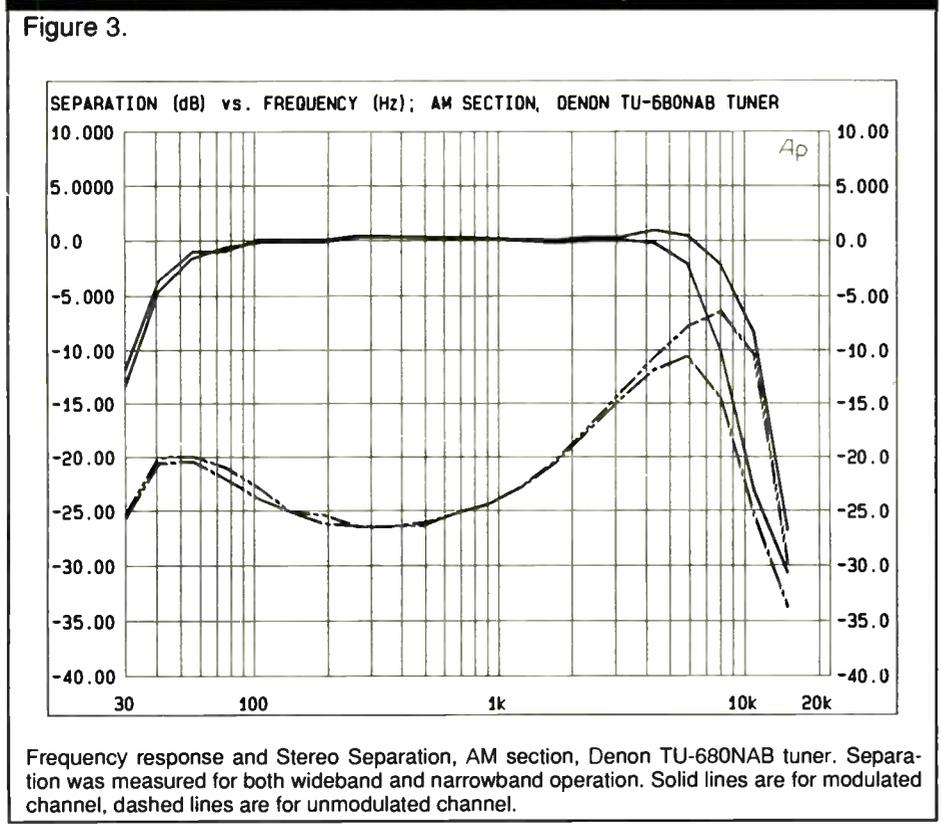
What a pleasure it was to finally come across a tuner whose AM frequency response extended well beyond 5.0 kHz. In fact, when the wideband AM mode is selected, response extended way out to 9.2 kHz before attenuation reached 3 dB! Even when using the narrowband mode, frequency response of this remarkable AM section extended to beyond 6 kHz. As for the bass end of the spectrum, the -3 dB point was reached at approximately 50 Hz.

Distortion plus noise varied with frequency for the AM tuner section, using modulation levels of 90 percent. At 1 kHz, THD plus noise measured 1.2 percent when using the wideband mode, while in the narrowband mode, THD plus noise increased slightly to 1.4 percent.

Note that the published specs for AM continued on page 29 ►

**AM performance measurements**

Alternate channel selectivity measured 60 dB in the wideband mode, increasing to 77 dB when the narrowband mode was selected. Image rejection exceeded published specs, measuring 85 dB as against 80 dB claimed. AM suppression measured exactly 60 dB as claimed, while capture ratio measured 1.2 dB. IF rejection was in excess of



Frequency response and Stereo Separation, AM section, Denon TU-680NAB tuner. Separation was measured for both wideband and narrowband operation. Solid lines are for modulated channel, dashed lines are for unmodulated channel.

cent, increasing to 0.085 percent at 100 Hz and just over 1 percent at 6 kHz.

For stereo reception, THD plus noise measured just over 0.1 percent at mid frequencies, increasing to 0.17 percent at 100 Hz and to 0.16 percent at 6 kHz. Tests showed how distortion of a 1 kHz modulating signal varied with signal strength. For both mono and stereo reception, lowest THD plus noise was attained with little more than a 50 dBf signal strength. This is generally better than what we have measured for other high quality tuners, which usually require at least a 65 dBf signal before reaching their

and unmodulated (right channel) outputs of the tuner when a 5 kHz left-only signal is used to modulate our FM signal generator.

The spectrum analysis shows the reference output level of the 5 kHz signal (peaking at 0 dB) as well as harmonic components at 10 kHz, 15 kHz and at 5 kHz intervals out to the end of the sweep. Even the greatest of these harmonic components (that at 10 kHz) was down about 60 dB below reference level, which is equivalent to an actual second harmonic distortion level of only 0.1 percent.

The 19 kHz pilot carrier has been suppressed by nearly 80 dB while the side-

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“repeat” mode permits automatic looping.

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# Products Introduced at Radio Show

by Charles Taylor

**NEW ORLEANS** While sessions at the Radio 1992 show here offered ways for stations to survive the agitation of a shaky economy, new offerings on the exhibit floor optimistically showed how traditional tasks can be done more easily, faster and, in some cases, less expensively than before.

As has become customary, the word around the hall was digital, and many of the products utilizing such technology had either not previously been seen on show floors or had been available only in prototype form.

In all, 160 exhibitors showed their wares, with

product innovations covering almost every realm of broadcast technology, from transmitters and consoles to digital workstations.

## STL, remote and telco

Among STL, remote and telco equipment manufacturers, Comrex featured its DXP and DXR digital audio compression codecs. The new DX system works on all of the expanding number of 56 and 64 kilobit per second (kbps) data services and allows full duplex audio transmission with 7.5 kHz bandwidth.

The codec has been selling swiftly in the U.K. and throughout much of Europe, according to the company's Tom Hartnett.

Telos spotlighted the 100 Delta, its top-of-the-line digital hybrid with dynamic digital equalization. The product was announced at NAB in the spring and now is shipping. Also shown was the Telos ONE plus ONE, two digital hybrids in a single rack space, including a mix-minus matrix, so that one mix minus can feed both hybrids. ONE plus ONE has been shipping since NAB.

Among products from RE America was the RE8720/8730 15 kHz stereo Tie Line audio codec. The codec operates over dry copper pairs at distances of up to six miles. The product offers significant savings in line lease charges for broadcasters utilizing equalized

telephone circuits for STL or program distribution. The tie line also can be used in studios where long cable runs present an equalization problem.

The tie line was utilized as a component in the show's USA Digital demonstration, feeding the stereo signal of WNOE-AM into the New Orleans Convention Center.

Also on hand from RE was the company's full line of radio data systems (RDS) equipment, including the new RE533 compact RDS encoder, RE331 RDS decoder, d940 digital audio headphone interface and the RE8720/8730 audio codec.

Audio Processing Technology offered new applications for its apt-X100 digital audio data reduction system. Included were the DSM 100 two-channel Digital Audio Transceiver and the ACE-100 Digital Audio Expansion Board. Also on hand was the eight-band apt-X200 Digital Audio Data Reduction System.

Dolby featured its established all-digital 950

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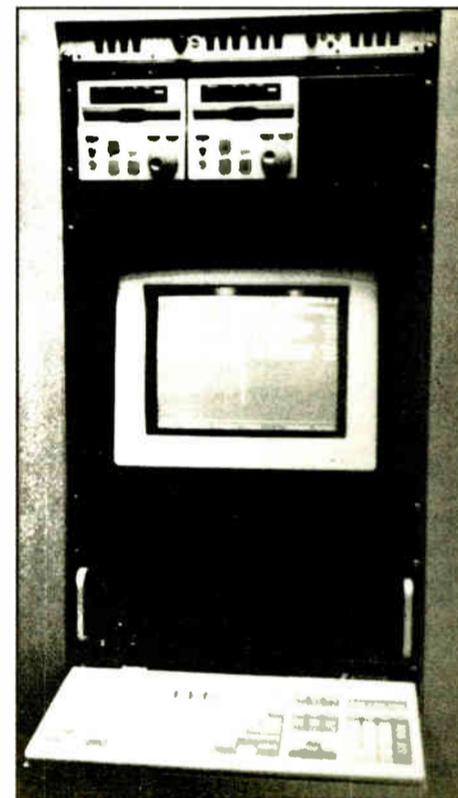
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kHz STL and codecs utilizing Dolby AC-1 and AC-2 digital audio algorithms. At the show, the company announced establishment of a Communications Products Group, responsible for developing and marketing new products specifically for broadcasting and other communications applications. Kevin Tamm will head up this new group.

Moseley's DSP 6000 was featured, offering broadcasters the ability to convey CD-quality audio between studio and transmission facilities. The unit features 90 dB dynamic range, 80 dB crosstalk and THD .01 percent at 1 kHz.

The DSP 6000 system features an encoder, decoder and uses any Moseley digital-ready STL transmitter and receiver.

Marti was on hand describing Plan A, a technical plan for facilitating stations' transitions to LMAs. The company's line of RPU and STL gear was also on hand.

TFT introduced an RDS option for its FM Modulation Monitor line. The option receives the 57 kHz RDS signal and displays the injection level on the test meter of TFT's Model 844A and 884 stereo monitors. The option replaces the seldom-used 38 kHz indication. TFT also showed its digital codec, introduced at Las Vegas in April, which can be used in a digital STL

continued on page 18 ►

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# New Products at Radio '92

► continued from page 16  
setup with other TFT products.

Corporate Computer Systems showed the new CDQ-1000 Musicam codec in prototype form. The unit offers 12-1 conversion, 10 kHz digital audio, dial-up convenience and broadcast-quality transmission. The CDQ-1000 will be in production by the end of the year. Also shown by CCS was the CDQ-2000 with a new AES/EBU digital interface. The codec enables broadcasters to transmit 20 kHz stereo programming using switched digital circuits.

ViaSat was on hand with its PSAT-1205K-NA portable satellite terminal, a completely self-contained Ku-band transmit/receive portable earth station providing 20 kHz

stereo broadcast-quality digital audio uplink, using as little as 112 Kbps space segment bandwidth. It is ideal for sporting events, concerts and fast-breaking new events. A duplex telephone or IFB channel can be added.

## On to consoles

Wheatstone showed a number of new consoles in its Audioarts Engineering line, first shown in Las Vegas. The R-10 is designed for small stations in small markets, and features a dynamic range of 113 dB, a frequency response of  $\pm 1/4$  dB (20 Hz to 20 kHz) and a THD of .002 percent. The R-30 on-air console is available with 12 or 18 input channels, has

two stereo outputs, and mono sum and mix-minus.

Wheatstone's A-50, available with eight, 12 and 18 inputs, comes with machine control functions, individually programmable channel logic, program, audition and telephone outputs and control/studio room monitors.

Fidelipac introduced the Dynamax MX Series modular audio console, available in six-, eight-, 10- or 12-channel models. The system features VCA mixer and monitor control; active balanced line inputs and transformer-isolated mic inputs; full monitoring/cueing facilities; and remote start logic.

Auditronics showed the prototype of its Air-Master 90 audio mixing console, which is scheduled to begin shipping this fall. The low-cost unit is available with eight, 12 and 16 inputs, and offers an A/B selector, telephone mix-minus assignment, stereo audition output assignment, stereo program output assignment and linear VCA fader controls. The 90-LO standard output module includes PGM, AUD and TEL amplifiers and mono output selector switches with LED.

Fidelipac company also showed its popular 800 and 850 Series of consoles for on-air and production capabilities, as well as the DCR-1000 digital cart machine.

## Outboard mixer

Pacific Recorders & Engineering offered its Radiomixer on-air console, as well as the ADX digital audio production system, with an outboard production mixer for eight-track recording and editing.

Harris-Allied featured Mackie Designs' low-priced mixers. Included was Model 1202, with 12 inputs and features such as phantom mic powering, two-band equalization and auxiliary sends and returns. A larger version, the CR1604, also is available from Harris-Allied.

ITC highlighted its offerings with the Audio Switcher, which uses a single switching matrix to route audio signals from multi-

ple input sources to multiple output destinations within a facility. It enables easy manipulation of formats without major wiring changes and reduces the need for patchbays and distribution amplifiers. Also on display was the DigiCenter hard disk-based digital audio processing system, including multiple digital cart machine automation.

## Signal processing

Orban showed its popular Optimod 8200 digital audio processor and displayed the 500th unit sold; the unit soon will be shipped to WUSR in Scranton, Pa. The system features Multiple Variable Processing architecture, allowing configurations to be changed with the push of a button.

Also on hand was Orban's Transmission Limiter 4000, which provides transparent limiting with any source without audibly

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Comrex's Digital Audio Codec

adding, subtracting or interfering with a signal.

Cutting Edge Technologies displayed its Unity 2000, an all-in-one processing box with digital signal processing and digitally controlled stereo generation.

AIR corp's Model 500 Pro Announcer microphone processor was on hand. Input levels on the Model 500 can be remotely controlled to correct levels between announcers. When levels are correct, the equalization can be established with no further adjustment needed. The compressor/expander combination of the Pro Announcer reduces room noise and equipment noise, while providing level control and increased loudness for the announcer.

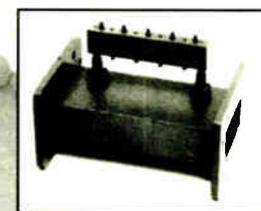
On display at the Broadcast Supply West

continued on page 20 ►

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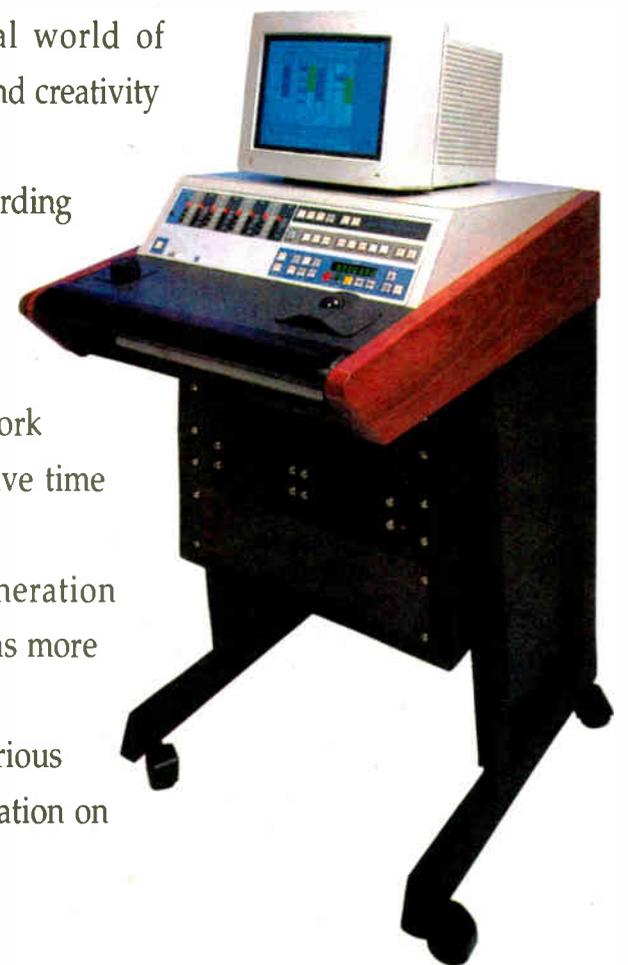
**I**ntroducing ADX, the first digital production system designed for the real world of broadcasting. A world where time is of the essence, change is the rule, last-minute is routine, and creativity is the competitive edge!

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World Radio History

## New Products at Radio Show

► continued from page 18

booth was the Symetrix 421 AGC-Leveler, which acts like a "phantom hand" on the fader. By presetting your target output level, the 421 will boost signals that drop below it, and pull back those that rise above it. The unit also provides a fast-acting limiter to catch transient peaks, speech curve filters to optimize voice range performance, stereo link mode, side chain insert facility and two parallel meters for fast set-up and accurate input/output monitoring.

Sabine Musical Manufacturing Co. showed its recently developed FBX-900 feedback exterminator, a digital signal processor controlled filtering device that automatically finds and

eliminates feedback in sound systems.

Audio Technologies Inc. (ATI) displayed its LA 10000 Modular Line Amplifier System, which allows a user to plug in up to 10 single or dual line amplifier modules and two power supply plug-ins. Units feature screwdriver front panel level controls. Also featured was the MA-10000 Modular Line Amplifier System, which allows the user to plug in up to 10 single or dual line microphone modules and two power supply plug-ins. Units feature knob front panel output level adjustments.

CRL showed the Audio Signature Processing System with the Real Time Event Sequencer. The sequencer allows 26 different processing presets to be stored, and 200

time events over a seven-day cycle. All front panel controls of the Audio Signature are programmable from the event sequencer. As well, five remote terminal connections allow dayparting from external contact closures. Also on hand was the Modulation Signature and the Amigo FM AGC, limiter and stereo generator.

Among transmitters shown at the NAB Radio Show, QEI showed its 10 kW solid

TTC's Russ Erickson said.

Continental Electronics stuck by its popular line of established AM and FM radio broadcast transmitters, as well as RF equipment for studio and transmitter facilities. Included was the 802B FM exciter, new at NAB in Las Vegas, which features a 12 dB improvement in signal-to-noise ratio over the previous model, 802A. THD is rated at .0005 percent. The unit also

"Country...  
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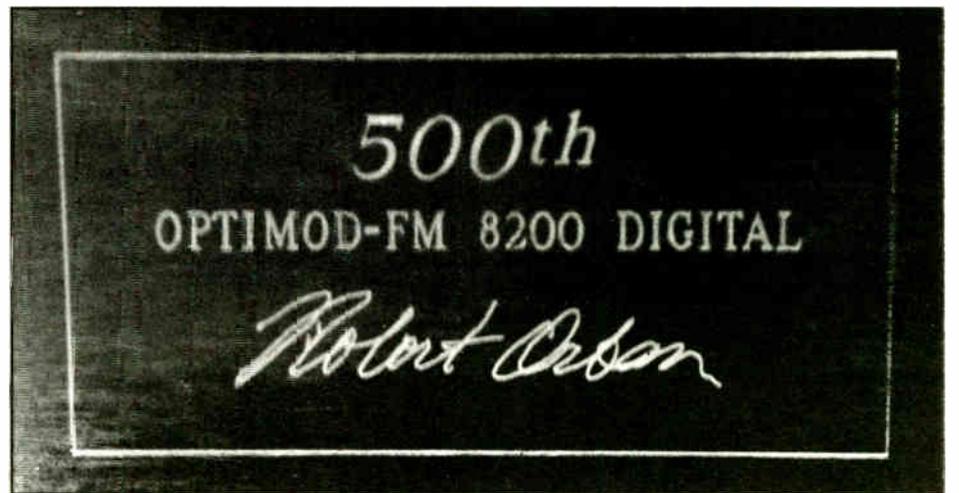
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Orban celebrated the sale of the 500th Optimod-FM in New Orleans

state FM transmitter, first seen in Las Vegas in April. The QSS-10000, which uses single phase on-line regulator switching, has been redesigned for air cooling. The company calls it the "quietest 10 kW transmitter in production today."

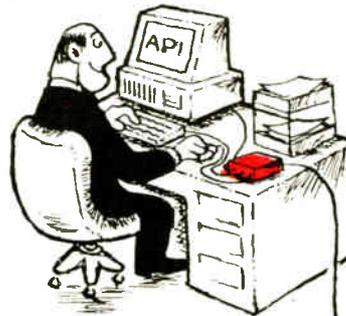
Television Technology Corp. (TTC) featured the FMS-100 100 W FM solid state transmitter/amplifier. FMS Series transmitters are in use in Canada, Venezuela, Thailand, Ireland and a number of other nations,

offers greater flexibility and additional front-panel metering. The 802B can operate as a stand-alone transmitter or exciter at any power level from 5 W to 50 W. Continental is also marketing Omnitronix transmitters and the Digi-Corder from Register Data Systems.

Nautel showed its ND Series of AM transmitters, which now include built-in C-QUAM stereo. Experience indicates that

continued on page 22 ►

### Have You Ever Needed Your Computer In Two Places at One Time?



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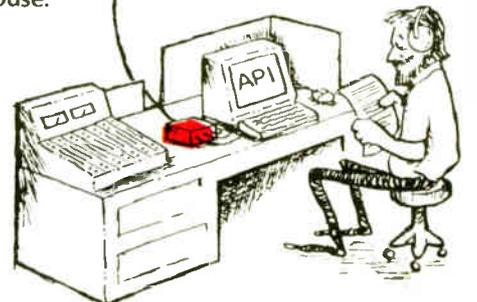
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- CD audio quality on 50¢ media.

**Immediate Delivery.**

*Broadcast Electronics...your single source for  
world class radio broadcast technology.*



## New Products at Radio Show

► continued from page 20

the majority of broadcasters installing a new transmitter, if not already stereo, will choose that time to upgrade, said Nautel's Jorgen Jensen. Built-in C-QUAM stereo will eliminate the added cost of an external exciter.

BE also has built-in C-QUAM AM stereo exciters in its recently-introduced series of AM transmitters, on hand at the show.

Motorola offered attendees its line of AM stereo exciters, including Models 1400 and 1410.

### Automation equipment

Workstations on display included the DM-80 from Roland. Its unlimited number of "virtual" tracks makes spot production sim-

ple and fast, while on-air applications are made easy with superior sound and expansion capability to 12 hours of memory.

TM Century demonstrated the Ultimate Digital Studio, which plays music from CD jukeboxes or "six-pack" magazine CD players, commercials, jingles and voice tracks from digital audio hard drives. It operates live or unattended.

TM Century also announced at the show an agreement in which the company will interface with Computer Concepts Corp.'s Digital Commercial System (DCS). The DCS features a patented audio board that can handle three stereo sources simultaneously (play, record and audio overlap). DCS offers CD-quality sound in live or automated operation, and flexible features.

The Management showed the Digital DJ digital audio hard disk system, useful for audio storage, programming, device control and real time control. Primary applications for the system are satellite programming, automation source replacement, cart machine replacement and newsroom and production capabilities.

SMARTS Broadcast Systems featured its Jock-in-the-Box digital audio CD automation system. The equipment is capable of integrating billing, logging, traffic and music rotation software with digital audio and full CD automation. The company now has Spanish-language software and is making a bid for the international market.

New from Arrakis Systems was TrakStar, a stand-alone addition to the company's DigiLink hard disk storage and retrieval system. An eight-track digital editor, TrakStar, the company's third digital editing product, is

specifically designed for the radio market, and is available with a number of options.

Register Data Systems offered its DigiCorder Digital Audio System, designed to replace cart machines, carousels, insta-carts and other audio equipment used to play commercials, PSAs, jingles and liners. The basic RDS system is a fully stereo or mono-compatible record/playback unit that will hold any combination and length of such material. It can be pre-programmed to schedule all stop sets and play them manually or automatically.

Prophet Systems showed its Audio Wizard digital audio system, featuring real-time digital editing on 19-inch color screens, unlimited walk-away automation, copy editing and hot standby backup. The system will be available in modules, allowing a user to start with a control room system that will grow with a station.

Enco Systems demonstrated the DAD486x, a digital audio distribution system that allows multiple users to access high quality stereo audio stored digitally on a shared data network. The system can start out as a stand-alone workstation with a single channel of record/playback capability, and grow to a multi-user, multi-channel per user system.

Broadcast Electronics showed its CORE 2000 and AudioVAULT hard disk systems.

Radio Computing Services displayed a variety of software products for radio, including Selector, Linker, SongTrack, Tracker and Pro-Rate. New for Radio 1992 was Master Control software, which provides state-of-the-art digital audio, using data compression to reduce disk storage. The integrated scheduling handles songs, spots, PSAs, jingles, promos and sweeps. All audio material can be played in a live-assist or fully automated mode.

Gentner Communications offered a new face on the Audisk hard disk automation system, exclusively distributed by Harris-Allied. Gentner also showed the Lazer digital FM limiter/stereo generator, the Prizm digital processor, and the PeopleLink II telco system.

National Supervisory Network demonstrated its VISION—VSAT Intelligent Satellite Integrated Operations Networks. VISION services combine comprehensive basic service with satellite digital audio program distribution and high-speed data service, giving station groups cost-effective tools for better programming, operations and management. The company provides broadcast groups with network design services, satellite hardware options and sales, installation options and space segment.

The DigiCord was showcased by Henry Engineering. The digital audio recorder can record up to 5:25 with 5 kHz response and can store up to 16 different messages for access playback.

### Source equipment

Among source equipment was the Disc Trak Digital Cart Machine from Broadcast Electronics. The system uses 3-1/2-inch floppy disks as the removable media and incorporates 16-bit linear digital technology. Disc Trak is capable of up to 112 seconds of stereo audio at full bandwidth on a single disk.

The DigiCart digital audio cart machine was on hand from 360 Systems. The system offers random access to hundreds of audio cuts and stores recordings on removable magnetic disks and optional internal/external hard disks. New for this year from 360 Systems is a software package for the DigiCart featuring an on-screen emulation of the machine's front panel controls.

Pioneer showed the CAC-V3200 300 compact disc autochanger. The prototype

continued on page 25 ►

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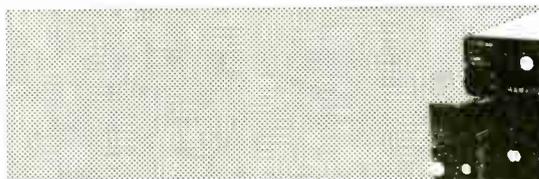
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- Online/Remote Access Services
- 3 Arc Second Terrain Data
- 1990 Population Data
- FCC & FAA Databases

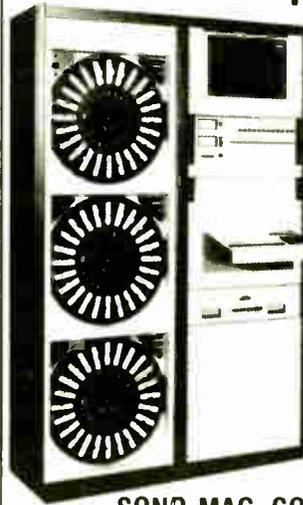
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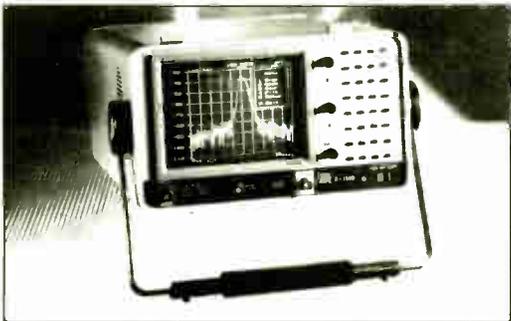
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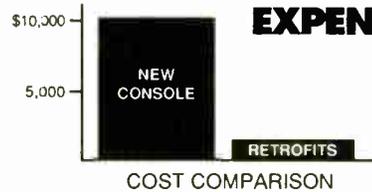
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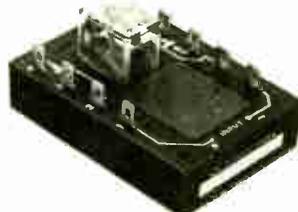


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READER SERVICE NO. 41

# New Products Showcased at Convention

► continued from page 22

shown provides access to 300 CDs with uninterrupted playback. The unit's built-in interface allows almost any type of PC to control it, and it can be pre-programmed for error-free playback. Up to 32 CAC-V3200s can be connected together, providing instant access to 9,600 CDs. Harris-Allied will distribute the product, available with a variety of control interfaces, including systems from Arrakis and Gentner.

Denon showed a new 200 disc CD changer, the DN-M200. The system employs two disc trays, each holding 100 discs, with 50 discs facing the front and 50 facing the rear in each tray. This secures them in less space than they would occupy housed in their jewel boxes. Moving from track to track is accomplished in 12 seconds or less.

Radio Systems will soon be shipping its new professional RS-6700 DAT machine, shown for the first time at Radio 1992. The unit is a composite of the successful RS-1000 and RS-700, according to Dan Braverman, RS's president.

The RS-6700 features the "smart chassis," a skirt of controls on the bottom of the unit's front, which includes large lighted controls for all major functions and

includes buttons for new enhanced functions not available on other DAT machines.

Also new at the show from Radio Systems was the first broadcast audio processor incorporating Dolby S, a new, cost-effective noise reduction system. Dolby S will be incorporated in the RS2, allowing stations to improve the audio performance of equipment with up to 24 dB of noise reduction.

Tapecaster featured the 900 Series cart machine, offering an LED level meter, selectable for monitoring playback, record or automatic.

Audio Precision showed its System One family of audio equipment, including Sys-

tem One, System One+ DSP and System One Dual Domain. The latter includes traditional features, plus digital audio inputs and outputs.

### Some computer-based services

Also featured was the new FASTTRIG program for System One that allows a complete audio channel performance evaluation to be performed in less than one second.

Sage Alerting Systems was on hand with its emergency alerting and notification system, custom designed for user needs.

Dataworld highlighted its offerings with a display showing a sample LMA market survey, terrain shadowing and ethnic popu-

lation breakdown. New services include wireless cable customers, remote access service, AM daytime and nighttime permissible radiation studies and mapping services. Dataworld also offered new issues of its AM daytime/nighttime and FM allocation map books.

Richard Biby's Communications Data Services offered its line of contour and engineering software, including Real World Propagation prediction maps, population data and contour curve programs.

Finally, antennas decorated the show floor from Jampro, which showed the JBBP balanced-fed, side-mounted antenna; Dielectric, which offered ring and panel antennas and the new anechoic chamber antenna measurement system; and Shiveley, which featured side-mount and mantle-style FM antennas.

## Outlining the DAB System

► continued from page 12

Eureka was first demonstrated in Geneva in 1988, then in Las Vegas, San Francisco, and Canada. Tests are currently underway in France and Germany.

The Eureka system combines many stations using an "n-times" multiplexer. The output signal of the multiplexer is then fed to a single transmitter, and radiated by a single antenna. Pinkham explained that the signal is multipath-proof because it is spread out in both frequency and time. Thus, on-frequency "gap fillers" can be used to cover shadowed areas. Only one-tenth the transmit power of analog is needed for equivalent Eureka DAB coverage, he said.

The final proponent in attendance was Amati Communications. The company's John Cioffi presented Amati's in-band concept of leaving room for improvement. One or two carriers are used as an auxiliary overhead channel (AOC). The AOC would transmit data rate and bandwidth information to the receiver for synchronization. This would permit the data rate to increase if the analog signal were someday eliminated.

LinCom Communications, American Digital Radio, Kintel Technologies, Mercury Digital Communications, Jerrold Communications/General Instruments, and MIT—all proponents of record—did not make presentations.

Responding to a question, USA Digital's Donahue acknowledged that the FM system relied upon the analog carrier to move the digital carriers and improve multipath performance. Their AM system, however, is different. Since it can exist without the analog signal, digital power—and hence, coverage—can be increased if the AM analog signal is removed.

□ □ □

Dennis Martin is a maintenance engineer for KBIG-FM in Los Angeles, and an occasional contributor to RW.

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PRESENCE BAND 0 DB 15 DB

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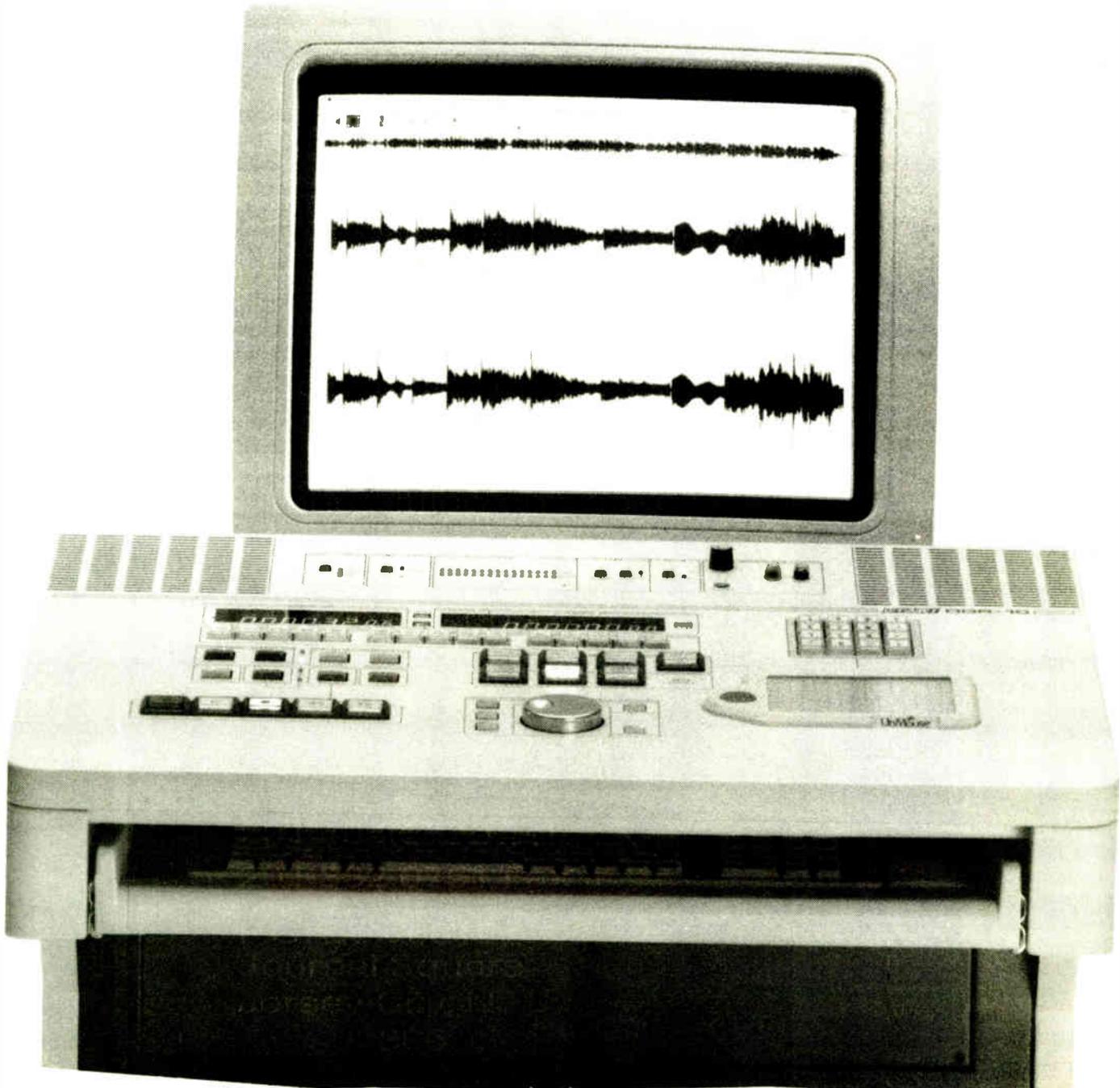
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John Rosso, of WNEW-FM in New York City, invited Frank Foti, developer of the UNITY 2000, to the station to oversee its installation. Frank gave a quick demo, and handed the controls over to John. "Within a couple of minutes, WNEW sounded better than we ever had," said John. "I couldn't believe the solid, open, loud sound! Thanks Frank!"

No Problem.

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Then there's our multi-tracks, from 32 tracks on down, at almost every price level – 8 machines, 12 different versions! And, of course, the CTM-10, a high performance cart machine we built for perfectionists, and an automated radio station reproducer.

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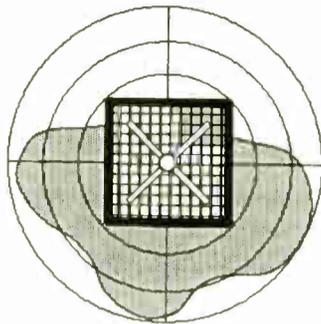
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READER SERVICE NO. 13

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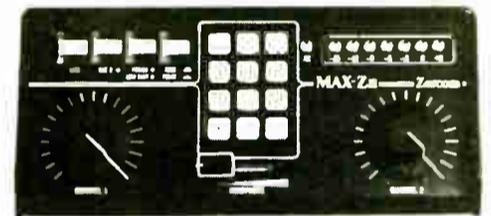


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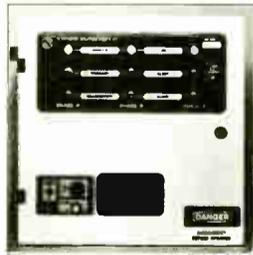
Sontec promises you something better. Install our MPA-1 pre-amp. If it's not cleaner and more transparent than what you're now using, just return it for credit. Now that is a promise!

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World Radio History

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READER SERVICE NO. 33

# New Programming Services Plentiful

by Lucia Cobo

**NEW ORLEANS** The exhibit floor at the NAB Radio Show in New Orleans offered as much variety for managers and programmers as it did for engineers. Products and services on display ranged from a glass cage for remote cash giveaways to the latest software designed to



help stations streamline operations. Superadio displayed its adult music format, satellite-delivered CITY-FM. The format features a showcase morning show with Top 10 market talent and targets the 22-44 listener.

One of the format's strongest selling points, however, is Superadio's proprietary Real Time Programming™. Real Time Programming locks the format feed to each affiliate's time zone. One of the benefits this feature allows is for the announcers to give the exact time (instead of a generic "20 minutes after the hour"). Superadio also offers "Open House Party" and "Super Country."

FirstCom Broadcast Services introduced Techsonics Production Libraries' three new production libraries. FirstCom Broadcast is the exclusive distributor of "Rock Flash," an AOR library, "Earthquake," a CHR library, and "House

Jamz," an urban contemporary library.

In addition to the three libraries, FirstCom also displayed and will distribute "Techsonics 2," "Chainsaw 1," "Turbo Techsonics," and "Primo Promos," as well as FirstCom's own production libraries: "The Sound Designer," "Maximum Impact," "Digital Production Library," and its exclusive "Custom Production Library."

The U.S. Department of Health and Human Services displayed information about its HHS Radio service. The service consists of three-to-five news stories daily that are recorded onto a five-

minute feed. The feed is available in Spanish.

Stations call a toll-free number to record the feeds for airing. The items include the latest developments or news in AIDS research, preventive medicine, substance abuse, children's health, cancer research, and family issues. The service is free to stations.

British Information Services displayed its news service for U.S. radio stations. "Newsbreaks from Britain" is a daily service that features one-minute actuality reports filed from London via satellite. The service is available 12-3 p.m.

Eastern Time weekdays and throughout the weekend.

"Newsbreaks from Britain" features hard news reports, health science consumer and cultural features as well as the London financial market report. The service is available in Spanish.

Broadcast Programming displayed its full menu of products and services for broadcast stations. The company featured its programming and consulting services as well as its Sentry System and its tape and CD formats.

BP's format library includes seven country formats, six AC formats, three light contemporary formats, four Christian music formats, three CHR formats, three adult standards formats, and a variety of

continued on page 30 ▶

## Tuner Undergoes Evaluation

▶ continued from page 15

distortion were given for 50 percent modulation. At that level of modulation, the claimed THD levels of 0.3 percent in mono and 0.5 percent in stereo were met or surpassed.

Using the spectrum analysis capability of our computer-driven Audio Precision test equipment, we isolated the actual harmonic distortion components from the residual noise, with results shown in Figure 2. Again, modulation level was set to 90 percent and the second harmonic component (2 kHz) appeared at a level of -41 dB, corresponding to distortion of just under 1.0 percent. Ultimate signal-to-noise ratio, with strong signals applied, measured 55 dB for monaural operation, against 53 dB claimed.

Applying a stereo signal to the left channel only, we measured stereo AM separation for this tuner sample. At mid-frequencies, separation measured a more than adequate 24.3 dB, regardless of whether the wideband or narrowband mode was used. At 6 kHz, separation decreased to 11 dB for the wideband mode and to 7.5 dB for the narrowband

mode. At 100 Hz, separation was approximately 23 to 24 dB, depending upon the bandwidth setting. Results of these tests are shown in Figure 3.

### Listening and use tests

We hooked up an ordinary indoor dipole antenna to the FM antenna terminal and oriented the dipole towards the west, in the direction of most of the transmitter antennas in our metropolitan area. Under those conditions, we were able to receive no less than 53 acceptable signals in mono. That's nearly a half dozen more than we usually receive with typical "hi-fi" tuners and receivers we have tested over the last several years. Switching to the "Auto" tune mode (thereby activating stereo circuitry), we logged some 43 acceptably noise-free stereo signals on the FM band.

Orienting the supplied AM loopstick for best reception, we then switched to the AM band and were able to log 26 acceptable signals. There was little difference in the logged signal count when we switched from the "Auto" tuning mode to the "Manual" mode. A few of the stations exhibited less interference when we switched to the

narrowband mode, but even under those conditions, audio fidelity was better than we have heard from an AM tuner in many years. (Back in the 1940s and 1950s, AM receivers—then in the majority—sounded a lot better than most of them do today. The Denon TU-680NAB is a happy exception to that rule.)

Perhaps the most startling revelation occurred when we tuned a classical music station on the FM band that also simulcasts on the AM band. The stations were WQXR-FM (at 96.3 MHz) and WQXR-AM (1560 kHz). This enabled us to switch back and forth between AM and FM while listening to the same program material. We know you're going to find this hard to believe, but to our ears (and to those of several visitors to the lab while these tests were ongoing), the audio quality of the AM transmission seemed actually better than that heard when tuned to the FM band.

Denon deserves to be congratulated for this effort. The TU-680NAB may well inspire other audio equipment manufacturers to follow a similar course in designing future tuners and receivers.

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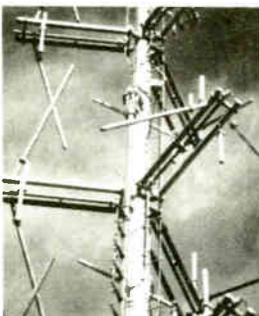
Len Feldman is a free-lance audio equipment reviewer.

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READER SERVICE NO. 84

# The All-Digital Facility

► continued from page 11

space. This technology makes automated regional networks, once cost prohibitive, relatively affordable to build and operate.

Cabling is changing too, Valley explained, from dedicated pairs of wire for every audio source to EtherNet, fiber optics, and digital interfaces. A single AES/EBU interface—one pair of wires—can carry four channels of audio.

Following an audible demonstration of multiple audio coding effects, Michael Smyth of APT explained the current usage of coding. Outside commentary links over Switched 56 or ISDN lines, dedicated links, audio workstations, digital cart recorders, studio-to-studio links, and digi-

tal STLs all rely on coding techniques.

Smyth posed the question, "How does audio quality degrade as the number of audio coding passes increases?" Nobody really knows, he admitted. A microwave link, where the bit error rate is very high, may cause degradation after fewer passes because the coder is working very hard to conceal errors. The problem is that degradation caused by coding is a subjective phenomenon and listening tests are usually inconclusive.

An additional complication is that coders react differently. Each has its own "critical" source material that suffers more degradation than other material. Single instruments and voice tend to be "critical" test signals while music, generally, is not.

As you make the transition to digital, "a good concise plan of attack on what you hope to do and accomplish within your studio," is what's needed as Dennis Schneider of BE described. It's important to develop a viable path for the future in terms of expansion and growth, and decide what equipment allows you to fulfill your plans.

A second key issue is payback. Although initial costs may be high, large digital systems offer tremendous power and the potential for substantial cost savings. It's important, though, to not underestimate the impact of this new technology on the staff, which amounts to a form of culture shock.

During the session's question and answer period, Lyman discussed some of the progress made by the CCIR working group studying multiple-pass coding. During recent broadcast-related tests, commentary codecs were subjected to one-pass tests; contribution codecs that link studios and network origination centers were tested for five passes; distribution codecs, three passes; and emission codecs—used between the transmitter and receiver—one pass. The results, Lyman said, were to be officially announced Oct. 5 in Geneva.

□ □ □

*Dennis Martin is a maintenance engineer for KBIG-FM in Los Angeles, and an occasional contributor to RW.*

# New Programming Products

► continued from page 29

ety of niche and alternative formats.

Station managers looking for the latest in format developments were invited to stop by the Children's Satellite Network booth. CSN offers stations a 24-hour format targeted to the 4.5 million children in the U.S., estimated to have \$75 billion spending income annually and to influence an additional \$131 billion in parental spending.

TM Century introduced its MegaMusic library, featuring adult contemporary, rock/CHR, country and specialty formats.

Super Gospel Country Radio Network displayed information about its new product, the "Christian Country" satellite-delivered format. The format blends southern/country gospel and country songs with positive messages and personalities. The company has signed 14 affiliates to date.

The Music Director programming service debuted an expanded version of its CD library of songs from the '50s, '60s, '70s, '80s, and '90s. The library features 768 more titles for a complete package of 2,540 songs.

Standard News exhibited its "Washington NewsDesk," a service it launched 60 days prior to the convention. The two-minute, unbranded newscast is designed to work as a stand-alone at the top of the hour or inside a local station's newscast at :03 past the hour. The service has signed 196 affiliates since it launched.

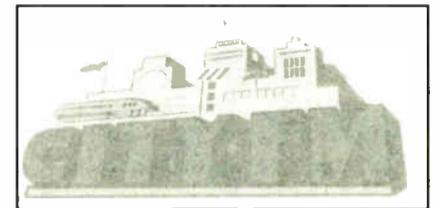
Associated Press displayed its news services and equipments on the exhibit floor, including its more recent product—the wire service launched in conjunction with Zapnews.

United Press International had a presence at the convention, if not a booth. UPI sponsored the opening reception of the Radio Show and displayed its products at its suite.

Metro Traffic Control, a company

best known for its traffic and weather reports, announced the introduction of an astrology program hosted by Howard Sheldon. The packages offered include: one 60-second "Astrological Highlight," discussing the day's most interesting astrological event; three 60-second "Radio Signs," each featuring four different signs of the zodiac, and a combination of the two.

The Sheldon program is satellite-delivered and available at no charge (a 10-second promotional announcement



airs with each report).

Broadcast Investment Analysts displayed information about its consulting services. Those include business valuations, tax appraisals, litigation support, acquisition consulting and restructuring and estate and financial planning.

NPR Satellite Services displayed its selection of satellite interconnection services such as fixed and transportable uplinking, SCPC audio transmission, downlinking digital fiber-optic audio channels and service to Galaxy and Satcom.

The National Guard Bureau disseminated information about its public service advertising campaigns.

The Omnia Group provided demonstrations of its personality testing and career counseling products which are related to the radio business.

The National Association of Home Builders displayed information on its "Right At Home" feed. Right At Home is a daily, one-minute vignette available on CD and covering issues ranging from repairs and improvements to financing.

## Fishing For A Phone Number?

Catch it in the  
**1992 Radio World Directory Issue**

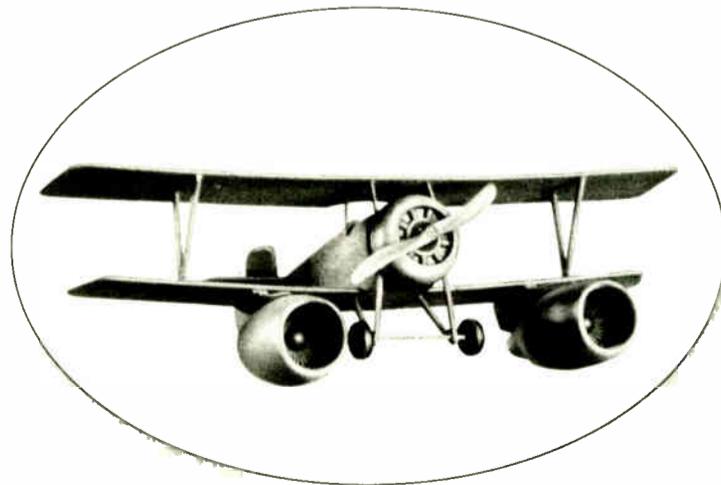
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**LOWPOWER LOWDOWN**

# Interest Rules Apply to Translators

by Howard Enstrom

**MOUNT DORA, Fla.** A tabulation of the 200 most recent applications for translators indicates that 70 percent are for non-commercial educational facilities (NCE).

About 30 percent of all translators are licensed to and supported by private organizations (some incorporated), and individuals. Another 23 percent are operated by universities, colleges and schools, while about 18 percent are directly owned by NCE primary stations.

NCE translators enjoy special treatment by the Federal Communications Commission. They are permitted use of all 100 FM channels; have greater options for primary signal delivery means, such as satellite; primary stations may operate their own translators; and signals may extend far beyond the primary station's coverage contour. In addition, there are no restrictions on financial support.

**Public translators**

Since many educational institutions are publicly funded, so are the translators. To some extent, this also is true in certain regions of the west, traditionally deprived of radio and TV service. Local taxing bodies are authorized, probably by public referendum, to operate translators, which then become publicly supported.

But by and large, most NCE translators are financially supported by direct contributions to small translator groups, often a one-time donation. Surprisingly, few such translators originate local announcements in connection with funding.

As for commercial translators, the nominal 30 percent is nearly equally divided in ownership between non-station-related groups, individuals, local taxing bodies or districts and commercial stations. With the latter, the systems are a fill-in translator or booster, since coverage beyond the station's class coverage contour is not permitted.

There is good reason to believe that not all

"independently-owned" translators have no interests with the commercial primary station. I regularly receive telephone calls from such station owners and managers who press hard to find a way to use a translator to increase coverage.

My usual response to these callers is, "I'll offer an opinion, but not legal advice, so read the rules." But the caller may not have the rules, or know where to find them. So, if requested, I read them over the phone or send them a photocopy of Section 74.1232, which reads: "An authorization for an FM translator whose coverage contour extends beyond the protected contour of the commercial primary station will not be granted to the licensee or permittee of a commercial FM radio broadcast station."

**No use skirting the rules**

The caller might come up with, "Oh well, I can have my chief engineer, brother-in-law, or some friend put up the translator." I know he's looking for a comment to support his hope. But further rules should be considered: "Similarly, such authorization will not be granted to any person or entity having any interest whatsoever, or any connection with a primary FM station. Interested and connected parties extend to group owners, corporate parents, shareholders, officers, directors, employees, general and limited partners, family members and business associates...."

Then the caller may want to discuss the possibility of getting some entity not included in the rules, but nevertheless pay for, or reimburse translator construction costs. Again, quoting from the rules: "An FM translator station whose coverage contour goes beyond the protected contour of the commercial primary station shall not receive any support, before or after construction, either directly or indirectly, from the commercial primary FM radio broadcast station. Such support also may not be received from any person or entity having any interest whatsoever...."

I've discussed these matters with Com-

mission attorneys, who are quite aware of numerous probable violations. But they state the rules are tough to enforce. To my knowledge, no case issues have ever been raised, nor have citations been issued about hidden ownership or illegal payment.

If the FCC doesn't investigate, I'm certainly not suggesting that chances be taken. But I know, if the FCC ever does look a little deeper into some translators, there'll be some problems.

**Non-profit translators**

So much for commercial translators. Things are a lot different with NCE ones. But we're still talking about money, some of it contributed by listeners. At what point is a listener- or advertiser-supported translator a profit-making venture? That may be hard to say, but certainly possible. One NCE translator customer of an entrepreneur who owns a fleet of translators has indicated to me that his lease expense is \$495 a month. That's got to be profitable for the entrepreneur.

Still, the Commission doesn't make that its business, and there are no rules or policies that call for accounting of funds received. That's a matter for the IRS.

The Commission's Report and Order, MM Docket No. 88-140, adopted Nov. 8, 1990 and released Dec. 4, 1990, contains some interesting language. The document prefaces announced new rules with reports of comments and basis of ruling. Paragraph 43, which deals with local announcements and fundraising, has a footnote 47, which states, "... (We) note that the new rules no longer require licensees of FM translators to operate non-profit facilities."

I interpret rules to mean, if a commercial translator applicant/licensee meets non-interest or relationship requirements under 74.1232, he may accept financial support from another entity: monthly rental to a group or individual, or advertisers.

Further, an NCE translator applicant/licensee, with permission of the primary sta-

tion, may operate its translator, including leasing to another entity, even for financial profit.

That's how I see things, not as a legal advisor, but as an engineer who must read and understand other FCC rules without calling upon a lawyer in a land where ten of them graduate each year, for every one engineer.

Contrast this with Japan, where ten engineers graduate each year, for every one lawyer.

□ □ □

Howard L. Enstrom is a broadcast consultant. He has owned and managed an AM station and is president of FM Technology Associates, Inc., specializing in engineering design and sale of FM translator equipment. He can be reached at 904-383-3682 or by fax: 904-383-4077.

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World Radio History

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# disk & dat



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# Museum Premieres Radio Studio

by Neil Lewbel

**NEW YORK** The Museum of Television & Radio (MT&R) unveiled a new Radio Studio earlier this year. The studio was built to provide a professional-grade studio for on-air and production use and to introduce visitors to the workings of radio broadcasts. Museum visitors will be able to watch radio programs being produced.

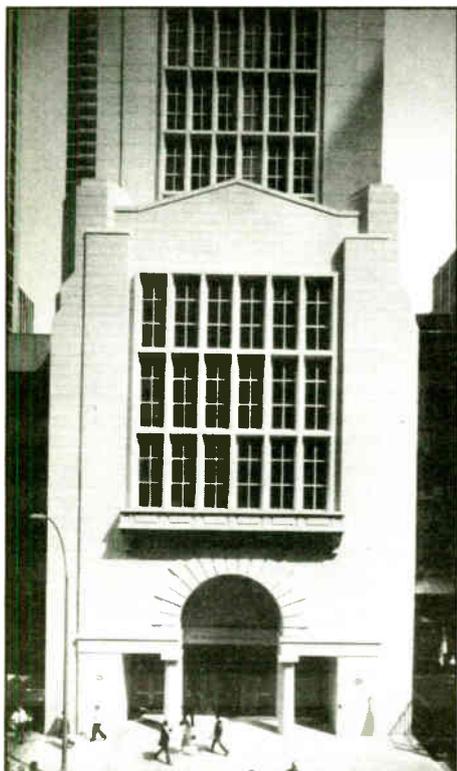
The studio can serve as a control room or combination control room and studio. The control room was built in one end of the Ralph Guild Radio Listening Room. This room is believed to be the first museum space ever created expressly for presenting radio programming.

It is possible to do the complete production from the studio area. It is also possible to use the full room for programs requiring a larger than normal area. Examples of this may include shows with audiences or recording large musical groups.

### Big name draw

Major radio personalities have been scheduled to do their programs from this studio. During the studio's first few weeks of operation several well-known radio people did their shows from the studio.

On June 23 through the 26, Mark Simone of WNEW(AM) originated his regular afternoon



A radio studio has been constructed in the Museum's new building on 52nd Street in New York. Museum visitors will be able to watch radio programs being produced.

program from the museum's studio.

Also on June 23, Art Athens of WCBS(AM) hosted a taping of the program "Let's Find Out." This featured an interview with architect Philip Johnson, design consultant to John Burgee Architects, which designed the museum's new building. (The museum opened its new building on Sept. 12, 1991.)

John Hockenberry of NPR originated his show, "Talk of the Nation" from the studio for a few days in July, while the Democratic Convention was taking place in New York.

On June 25 the studio was used to record the Meridian Arts Ensemble for the McGraw-Hill Young Artists Showcase, which is hosted by Robert Sherman of WQXR-FM. The string quartet performed in the larger listening room area, with a live audience.

A number of other programs are scheduled

to be done by press time. One such program is "Fresh Air with Terry Gross" which is an NPR program from WHYY(FM) Philadelphia.

### Variety of distribution modes

According to Bill Beam, Director of Technical Operations and Engineering for the museum, one interesting aspect of the studio is that it features connections to a variety of distribution systems, including satellite and microwave. IDB Communications Group, Inc. provides a connection to a switching facility, which supports video and audio.

Through this facility the studio can be connected to satellite uplinks, radio stations and

switched 56 kilobit phone lines. A fixed microwave antenna on the museum's building provides a link from the museum to the Keystone Corporation Technical Operations Center at the Empire State Building.

From the Empire State Building, signals can be sent to uplink facilities or other communications facilities. The Museum's studio is equipped with a Telos Systems telephone interface.

Most of the equipment for the studio was donated to the museum. The studio is based around a Radiomixer 12 console from Pacific Recorders & Engineering Corp. with all interconnections made through jackfields by Audio Accessories, Inc.

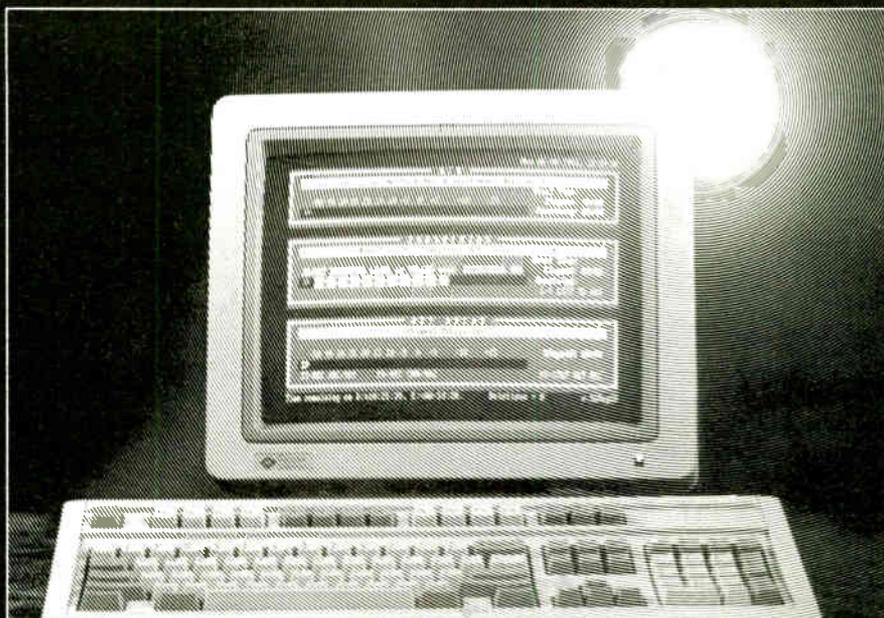
Tape and disc equipment was supplied by Studer ReVox America, Inc., Denon America, Inc., TEAC America/TASCAM, and International Tapetronics Corp. Furnishings for the studio were provided by Murphy Studio Furniture. Many other companies also supplied various pieces of equipment.

The Museum of Television & Radio was founded in 1975 by the late William S. Paley, to collect and preserve television and radio programs. Its collection includes over 40,000 programs. If you are interested in visiting the museum, it is located at 25 West 52nd Street in New York City. The museum's phone number is 212-621-6800.

□ □ □

Neil Lewbel is a product development consultant, who frequently works and writes in the radio communications field. He can be reached at 203-377-8517.

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USER REPORT

## Telos Delta Adds New Ring to Telco

by Joe Talbot  
ATI Systems

**HELENDALE, Calif.** I've been playing with telephones for years. So naturally, when somebody around here has a problem with phones or just needs some information about them, I get a call.

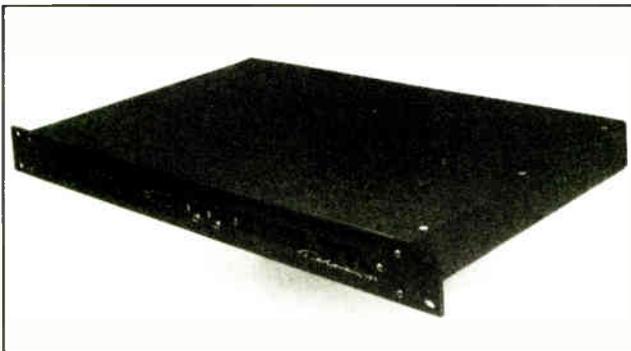
That's OK—I've been doing it since my early teens and I still enjoy it. I think that's true because the phone network is always changing, probably more in the last 10 years than ever.

Usually, it's the same problems time and time again (though there have been some fascinating and sometimes gnarly exceptions). I've accumulated experiences and solutions to these problems, and often the answer comes from the crew at Telos in Cleveland.

### New features

Telos sent me a new Telos 100 Delta to try out. This unit replaces the Telos 100, but has a bunch of new features at no extra cost. After I removed it from the box and its wrapping, I checked out the controls and connectors. On the back panel: XLRs for the audio and for AES/EBU digital in and out, two modular jacks for phone and line connection, and a 9-pin "D" connector for remote control.

The audio connections looked interesting. There are two inputs and two outputs provided so that a hybrid can be cross-coupled for loss-less conferencing and to allow everything to come in on one pot. This also means you only need one mix minus. One input even has a mic/line gain selector switch. I've used mixers in the past to get the gain I need-



Telos' mighty 100 Delta

ed to put a mix-minus on a console that didn't (and maybe shouldn't) have one. I won't need to use mixers anymore in that situation.

On the front panel, behind a door hidden from the probing fingers of DJs, I found an adjustment for AGC drive (from the caller to you) and other curious controls, including EQ. This box actually has a two-band audio processor in it to help keep the caller audio more consistent and intelligible.

Ever had somebody call in on a "football phone?" The EQ can be dynamic (my favorite) or fixed by setting a switch.

The AGC is gated to prevent "noise suck-up" during pauses in speech. This is useful when you have lots of cellular phone callers, or international feeds (or even if a caller is using a low-grade long distance service).

### At the same time

Besides the normal input/out level controls, there also are two knobs to allow you to set the amount of "duplex"—that is, whether both parties can speak at the same time. Many talk show hosts prefer to override the caller and this can be set.

You can have two preset duplex settings for different host preferences, which I've also found useful when jocks

just want to use the system as a speaker-phone. If the channel is on the air or a tape recorder is running, use full duplex. If not, use less duplex. It's amazing how loud you can run the monitor speakers with an open mic even with full duplex. If you put the mic in front of the speaker, you can hear it work, but you'll be amazed.

It works with all the different Telos control panels. They have them for Pacific Recorders consoles, Auditronics, BE and others now. They're simple to use, look great and are really easy to install (a single modular phone cord).

There's also a desktop console that you can put anywhere. The system will run several in parallel (great for a busy morning team) or in a control room/studio configuration. They work just like a familiar key phone but sound better and

continued on page 36 ▶

USER REPORT

## Comrex Digital Codec Links 120-Mile STL Hop

by Thomas Russell  
Corporate Engineer  
KFRM(AM),  
Proud Country Inc.

**HUTCHINSON, Kan.** KFRM is a 5,000 W station in northern Kansas that broadcasts into eight states—Nebraska, Colorado, New Mexico, Texas, Arkansas and beyond. Our format is a good mix of farm news and country music.

What's unusual about KFRM's operation is our 120-mile studio-to-transmitter link. The parent company, Proud Country Inc., owns six other stations and found it impractical for KFRM to maintain its farm director, disc jockeys and other personnel at our transmitter site studio in Cloud County. So they consolidated station operations in corporate facilities in Hutchinson.

That presented me with the problem of how to get our signal to the transmitter site without negatively impacting KFRM's music and program quality.

I first looked into leasing a dedicated phone line until I found that it would involve working with several different phone companies and area codes. It was a complex and expensive solution, and I've found the quality is not always that great.

### Logical link

A terrestrial microwave link seemed logical because it would give us a broadband program channel to ensure good audio quality, plus the capability for remote control and two-way talk-back channels. I was also thinking of the potential for long-term returns.

The sand trap in this scenario showed up when we mapped the course and found that in addition to our initial

\$25,000 expense, we'd be incurring another \$9,000 per year (\$800/month) for tower rental charges.

I had been monitoring Comrex's offerings in digital audio codecs, and that option with a 56 kilobit per second (kbps) line was a logical contender, so I arranged with them for an evaluation unit. For two or three days, I installed it on a loop-through basis on another of our AM stations and, happily, as I had expected, no one—from our sales staff to engineering to our listeners—observed any change in the sound quality.

So this proved to be by far the most cost-effective solution and easiest to implement in terms of acquisition and operating costs.

### Kansas Cellular

I was most fortunate to have Kansas Independent Networks (also known as Kansas Cellular), a group of small telcos that formed a statewide cellular network, for our carrier for two reasons: They have a 92-mile stretch of fiber optic line from Hutchinson to another Kansas Cellular site only 12 miles from our transmitter; and they are unusually cooperative and let us install our codecs and microwave receivers/transmitters directly in their points of presence in Hutchinson and near the transmitter site.

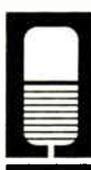
We microwave our signal from our studio in Hutchinson to Kansas Cellular's first point of presence four miles away, where we have installed our microwave receiver in their equipment rack. From there the signal goes to the Comrex codec, which plugs directly into the channel service card in the channel bank that serves the T-1 con-

continued on next page ▶

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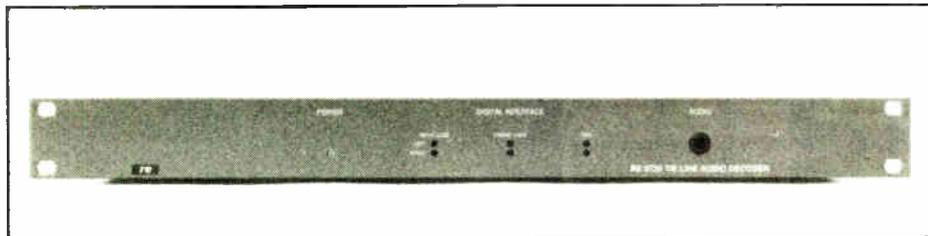
TECHNOLOGY REPORT

# RE America Tie Line Feeds Acorn Demo

by Jim Switzer  
Sales Engineer  
RE America

**WESTLAKE, Ohio** Preparing for the USA Digital Acorn DAB in-band demonstration at the NAB radio show in New Orleans last month was no easy task. The participants (CBS Radio, Gannett Radio and Group W) felt strongly about proving the AM DAB technology at the NAB Radio Show.

The results of the show proved exciting for the group and its achievements, with positive reactions from the show attendees.



The RE 8730 Tie Line audio decoder

In planning for the demonstration, the USA Digital group assumed they would use CDs as the program source. E. Glynn Walden, director of engineering for Group W Radio, was a strong proponent of using real studio board audio from a local radio station. For Walden, it was the best way to demonstrate a live A/B test.

**Stereo signal**

The biggest obstacle was to get a stereo signal into the New Orleans Convention Center. WNOE(AM) was selected for the studio feed source, located about two miles from the convention center. Time became the critical factor as Hurricane Andrew was fast approaching New Orleans. It was risky to assume that the telephone company could give a solid commitment to provide a working T-circuit at the same time that they may have had to repair massive storm damage. The solution was to use the fastest hookup possible, while still providing CD-quality sound.

That solution was good, old-fashioned dry copper pairs. End-to-end copper from within the central office bound-

aries of the telephone company was readily available. Since mechanical equalization adds a modest level of group delay, and over a distance of two miles would not have been feasible for the desired high quality result, a digital solution was necessary.

That's where RE America's RE8720/8730 stereo Tie Line codec came in. This codec operates on telephone company DC (dry copper) pairs, alarm circuits or old LMC circuits. Since the RE Tie Line codec has built-in automatic line equalization, dissimilar telco pair lengths were not a concern.

Installation of T-1 circuits were not possible within the time frame of the NAB Radio Show, but dry copper was made available by the phone company on time on the date requested. The best part was that it was about one-tenth the cost of the T-1 circuit that couldn't be installed in time.

The RE Tie Lines operate at a very high 390 kilobits per second (kbps) per channel for a total of 780 kbps stereo bit rate. That translates to slightly less than a 2:1 compression ratio in the algorithm. Audio processing delay in the RE Tie Line codec is 4 milliseconds (ms), a very desirable specification for the AM DAB demonstration. Delays of less than 10 to 15 ms are generally imperceptible.

**Connectors**

Installation is simplified through XLR connectors for audio as well as digital connections. The RE 8720/8730 Stereo Tie Line offers 600 or 10K ohm analog inputs with switch-controlled clipping levels. Optional pre-emphasis can be turned on via dip switch settings on the rear panel.

The overall high level of quality from the RE Tie Line was essential to the delivery of the WNOE studio feed to the USA Digital AM DAB demonstration. Any compromise in less than CD-quality to the inputs of the DAB transmission would have detracted from the exciting accomplishment.

The RE Stereo Tie Line audio codec is a great tool for nearly every broadcaster's bag of tricks. It gets you out of a jam, and it has a variety of uses, such as the AM DAB demonstration, STLs linking to an STL, remote pickups in a hurry, long private wiring runs and so much more.

A task as large as the USA Digital Radio AM DAB demonstration at the NAB Radio Show requires the help and assistance of many industry professionals. RE America, Inc. was among several companies donating time and equipment. Others include Harris Allied, WNOE, Group W, Gannett Radio, CBS Radio, affiliated engineers and more.

For information on the RE America RE8720/8730 Stereo Tie Line coder and decoder, contact Jim Switzer at RE America in Ohio: 216-871-7617; fax: 216-871-4303; or circle Reader Service 94

# Comrex Codec Links STL Hop

► continued from previous page  
necting to the fiber optic cable. At the remote end we go through our second codec and then to our microwave relay, the last 12 miles of our studio-transmitter-link.

I was more than pleased with this solution, since the two codecs cost less than \$4,000. The channel we lease is the equivalent of a single, telephone-quality voice channel, so the circuit costs only \$142 per month. This includes a modest charge for the terminations.

We used the Comrex model DXR rack-mount codecs. These units incorporate the international standard G.722 to transform a narrowband digital voice channel into a wideband program circuit (7.5 kHz). The codecs will sense and adapt to a data rate of 56 or 64 kbps.

Recent technology allows telephone networks to carry more information than ever before. With the Comrex codecs, I was able to take advantage of this capability and implement a high-quality audio transmission link at a cost far below any alternative.

For information on Comrex codecs, contact VP of Sales Lynn Distler in Massachusetts: 508-263-1800; fax: 508-635-0401; or circle Reader Service 107.

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## TECHNOLOGY REPORT

# Upgrades Add New Life to CAT-LINK

by Eric Eckstein  
Project Engineer  
QEI Corp.

**WILLIAMSTOWN, N.J.** In 1987, QEI Corp.'s digital group developed CAT-LINK, the first all-digital, real-time, composite studio-to-transmitter link.

Since the release to market, many have asked how we managed to fit a digitally sampled composite FM signal into a T-1

details of CAT-LINK operation.

The first step is the equation for FM stereo:

$$c(t) = L(t) + R(t) + \sin(2\pi 38000t) \times (L(t) - R(t)) + \text{Psin}(2\pi 19000t)$$

Using sampling theory, it can be demonstrated that by sampling at a fixed frequency of four times pilot frequency locked to the pilot and adjusted to a con-

stant 45 degree delay, the resultant samples would contain the following:

1.  $2L(t) + .707P$
2.  $2R(t) + .707P$
3.  $2L(t) - .707P$
4.  $2R(t) - .707P$

All information required for accurate digital reconstruction of the composite stereo signal is derived from a sample rate of only 76 kHz.

The modulated SCA channels cannot be transmitted in this manner because of alias products; however, since CAT-LINK has the capability of sending up to four auxiliary channels of up to 15 kHz depending on system configuration, this limitation does not impose system problems.

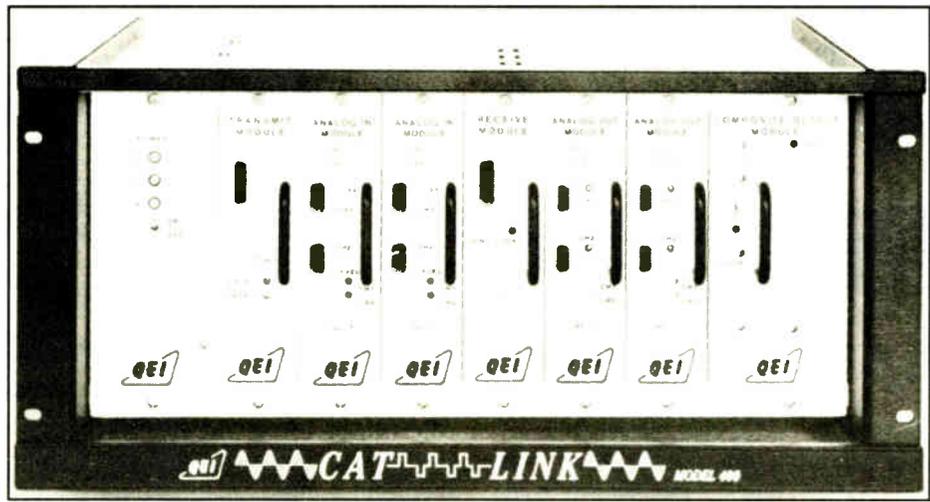
A major advantage of this method is

that the composite stereo signal is, in effect, digitally filtered even though it was produced by a conventional analog stereo generator. User reports have claimed a noticeable decrease in multipath effect. The model 710 digital stereo generator shares this advantage since its development is a result of this QEI-patented technology.

The CAT-LINK is designed as an open system, which means that the chassis and interface to the modules is open to continuing development as the digital state of the art improves. As a benefit of this forward-looking design, the original switched capability filters in the auxiliary modules have been replaced by Sigma-Delta technology in both input and output circuits.

Stations with CAT-LINK systems desiring an upgrade simply plug in new modules. As new technology becomes available, the initial investment in CAT-LINK will be the basis for further improvement.

For information on CAT-LINK, contact Eric Eckstein at QEI Corp. in New Jersey: 800-334-9154; fax: 609-645-2541; or circle Reader Service 32.



QEI's Model 400 CAT-LINK FM and BTSC Digital Composite STL/TSL

**CAT-LINK is designed as an open system; the chassis and interface to the modules are open to continuing development.**

bit rate. (We also had enough excess space to fit additional channels.) Since U.S. Patent No. 5,054,070 was issued on Oct. 4, 1991, we have been able to explain the

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Circle (8) On Reader Service Card

## New Features for The Telos 100 Delta

► continued from page 34  
hold up better under heavy usage. I try to use the control panels whenever possible. They make the phone look like just another part of your operation, not a "glue-on" or afterthought.

If you ever have a problem or question with phones—and I've called them with some amazing situations—you'll get the support you need.

When I have good experiences, I tend to evangelize. Am I doing that now?

For information, contact Kevin Nosé, director of engineering research and development at Telos in Ohio: 216-241-7225; fax: 216-241-4103; or circle Reader Service 121.

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TECHNOLOGY REPORT

# RS<sup>2</sup> Dolby S Encoder Passes EZ Test

by Paul McLane  
U.S. Sales Manager  
Radio Systems

**BRIDGEPORT, N.J.** For Ben Hill, CE of WIOQ in Philadelphia, the name of the bar for Friday afternoon's happy hour remote was the first tip-off.

True to its "down under" motif, Outback Jack's is more than 35 air miles from center city Philadelphia, where the EZ Communications station maintains its directional RPU receiver antenna on a tall downtown building. This distance is certainly considered "fringe" for the

station's 450 MHz Marti RPU. But the sales department had already sold the remote, and engineering had to make it work.

Planning ahead, Ben had surveyed and tested the site several days earlier, but found the shot marginal, at best. Even with the new pneumatic mast of the remote van fully extended, the signal was very noisy, with hiss "pumping" as signal strength varied.

Confronted with the possibility of having to rent expensive leased lines, Ben remembered having seen Radio Systems' new RS<sup>2</sup> Dolby S noise reduction pack-

age at the Radio Show in New Orleans a few days earlier.

He called us to ask if we'd be willing to try out the system on the remote broadcast. After securing a guarantee of free hors d'oeuvres at Outback Jack's, we readily agreed.

**The system**

Dolby S technology provides up to 24 dB of noise reduction via an encode/decode system of multiband compression. Because it is especially effective at eliminating high-end noise (just like its A, B, C and SR type precedes-

sors), Radio Systems engineers reasoned that Dolby S would effectively reduce RPU hiss.

At noon of the remote day, Ben and RS President Dan Braverman installed the RS<sup>2</sup> Dolby S encoder in the remote van parked outside WIOQ's studio. At the same time, they installed the studio decoder unit and fired up the RPU to perform the Dolby unit's only calibrations, input and output levels. The system sounded fine, but the real test would

continued on page 45 ▶

USER REPORT

## T-Tech Adds Fiber to WGUC's Diet

by Brent Reider  
CE, WGUC Radio

**CINCINNATI** WGUC is a 24-hour classical music station licensed to the University of Cincinnati, and also serves as a regional NPR uplink.

Using purpose-built control rooms at Cincinnati's historic Music Hall, the University's College Conservatory of Music and a battery of portable equipment, we record upwards of 200 musical events a year for broadcast. A 16-track control room and adjoining acoustic studio complements our facility. Our listeners are loyal and discriminating and we constantly strive for quality on-air sound.

To our advantage, optical fiber and digital audio transmission technologies have been integrated in a unique and useful product for the broadcaster. The Pro-Audio-Fiber System, manufactured by T-Tech of Hudson, Mass., consists of two rack-mount units: the transmitter and receiver. The transmitter accepts four

analog inputs, converts these to a digital bit stream, adds error correction coding and synchronizing data, and ultimately modulates a laser diode.

An intervening run of single-mode optical fiber—up to 45 miles in length—couples the laser's energy to the receiver. Following the receiver's optical detector, careful filtering and amplification are employed to reduce inter-symbol interference. Four levels of error-correction are applied; digital to analog conversion follows, resulting in four analog outputs.

In the transmitter, the four analog inputs are connected to their own dedicated in-house-built A/D converters. These operate at a sampling rate of 200 kHz, with 16-bit resolution; thus, the system is capable of delivering a bandwidth of DC to 67 kHz for each of the four channels with a 95 dB dynamic range. It should be noted that to ensure minimum group delay and very flat response, a gradual-slope, anti-alias filter is employed (-30 dB at 120 kHz).

This system is capable of transmitting composite FM stereo with SCA and may be adjusted to achieve 60 dB stereo separation. For audio purposes, needless to say, performance is outstanding. The system essentially provides oversampling of 4.5 times for full audio bandwidth.

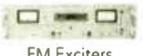
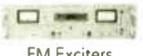
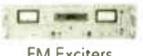
There are other optical systems employing frequency-division-multiplexing. The T-Tech Pro-Audio-Fiber system, however, uses time-division-multiplexing, thus eliminating any possibility of crosstalk between channels.

Each A/D converter outputs 16-bit words, which are transmitted twice for error correction purposes. Next, the four signals are serially combined; to this stream synchronizing pulses are added. A modulator stage takes the final digital product and drives a laser diode operating at 1300 nanometers, with a typical output power of 200 microwatts.

Within the laser module is a photo continued on page 45 ▶

**If you're in a hurry, we understand.**



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## TECHNOLOGY UPDATE

# TFT DMM92 Meets STL Requirements

by Darryl Parker  
Director of Marketing  
TFT Inc.

**SANTA CLARA, Calif.** Digital audio penetrates almost every aspect of broadcasting, from microphones to DAB. Quite naturally, the first place to apply digital techniques would be to the weakest link in the broadcasting chain today: the STL.

An improvement here would have the maximum benefit to improve the quality to the listener. Unfortunately, Part 74 bandwidth allocations for STLs necessitate state-of-the-art digital and analog designs and sophisticated audio compression to accomplish this desired improvement.

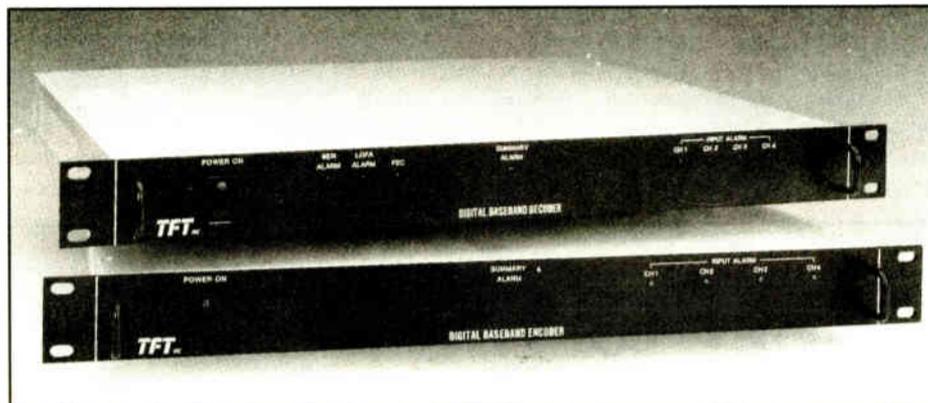
TFT has introduced a very spectrally efficient digital modem and multiplexer, the DMM92.

## Increased channel capacity

With the change in ownership rules for broadcast and the popularity of local marketing agreements (LMAs), any digital STL solution must also offer increased channel capacity to handle the complex program distribution problems required. Frequently, as many as four channels are necessary to feed two FM stations, one AM and one FM, or maybe even split the channels into many different directions,

while still maintaining provisions for transmitter remote control. The TFT DMM92 series meets all these requirements.

The DMM92 can be used to carry program information, SCAs and MUX data in a digital format that is virtually error-free, even in receiving signals below 10 V. But, because of the RF spectrum limi-



TFT's DMM92 comprises a spectrally efficient digital STL modem and multiplexer.

tation, audio compression is required. TFT also has introduced an IF Interface STL, which simplifies the digital interface issue, does not require audio compression and solves the shortcomings associated with audio compression algorithms and digital transmission delay.

The DMM92 can be used in conjunction

with conventional analog STLs. The 15-level duo-binary modulation used allows stereo (either L, R, analog or AES/EBU), SCA, MUX and remote control signals to be carried on a single RF carrier with a baseband requirement of only 75 kHz. In comparison, three-level modulation requires three times that bandwidth. This means that at better than 2 bits/Hz, it is

accepted or furnished by any input. The analog I/O models have the audio compression internal to the DMM92 and provide for 16-bit AES/EBU input. In addition to the audio ports, both models provide a 0-9600 baud RS-232 asynchronous input that is 8x oversampled. For higher data rates on this RS-232 port, 32 kbps is available on a synchronous basis.

The DMM92 encodes high-quality audio, using either internal or external codecs, into a serial high-speed data stream using sophisticated adaptive algorithms, adds Forward Error Correction, and generates a "digital composite" signal, employing 15-level, Class IV partial response signaling.

## STL transmitter

This "digital composite" signal is delivered by a conventional and often existing composite STL transmitter at the studio via an RF link to the STL receiver at the transmitter site. The "digital composite" signal at the STL receiver's output is then equalized using Adaptive Signal Equalization, corrected for any errors that may occur, and finally broken down into various respective digital data paths corresponding to the original inputs.

The principle advantage of 15-level mod-

**The DMM92 can be used to carry program information, SCAs and MUX data in a digital format that is virtually error-free.**

V35 inputs for direct connection to many popular external audio compression codecs, including APT-x, MUSICAM and Dolby. Standard bit rates offered are 256 kilobits per second (kbps) and 64 kbps, and clock signals can either be

ulation over other techniques is that it requires a baseband bandwidth of about one-sixth of the aggregate data rate, whereas three-level modulation requires about half the aggregate data rate. This means that an aggregate data rate of 451 kbps (capable of accommodating 2x15 kHz audio channels, 2x75 kHz audio channels, and 1x0-9600 baud asynchronous data channel and 8 percent overhead for error correction) can still be transmitted in an RF spectrum of less than 250 kHz.

Thus, the DMM92 with full channel capacity can easily be used in areas where only narrowband (250 kHz) channels are available, without compromise on capacity or adjacent channel protection.

Because of the DMM92's architecture, a variety of external codecs can be used, even mixed. The digital I/O models can even transmit 256 kbps, 128 kbps and 64 kbps data streams being considered for DAB. This makes the DMM92 flexible enough to handle signals that will be required in the future.

No modification of existing composite STLs is required when using the DMM92. Because a 451 kbps data channel using 15-level modulation can be transmitted with only 75 kHz of baseband, most composite STLs have adequate bandwidth and filtering. Response characteristics are equalized by a software implemented Adaptive Signal Equalization design.

□ □ □

For information on TFT products, contact Darryl Parker in California: 408-727-7272; fax: 408-727-5942; or circle Reader Service 151

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USER REPORT

# Dolby Digital DSTL KIX at 106

by Grady Moates  
Owner/Operator  
Loud & Clean

**BOSTON** I like it when a product makes a difficult problem easy to solve. I had been fighting dirty audio for more than a year at KIX 106 in Woonsocket/Providence, R.I., and had been through nearly everything in the chain making improvements that should have been audible but weren't.

After setting up a CD player and audio processing at the transmitter and hearing a striking difference, it became apparent

that the problem was in our recent-generation composite STL link.

**Second STL**

KIX 106 had planned to purchase a second STL system for hot-standby purposes, so we decided to delay factory repair of the composite system and step into the digital age with a new digital STL.

My recommendation for the Dolby DSTL was based mostly on my experience with other Dolby products, in particular the company's analog noise reduction gear.

The Dolby people made the transition a real pleasure. On May 19, 1992, Tom Daily and Steve Forshay brought in the system, along with a spectrum analyzer. A quick setup on the bench to make certain that no in-transit damage had occurred made us more confident that we'd have an early night.

At midnight, we pulled the plug and installed the DSTL transmitter in about an hour, including interfacing the Pawtucket Red Sox Network audio to the Auxiliary 7 kHz channel and the remote control to the voice-grade chan-

nel. Our mood was quite cheerful when we stopped for snacks at Christy's, and we were at the transmitter site before 2 a.m.

While I yanked stuff out of the rack and moved things around, Steve hooked up the spectrum analyzer to the hose from the dish and said, "Hello, what's this?"

We'd left the DSTL transmitter off, after showing the overnight announcer where the on-switch was, so there should have been nothing to see. But there, floating nicely above the grass, was a carrier on our frequency.

**The plot thickens**

After checking the level of our transmitter's received signal, we found that this interfering carrier was only about 27 dB down. Since the DSTL runs about 1 W and our old composite link was closer to 10 W, this meant that the interfering carrier was about 36 dB down with the old system—not hot enough to hear, but hot enough to add sideband information that would show up as distortion.

"Aha!" I cried. Or something like that.

After the DSTL receiver was mounted and all connections were complete, we turned on the new system. That's when I started to get really impressed. The front panel stereo headphone jack, complete with volume control, allowed us to monitor not only the left and right program audio, but also the sports network and the remote control signal. The front panel meter (a good old high-quality analog meter movement) allowed us to see all the usual stuff, but with an interesting addition called "Bit Error Rate," calibrated in log increments. It was hard against the left-hand peg.

"So what's this mean?" I queried.

Tom smiled and said, "No data errors detected in a billion bits."

After setting levels on the Aux and voice grade channels, we called the overnight jock and said, "Go for it." A couple of tweaks to get the L-R nulled in mono and we were done by 3 a.m. We posed so my buddy Bob could shoot a few pictures and we were out there.

**But how does it sound?**

Well, I had to back off on the audio processing considerably. All of a sudden the station was just *loud*. Nearly every control on the compressor, limiter, clipper and filter stages went counterclockwise, some by a lot. Adding all the reductions in processing together, I went down about 12 dB, without losing that full, punchy sound. All the work we'd put into the KIX 106 system over the previous year and hadn't heard finally came pounding out of the speakers.

Tom and Steve left the next afternoon, and that evening I spent about four hours reconfiguring the old stuff for hot standby. The DSTL makes configuring just about any other STL system as a hot standby simple and easy. An RF splitter gives RF to both receivers, and the DSTL provides floating "form C" contacts to control the external switching.

Placing a relay in a box to switch the composite output of the DSTL stereo generator was quick and easy. Remote control interface was almost as simple.

In the transmitter unit, the SCA is demodulated to recover the FSK, which then is demodulated to recover the data. This makes it easy to simultaneously

continued on page 46

# SEE SPOTS RUN.

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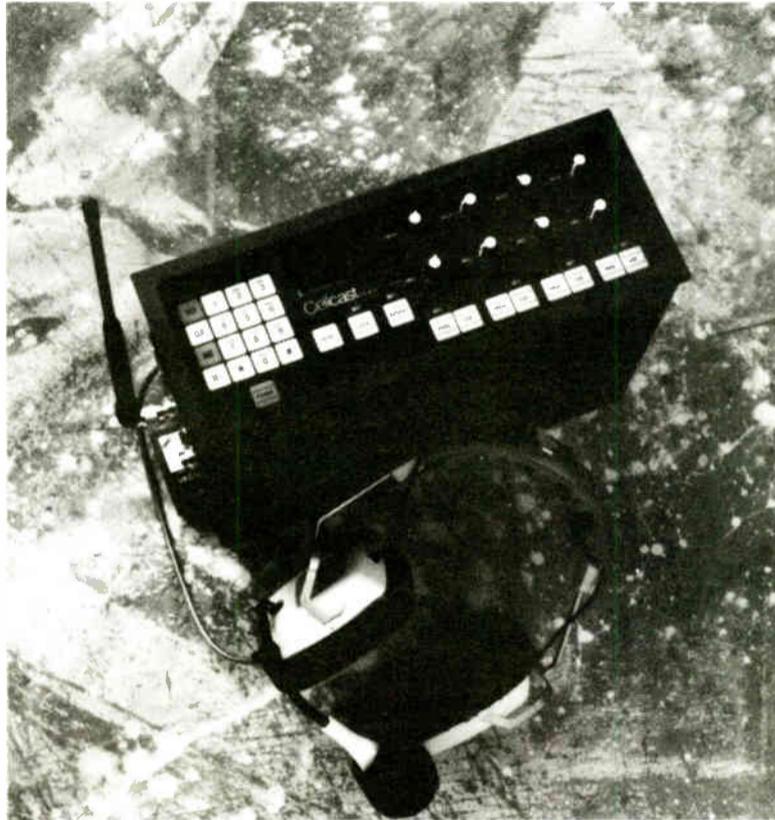
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USER REPORT

# WTIC-AM-FM Dedicated to DSP-6000

by Thomas R. Ray  
CE, WTIC-AM-FM Radio

**HARTFORD, Conn.** Among the unique attributes of WTIC-AM-FM is the fact that our satellite downlink is located at our transmitter site, 10 miles to the west of our studios in downtown Hartford.

We downlink everything from CBS networks to Talknet to FNN and the Boston Red Sox broadcasts for the AM, and concerts and special programming for the FM. We had been backhauling the audio via leased equalized phone lines, but there were two problems with this. First, Alexander Graham Bell himself installed the cable on Avon Mountain, so every time we had ice and snow, the lines would either hum or, at worst, go away.

Second was cost. Our circuits were becoming increasingly unreliable, costing more than \$12,000 in 1992. Add to that the fact we needed more channels coming back because of CBS's conversion to SEDAT. Something had to be done.

**Lose signal**

When CBS converted to SEDAT, we put up two Inter-City Relay Links. They were slightly noisy because we have a 300-foot run of one and a quarter-inch cable up to our six-foot ICR transmit dish on the tower. We also lose signal because both ICR transmitters go through a Cel-wave combiner to allow the use of a single transmit dish.

At the studio end, I was stuck with 300 feet of half-inch coax from the ICR receive dish, and I had no choice but to use a Scala Mini-Flector on the roof of the building. Winds pulled a four-foot dish off the mount on the roof of the building. The Mini-Flector had considerably less wind loading, so that's the antenna we ended up using.

We had attempted to stack analog sub-carriers on the ICR links, but because of the reduced signal level on the receivers, anything above 39 kHz was noisy and crosstalk was rampant. After talking to Dave Chancey at Moseley, I put the request in to our corporate office for two DSP-6000 boxes.

Both of our DSP units were configured for four 15 kHz bandwidth audio channels.

We decided to convert our ICR link using an old Moseley PCL-505C. The conversion of the receiver was a simple case of cutting a wire and soldering another in. We then used an oscilloscope to adjust the output of the DSP-6000 to the required peak-to-peak level to properly deviate the 505 transmitter. Data was plugged into the transmitter, and we drove back to the studio to find our DSP-6000 decoder—not working!

**Broad enough**

A quick call to Moseley revealed that the IF bandwidth of the 505 receiver may not be broad enough to accommodate the 500 kHz wide digital signal. Looking at the output waveform of the 505 on a scope showed that the recovered signal looked nothing like what went into the transmitter. Here's where I began to get very intimate with the DSP-6000.

A call to one of our local TV stations got me the use of a spectrum analyzer.

Looking at the 949 MHz signal on the antenna revealed that we were indeed occupying the full 500 kHz of the channel. Looking at the output of the IF stage, however, revealed that only about half the bandwidth was getting through. Several hours later, I had the full 500 kHz signal getting through the IF stage. The output waveform looked considerably better than it had before the IF adjustments, but the DSP-6000 still wouldn't perform without data glitches.

A closer examination of the IF output showed that our AM STL transmitter,

located on the roof of the studio building and transmitting on 948.5 MHz, was getting into the lower skirt of the 949 MHz signal, glitching the data when a song with bright music was being played on the AM.

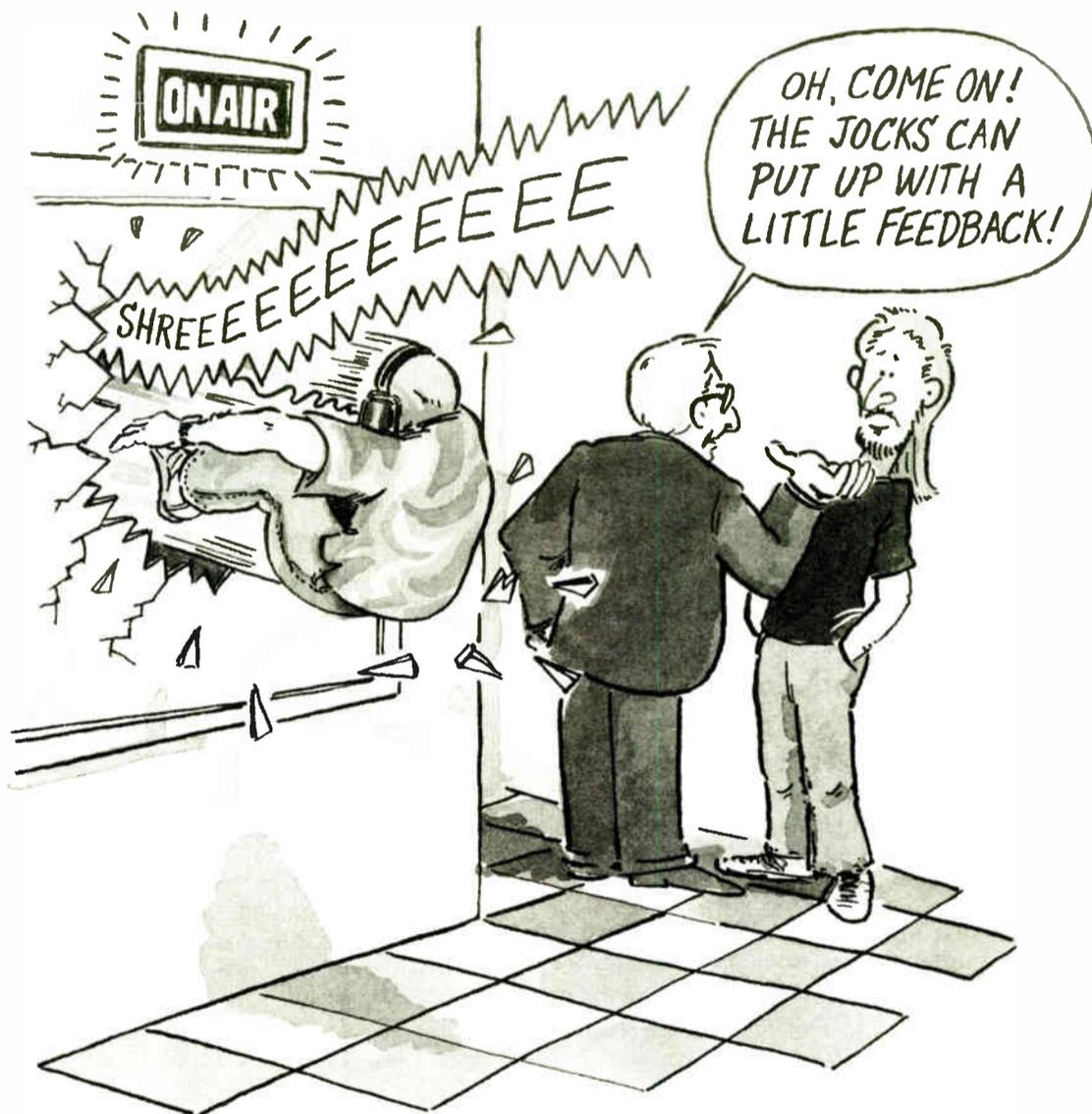
Several hours later, I had managed to pull in the lower skirt slightly, while opening up the upper skirt a tad. The result was that the DSP-6000 locked up quickly, and only showed a very minor data error once in a blue moon.

The decisive test was one day when CBS was carrying an unanchored press conference by President Bush. During the

testing period before air, CBS was sending the output of a sweep-frequency generator. The phone line varied as much as -3 dB from 50 Hz to 15 kHz. The output of the DSP was perfectly flat.

The next step was to convert our ICR link using a Moseley PCL-606C. This again was a simple receiver conversion which involved removing an IC and soldering in a wire in the demod module. The fly in the ointment on this link was that our remote control telemetry for both stations was located on a 152 kHz sub

continued on page 48 ▶



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Paul Christensen, WIVY-FM, Jacksonville, FL

"CAT-LINK makes money for us, and it improves the sound of the station."

Mike Callaghan, KIIS-FM, Los Angeles CA

"CAT-LINK has held up through extreme heat, a hostile RF environment and nasty summer lightning storms."

Dick Byrd, WZGC-FM, Atlanta GA

### Two-way multi-channel communications

CAT-LINK digitizes the entire composite signal with no data compression, so you can run the stereo generator and processing at the studio, where they really belong. At the same time, CAT-LINK sends and receives up to four customized auxiliary channels with no crosstalk—SCAs, control channels, voice communications, RS232 data, AM audio, transmitter readings and satellite or remote program feeds. What's more, CAT-LINK gives you extra capabilities like transmitter building surveillance via closed circuit TV and an analog telemetry channel.

### Transparent digital transmission

CAT-LINK encodes the fully processed composite signal, then decodes it at the transmitter. You always get full stereo separation, without the phase or amplitude variations that plague two-channel STLs. Dynamic range is up to 84 dB, and your processed composite signal can use virtually all of it. You hear clear, clean, undistorted audio—all the time.

### No audible delays

CAT-LINK's real-time digital encode/decode process doesn't introduce audible delays as data compression can. Jocks can monitor on-air without problems.

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

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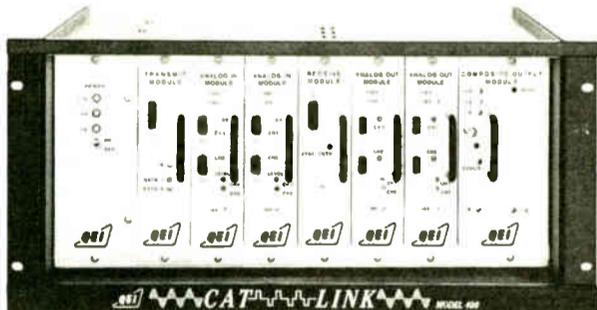
CAT-LINK is cutting phone bills for stations that don't have a clear microwave path. With CAT-LINK, a single bidirectional DS1 line replaces multiple Class A telco lines, providing multi-channel STL and TSL over the same link. Already available virtually anywhere, DS1 service is getting cheaper every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

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## USER REPORT

# Gentner PeopleLink II Offers Phone Flexibility

by Elaine Jones  
Director of Broadcast Products  
Gentner Communications Corp.

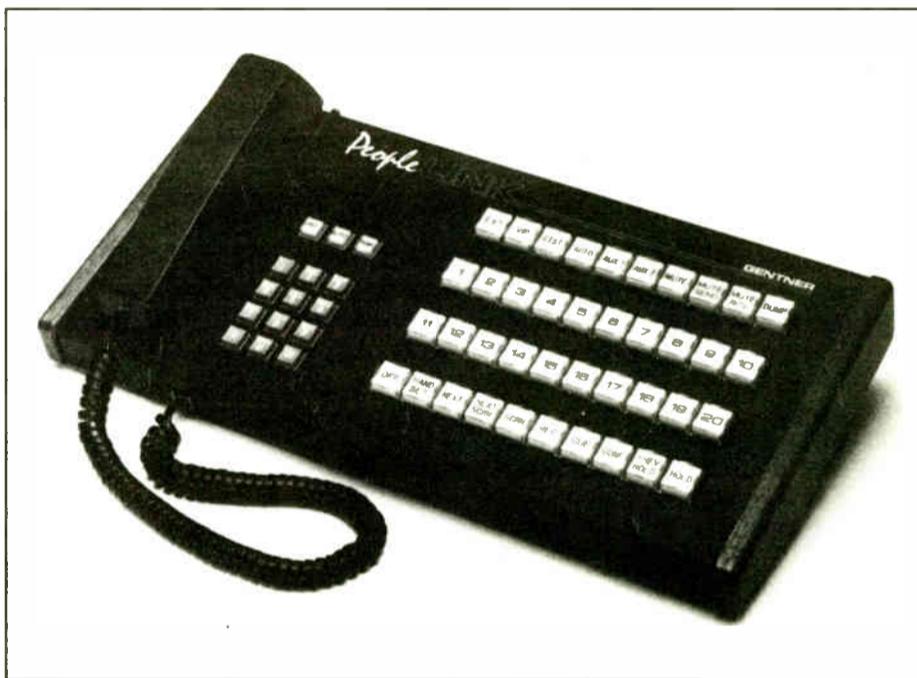
**SALT LAKE CITY** Listener interaction in today's competitive broadcast environment has created the need for an on-air telephone system that offers high quality, multiple lines on-air at once, multistudio operation with call screening, rapid reconfiguration and varying degrees of automation.

Gentner's PeopleLink II Broadcast Telephone System offers all of the above and more.

PeopleLink II is the second generation of a broadcast telephone system designed for large market stations or group broadcasting facilities. PeopleLink was first

al components may be added to the basic system, including up to three more 10-line interfaces, providing total system capability of 40 telephone lines; up to five more Digital Hybrid II units; up to five (each) more control surfaces and audio interface units; and frequency extenders, up to six. Non-extended telephone lines can be conferenced with frequency-extended lines.

All components except the control surfaces and audio interfaces are centrally located in an equipment room. System functions such as telephone line assignments, number of hybrids, all screening functions, etc. are not dedicated to specific studios. Rather, these functions are dedicated to control surface operational programs. Up to 16 of these programs are



Gentner's PeopleLink II broadcast telephone system is enhanced with cutting edge features.

introduced in 1990; during the past year it underwent a significant engineering update by Gentner and has been re-released as PeopleLink II.

Unlike many telephone call direction devices, PeopleLink II is a true system. It consists of modules that can be interconnected in a variety of ways to provide the user with a great deal of flexibility.

### Modules

Modules include: power supplies, main and secondary; the mainframe (the main processing center for the system); 10-line (telephone) interface units, each providing connections for up to 10 telephone lines; Digital Hybrid II telephone hybrids; control surfaces, which resemble large multiline telephone sets (each has a handset, DTMF pad, call timer and a series of buttons that are assigned to telephone lines and specific functions in the system); audio interfaces, which provide audio connections to and from the user's consoles; and optional EFT-100 single-line frequency extenders.

A Basic PeopleLink II system consists of the main power supply, mainframe, one 10-line interface, one control surface, one audio interface, and one Digital Hybrid II telephone hybrid.

Depending on the user's need, addition-

available in the PeopleLink system, and any program can be accessed by any control surface.

### Useful flexibility

This flexibility is especially useful in multi-studio operation of the system. As an example, let's look at a theoretical AM/FM combo setup. The AM station runs a news/talk format, with a large talk show in the evenings; the FM is CHR with heavy listener interaction and frequency contests during morning and afternoon drive hours.

Twenty phone lines are available for on-air use. Ten additional telephone lines have been installed in the building and are used as business lines from 8 a.m. to 6 p.m.

Daytime use of the system shows the AM with 10 phone lines and automated call answering, and the FM with 10 phone lines. At night, however, the AM talk show requires its existing 10 lines and most of the FM's lines, plus the 10 business lines and a live call screener.

In the past, providing this capability was highly difficult, if not impossible. With the PeopleLink system, this switchover can be accomplished by pressing three keys on each studio's control surface.

continued on page 48 ►

## T-Tech Adds Fiber to WGUC's STL Diet

► continued from page 37

detector diode whose output feeds the modulator stage to compensate for output level drift due to temperature, aging, etc. The optical output is delivered at a rear-mounted ST-type connector. The transmitter power supply uses a toroidal power transformer; regulators are mounted on rear-panel heat sinks, as are fuses for each supply branch and AC mains. The transmitter occupies two units of racks pace and requires approximately 16 inches of depth, including connectors. The front panel holds four illuminated peak-reading, analog meters, which read 0 to 100 percent.

Turning to the receiver, a rear-mounted ST connector accepts the incoming fiber and illuminates a PIN diode. At this point, it is useful to consider T-Tech's design philosophy: Errors will occur. The system anticipates difficulties and is ready to act accordingly. After amplification and filtering, the received bitstream is converted to parallel data and fed to four D/A converters. The 16-bit redundant words are compared, checked for format, bit rate and synchronization errors. Corrections are accomplished by each D/A converter.

Physically, the receiver occupies two rack units and 19 inches behind rack rail. The front panel contains one item: a code-error LED. The alarm is available as

a contact closure on a rear-mounted triaxial connector.

Both the transmitter and receiver utilize rear-mounted BNC connectors for analog inputs/outputs. Input signal levels of -5 V are bridged by 100 K ohms in the transmitter; the receiver outputs -5 V into a load of 600 ohms. In February, we inaugurated two T-Tech Pro-Audio-Fiber

links between our main complex and transmitter site: one for STL and the other for TSL. Having four wideband signal paths in each direction permits a degree of flexibility that previously was impractical. At present, discrete stereo and SCA (radio reading service) occupy three outbound circuits. Two remote pickup receiver audio outputs and composite out-

put from the transmitter modulation monitor return via the inbound fiber.

The remaining circuit is used for experimentation. At this writing, absolutely no difficulties have been experienced. The beauty of the system is its simplicity: What goes in, comes out. There have been no complaints from listeners or on-air operators.

□□□

For information on the T-Tech Pro-Audio-Fiber link, contact Dan Talbot in Massachusetts: 508-562-5820; fax: 508-568-1219; or circle Reader Service 18.

## RS<sup>2</sup> Dolby S Passes EZ Test

► continued from page 37

come later when the van was 35 miles away.

After installing a decoder on/off switch at the studio board-op position, the test crew hitched a ride to Outback Jack's.

Only a few minutes were required for WIOQ's five-person remote staff to set up. While the bar was decorated with station regalia and the mixing board was installed in the lighting booth, the remote van was positioned and the mast was raised to full height. Next, using a custom-designed dial-up remote, Ben optimized the transmit and receive Yagi antennas for maximum signal strength. A call by cellular phone to the station confirmed that the link was established but, as expected, was very noisy.

Then, five minutes before air time and with the jock just arriving on-site (why do they always do that?), Ben told the

board operator to run the Dolby decoder only. According to the operator, the effect was dramatic: "Wow, it's like you guys just jumped 20 miles closer. The show sounds like you're right next door."

### Other Dolby S uses

While RPU applications represent exciting options for Dolby S, Radio Systems licensed the technology from Dolby Labs primarily for tape cartridge applications. A standard feature of the cart system is tone encoding that allows the decode circuitry to "recognize" a non-Dolby cart and instantly switch off the decode system. In this way, cart libraries can be mixed and slowly converted to Dolby S processing.

Another standard feature of the Radio Systems Dolby package is phase correction when used with stereo media. Borrowed from the RS-2000 cart machines,

this circuitry provides up to 90 degrees of phase correction at 5 kHz. The cards also are available in a phase-only model. Similar to the no-longer-available "Phase Chaser," this version provides full program chain correction of stereo phase error.

Radio Systems packages the Dolby S noise reduction system in a single rack frame, which houses a power supply and up to three encode or decode cards. When used with tape cartridge systems, noises can be reduced to digital noise levels without the expense or hassle of changing to a digital format. For RPU or discrete STL use, high-end noise is reduced up to 24 dB with no audible processing artifacts.

□□□

For information on the RS<sup>2</sup> Dolby S noise reduction package, contact Dan Braverman or Paul McClane at Radio Systems in New Jersey: 800-523-2133; fax: 609-467-3044; or circle Reader Service 192.

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## TECHNOLOGY REPORT

# CCS CDQ-2000 Advances the Codec Cause

by David Lin  
Product Marketing Manager  
CCS Audio Products

**HOLMDEL, N.J.** With the introduction of Corporate Computer Systems' CCS Micro 56 7.5 kHz Audio Codec in 1989, radio broadcasters began transmitting high-quality news and sports feeds digitally.

Based on the CCITT G.722 ADPCM compression standard, the Micro 56 codec required a single Switched 56 or

width at higher compression ratios than provided by 7.5 kHz G.722 ADPCM-based codecs. The CDQ-2000 stereo MUSICAM codec was developed in response to these needs.

### International standard

The CCS CDQ-2000 codec uses the internationally standardized MUSICAM compression algorithm. By using MUSICAM for audio encoding, the CDQ-2000 allows the user to select different compres-

less than a dollar a minute.

The CDQ-2000 encoder accepts analog audio through industry-standard XLR inputs. The audio is digitized, compressed and output to either V.35 or RS 422 digital connectors in binary data form. To take advantage of low-cost Switched 56 data service, the CDQ-2000 has a built-in inverse multiplexer, which splits a 112 kbps stream into two separate Switched 56 data circuits and automatically compensates for any differential line speeds.

### Receiving end

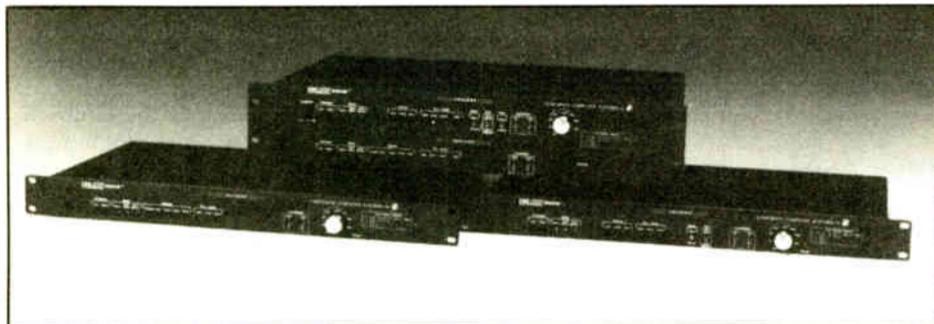
At the receiving end, the CDQ-2000 decoder recombines the split data stream,

decodes it and recovers the original high-fidelity audio. If higher bandwidth digital carriers such as fractional T-1 or SCPC satellites are available, the CDQ-2000 can be switch configured to utilize the bandwidth to provide even higher quality audio transmission. This permits multiple encode/decode cycles without audio degradation.

AT&T switched digital services currently connect the U.S. with most of Europe, as well as Singapore, Japan, New Zealand and Australia. By using the CDQ-2000 codec and dial-up digital phone circuits, backhauling a stereo concert from Sydney is as easy as one from across town.

□□□

For information on the CDQ-2000 from Corporate Computer Systems, contact David Lin in New Jersey at 908-946-3800; fax: 908-946-7167; or circle Reader Service 69.



The CCS CDQ-2000 codec utilizes MUSICAM compression.

ISDN digital phone circuit for 7.5 kHz audio transmission. This technology quickly replaced the multiline analog frequency extenders and today, there are more than 1,000 Micro 56 codecs in use.

However, since the majority of radio programming is done in 15 kHz stereo, broadcasters soon demanded more band-

width at higher compression ratios ranging from 4:1 to as high as 13:1. At the maximum compression rate, the CDQ-2000 permits the transmission of near CD-quality stereo audio using as little as 112 kbps of digital carrier.

Because of CCS's CDQ codec, now stereo concerts can be sent from New York to Los Angeles by using a pair of Switched 56 dial-up circuits at a cost of

## Dolby DSTL KIX at 106

► continued from page 40

provide FSK to the DSTL transmitter and 110 kHz SCA to the composite STL transmitter. At the receive location, a

Since the KIX 106 installation, I've had an opportunity to test compatibility of the DSTL with analog systems in the crowded Boston STL band. My client and another station both run dual mono links on the same channel, one carrier 125 kHz below the channel center, the other carrier 125 kHz above. When I received an interference complaint from the other station, I stuck a DSTL system on my station on the channel center frequency, between the dual mono carriers. The other station's problem went completely away; they could hear no evidence of my presence on the channel.

Oh, one more thing—the PD hasn't com-

plained about the sound lately.

□□□

Loud & Clean is a radio facility design, construction and maintenance organization in Boston.

For information on Dolby products, contact Kevin Tam in California at 415-558-0200; fax: 415-863-1373; or circle Reader Service 179.



Steve Forshay (l), Tom Daily and Grady Moates gather around their ally, the Dolby DSTL.

small isolation transformer, a trace cut and a dip relay in the Burk unit allowed the DSTL to insert FSK directly, interrupting the demodulated SCA signal from the composite link. If the DSTL receiver fails to receive valid data, the relay drops out and restores the internal connection from the SCA demodulator to the FSK demodulator. Nifty.



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TECHNOLOGY UPDATE

# DRC200 System: The Next Generation

by Harold Hallikainen  
Hallikainen & Friends

**SAN LUIS OBISPO, Calif.** In 1978, Hallikainen & Friends got its start in the broadcast transmitter remote control business with introduction of the TEL171. The product replaces the analog metering circuitry of the Moseley TRC-15A with digital, improving accuracy and readability. At that time, we thought the digital data was just too valuable to "keep inside the box," so we put a connector on the front and marked it "data."

As we became familiar with microprocessors, we prototyped a system that would plug into the TEL171 jack. We used an integer Basic interpreter (from Technical Systems Consultants) in the prototype. We added words to Basic, allowing an application program to get readings from the TRC-15A and send Raise or Lower commands. We ran this prototype for several months on a local directional AM station before deciding to take another design approach.

The above computer interface suffered from two shortcomings. First, it used an integer Basic. Second, it worked only with the TRC-15A. We solved the first by licensing a floating point Basic interpreter from Microsoft. To solve the second problem, we ignored the "valuable data" on the front of the TEL171.

**Interface software**

In the PC180 series, we built modems and wrote interface software so the PCC would emulate the studio end of several remote controls. These included the TRC-15A (with the TEL171), the TFT 7610 and the Moseley DRS-1A. The first PCC180 shipped in 1981. It is still on line in Chicago. Through a user-written applications program, the system presents several user data screens, does limit checking, adjustments, pattern changes and logging.

By 1984, we decided we should make our own remote control; a full remote control system, not just a computer interface for an existing system. Again, Basic was the language of choice for the user programming of the system. The DRC190 includes a front panel alphanumeric display, allowing manual operation

**Through a user-written applications program, the system presents several user data screens.**

using the familiar "channel raise/lower" controls. User full-screen displays, automatic control and logging are handled by a Basic program running in the DRC190.

In 1988, we finally put the TEL171's "valuable data" to use. The ITO177 (designed by Bill Bordeaux of Interstellar Communications) adds words to the Basic of a Commodore 64 or 128 and drives the "data" jack on the TEL171. This low-cost system continues the Basic programmability of the PCC and DRC family.

**New processor**

As applications programs for the DRC190 became more and more involved, the 64K memory map of the 68B02 became a limiting factor. We worked out a "RAM disk overlay" system that allows larger programs, but with some added complexity in the user program. We started looking for ways to expand the complexity in the user program and the memory map.

The DRC200 consists of a custom rack mount cabinet that holds an expanded 80286 motherboard, power supply, and I/O boards. The I/O boards include a standard video interface, a modem, a status input board, an analog input board

and a control output board.

The transmitter site user interface is a standard video monitor and keyboard, as opposed to the more typical 32-character LCD.

The modem provides communications to the control point. A variety of standard low-cost modems can be used on dial-up or leased circuits. The standard modem operates at 2400 bps.

The status input board accepts 16 or 48 TTL inputs. These can be driven by contact closures to ground, open collector outputs or TTL/CMOS drivers. All inputs include pull-up resistors and series current limiting resistors.

The analog input board accepts 16 or 48 DC or AC sample voltages. This board uses the MAX134 digital multimeter chip. The user can set the input voltage range on each channel from 40 mV full scale to 400 V full scale, DC or AC. The board includes an RMS to DC converter to handle AC sample voltages. It also includes a temperature sensor IC, allowing the temperature inside the DRC200 to be measured. Since this is generally just a few degrees above ambient, an approximation of room temperature is available with no external hardware. One side of each analog input is grounded, but differential voltages can be measured using software techniques ( $V_{ab}=V_a-V_b$ ).

**Collector control outputs**

The control output board provides 16 or 48 open collector control outputs. These can directly drive most transmitter site control inputs. The board also includes a watchdog timer, system firmware and battery-backed RAM for system setup data.

The status, analog and control inputs/outputs appear on the rear panel on 50-pin "microribbon" connectors. Prewired cables and "66" type punch-down blocks are provided with the system.

The system firmware is held in EPROM

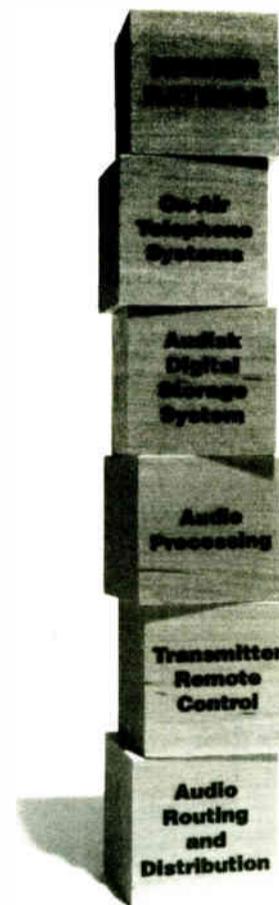
at address 4M. On system reset, it is copied down to "conventional" RAM and executed. A spread sheet is used to calibrate and configure the system.

At the control point(s), a standard CRT terminal modem and (if automatic logging is desired) printer complete the system. The operator is presented with up to nine screens of user information plus the set-up screen. A standard computer running terminal emulation software may be substituted for the terminal. The transmitter site software is multitasking, allowing several operators to access the transmitter data simultaneously.

□ □ □

For information, contact Harold Hallikainen in California: 805-541-0200; on internet at ap621@cleveland.freenet.edu.; or circle Reader Service 188.

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# Gentner Offers Phone Flexibility

► continued from page 44

The PeopleLink II system offers several unique capabilities, some of which are:

- Up to six control locations, making it possible to have locations such as AM Control, FM Control, TV News and call screeners all on-line at the same time. Each location can have its own custom programming to fit its particular needs.

- Connection of up to 40 telephone lines. Lines are connected directly to the PeopleLink II system; no special key system or PBX is required. The system also permits loop-through connections, for use of telephone lines "downstream" from PeopleLink.

- On-air conferencing of callers. Up to four lines may be placed on-air at once in an air studio.

- VIP line assignments. For talk shows with a remotely located guest, the guest line(s) may be designated VIP, making it virtually impossible to accidentally disconnect the guest. Any number of lines can be designated as VIP lines.

- Advanced call screening capability. As telephone lines are answered and placed on hold, the on-air studio simply presses a "Next" button. This action places on-air the call that has been waiting the longest. It also is possible to shuffle the "Next" queue to place a preferred line at the top of the waiting list.

- Auto answer/disconnect. For unscreened talk shows, the system can automatically

answer ringing lines, play a short message, then place the lines on hold. As with the call screening feature, this feature permits use of the "Next" button to place calls on-air. Or, the operator can press any line button to take a call.

- Automated contest operation. Operators who run frequent contests can announce the contest, enter the number of the winning caller and go on with other business. PeopleLink II answers the calls, plays a short message, disconnects and moves to the next caller; when the winning number is reached, it alerts the operator with a flashing button.

- Ability to control PBX and special central office functions. The PeopleLink II's "Hook Flash" feature gives the control surface the same signaling capability as a regular business telephone, to take advantage of special functions on the business phone system. Also, PeopleLink II can take telephone lines that have been answered "downstream" from the system on the station's business system.

PeopleLink systems are in use around the world. Users include WLUP, Chicago; CBS Television, New York; NBC Radio, New York; the Canadian Broadcasting Corporation (multiple sites);

CFRB, Toronto; and RTL/Berlin, to name a few. Systems also are in use for business TV applications at companies such as The Home Depot and Georgia Power & Light, and in Distance Education applications such as one in place at the University of Alabama.

PeopleLink II offers flexibility in configuration and operation. This flexibility does carry a hefty price tag: System prices begin at \$12,990. For many stations, though, the ability to interact with listeners under varying circumstances is worth the price.

□□□

For information on PeopleLink, contact Paul Anderson, national sales manager for Gentner in Utah at 801-975-7200; fax: 801-977-0087; or circle Reader Service 164.

## WTIC Dedicated to Moseley DSP-6000

► continued from page 43

carrier. Figuring that the digital signal occupied the full 500 kHz of channel space, thus wiping out the telemetry, we decided to see if we were correct.

My assistant plugged the digital unit into the 606 transmitter on the mountain, and I watched the transmitter readings rapidly disappear. No problem. With a DSP configured for four 15 kHz channels, you have one RS-232 data port available. A call to the manufacturer of our remote control got us the correct modem cards the next day, and we thought we'd be in business.

The next day, we swapped cards in the remote control and connected it to data port 1 with the parameters of 300 baud, odd parity, one stop bit. All parameters for the data ports are set via dip switches on the DSP-6000 motherboard. No dice.

A quick call to Moseley revealed that because of the algorithm used in the data transmission, data port 1 is not useable for odd parity data. Rather than go through the problems of having our remote control manufacturer configure a set of UARTS with even or no parity, I opted to convert the second set of channels on the DSP-6000 to 7.5 kHz bandwidth. This would activate data port 2. The conversion was simple, and this time, our remote control worked fine.

After six months of flawless service and greatly improved quality on our satellite services, it was decided that our 17-year-old PCL-505C should be retired. As luck would have it, Moseley had a special price on purchasing a PCL-6020 system

with a two-channel DSP-6000.

You may wonder if, having installed and used three DSP-6000s, I'd buy another one. Well, I'd like to convert the AM STL to a four-channel unit, two for AM, two backup for FM. I want to convert the FM unit to four channels, with the second two being backup for AM. Using the status outputs for the alarms from the DSP-6000, I can build an audio switcher that would automatically switch to the backup audio channels should a data fault be detected.

With the status outputs to monitor the DSP-6000 on the remote control, the ease to set parameters on the data ports, and the incredible audio quality of the DSP-6000, Moseley has found a friend for life.

□□□

For information on the Moseley DSP-6000, contact Jamal Hamdani in California: 805-968-9621; fax: 805-685-9638; or circle Reader Service 65.

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**7 SENDS** via 4 knobs with plenty of gain above unity for special effects and center detent at unity gain, **4 STEREO AUX RETURNS** with super-high headroom, low noise and enough gain to work with all levels.

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**LARGE INTERNAL POWER SUPPLY** provides power for +48V phantom mike power, 12V BNC lamp socket, and bi-polar power for main circuitry, hi-output headphone amp and sophisticated enhancements such as our XLR10 mic preamp expander & internal full-fader/muting MIDI automation board. Our supply not only eliminates inconvenient "wall warts" & "line lumps" but gets rid of their hum-inducing magnetic fields, too. Instead of being driven into non-linearity (causing stray 25-35µV magnetic fields), our oversized, instrumentation-grade transformer cuts along, reducing stray fields to under 1µV for quiet operation.

**GNARLY CIRCUIT BOARDS.** Unlike brittle phenolic, our horizontally-mounted, double-sided, thru-hole-plated fiberglass boards and rigid, multi-point suspension prevent damage from external impact.

**MIX AMPS WITH TWICE THE HEADROOM.** Signals from all inputs simultaneously converge here. Conventional mix amps can overload and distort when you start pouring on the channels. Our gain structure solves the problem for audibly better sound. Cram the CR-1604 with 16 hot signals and it still has more headroom than other mixers running 8 inputs.

**ULTRA-DENSE CIRCUIT TOPOLOGY.** Unlike budget mixers which cut corners with passive circuitry, we added input and output buffers so the CR-1604 is compatible with a much wider range of devices.

**HIGHLY EFFECTIVE RF PROTECTION.** A plus for musicians. RF resistance is absolutely mandatory in broadcast. So we designed the CR-1604 with steel jacks and a shunting capacitor on each channel to route RF back out onto the main ground plane instead of re-radiating it through internal circuit traces. Read Radio World, March 25, 1992, pg. 27 for the rave results of a grueling RF field test on the CR-1604.

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## USER REPORT

# WEOS Upgrades with Burk ARC 16

by Michael Black  
GM/CE  
WEOS(FM)

**GENEVA, N.Y.** When WEOS made the transition from a standard college radio program format to one that incorporated National Public Radio and overnight services from the BBC and American Public Radio, we had to upgrade our transmitter remote control to handle the legal requirements of walkway operation during the late-night hours. This included not only the transmitter control, but EBS at the studio site.

The Burk ARC 16 was chosen for its design, as well as its ability to meet economic constraints. The two-site system (expandable to four)—one unit at the studio and one at the transmitter, with dial-up and computer control—was less than half of similar computer-based systems in the marketplace. However, what really motivated us was the flexibility of the system, and its simplicity of set-up and operation, a consideration for our mostly student and community volunteer staff.

## Detailed information

The ARC 16 was easy to install; the manuals give detailed information and examples on interfacing to other equipment. A lot of the newer equipment can interface directly to the ARC 16's open collector outputs. For those that can't, a very neat auxiliary relay and contact panel is available that gives you all status, input and control functions on a terminal strip. Up to 16 channels are available at each site, including the studio. This attracted us to the system.

WEOS uses eight channels at the transmitter and 16 at the studio, for controlling cart machines, EBS, R-DAT, satellite switchers, audio consoles and even a phone hybrid. Utilizing any touch-tone phone, any device hooked to it can be controlled.

This is very helpful for activating the EBS from a remote location and going live on the air from the phone. With station and off-site monitoring, you can get on the air from the phone in fewer than 30 seconds from an EBS reception. The ARC 16 will even phone you when an EBS alarm is received or when any other out-of-parameter setting is triggered. We have our ARC 16 phone, a pager and a cellular phone.

One time I was in Arizona and the ARC 16 called to alert me to a power failure at the transmitter site. I was able to restore operations before the engineer who was covering for me got to the transmitter site to manually check on things.

The real gem is the Autopilot software. This simple, easy-to-program package, operating on an IBM AT platform, with a small hard drive, allows the user to set up automatic and manual programs, to monitor and trim transmitter power levels, automatically restore on air after a power failure, change antenna patterns, print logs or even turn on the transmitter building lights for a maintenance shift.

## Autopilot

At WEOS, we use the Autopilot to automate certain parts of the program day, or to play drops in network programming breakaways. For example, we start an R-

DAT to play during one hour of the day on an Autopilot time program or to start a record at a different time. Exact time-keeping is not a problem. Our AT's time

of SMN or Unistar. We automate part of our NPR programming this way, which requires the drops to be at set times, but there are no automation or cue pulses

**The Burk ARC 16 was chosen for its design, as well as its ability to meet economic constraints.**

board sets the PC's time to WWV; thus exact, to-the-second events are possible, from station IDs to weather drops.

This is very useful for satellite programs that do not have the automation features

from the network. Long-form programming on reel-to-reel or DAT also can be started in this manner. There are so many other features that Autopilot can be used for, which usually is limited only by the

engineer's imagination. The ARC 16 has worked flawlessly and the support from Burk, including updates on software, has been exceptional. I would highly recommend the ARC 16 for any station, large or small. We have pushed the software to the limit, and it still works beyond our expectations. Simplicity, reliability, flexibility and economy make ARC 16 the unit to have for your station.

□□□

For information on the ARC-16, contact Peter Burk at Burk Technology in Massachusetts at 508-433-8877; fax: 508-433-8981; or circle Reader Service 42.



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# MARKETPLACE

Radio World's Marketplace, a compendium of new and recently introduced radio broadcast products, appears monthly in Buyers Guide

### Digital Audio Board

Antex Electronics Corp. has developed the first and only digital audio board with Dolby AC-2 coding, providing real-time professional broadcast-quality stereo sound through PCs, PS/2s and compatible computers.

The new PC add-on board, model SX-20, is the latest DSP-based digital audio board from Antex. All are based on Texas Instruments' digital signal processor chips. This newest model utilizes the advanced floating point TMS320C31.

Using the Dolby AC-2 adaptive transform coding technology, the Antex SX-20 offers 20 Hz to 20 kHz audio frequency response in only 128 kbit/second, about one-sixth the rate previously available.

For information, contact James Antrim in California at 310-532-3092; fax: 310-532-8509; or circle Reader Service 124.

### Mic Preamp on a Jack

Benchmark has announced the new MP-3, a high-quality microphone-preamp on a jack. The MP-3 has a balanced input, variable gain from 26 to 65 dB, a balanced output and has the ability to feed

phantom power (external source required) to the microphone.

Performance offers a 1 dB noise figure, a 2 kHz THD at A=40 dB of 0.0005 percent and a bandwidth of greater than 200 kHz. The balanced output allows it to drive lines up to 300 feet in length.

The MP-3 requires bipolar power, such as Benchmark's \$35 PS-1 wall mount supply.

For information, contact Rory Rall, sales department in New York at 315-437-6300; fax: 315-437-8119; or circle Reader Service 98.

**Address Changes** Due to changes with postal regulations, audiopak has new correspondence and shipping addresses. Please send all correspondence to: P.O. Box 3100, Winchester, Va. 22604. Shipping address: 255-1 Tyson Drive, Winchester, Va. 22603.

TDI America moved its East Coast office from New York City to Norwalk, Conn. The new address is: 101 Merritt 7, 4th Floor, Norwalk, Conn 06856. Phone: 203-849-8211; fax: 203-849-3035.

Studer Revox America has relocated from downtown to uptown New York City. The new address: 1120 Avenue of the Americas, 4th Floor, New York, N.Y. 10036. Telephone: 212-626-6734; fax: 212-626-6735.

**Distributors** Richardson Electronics Ltd. and Shure Brothers signed a distribution agreement naming Richardson as a stocking distributor of Shure's line of microphones, mixers, accessories and other related audio products.

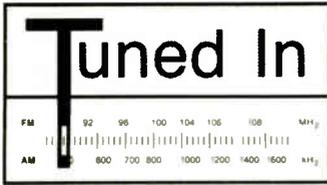
The terms agreement enable Richardson to sell many of Shure's popular microphones.

CCA Electronics has appointed Dyma Engineering Co. of Los Lunas, N.M., as its exclusive CCA transmitter sales representative in Arizona, Colorado, New Mexico, Oklahoma, Texas and Utah. CCA manufactures a complete line of FM, AM and shortwave broadcast transmitters up to the 50 kW power level.

**Incentive** Sometime during the month of October, Henry Engineering will ship its 10,000th Matchbox. The person who receives this unit will also receive \$1,000 worth of Henry Engineering products.

Henry Engineering produces equipment for the broadcasting and professional audio industries. As of September 1992, more than 9,800 units had been delivered to users worldwide.

**People** Thorsteinn "Thor" Thorsteinson has been appointed Eastern Regional manager at Studer's New York office. He will assume all responsibilities for sales, engineering, service and personnel in the Northeastern region. He has been with the office for almost three years in sales and service.



## BUYERS BRIEFS

**TEMPE, Ariz.** WavePhore has introduced the Audio 2000 Digital Audio Compression System, which utilizes four-to-one compression technology that produces a CD-quality signal able to remain constant in the presence of bit errors caused by noise.

The System 2000 encoder/decoder set provides compressed digital audio transmission and reception over telephone lines, broadcast systems that include satellite or FM signals, or through storage on CD, PC or



DAT. When compared to the 16-bit CD audio, the system 2000 reduces the bit rate requirement by 75 percent and exhibits excellent tolerance to bit errors in the transmission channel or the storage medium.

Based on a proprietary dynamic encod-

ing scheme that makes use of psycho-acoustic properties of the human ear, the WavePhore encoder converts the two channels of stereo analog audio signals into a digital data stream. The decoder

separates the multiplexed signals and converts the data stream to an analog signal.

For information, contact David Deeds, chairman of WavePhore, in Arizona at 602-438-8700; fax: 602-438-8890; or circle Reader Service 132.

**CLEBURNE, Texas** The Marti Model STL-10 aural studio-transmitter link offers high performance and reliability at low cost, producing sales of nearly 6,000 systems worldwide.

Used in mono as well as SCPC stereo configuration, the STL-10 delivers near-digital performance with channel separation of 80 dB and noise floor of -80 dB at 950 MHz. A calibrated directional wattmeter, test meter and bar graph peak-hold modulation meter are featured on the transmitter. The state-of-the-art R-10 receiver employs a Ga As fet low-noise amplifier, double conversion and selective I.F. filter with low-group delay distortion. High system gain easily spans long paths and most multi-hop systems out-perform typical single hop "Composite" STLs.

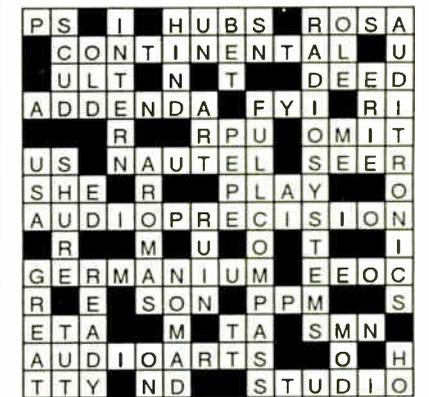
For information, contact Dan Rau at Marti in Texas at 817-645-9163; fax: 817-641-3869; or circle Reader Service 15.

**LITTLETON, Mass.** Recently in Chicago, WLS-AM/FM contracted to replace its 32 dedicated analog lines with four T1 lines, using digital multiplexers and audio codecs for Intraplex. Over the eight-year depreciated life of the Intraplex equipment, the stations anticipate savings of more than \$300,000.

The Intraplex equipment enables a single T1 line (one copper cable) to carry up to 12 15 kHz audio channels, with higher fidelity than equalized analog lines. Modular system architecture and a wide array of standard and specialized channel modules enable the Intraplex multiplexers to "mix and match" a package of voice, data, audio backhaul, SAP and other signals along with the program audio in the same T1 line.

For information, contact Peter Eadie, president of Intraplex in Massachusetts in 508-486-3722; fax: 508-486-0709; or circle Reader Service 50.

### Solution to October 7 Puzzle



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# Broadcast Equipment Exchange

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## AMPLIFIERS

### Want to Sell

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

Harmon Kardon CA-40 tube amp, 40 W, \$100. E Davison, 217-787-0800.

Haffer: Crown, QSC, Bellies mon amps, Ramko dist amps. K O'Connell, O'Connell Prod., POB 909188, Gainesville GA 30501. 706-983-9841.

EMC 120ex 120 Hz 2-way crossover, rack mount, \$100. D Tebbe, WMEE, 2915 Maples Rd, Ft Wayne IN 46816. 219-447-5511.

Dynaco PAS 2, gd cond, \$95. J Parsons, Parsons Sound, 2781 Fayson Cir, Deltona FL 32738. 904-532-0192.

Crown D-150, \$250; D-300A, \$350; Soundcraftsman stereo, 21-band, \$200. B Wilson, 502-465-3342.

### Want to Buy

Denon POA440, 6600, 8000; Sansui B2301, C2301/BA5000; Fisher SA1000, K1000; Nak PA5/2; B&W MPAB10; Peplow all; ARC M360, D150, D79, D75, D76; Crown Macro Reference; Marantz 1-10; McIntosh all; JBL Harstfield; Paragon; Cascade. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

## ANTENNAS & TOWERS

### Want to Sell

Gorman Redlich AM direc mon, \$1000. J Randolph, WMGE, Box 1230, Danville KY 40422. 606-236-2711.

Used towers bought and sold. Call 1-800-643-6988.

Andrews 87N (3) female N-conns for HJ7-50A Heliac, \$50 ea; (10) 44ASW male N-conns for FSJ4-50B Heliac, \$25 ea; (10) 74N for LDF-50/HJ4-50 Heliac, N male, \$25. A Olean, Univ of S ME, 96 Falmouth St, Portland ME 04103. 207-780-4424.

Potomac Inst PM 190 3-twr phase/current monitor, \$500. CD, KVLL, POB 459, Woodville TX 75979. 409-283-3734.

H&P (2) 300mm code beacons, excel cond, \$500 ea + s/h. J Weitzman, New World Radio LP, POB 27781, Washington DC 20038. 202-682-3536.

Collins phasor, 3-twr, cabinets match Collins 21E xmt, 5 kW/1 kW DA-2, 1280 kHz, (2) cabs w/ATUs, excel cond, \$10000/part out. P Berger, WNAM, POB 707, Neenah WI 54957. 414-727-2040.

Gates FMC 4A 4-bay, side mount, pressurized, tuned to 103.1 w/deicer, \$1000. B Derking, KNDY, RR3, Marysville KS 66508. 913-562-2361.

ERI FML3E 3-bay tuned to 104.9, 1 5/8" flange, exc cond, BO. Alan, 205-275-8839.

Harris 2-stage nitrogen regulator, \$40. J Guber, Auburn Univ, POB 2633, Auburn AL 36831. 205-987-9198.

Shively 6810 new, 8 bays w/radomes, direc ant, freq on 100.3. 312-374-9200.

Gorman Redlich AM, direc mon, \$1000. J Randolph, WMGE, Box 1230, Danville KY 40422. 606-236-2711.

Andrew 40525A dehydrator, gd cond, \$300. J Guber, Auburn Univ, POB 2633, Auburn AL 36831. 205-987-9198.

ERI FML 2-bay FM tuned to 96.7 MHz, gd cond, avail immed, \$900. M Ripley, KOZE, POB 936, Lewiston ID 83501. 208-743-2502.

Rigid line, 3-1/8", up to 800' avail, on tower, exc cond, pressurized, you remove from tower. M Kobylch, WJET, 1835 Ash St, Erie PA 16503. 814-455-0240.

Dielectric 4-bay high pwr tuned to 97.3 MHz, 1 bay bad, mounting hardware, BO. D Tebbe, WMEE, 2915 Maples Rd, Ft Wayne IN 46816. 219-447-5511.

### Want to Buy

3-twr array phasor, 1290 kHz w/5000 W day/night power rating. D Wolfe, 714-684-1991.

ERI/RCA FM ant & number of bays tuned to 106.1 or 99.7 MHz. D Lacy, Mtn States Bdctg, 1885 Ponder Hts Dr, CO Spgs CO 80906. 719-636-2470.

## AUDIO PRODUCTION

### Want to Sell

Akai DD1000 Mogneto optical disc recorder and digital waveform editor, Q-mac software included, for just \$7,900. Berler Communications Company, 708-263-6400.

dbx 118 expander/compressor, \$100; Phase Linear 1000 audio correlator, \$100; dbx 110 subharmonic Boombbox w/crossover, \$125. R Glenn, WJGR, 1718 Shannadoccy, Wimauma FL 33598. 813-634-1940.

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Altec 3/4 octave rack mount graphic EQ, \$95. G Wachter, 602-258-6161.

Eventide H949 Harmonizer, excel cond, \$795. B Mountjoy, WXR, POB 938, Hickory NC 28603. 615-543-5849.

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BBE 822 sonic maximizer, BO. Tom KMXN, 499 Humboldt St, Santa Rosa CA 95404. 707-544-5693.

TEAC/Tascam M320 20-chnl, 2 yrs old \$1500/BO. D Matyis, KLTR, 10333 Richmond #6937, Houston TX 77042. 713-780-0937.

ADC Pro Patch (48) bay, #4-26169-0010 w/patch chords, \$100. G Hultman, Hultman Media, 300 Limpy Creek Rd, Grants Pass OR 97527. 503-474-6466.

dbx 142 bdct noise reduc system, \$200. J Guber, Auburn Univ, POB 2633, Auburn AL 36831. 205-987-9198.

### Want to Buy

Single ended noise reducer, pop & scratch remover for improving old records. D Tepe, WQEP, 4802 5th Ave, Pittsburgh PA 15213. 412-622-1432.

## AUTOMATION EQUIP

### Want to Sell

SMC 250RS needs heads & cleaning, \$150 +s/h. D Lacy, Mtn State Bdctg, 1885 Ponder Hts Dr, CO Spgs CO 80906. 719-636-2470.

SMC 250 (4) Carousels, 1 for parts, \$150 ea +s/h; (2) SMC 350 Carousels, 1 for parts, \$200 ea; (5) Harris racks & 2 end panels, \$500. F Konwinski, WSOY, 1100 E Pershing Rd, Decatur IL 62524. 217-877-5371.

SMC 350 Carousels (4) w/random access controller, \$400 ea/BO; (2) SMC 722 cart plyrs, rack mounted, \$150 ea/BO; (2) Revox A77 R-R tape P/R, \$200 ea; (2) 19" equip racks, BO. D Quinlan, KYRE, 316 Lawrence Ln, Yreka CA 96097. 916-842-4158.

Tape-a-thon Chnl Caster w/(5) 10-1/2" R-R, gd cond, \$1000. R Swafford, IAM, 610A S Battlefield, Springfield MO 65807. 417-883-7513.

Schafer 800S w/(5) mdl AG 440 Ampex stereo PB units w/TTD-4A cue time delays, rblt hds, rack mounted, very gd cond, \$5500. L Weidman, WGRC, 150 Buffalo Rd, Lewisburg PA 17837. 717-523-1190.

Systemation X7D cass w/(6) Nakamichi MR2 cass decks, nds 2 Commodore computers to run, BO. Tom, KMXN, 499 Humboldt St, Santa Rosa CA 95404. 707-544-5693.

SMC syst in (3) racks w/3060 10-source prog, AS-10 switcher, (3) RS250 Carousels, (2) Otari ARS1000 reel PBs, dual SMC TS-25 tone sensor, PDC-3 time announce control, (2) 721 dual play cart plyrs, LA-246 stereo AGC amp, LA-246 mono amp, PSA-1 pwr sply, RC-10 rem ctrl w/50' cable, SMC 790 mono cart R/P nds work, all manuals, spare parts & 80 reels 80s C&W music, \$5500. D Sports, 912-739-3035.

IGM-EC syst Alpha 250 UPS, (4) stereo Go-Cart 24s, (2) racks w/AC, Panduit & (2) side panels, PC422 I/O cards, interconn cabling & spare parts kit, BO. L Martino, 714-684-1991.

Conex CG25R 25 Hz tone gener, \$200. A Moii, Moii Tex, 6231 E 100th, Tulsa OK 74137. 918-743-7834.

SMC RSC-50 & RSC-100 random selector units for Carousels, dig display, \$100. G Gibbs, KMNS, 901 Steuben St, Sioux City IA 51102. 712-258-0628.

Bdct Automation live assist controller w/thumbwheel operation, 24 events of progr, LEDs at a glance, 1 yr old w/manual, \$1950. R Chambers, KSUE, 3015 Johnstonville Rd, Susanville CA 96130. 916-257-2121.

Instacart (2) 48-hole w/Sentry firing systems; IBM PC w/software. 503-774-0459.

IGM-EC (2) 24 mono Go-Carts, 18 mos old, \$11K; (4) Harris 9000, (3) cart decks, (3) SMC Carousels. J Murphy, WMXO, 118 W Henley St, Olean NY 14760.

SMC MSP-1 2000 event prog w/batt backup, logging printer, (4) 450 Carousels, (3) mono cart PB, sat switcher in 2 racks, \$5995. D Kelly, KWPN, Box 84, West Point NE 68788.

Cetec 7000 (4) ITC 7-70 PBs, (2) 24-tray Carousels, (1) 48-tray Audiophile, (2) terminals, batt backup, \$7000/BO. D Greene, WGMM, 3037 Palmer Rd, Big Flats NY 14814. 716-433-5944.

Conex CS-25 dual 25 Hz tone decoder w/hi-pass filter, \$125/BO. R Bauer, KCPX, 35 Century Park Way, SLC UT 84115. 801-486-3911.

SMC 250 Carousel, rblt & aligned, \$200+s/h. R McDaniel, KJRG, Box 567, Newton KS 67114. 316-283-5150.

### Want to Buy

Systemation X7/X7D. R Kleven, RR2 Box 150, Monticello IL 61856.

## BUSINESS OPPORTUNITIES

### Want to Sell

Midtown NYC (2) audio prod studios, 24 trks, great oppor. 212-949-9198.

## CAMERAS (VIDEO)

### Want to Sell

RCA TK-761 (4) w/cases, cables, CCU & (4) TD-8 stands; Ampex VPR-1, \$5000 all. C Elmasian, Tri-Core, 27503 Five Mile, Livonia MI 48154. 313-427-0832.

Hitachi FP15 (2) color, 3-tube Salicon, 1-1/2 & 4-1/2" viewfinders, rear servo zoom & manual focus ctrls, rem ctrl units & cables, ext pwr sply, case, svc manual, extender cards, 10:1 Hitachi zoom lens, \$3500 +s/h; Hitachi FP21 color 3-tube 1-1/2" view finder, Anton batt brckt, case, svc manual, extender cards, camera plate, VTR cable, \$2000 +s/h. D Hurd, Harding Univ, 805 Park St, Searcy AR 72149. 501-279-4658.

## CART MACHINES

### Want to Sell

ITC 3D clean, just svcd, 3-deck, \$1000; ITC 99B stereo R/PB, great shape, \$2000. P Van Houten, KBBY, POB 5600, Ventura CA 93005. 805-656-6300.

ITC 99B (8), \$1295 ea. J Addie, 312-565-5033.

ITC Delta series stereo cart plyr, new, guar, \$1450. M Hoffman, Laurelwood, Rt 3 Box 281-14, Charlottesville VA 22903. 804-823-6314.

ITC 3D mono, triple deck w/WRA rec elects, 3-tone, \$800/BO. R Bauer, KCPX, 35 Century Park Way, SLC UT 84115. 801-486-3911.

BE Dura Trak 90A (2) stereo R/P, \$1425 ea; (4) stereo PB, \$950 ea; 3000A stereo R/P, \$1325; 3000A mono delay rec, rack mount, new, \$800. D Kelly, KWPN, Box 84, West Point NE 68788.

ITC R/P stereo, 3-cue tone, exc cond, \$900. J Guber, Auburn Univ, POB 2633, Auburn AL 36831. 205-987-9198.

Spotmaster 2000 R/P mono compact w/sec tone, recon, very gd shape, \$500. G Gibbs, KMNS, 901 Steuben St, Sioux City IA 51102. 712-258-0628.

ITC SP (2) w/3 cue tones, exc shape, free spare audio card & mating conns if you buy both, \$375 ea. P Hess, WPPJ, 134 Derwent Dr, Pittsburgh PA 15237.

BE 400-A mono, rec & PB, \$175; Tapecaster 700-P stereo PB, \$225. M Gollub, WMJS, Box 547, Prince Frederick MD 20678. 410-535-2201.

## Want to Buy

Tone board for ITC Delta III triple decker, not working OK. K Austin, KFXI, 1101 Hwy 81 N, Marlow OK 73055. 405-658-9292.

Gates 994-6900-01 R/P manual/photo-copy. M Salvaggio, MFS Prod Svcs, 417 Laubach St, Hellertown PA 18055. 215-838-1657.

## CASSETTE & REEL-TO-REEL RECORDERS

### Want to Sell

Ampex ATR-102 1/4" track, excellent, \$4000; Otari MK-III 8 track w/dbx 150x & pedestal, \$2650; Otari MX-5050-B 1/4" 2 track, \$1100; Makamichi MR-1 cassette recorders (3), \$575; Sony 2500 DAT recorder, \$1500. Tom 816-931-3338.

Otari MX-5050 swivel/tilt floor stand, \$50; Scotch 8260 1" tape on 10-1/2" metal NAB reel, \$8 ea. G Wachter, 602-258-6161.

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MCI 110B parts & spares, motor hds, xport bds, audio drawers, BO. M Shea, Precision, POB 723, NY NY 10276.

Ampex 350 w/transistorized elects, Lang cab w/rusty top plate; Ampex 400 w/tube elects, push capstan in cabinet, coil item; Pultec filter w/WFE filter combo, BO. 212-949-9170.

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Ampex AG-350 mono/cons, \$350; AG-440 mono/cons, \$400; Sony TC854-4S w/dbx 154, \$800; (3) Crown decks, mono quad, \$450 all. J Krepol, JVK Studios, 7 Dustin Dr, Claymont DE 19703. 302-798-4076.

Tascam MS 1" 16-trk w/rem, ES-500 synch, used 7 times, mint cond, \$10K. 800-285-4252.

Pioneer RT 1020L gd shape, \$300; Ampex ATR 700, \$750; Pioneer RT 701, new hds, \$350. J Parsons, Parsons Sound, 2781 Fayson Cir, Dellona FL 32738. 904-532-0192.

Ampex AG440 8-trk rec, 10 hrs on relapped hds, exc cond, \$1800, w/roll around cab, \$2300. B Seifried, Eclair Engrg Svcs, 221 Pine St, Florence MA 01060. 413-584-6767.

Otari ARS1000 (7) 2-chnl w/25 Hz tone sensor & cue tone relays, exc cond w/manuals, \$650 ea. R Chambers, KSUE, 3015 Johnstonville Rd, Susanville CA 96130. 916-257-2121.

Studer A807-2/4-VUK 2-trk analog mastering w/rare 4th hd for 1/4-trk PB, \$5950/BO; Studer HS77 Mk IV full-trk mono, 10 hrs use, \$875/BO/trade; port case for A77 w/mon spkrs & pwr amps, exc cond, \$375. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

Crown CX824 classic, new w/sync, var spd, rem, 800 xport, \$850. D Kocher, Dig Sound Makers, 1901 Hanover Ave, Allentown PA 18103. 215-776-1455.

Otari MX 7308 1" 8-trk, 15/30 ips, low hrs, exc cond w/rem, \$3900; Ampex 350/40 motors & parts, \$150 & under; Studer PR99 2-trk 7 1/2 & 15 ips, low hrs, exc cond, \$1950; Technics 1500RS 2-trk, 15, 7 1/2 & 3 3/4 ips + 1/4-trk PB hd w/rem, exc cond, \$950. L Wagner, 407-299-1299.

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Tascam 388 8-trk board/rec combo w/dbx, manuals, gd cond, \$1500+s/h. H Lam, APT, Box 22801, Houston TX 77227. 713-780-7227.

Tandberg 11/P, whole/parts. J Morinelli, 215-789-2742.

AKAI MG1214 12-trk rec/mixer, \$3000 B Seifried, Eclair Engrg Svcs, 221 Pine St, Florence MA 01060. 413-564-6767.

Ampex ATR-102 1/4", 1/2 track, excellent, \$4000; Otari MK-III 8 track w/dbx 150x & pedestal, \$2650; Otari MX-5050-B 1/4" 2 track, \$1100; Nakamichi MR-1 cassette recorders (3), \$575; Sony 2500 DAT recorder, \$1500. Tom 816-931-3338.

**Want to Buy**

RCA RT-21 parts, working/not. M Salvaggio, MFS Prod Svcs, 417 Laubach St, Hellertown PA 18055. 215-838-1657.

Ampex AG400 1/2" 4-trk, xport & hds only. B Seifried, Eclair Engrg Svcs, 221 Pine St, Florence MA 01060. 413-584-6767.

Nagra 3S/4S w/NAB hds; Sony TC880/8750; Studer B215 cass deck. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

MCI/Sony capstan & reel motors, any cond., recdg heads, most mfgs, machines, new, used. Relapped then sold. Amp Services, 224 Dature St No 614, W Palm Beach FL 33401. 800-826-0601, in FL 305-659-4805.

Scully '100' recorders, record/play amplifiers, 8, 16, 24 track heads. Sequoia Electronics, 1131 Birginea Ave, Campbell CA 95008. 408-866-8434.

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

Harrison MR-4, 28x24, great condition, \$26,500. Tom 816-931-32338.

**CD's**

**Want to Sell**

Soundcraftsman Pro-CD 750 CD plyr, BO, Tom, KMXN, 499 Humboldt St, Santa Rosa CA 95404. 707-544-5693.

Denon DN-950F (3) fresh optics, gd cond, \$550 ea. D Tebbe, WMEE, 2915 Maples Rd, Ft Wayne IN 46816. 219-447-5511.

**COMPUTERS**

**Want to Buy**

Tandy TRS Mdl 3/Mdl 6000 bootup disk & WP program. Q Morrison, KGLL, 5125 S College Ave, Ft Collins CO 80525. 303-223-0435.

**CONSOLES**

**Want to Sell**

Interface 300 16x8 mixer w/manual, works but rough, \$700. A Olean, Univ of S ME, 96 Falmouth St, Portland ME 04103. 207-780-4424.

GE audio ctrl bd w/8-chnl stereo, exc mon, gd cond, \$1000; (2) QRK 6-chnl audio ctrl bd, \$750; RCA mono, 6-chnl audio ctrl bd, gd cond, \$400. J Kennedy, 407-388-0065.

Gates Diplomat 10 pot/20 chnl & McMartin B501 5 pot/10 chnl, clean, no mods, \$500 ea +s/h. CD, KVLL, POB 459, Woodville TX 75979. 409-283-3734.

British Helios 24/16/24 circa 1970s, updates/mods w/doc, mic preamps, (9) sep ps w/wood rack cab, mahogany desk; Neve, \$9500/BO/trade; snake (16) inputs w/ext PS, 250' Belden 19-pr cable, MIL conns, ss strain reliefs, 10' Neumann XLR snake mates w/box/Belden snake, exc cond, \$750/BO/trade. Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

RCA BC-8A (2) 8-chnl mono, \$150 ea FOB. R Bauer, KCPX, 35 Century Park Way, SLC UT 84115. 801-486-3911.

Auditronics 200 tel phone interface mod, \$250; 201 peq personality EQ w/eq card & ext card, \$225. D Tebbe, WMEE, 2915 Maples Rd, Ft Wayne IN 46816. 219-447-5511.

Altec 15C7A (3), gd shape, \$100 ea. J Parsons, Parsons Sound, 2781 Fayson Cir, Dellona FL 32738. 904-532-0192.

Harris Gatesway 80 mono 8-chnl, gd cond, \$500. M Ripley, KOZE, POB 936, Lewiston ID 83501. 208-743-2502.

Roland CompuEditor (2) auto fader pkgs, SMPTE based w/15 long throw ALPS faders, 15 chnl of voltage-controlled gain elements, \$850. B Seifried, Eclair Engrg Svcs, 221 Pine St, Florence MA 01060. 413-584-6767.

Rockwell Collins 212R-1 not working, parts, BO. Q Morrison, KGLL, 5125 S College Ave, Ft Collins CO 80525. 303-223-0435.

Ampro AC-6 mono, very gd cond, \$600; Spolmaster 5BM100 5-chnl dual mono, very gd cond, \$700. J Arzuaga, WREI, Road 2 KM 102.5, Quebradillas PR 00678. 809-895-2725.

BE 8M150 8-chnl rotary mono, \$975. J McDonald, Wind River, 329 E 3rd, Loveland CO 80537. 303-669-3442.

Trident Series 65 32 in, 16 out, oak cab, pedestal base, wiring harness, mod ext card, new, \$10K. J Diamond, Blue Diamond Studios, Box 102C Chubbic Rd RD1, Canonsburg PA 15317. 412-746-3455.

RCA BC-8A dual prog output, 24-input, gd cond, \$950. G Gibbs, KMNS, 901 Steuben St, Sioux City IA 51102. 712-258-0628.

Harrison MR-4, 28x24, great condition, \$26,500. Tom 816-931-3338.

**Want to Buy**

Howe console manual w/parts list & drawings, urgent. K Austin, KFXI, 1101 Hwy 81 N, Marlow OK 73055. 405-658-9292.

McCurdy SS7500 stereo slide pot, Danner-type, PCF 5K/85-2. S Boyley, CKPL, 571 West St, Brantford W3T 5P8 Canada.

8-chnl w/0.25 V AC audio output & 10-25 W, 60 Hz & AC 120 V. F Smith, 615-624-7126.

Ramsa WR-8724 test jig. E Stewart, WDCI, POB 371, Bridgeport WV 26330. 304-842-8644.

Opamp Labs 20-input, 8 subs plus stereo mix out, gd prod board, \$2500. L Wagner, 407-299-1299.

McCurdy SS 7400 manuals, schematics, parts, working/not. M Salvaggio, MFS Prod Svcs, 417 Laubach St, Hellertown PA 18055. 215-838-1657.

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**Want to Sell**

Star heavy-duty fiberglass road cases w/key locks, 18"x20"x20-1/2", 11x28x21, 15x25x14, 10x25x20, new; Audix 8x2 rcdg studio console, excel cond. J Krepol, JVK Studios, 7 Dustin Dr, Claymont DE 19703. 302-798-4076.

Fairlight Series III dig workstation/music mach, \$17K; complim by Valley & Symetrix; dbx de-essers; Aphex compellor/aural exciter. K O'Connell, O'Connell Prod, POB 909188, Gainesville GA 30501. 706-983-9841.

Symetrix SE-400 stereo para EQ, new, \$450/BO; (2) phase shifters, new, \$250 ea/BO; (2) SG-200 2-chnl noise gates, new, \$300 ea/BO; A-220 headphone amp, 20 W/chnl, new, \$200/BO. J Diamond, Blue Diamond Studios, Box 102C Chubbic Rd RD1, Canonsburg PA 15317. 412-746-3455.

Sound Workshop 262 stereo reverb, new, \$500/BO; ART DR1 & 01A dig reverbs, new, \$895 ea/BO; (2) ADA 2.56T dig delays, new, \$500 ea/BO; (2) Nexus 96-pl patch bay 1/4" front, RCA back, new, \$300 ea/BO; (2) Loft 450 delay line plyr, new, \$500 ea/BO; AB Syst 301 amp switcher, new, \$250; (2) AB Syst pwr amp, new, XLR, trans inputs, \$500 ea/BO; Switchcraft 48 patch bay, used, \$100/BO. J Diamond, Blue Diamond Studios, Box 102C Chubbic Rd RD1, Canonsburg PA 15317. 412-746-3455.

HME MX10 6-chnl stereo, hi lo EQ, rack mount, \$300; Shure audio master & feedback controller, \$85 ea; dbx 1531-P stereo graphic EQ, \$225. D Kocher, Dig Sound Makers, 1901 Hanover Ave, Allentown PA 18103. 215-776-1455.

Community CSX-52 500 W 3-way loud-spkr, 15" woofer, 6 1/2" mid, pzt tweeter, power sense protection cover, carpeted cab w/handles, comers & steel grill, 40 Hz-20 kHz, exc cond, \$600 pair. B Fisher, KPOK, Box 829, Bowman ND 58623. 701-523-3883.

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Ampex 350 (2), \$100 ea; RCA RT21 stereo rec, \$150. F Konwinski, WSOY, 1100 E Pershing Rd, Decatur IL 62524. 217-877-5371.

Ampex AG-440B (2) in Russ Lang cabs, gd cond, 1 w/lyric timer, \$350 ea/\$600 both; (2) ATR-800 in roll around cabs, gd cond, \$600 ea/\$1000 both; 350 mono tube in Russ Lang cab, fair cond, BO. J Kryns, 513-556-4444.

Ampex 440B (2) stereo 7.5 & 15 ips in roll around fact stands, mint cond, \$550 ea. C Elmajian, Tri-Core, 27503 Five Mile, Livonia MI 48154. 313-427-0832.

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Emulator II+ sampling kybd, 2 disk drives, reads & writes SMPTE, built-in sequences w/small library of sounds, \$850. B Seifried, Eclair Engrg Svcs, 221 Pine St, Florence MA 01060. 413-584-6767.

UA 1108 (10), \$100 ea; (12) UA 508 EQ, \$65 ea; (10) Neumann PV-176 preamps, \$100 ea; (10) Neumann 3-band EQ, \$175 ea; API 550 EQ, \$475; (2) API 553 EQs, \$165 ea; (2) APSI 559 graphic, \$225; (2) APSI 562 Param, \$200 ea; Lexicon super Prime-time, \$775; PCM-41, \$250; Eventide H-910, \$225. M Linett, 818-244-1909.

Noise reduc units: dbx 208 8-chnl, new, extra card, \$2000/BO; dbx 150 2-chnl, new, \$300/BO; dbx 154 4-chnl & dbx 155, both in rack, used, mint, \$600 both. J Diamond, Blue Diamond Studios, Box 102C Chubb Rd RD1, Canonsburg PA 15317. 412-746-3455.

Want to Buy

McIntosh tube gear, JBL 4343 mon spkrs, Harmon-Kardon tube gear, SAE 2800 EQ, dbx 120 XOS. R Glenn, WJGR, 1718 Shannadocoy, Wimauma FL 33598. 813-634-1940.

Tannoy SRM 12B studio mons. B Seifried, Eclair Engrg Svcs, 221 Pine St, Florence MA 01060. 413-584-6767.

Crown EQ2; dbx 10/20, 20/20, 14/10; Yamaha REV5, REV7; Burwen TNE7000. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

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UREI LA-4 comp/limiter, \$275; UREI 1176 peak, \$275; dbx 163x comp/limiter, rack, \$125. G Wachter, 602-258-6161.

Audimax 4450A; FM Volumax 4111; CBS stereo peak controller, black panel; Audimax CBS M ctrl, black panel, \$75 ea w/manuals +s/h, all need work but complete. F Konwinski, WSOY, 1100 E Pershing Rd, Decatur IL 62524. 217-877-5371.

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Inovonics 222 NRSC/AM preemphasis low pass audio proc, \$945; (2) UREI LA-3A audio lvtrs w/manuals, excel cond, \$800 pair. B Mounjoy, WIRC, POB 938, Hickory NC 28603. 615-543-5849.

Gentner Lazer/Prizm used 2 mos. D Feam, WKSZ, 1001 Baltimore Pk, Media PA 19063. 215-565-8900.

dbx 166 dual-gated, \$450. B Derking, KNDY, RR3, Marysville KS 66508. 913-562-2361.

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CBS Audiomax AGC, \$100; (2) Orban 145E stereo syn, \$100 ea; Orban stereo reverb, \$300. J Kennedy, 407-388-0065.

UREI 1176 (2) for mono/stereo. J Kry, 513-556-4444.

Neve 3314A w/meters & pwr sply, \$2600 pair. M Linett, 818-244-1909.

CBS Labs 4110 FM Volumax, gd cond, stereo, \$175. G Gibbs, KMNS, 901 Steuben St, Sioux City IA 51102. 712-258-0628.

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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

Take charge, revenue, ratings, driven GM, 25 yrs sales, prog expert, new construction upgrades, prefer south/midwest. John, 502-247-0090.

Ex-college station mgr now DJ/news at small AM ready to move anywhere/any shift. 167 Lake St, Saranac Lake NY 12983. 518-891-3915.

Ex-Armed Forces Radio DJ eager to get back into radio. Box 195, Spana Way WA 98387. 205-536-2070.

Over 25 yrs exper in small mkt radio/TV as news dir & GM seeking similar pos in AL/MS/TN. Bill, 803-245-2127.

Radio CE/ASEE, ham, GCC general, former CE, Boston/Houston/Miami/FL Laud, comp literate. 415-221-2000.

Entry Level Consultant avail for small mkt sat, auto/basic turnaround, exper, all replies confid. Spiritradio, Box 275, Constock Park MI 49321.

Quick fix prog, sales, mktg & engrg expert seeks oppor w/struggling station anywhere. 813-849-3477.

Prof bdcter w/excel prod skills, 18 yr vet, exp live remote, seeking solid organization w/gd trk rec, will relocate. AC/OG/R&B, team plyr will respond to all inquiries. Stevie B, 4118 McKay Ave, Richmond VA 23224.

Oregon air talent w/2 yrs exper in on-air, news & prod seeks pos in small mkt up, not humor, powerful prod, budding brain. 503-648-7681.

10 yr male radio vet exper in most formats seeks PD/air pos, pref Chicago, will relocate anywhere for right station, familiar w/dig DJ. 219-271-8457.

Recent college grad interested in sports bdcg pos w/2 yrs exper in coll radio, will relocate, top refs avail. David, 107 Jarrett Dr, Syracuse NY 13219. 315-487-2910.

Aggressive self-starter interested in sports bdcg pos; 3 yrs combined exper in radio, TV & newspaper writing, will relocate, top refs. David, 107 Jarrett Dr, Syracuse NY 13219. 315-487-2910.

Quick fix prog, sales, mktg & engrg expert, freelance for struggling stations anywhere. 813-849-3477.

Freelance engr w/heavy duty exper for any job, anywhere w/great refs, audio, RF, automation, xmtrs, ants/construc, domestic/intl. 813-849-3477.

Tell your GM you've found that new prod dir, 15 yr pro, MIDI, dig, multi-trk, airshift. 203-350-NOW-7.

17 yr pro seeks PD/mgr pos in OR, pref coast, can he p bring your station to life. David, 702-825-0945.

HELP WANTED

NEW start-up 25kW FM in central VA seeks sales oriented Manager to direct sales and assist in management of new station. Must have strong sales background and references. Excellent new facility. Send resume to: WFXQ, POB 305, Chase City VA 23924. 804-372-3996. EOE.

Paxson Bdcgng of Jacksonville has an opening for an assistant to the chief engineer of a multi-station complex. Applicant should have at least an Associates Degree in electronics, a minimum

of three years experience in radio broadcast engineering and be able to handle any emergency, from the studio site to the transmitter sites. Computer knowledge a plus. No phone calls please, send resumes to: Kyle D Dickson, Chief Engineer, Paxson Broadcasting, 8386 Baymeadows Rd., Ste 107, Jacksonville FL 32256. EOE

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For 50 kW AM, should have knowledge of AM transmitters, directional antenna systems, studio equipment and maintenance skills, and experience in installation of new studio facilities. Salary commensurate with experience. Send resume to:

WKNR

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PO Box 1214, Falls Church, VA 22041  
Attn: Simone Mullins

Contact Radio World Newspaper for availabilities.

P.O. Box 1214 • Falls Church VA • 22041

**LIMITERS...WTS**

Dorough 310 AM/FM AGC, peak limiter, \$450. J Arzuaga, WREI, Road 2 KM 102.5, Quebradillas PR 00678. 809-895-2725.

UREI LA-4 (2) manuals; 535/533 manuals, BO. D Tebbe, WMEE, 2915 Maples Rd, Ft Wayne IN 46816. 219-447-5511.

CBS 4400 Volumax gd cond, \$100. R Laine, All Oldies, POB 10665, Golden CO 80401. 303-233-9393.

Gates M35298 stereo tube, \$100/trade. B Wilson, 502-465-3342.

Optimod AM 9100B, new, \$5500. B Ray, WGA1, 179 Lovers La, Elizabeth City NC 27909. 919-335-0856.

Ashely SC-50 exc cond, \$150; Marti CLA-40, gd cond, \$60. J Gober, Auburn Univ, POB 2633, Auburn AL 36831. 205-987-9198.

Altec 1591A, \$125. J Parsons, Parsons Sound, 2781 Fayson Cir, Deltona FL 32738. 904-532-0192.

Harris/Gates M-6543 Solid Statesman FM w/manual, \$100. T Rosen, ISBCC, 1129 Acocia Ave, Bakerfield CA 93305. 805-871-6094.

**Want to Buy**

IMP (2) tri-band w/limiting & AGC, \$500. J Kennedy, 407-388-0065.

Optimod 8000A/8100A. T Gollieher, WPFB, 4505 Central Ave, Middletown OH 45044. 513-422-3625.

**MICROPHONES**

**Want to Sell**

Shure 540 SPL length 12" dynamic omni for interviews, \$25 ea/5 for \$100. E Davison, 217-787-0800.

Comrex wireless syst, 2-chnl RS & (2) 2-chnl TX, operates on 450.2 & 450.4, \$1000. M Aldridge, RSE, 5587 Tucker Rd, Ooltewah TN 37363. 615-396-2893.

Altec 639A, \$350; Shure 555W, \$100; American D9AT, \$350. C Elmasian, Tri-Core, 27503 Five Mile, Livonia MI 48154. 313-427-0832.

Sony ECM-33P, new, \$200; C-22 & ECM-22, used, mint, \$150; ECM-21, used, mint, \$100; Fostex M55RP, new, \$300/BO; (2) MB Peerless MBC-520 new w/pwr sply, used, mint, \$400/BO. J Diamond, Blue Diamond Studios, Box 102C Chubbic Rd RD1, Canonsburg PA 15317. 412-746-3455.

Telefunken/Schoeps CM61 tube mic, mint cond, \$2475; CR-176 large diaphragm tube mic, \$1250. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

Milab 1111 VIP-50 (2) w/shock mounts, \$800 ea. K O'Connell, O'Connell Prod, POB 909188, Gainesville GA 30501. 706-983-9841.

**Want to Buy**

AKG C24. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

**MISCELLANEOUS**

**Want to Sell**

Kleig 2 kW (100) focusing fresnels w/barn-doors, clamps, 2000 W, \$150 ea; 1000 W studio scopes, \$150 ea. 212-969-0240.

Estate sale w/Altec 10-chnl 1220 audio mixer (2) GE TV B&W cameras, circa 1953, Hercules 5302 tripod, Gibraltar tilt head, Collins 12-Z remote amp, (5) Shure audio mixers, Collins 26 C limiter amp, more. G Reiss, RT 1 Box 141, Wilcox NE 68982. 308-995-5541.

Scoop light fixtures for TV studio, \$25 ea; EV HR-90 radial horns, \$175 pair; Gollehon radio horns, \$125 pair. B Wilson, 502-465-3342.

Alrchecks of favorite AM as rcvd on qual equip at this location. J Douglas, 402 Shirley Rd, Seaford VA 23696.

**Want to Buy**

Wisconsin AM/FM/TV stations history, print/tapes/photos for WI book of bctg history. D Kerl, WHRM, 3200 Park Rd, Wausau WI 54401. 715-845-1319.

1936 Crosley WLW AM/SW rcvr w/PA system. M Hauff, KDFO, Box 16351, Minneapolis MN 55416.

**MONITORS**

**Want to Sell**

Motorola 1410 AM stereo mod monitor, BO. Tom, KMXN, 499 Humboldt St, Santa Rosa CA 95404. 707-544-5693.

TFT 884 FM mod & stereo mon; 845 FM SCA, 67/92 kHz. L Martin, Musiplex, 4541 S 88th St, Omaha NE 68127. 402-331-2632

**Want to Buy**

Any older McMartin mod monitors. C Goodrich, 11435 Manderson, Omaha NE 68164. 402-493-1886.

F amp to drive FM station mon pckg, will tune, \$200-300. P Adams, WKUZ, POB 342, Wabash IN 34692. 219-563-4111.

**RECEIVERS & TRANSCEIVERS**

**Want to Sell**

Marti SCR-8H subcarrier rcvr & SCG-8H subcarrier gener, \$695; McMartin BFM1531R SCA gener, \$400. R Johnson, KQWR, 1705 Liberty St, Mexico MO 65265. 314-581-2900.

Marti MR 30/150/170 tube-type w/pwr sply, \$150. J Michaels, WMWR, POB 889, Sidney OH 45365. 513-498-1055.

Tube tuner, AM/FM mono, selective, works, \$20; SCA McMartin TN-77, XTAL controlled, \$25. E Davison, 217-787-0800.

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BE FC30 SCA gener & mod mon tuned to 67 kHz; RCA BW95A mod no, nds repair, \$600 both. Gene, 319-243-1390.

SCA decoder, high quality micro-miniature 67/92 kHz, prewired & ready to install, \$15. D Jackway, Background Music Eng, 5742 Falroak, Springfield MO 65810. 417-861-8401.

Lafayette LT-725 AM/FM/SCA stereo tuner, just tweaked, \$100/BO. Dave, 703-751-9346.

**REMOTE & MICROWAVE EQUIP**

**Want to Sell**

Moseley TRC-15 15-chnl xmtr rem ctrl w/Hallikainen dig update kit, \$795; Moseley TRC-15 xmtr rem ctrl w/factory analog metering, \$595. B Mountjoy, WIRC, POB 938, Hickory NC 28603. 615-543-5849.

TFT 7610-C & R w/chnl expander & spare parts, \$1000. G McClintock, WNCM, 1300 WWCRC Ave, Nashville TN 37218. 615-255-1300.

TFT 7703 STL rcvrs, gd cond, \$1000 pair; Textel autopatch interface for 2-way radio, \$100. D Tebbe, WMEE, 2915 Maples Rd, Ft Wayne IN 46816. 219-447-5511.

Radiation Systems (2) 940-960 MHz 6' round STL ants, 1 in crate, 1 used 4 yrs, both w/dipole element, \$500 ea/\$900 both. W Bevis, WING, 717 E David Rd, Dayton OH 45429. 513-294-5858.

Marti STL-8 xmtrs, rcvrs & combiners, dual stereo/indiv link, very clean, exc cond. M Ripley, KOZE, POB 936, Lewiston ID 83501, 208-743-2502.

TFT 7610C & R w/7630 expander & spare parts, \$950. G McClintock, WWCRC, 1300 WWCRC Ave, Nashville TN 37218. 615-255-1300.

Moseley WRC-10 dial up, \$500. J McDonald, Wind River, 329 E 3rd, Loveland CO 80537. 303-669-3442.

Burk Tech TC-8, \$1200. J Murphy, WMXO, 118 W Henley St, Olean NY 14760.

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Moseley DRS-IAR dig w/status panel, gd cond, \$700/BO; RCA BTR-15BW w/Hallikainen dig display, gd cond, \$500/BO. R Bauer, KCPX, 35 Century Park Way, SLC UT 84115. 801-486-3911.

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Audio/Video Consultants 215-642-0978

Marti RPT 15 UHF/higher wattage. C Phillips, WXVO, POB 987, Clinton TN 37717. 615-457-2697.

**Want to Buy**

Stereo STL that meets new standards. Bob, 603-448-0500.

Moseley PBR-15A 51A5315 subcarrier up gener; 51A5317 metering demod; 51A5325 voltage to freq counter; 51A5327 sub-audible metering proc. H Akers, 407-395-4215.

**SATELLITE EQUIPMENT**

**Want to Sell**

TV antenna dehydrators, \$2500 ea/trade for Ku-band exciter. 212-969-0240.

Wegener 1601-50 RS w/1606-21 black converter, 1621 sat audio demod, 1645 25 Hz decoder, 1646 35 Hz decoder. 1605-03 pwr sply, exc cond, \$750/BO. R Bauer, KCPX, 35 Century Park Way, SLC UT 84115. 801-486-3911.

Sci Atl 7300/7325 w/rcvr w/15 cards, will sell w/ or w/o McCurdy decoder system for Unistar format & T2F-100, \$5500. P Posen, KEZN, POB 291, Palm Desert CA 92261. 619-340-9383.

Harris 6529; Chnl master 6128; Skantic Mark One rcvrs, cond uncertain, BO. J McDonald, Wind River, 329 E 3rd, Loveland CO 80537. 303-669-3442.

Wegener Panda 2 rcvr w/1601-50 main-frame, 1605-12c pwr sply, 1606-51, 1610-01 (2), 1646 35 Hz tone decoder, set on CBN, can be changed, used 8 mos, \$2200. M Schwarzbauer, WPF, 1715 Michigan St, Sturgeon Bay WI 54235. 414-743-7443.

Cablewave 12' one piece spun aluminum dish, Avantek LNA, Eclipse actuator, Auto Tech Rx, special design 3 leg mount, gd working cond, \$5000 or BO. T Landers, Suffield CT, 203-668-2991.

**Want to Buy**

Fairchild/Sci Atl dig DAT/SEDAT, \$2000. B Vinikoor, WNTK, POB 2295, New London NH 03257. 603-448-0500.

Ku-band exciter, working. 212-969-0240.

Tuner cards for Wegener 1601-05 rcvr for 4.47, 4.65, 5.01 & 5.2 freqs. L Wise, KNEO, POB 845, Neosho MO 64850. 417-451-5636.

Wegener 1681 for Unistar format 41. P Posen, KEZN, POB 291, Palm Desert CA 92261. 619-340-9383.

Sci Atl 20 kHz card. D Mance, WDNV, 129 Main St, Danville NY 14437. 315-782-1240.

**STATIONS**

**Want to Sell**

Class "A" FM. Exclusive in County of 170,000, city 8,000. License, transmitter bldg, land, tower partially up. Cash/terms/BO. 314-586-4090.

Missouri AM/FM. Only station on county of 160,000. Station dark. Flexible terms or discount for cash. Owner/Broker. Hal Duff, 314-348-3101 or 314-348-5526 evenings.

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Ohio full time AM. Small amount down or discount for cash.  
POB 69, Bellefontaine OH 43311

Estate Sale —North Florida Class A FM, upgradable to C-2, bills \$180-\$250K with \$100K down. Also, coastal CP. World Media (804) 525-0900.

Complete facility set up for talk/news/music, late high qual equip, 14'x30', 2-axle mobile, less than 5 yrs old w/AC & restroom. 503-774-0459.

**Want to Buy**

Radio properties min down, pymts w/2 yr balloon. J Sokolosky, 405-427-6869.

**WANT TO BUY AM STATION**  
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**708-416-1500**

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JT Comm, 579 N.E. 44th Ave.  
Ocala, FL 34470 904-236-0744

**Want to Buy**

CCA SG-1E schematic & assoc svc info. L DuPre, KQID, 1115 Texas Ave, Alexandria LA 71301. 318-445-1234. Call collect.

**TAPES/CARTS & REELS**

**Want to Sell**

Ampex 642 (500) 1-1/4" & 10-1/2" NAB; 200 poly cass boxes. B Derking, KNDY, RR3, Marysville KS 66508. 913-562-2361.

Oldies library w/Christmas on 10", BO. J Kennedy, 407-388-0065.

Ampex & 3M (100) 7"x1/4", 1800', used one pass, exc cond, \$2 ea; (50) empty reels, 101/2"x1/2", plastic, gd cond, \$1 ea. L Wagner, ARN, POB 1788, Orlando FL 32802. 407-299-1299.

Scotch 176 (15) AOR from 70s, classic rock/DJs, \$75/BO. Dave, 703-751-9346.

**Want to Buy**

Cash for Orr radio, Irish band A/V tapes & boxes, 3, 5, 7 & 10" reels; Ortronic Car Mate; Aeromate tape plyrs. H Norman, 205-825-0390.

Disc recs, needles, blanks, rec xcriptions. B Davies, Virgo Prods, 5548 Elmer Ave, N Hollywood CA 91601. 818-761-9831.

C89, \$200/1000 or \$125/500. L Wagner, 407-299-1299.

**TEST EQUIPMENT**

**Want to Sell**

Tellabs 4008 (6) EQ cards & pwr sply, BO. J Kennedy, 407-388-0065.

HP 206A audio gener, rack mount w/manual, \$150+s/h. F Konwinski, WSOY, 1100 E Pershing Rd, Decatur IL 62524. 217-877-5371.

RCA WX-2E field intensity meter, nds re-cal, gd cond, \$350. J Gober, Auburn Univ, POB 2633, Auburn AL 36831. 205-987-9198.

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3 kW FM	1975 CCA 3000D	5 kW AM	1968 Harris BC5H
3 kW FM	1974 Harris FM3H	5 kW AM	1972 CCA AM5000D
15 kW FM	1975 AEL 15KG	5 kW AM	1977 RCA BTA 5L
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Philips PM6507 curve tracer, \$1475/BO/trade. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

## Want to Buy

Belar FM stereo mod mon. Bob, 603-448-0500.

Crown RTA2 real time analyzer; Tek 570 tube curve tracer; pwr splys by Lambda & HP. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

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## Want to Sell

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**NEW 6 kW FM transmitters for under \$18,000.**  
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FM 1987/newer, 20 kW within 1000 miles of Houston, on/close to 94.7 MHz. CD. KVLL, POB 459, Woodville TX 75979. 409-283-3734.

Motorola 1300 AM stereo exciter, BO. Tom, KMXN, 499 Humboldt St. Santa Rosa CA 95404. 707-544-5693.

Gates BC1T 1000W AM, \$700; BC1F 1000 W AM, \$600. J Randolph, WMGE, Box 1230, Danville KY 40422. 606-236-2711

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500W QEI 675T500  
1 kW Harris 1 H 3  
2.5 kW Collins 831-D

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JT Communications—579 N.E. 44th Ave.  
Ocala, FL 34470 904-236-0744

Gates/Harris BC-1G 1 kW/500 AM on 1230 kHz, \$2250. J McDonald, Wind River, 329 E 3rd, Loveland CO 80537. 303-669-3442.

Gates BC1T 1000 W AM, \$700; BC1F 1000 W AM, \$600. J Randolph, WMGE, Box 1230, Danville KY 40422. 606-236-2711.

## DEMOED EQUIPMENT

BEXT Inc. has a few demoed exciters, amplifiers and STL's for sale. All demoed systems are sold first come first served and have the same 2-year warranty as BEXT's new equipment. For information: **619-239-8462**

RCA BTE-15A w/2 SCA gens, ext board & book. 503-774-0459.

ITA AM-1000A 1 kW AM w/tubes, \$750. G McClintock, WWCR, 1300 WWCR Ave, Nashville TN 37218. 615-255-1300.

## 50KW AM TRANSMITTER

One Harris MW-50A in good condition, optional spare parts. One Gates MW-50 upgraded to MW-50A in good condition, optional spare parts. Available now! Call 806-376-4064.

QEI 675T300 FM, 88-108, 1985 mdl w/book, gd shape, \$2750. B Barrett, KZPI, Box 2207, Deming NM 88031. 505-546-7477.

RCA BTA 506 low hrs, great cond, \$10K/BO. K Alford, KLTx, 190 Queen Anne Ave N, Seattle WA 98109. 206-285-2295.

Collins 21 E/M 5 kW AM, gd cond, \$2000; Robert Jones J-318 FM booster, \$2800; CSI FM exciter tuned from 88-108, gd cond, 10 W, \$950; QEI 675, \$1025 w/spare boards. J Arzuaga, WREI, Road 2 KM 102.5, Quebradillas PR 00678. 809-895-2725.

Harris BC10H 1983 10 kW, great cond, \$25K. T Beschta, WAQE, POB 703, Rice Lake WI 54868. 715-234-9059.

ITA for Collins 250-B 1950s w/FM 5000-B amp, workable, will sell w/ or w/o exciter, cheap. K Smith, KYCN, POB 248, Wheatland WY 80801. 307-322-5926.

## Want to Buy

AMPFET P-400 solid state, used, tuned to 530-540 kHz; any 250 W AM solid state. F Smith, 615-624-7126.

McMartin AM/FM xmtr, any model, exciter or stereo modules. Goodrich Ent. 11435 Manderson, Omaha NE 68164. 402-493-1886.

**WANTED RCA Transmitters BTF-5E, 10E or 20E 414-482-2638**

Low pwr AM/FM pref tunable, usable w/o extra equip w/console. Heritage Radio, POB 16, Boston MA 02167. 617-969-9966.

TTC 10W FM for educ FM. J Stark, KNPR, 5151 Boulder Hwy, Las Vegas NV 89121. 702-456-6695.

**WE BUY MOSELEY PCL-303, 505, & 606's 414-482-2638**

Collins 300-G parts. D Daigle, House O'Sound, RR2 Box 73, W Frnshp MD 21794. 410-721-6822.

Crystal on 102.5 for Collins exciter A830-2 & manual. Q Morrison, KGLL, 5125 S College Ave, Ft Collins CO 80525. 303-223-0435.

## TUBES

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Penta KT88, \$35; KT99, \$49; EL34 (HD), \$15; 12AX7B & 6072M/PR. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

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Eimac 4CX1000. Bob, 603-448-0500.

## TURNTABLES

## Want to Sell

QRK 12C (2) w/Micro-trak tonearms, exc cond, \$250 both. R Laine, All Oldies, POB 10665, Golden CO 80401. 303-233-9393.

Technics SP10 Mrk II (2) DC servo w/pwr sply, working, \$250 ea. J Stark, KNPR, 5151 Boulder Hwy, Las Vegas NV 89121. 702-456-6695.

ATI P-1000-2 phono preamps, 2 in rack mount, xformer outputs, manual, \$175 ea/\$300 both/BO. D Tebbe, WMEE, 2915 Maples Rd, Ft Wayne IN 46816. 219-447-5511.

## Want to Buy

Studio disc lathes & rcdg gear by Fairchild, Westrex, Gramplan & Presto; hi-fi tube gear; 45/78 recs. K Gutzke, Custom Rcdg, 7134 15th Ave S, Minneapolis MN 55423. 612-866-6183.

6072; 5651, 5691, 5692, 6005, 6084, 6386, 7308, 6AQ5, 6BL7, 6DN7, 6EJ8, 6EM7, 6GK5, 6HU8, 6JK6, 6XK8, ECC808, ELL80, 300B, 2A3, 13CW4, VF14, AC701. R Katz, Allegro Sound, 17015 Ventura Blvd, Sherman Oaks CA 91403. 818-377-5264.

## VIDEO PROD EQUIP

## Want to Sell

Sony CUM 1250 12" color video mon w/UHF/VHF tuner & manual, excel cond, \$250. R Glenn, WJGR, 1718 Shannado-cy, Wimauma FL 33598. 813-634-1940.

## Want to Buy

RCA TK 31, 44, TKP 45, TK76 circuit manuals for N Elec & Cohu sync gens; Ku & C-band exciters; RCA DX77 mic; Quantel 1550 TBC; Hitachi 24-pin cable. F Jodry, 6 Van Horn St, Demarey NJ 07627.

## VIDEO TAPE RECORDERS

## Want to Sell

JVC CR4400 port 3/4" rec, pwr sply & batt, Portabrace case, \$750 +s/h; Snger/Graflex 16mm carbon arc proj, \$1500 +s/h. D Hurd, Harding Univ, 805 Park St, Searcy AR 72149. 501-279-4658.

Sony SLO-323 Betamax I 2-chnl, large qty, excel cond, \$75 ea + \$15 s/h. 818-769-5544.

## Want to Buy

Circuit boards & cables for Ampex VR3000; Ampex VPR2, 20 or 3 for parts & cables; lens, circuit manual, cables, parts & access. F Jodry, 6 Van Horn St, Demarey NJ 07627.

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SP-6

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A-6000

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