

# Radio World

Analyze Source Impedance.  
See page 34.

Vol 17, No 15

Radio's Best Read Newspaper

August 11, 1993

## Analysts Forecast Five Years of Radio Growth

by Mark Strausberg

**WASHINGTON** "With more music and less commercials." How many times have you heard this or a similar phrase flooding the airwaves of radio stations? The truth of the matter, however, is that radio is dependent on that advertising for

its subsistence—advertising that is projected to increase in the next five years.

According to Robert Coen, senior vice president and director of forecasting at the McAnn-Erickson advertising agency, the lag time between improvement in business and a boost in advertising is about over. John S. Suhler, president of Veronis, Suhler & Associates Inc. (VSA), an investment banking firm for the communications industry, estimates that by 1997, nearly \$12 billion will be spent on radio. This figure is 11 percent of total measured media advertising, slightly higher than the 1992 percent.

### Constant growth

Over the last five years, radio advertising increased at 3.7 percent compound annual rate and Suhler expects to see annual growth over the next five years to accelerate to 6.8 percent. VSA attributes the underlying strength of the market for future growth and used the 1992 growth as confirmation.

In 1992, radio advertising totaled \$8.6 billion, an increase of 1.9 percent from 1991. Local advertising was the key factor in the expansion, accounting for \$1.5 billion, or 78 percent of total radio



### Production Facility:

Catspaw Productions' (L-r) General Manager Sharon Paul, Director of Sales Ralph Destito and President Doug Paul in the studio with a Yamaha DMC 1000 console and Studer Dyaxis workstation. See story page 13.

advertising. Local radio advertising rose 5 percent in 1992, an impressive figure following 1991's 3 percent decline. According to Suhler, that number is even more impressive since local advertising contains fairly little quadrennial spending (spending for the Olympics and/or presidential elections which occur every four years).

Radio accounted for 10.7 percent of measured media advertising, practically the same share as in the mid 1970s. In fact, radio's share has barely varied from year to year. What makes this noteworthy is the expansion sustained by cable television and barter syndication

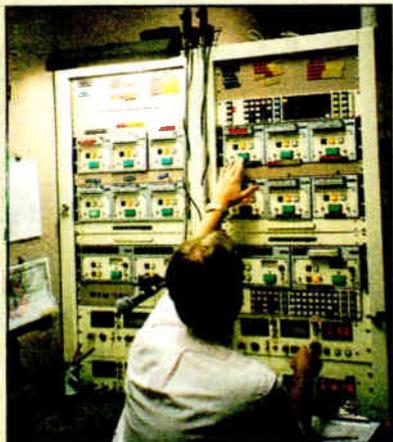
advertising during the 1980s.

Unlike its counterparts, radio listenership remains relatively unchanged. While home usage has declined due to cable television and home video, usage out of the home has rocketed. The number of people reached by radio in an average quarter hour rose 3.8 percent in 1992, marking the highest level of listening since 1982. One theory is the increased power of talk radio during a political year, but Suhler believes that the dominant factor was the recession. With high unemployment rates, people had more free time for radio. The last time radio usage jumped as high as in 1982, a recession year as well.

## FCC Faces Aftermath of 'Paul'

by Randy Sukow

**LAKEWOOD, Colo.** Colorado survived Hurricane Paul and the cleanup has begun. But the maelstrom of paper and electronic data left in Paul's wake is not in Colorado, but thousands of miles away in Washington.



The National Weather Service's Todd Heitkamp sends one of the week's many "Hurricane Paul" alerts.

"Hurricane Paul"—aptly named after consultant Paul Montoya, president, Broadcast Services of Colorado, who organized the FCC's four-day (June 27-30) Denver-area field trial of proposed new Emergency Broadcast System (EBS) technologies—was test participants' tag for the mock alert, which was continuously transmitted from either the state Emergency Operation Center (EOC) or the National Weather Service Station near Stapleton Airport (RW, July 28).

continued on page 7 ▶



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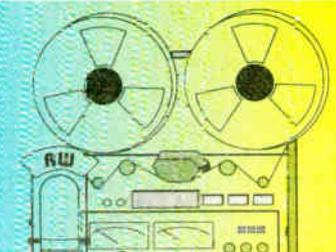
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**HARRIS ALLIED**

### A new structure

A new development in local advertising is the genesis of local marketing agreements. Two stations band together to sell local advertising as a group, with one station chosen as the lead operator. This station then sells advertising for both stations and controls promotion for both. In many cases, the buyer makes one buy and is heard on both stations covered by the agreement. The lesser station is assisted by being associated with a stronger station,

continued on page 3 ▶



**Studio Sessions**

Equipment and Applications for Radio Production and Recording, begins on page 13.

# NEWSWATCH

## NAB Issues Call for Papers

**WASHINGTON** The NAB has set Dec. 15 as the deadline for submission of technical papers for the March 20-24, 1994 spring convention's broadcast engineering conference, HDTV World, and Multimedia World.

According to the Science and Technology Department, a one-page proposal is due by Sept. 1. It should be sent to: NAB Technical Conference Committee,

NAB Science and Technology, 1771 N Street, NW, Washington, D.C. 20036; Fax: 202-775-4981.

## PC-Based System Provides for Allocation Analysis

**CHICAGO** Thomson-CSF has developed an advanced PC-based software and systems for administrative data management and allocation of frequencies.

According to Thomson-CSF, the database management sys-

tem handles large volumes of administrative and technical data associated with radio communications. Information on operators, licenses, allocated frequencies, equipment characteristics and transmitters is stored and processed by dedicated software.

For frequency allocation, for example, software simulates interference patterns between transmitters in specific locations, taking into account factors such as terrain, transmitter power/frequency, and antenna heights.

Data is analyzed and a graphic display is generated to indicate the geographic range of a transmission.

For more information, call 703-769-4776.

## Translator Rules Clarified

**WASHINGTON** The FCC recently clarified the FM translator rules including revised standards for ownership and financial support, definition of major change in translator coverage areas, maximum output, and interference criteria.

The FCC said that "other area" translators "whose ownership and

financial support relationships with a primary station are temporarily grandfathered will not be required to comply with the new service rules for the remainder of the three-year periods if the translator changes its primary station."

The Commission said a change in primary station does not alter the technical aspects of a translator's operation.

The clarification of the translator rules also amended the grandfather provision (those that were authorized prior to the effective date of the rules change), requiring compliance with the "full scope of the technical requirements when a major change is made or interference is caused. A major change is one that increases the 1mV/m coverage by more than 10 percent

Minor changes do not require compliance with the new technical rules provided translators are not causing interference.

For more information regarding translator rules, call 202-632-6302.

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World Radio History

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# Radio Affected by Quincy Flood

by John Gatski

**QUINCY, Ill.** Along with the millions who live in the flood ravaged Midwest, two major broadcast equipment manufacturers and a number of radio stations also were affected by the swelling of the Mississippi River.

Harris Corp. and Broadcast Electronics are both located in Quincy, but officials reported no flooding damage because the companies are located east of the river.

"Quincy is on a bluff. The flood plain is to the west and the north," Broadcast Electronics, Bill Harland said.

Harris, however, does have an antenna plant in Palmyra, Mo. an area that was affected by the flood.

As for the main headquarters of both companies in Quincy, the biggest problem was the significant number of people in Missouri who lost their

direct route into the city.

The bridge, known as the Bayview Bridge that links Illinois and Missouri in the Quincy area, was overwhelmed by water. According to BE's Harland and Harris' Ron Frillman, employees had to: take either a 140 mile detour via Burlington, Iowa to get to work, take a trolley across the river and catch a bus into Quincy, or stay in town.

At presstime, Harris and Broadcast Electronics reported no major product shipping problems, although Harris said it was taking a little bit longer to get shipping from the west.

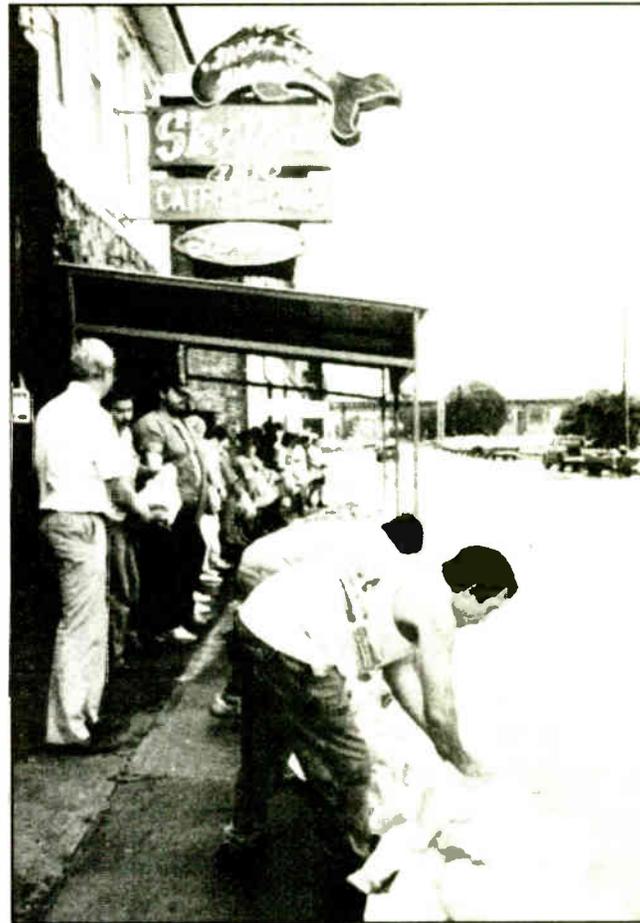
Quincy AM station WGEM, normally 5 kW during the day and 1 kW at night, was able to broadcast at the higher power 24 hours a day for several days because of an FCC rule that enables a broadcaster to increase power if it is the only conduit for evacuation information.

According to WGEM Director of Operations Leo Henning, the station was the "official information source" for the Quincy area.

In Missouri and Iowa, several radio stations reported problems from the flood; many had to go to generator power as waters overran electric substations. The Des Moines, Iowa area was hit hard by the floods, and some stations were providing round-the-clock information to residents about evacuation plans, emergency services and where fresh drinking water could be found, a major problem as flood water overran water and sewerage systems. Most stations, however, reverted back to their regular formats with periodic news updates when the situation stabilized.

KFMG in Des Moines nearly got flooded, but was spared major damage except for a flooded basement. However, it was operating on generator power and with limited phone service at

press time. KGGG Chief Engineer Rick Chalfant said he promised KFMG spare transmitting equipment (an STL and a console) if the water crested again.



Volunteers sandbagging along a street in Quincy, Ill. during last month's flood.

—Photo by Joe Liesen for the Quincy-Herald Whig

## Analysts Forecast Growth

► continued from page 1

while the stronger station is more capable of selling advertising in a competitive industry. The result is a more efficient use of resources for both stations and advertisers. According to Gary Fries, head of the Radio Advertising Bureau (RAB), local marketing agreements increase the targetability of the medium. "In the past, advertisers wanted to hit the target," said Fries. "Now an advertiser wants to hit the bull's eye."

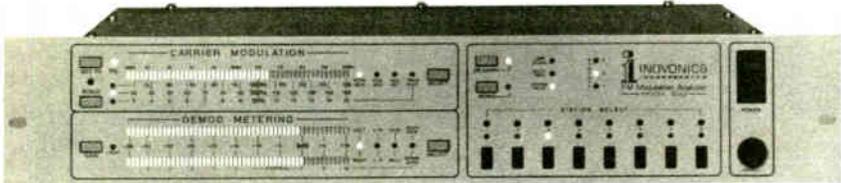
Another issue helping profit margins is the new FCC duopoly rules which allow owners to buy more than one station. Multiple-station owners can cut fixed costs and in addition, reduce the cost of selling advertising. However, Suhler said, "While profitability should be enhanced, the new duopoly rules will not affect the overall outlook for radio advertising."

Furthermore, VSA does not expect digital cable radio to have much of an impact on radio advertising. Reasons cited include potential digital cable radio subscribers owning a large CD library already and consumers not wanting to make the adjustment to having to pay for radio.

Although he cites different reasons, Fries agrees that digital cable radio will have a very limited impact on radio advertising. "We keep an eye on it but we don't perceive it as a real threat. It goes back to the portability of the radio. That overrides all else. People don't expect radio to be tied down."

People will expect to hear advertisements on the radio and those expectations are quite sensible, considering the sufficient evidence that radio advertising will continue to grow, well into the late 1990s.

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# Radio Business Is Multifaceted Affair

by Lucia Cobo

I'd like to congratulate all the participants in the EBS tests held in Denver. Roughly 100 broadcasters, equipment manufacturers, government officials and other volunteers gathered in Denver to help test potential new EBS systems.

Their efforts reinforce my longheld belief that one of the nicest things about radio



people is that they love the radio business. All aspects of the radio business. Whether someone is an engineer, a manager, or into programming, I've discovered that as a rule, you all care about and want to know what is going on with the medium.

To serve that end, we're enhancing our news section with a new, regularly scheduled news analysis section. The brainchild of Managing Editor Randy Sukow, the idea is to spotlight one of the pressing issues of the day regularly covered by **RW**. Once a month, you can read about a specific topic (see our in-depth look at EBS this time out) from all sides of the issue.

As we execute this idea in print, we will endeavor to fine tune it with each installment and in response to input from our readers. Each issue will be presented as a package of several different elements, including (but not limited to): A lead story that maps out the issue and its main players; guest analyses from both sides of the issue; short Q&As with the main players, and color pictures and charts.

Look for analysis on issues such as AM Stereo, RBDS/RDS, digital compression, and the various facets of Digital Audio

Broadcasting. Other potential topics include AM improvement and the expanded band, RF radiation, FM directional antennas and short-spacing, FCC fines for technical violations and the current review of the FCC's forfeiture schedule

★ ★ ★

And while I'm on the subject of enhancements to **RW**, I'm pleased to tell you about our newest feature columnist, Richard Mertz. Richard, an associate with Washington-based Jules Cohen & Associates, was formerly the CE at WJZE(FM) here in town.

Richard will be writing about computer applications for radio stations. His column (as yet untitled) will debut with a series on Programmable Logic Controllers. He will tell you what they are, how they

and the equipment connected to it.

Richard will walk you through an overview of the application, its design and implementation, as well as a sequence of events to ensure things are happening as they should in the design. And this is just for openers!

★ ★ ★

Those of you who are into audio production have probably noticed the new look and enhanced contents of *Studio Sessions*. Studio Sessions/News Editor John Gatski is working tirelessly to serve your needs with a variety of regular columnists, product reviews, interviews and product introductions. Let him know how he's doing—drop him a line with comments and suggestions.

If you are looking for Bruce and Jenny Bartlett's ongoing series on hum prevention in the studio, the next installment will appear in the Aug. 25 issue of **RW**.

★ ★ ★

Many radio people, especially engineers, also are amateur radio enthusiasts. For you, the West Palm Beach (Florida) Radio Club is sponsoring its first annual High Speed CW contest. The contest will be held on Oct. 23, as part of the Palm Beach County Hamfest held in the Palm Beach County Fairgrounds, Oct. 23-24.

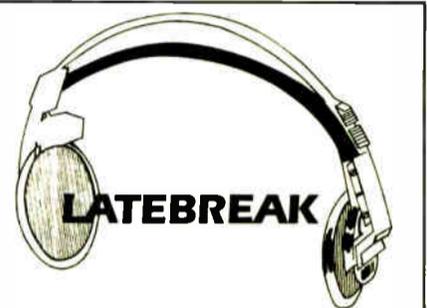
The contest is scheduled to begin at 1 p.m. It has been coordinated with and conforms to American Radio Relay League (ARRL) standards. Observers will be welcomed and allowed to hear the test material simultaneously with the contestants through a loudspeaker.

The overall speed winner will receive a

trophy attesting to his/her skill. For everyone else, plaques will be awarded to each person who copies code faster than anyone else in age groups: 20 years and younger; 21-40 years; 41-60 years, and 61 and older.

The purposes of the contest include: a). For both contestants and observers to have fun; b). To demonstrate that CW is alive and well, and c). To proliferate CW in the amateur radio world.

For more information, contact contest organizer Ted Herrman, AE8G, telephone: 407-586-7940; FAX: 407-585-3466.



Dean A. Pomeroy was named controller for Harris Allied Broadcast division. He joined the company in 1977 as an account executive, and has since held various posts, most recently as director of finance for the RF Communications Group.

James W. Witt was named total quality director for the Office of Engineering and Technical Operations for the Voice of America (VOA). He will support the integration of "Total Quality" principles, practices and techniques into the Office's "institutions, systems and practices."

Witt has served in various overseas and domestic positions while with the Naval Facilities Engineering Command, the U.S. Army Corps of Engineers and the United States Information Agency (USIA).



KISS 108 FM (WXKS-FM) Boston hosted its fourteenth annual benefit for the Genesis Fund. This year's event raised \$50,000 and featured artists such as the Bee Gees, Barry White, Duran Duran and Neneh Cherry. Pictured above is KISS' Cadillac Jack and SWV.

work, and how they can be used in a broadcast environment. He will also tackle an application, using a controller to monitor the operation of a coaxial switch

welcomed and allowed to hear the test material simultaneously with the contestants through a loudspeaker.

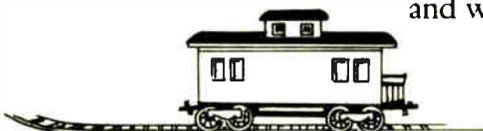
The overall speed winner will receive a



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World Radio History

# 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.

## 'Living' history in danger

Dear RW,  
I once read a story in RW about Canadian scientist and inventor Reginald Fessenden (Aug. 7, 1991) that recounted how Fessenden made the first voice broadcast from Brant Rock, Mass., on Dec. 24, 1906. I had never heard of Fessenden before and, being a fan of radio history, found the story very interesting.

I got to visit Brant Rock in early June while on vacation. (It's about 40 minutes south of Boston on the Massachusetts coast.) After driving around for a while, I located the property where Fessenden's broadcast took place. It is now a trailer park owned by Bradford Blackman, a descendant of the family who leased the land to Fessenden. Mr. Blackman was kind enough to show me where the original tower base is still standing. The structure is about eight feet high—six feet of concrete with a metal ball on the top.

It was exciting to see this "living" piece of history, but I was surprised that it is totally unprotected from vandalism. A plaque commemorating Fessenden's Christmas Eve broadcast was stolen. (Fortunately, it is now back in Mr. Blackman's possession.) The base is even vulnerable to careless drivers.

It's a little sad that nobody has seen fit to care for what remains of Reginald Fessenden's transmitter site. I hope that someone will take responsibility for the tower base and maintain its historic value.

Tim Portzline  
Chief Engineer  
Broadcast Equities Inc.  
Virginia Beach, Va.

is more show than substance. The FCC seems as if it won't or can't make a decision regarding the future of EBS. In fact there has even been mention of allowing broadcasters to use whatever system they see fit for their station or market.

We are faced with a dilemma once again. We may end up with a system that will fail, not because of technical considerations, but due to a lack of care, concern or knowledge of how and when to use what is chosen. What is the benefit when in any given market various stations are adhering to different EBS systems or when the system is once again ignored when needed or misused when instituted? We need one system that will be affordable for all stations and can be used effectively when necessary.

There also must be better a description of when and why to use the system. We have two extremes now. Some stations never use the system and barely keep track of current testing and monitoring rules. Others set off EBS alerts every time the skies turn grey. Too many just don't give a damn about the system or don't understand its proper use.

As broadcasters it is our obligation to serve communities. It is our duty to get together and settle on one system that is best for all and not for each station on an individual basis. It is also our duty to install that system quickly. If we don't make the right choice now, we will have wasted a great deal of time, money and energy only to arrive at another dead end.

Aaron Brodbar  
Chief Engineer  
WEHM(FM) East Hampton, N.Y.

## New AM band is positive

Dear RW,  
I am becoming concerned about the negative press our industry's newsletters are putting out on the new extended AM band (1605-1705).

I think the extended band is the greatest thing to come along since AM came on the air. For the first time in modern history, we have a standard for expansion that is universal. Everyone gets 10,000 watts days and 1,000 watts nights on a single stick.

The whole plan revolves around eliminating interference on other places on the dial, and improving the remaining stations on the regular band.

With a preference to existing broadcasters and an extra credit for AM stereo, we finally have a place to tune those millions or so car radios that only see one or two stereo signals in a market now.

I currently own two stations near the top of the dial. One nearly reaches the metro Green Bay area, the other nicks the metro Milwaukee market. We struggle, not due to our effort or our programming, but due to our coverage.

Knowing that a 10,000-watt signal on an uncongested band can punch a hole through a current 250-watt directional patten that only operates days gives me the courage to make the bank payments to see this become reality.

Looking at our current ground conductivity, our 0.5 mV/m contour should increase from 30 to 85 miles radius. Even our 1,000-watt operation will increase from 50 to 85 miles, and our

## More to EBS Than Meets the Eye

This summer's Mississippi-Missouri River flooding reached levels weather experts say we can expect only once every 500 years. How do you prepare for that? Spend billions for 80-foot levees? Another flood like this could come along any century now.

One thing to do is be ready to get the word out. An Emergency Broadcast System is not needed

to let you know when a flood is coming. Floods are pretty obvious disasters. But when the waters overrun the water treatment plant, contaminating the water for thousands of households, people need to know immediately.

All of this simply underscores the need for a new EBS, which the FCC already has begun to redesign. Some, such as the letter writer appearing on this page, interpret the FCC's EBS proceeding as either apathy over the reliability of the next generation of EBS equipment or indifference over broadcasters' ability to pay for it.

Actually, about 100 broadcasters, equipment manufacturers, government officials and other volunteers cared enough to spend four days in Denver to test new EBS systems. (Some manufacturers were there up to two weeks in advance to prepare; some volunteers paid for the trip out of their own pockets.) Another 100 will meet in Baltimore next month.

What may seem like needless delay and indecisive FCC policy-making from the outside is actually an effort by government and industry to deal with complex economic, technological and even sociological issues, as this issue's in-depth report hopefully illustrates.

City councils along the Mississippi are now grappling with a thorny question: Should large sums be spent for emergency measures that may never be necessary?

If the FCC's EBS Office is successful, broadcasters will not have to face that dilemma. Depending on how broadly it writes the new EBS rules, the commission will be able to let broadcasters pick a relatively low-cost system that is still much more reliable than the current system.

Those willing to spend more, especially FM stations gearing up for radio broadcast data service anyway, can buy a system that does things like turn on an RDS clock radio in the middle of the night to broadcast news of an on-coming emergency.

After all, if the water treatment plant is suddenly submerged, most would not mind being roused. It's better than waking up and showering in sewage.

—RW

nighttime power will increase from 33 watts to 1,000.

I hope the doom and gloom people who are throwing monkey wrenches into something that hasn't started yet realize they hurt the entire industry by casting dispersions on what may help the industry survive into the next century.

Mark Heller, President  
WTRW(AM) Two Rivers, Wis. and  
WGLB-AM-FM Port Washington, Wis.

## C-QUAM qualms

Dear RW,  
I could not agree more with Lee Parr's letter in the June 23 issue. I am becoming tired of the hype regarding the adaptation of C-QUAM as the standard for AM stereo broadcasting.

After the experience with both types of AM stereo systems, I find it difficult to comprehend how anyone, after properly researching both C-QUAM and (Kahn Communication's) ISB stereo methods, could make the claim that C-QUAM is the superior method of AM stereo.

Let's face facts. Any adaptation of C-QUAM as the AM stereo standard has been driven mainly by the David-and-Goliath factor. Unfortunately, ISB was unsuccessful in bringing down the Motorola giant.

If and when C-QUAM is chosen as the method, I don't see much hope for the future of AM stereo competing with FM stereo music stations. A few stations here in the Seattle area are broadcasting in C-QUAM. None that I know of are actively promoting it. The station I worked for removed C-QUAM due to a loss in fringe area coverage, which subsequently improved dramatically.

The ability to compete with FM stereo stations for quality of stereo broadcasting

went out the window with the 10 kHz NRSC standard. It will surely be dead with the adaptation of C-QUAM as a standard.

Anyone who claims that they are unable to tell the difference between current AM stereo and FM stereo should have their hearing checked.

Kelly D. Alford  
Seattle

Dear RW,  
I too am curious as to how the Motorola system became the AM stereo standard, especially in light of W.C. Alexander's article on preparing for AM stereo (RW, June 9) and a subsequent letter from Lee Parr.

As a matter of fact, the FCC had a standard to begin with. Does anybody remember the Magnavox PMX system? Engineers were quoted in the pages of this very publication complaining that it made popping noises as it approached 90 percent negative modulation.

Now Cris Alexander says many of the decoders can't take more than 75 percent negative peaks without distortion. Am I wrong to think this is a step backwards?

I'd be anxious to hear from some Motorola engineers on this one.

Scott Todd  
Skylight Satellite Network  
Roseville, Minn.

## Correction

In the June 14 RW article, "AT&T Algorithms Vital to Three DAB Systems," the reference to the Swedish Radio Tests conclusion that the PAC algorithm was transparent was incorrect. AT&T's own internal test results concluded that 'PAC is transparent to most audio material at a rate of 128 kbps,' according to AT&T's Nikil Jayant.



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Next Issue of  
Radio World  
August 25, 1993

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# Tough Choices After Denver Tests

► continued from page 1

The tests produced reams of data, most of it in the form of subjective observations, from about a dozen volunteer observers stationed at EBS send and receive stations within and outside the city.

Many of the Denver participants said the three-person FCC EBS Office now faces a daunting task in synthesizing the data into a new set of rules.

"There will be a lot of drafting, fine-tuning and editing of what we think the new system should be. That will take several months," EBS Chief Helena Mitchell said, who had hoped as late as last spring to have the new rules written and approved by this fall. They are now expected to be finished in early 1994, at the earliest.

## Objectives

The EBS Office will not have finished analyzing the Denver results before another storm of data descends on it next month. The commission has inked in Sept. 12-15 for a second round of EBS field tests to be headquartered at the Maryland EOC in Pikesville (just outside Baltimore).

The main things the commission hopes to

achieve with the new EBS (the system will be given a new name when the rules are approved) include:

- Higher networking reliability by replacing the current "daisy-chain" networking of broadcast stations with a more reliable network architecture.
- The ability to send more complete emergency information from a greater variety of sources directly to the public than is currently possible over EBS.
- Elimination of the weekly on-air EBS tests using the 20-second tone, which the public has become desensitized to and no longer heeds, broadcasters say. They will be replaced with coordinated tests among broadcasters and local emergency authorities and a silent tone that can be tested without interrupting programming.

The new system also is likely to authorize a new level of station automation, allowing stations to relay EBS alerts by remote control and eliminating the need for an operator near the EBS monitor 24 hours a day, as current FCC rules require.

The three major systems under consideration by the FCC—Information Systems Laboratories (ISL), Vienna, Va.; Sage

Alerting Systems, Stamford, Conn., and TFT Inc., Santa Clara, Calif.—each proved that they could meet those objectives during the Denver tests. Except for a few minor glitches, all three worked as they were expected to work.

But the three systems approach alerting from very different angles (see system descriptions, page 8). The commission could base its new rules mainly on one of the systems, forcing the other two to scrap or dramatically redesign their systems.

The alternative is to write a broad set of minimum EBS equipment standards for FCC type-acceptance that would allow all three companies to market their systems

with little or no redesign. A station could decide on a system for itself or choose a system as part of a regional agreement with other stations and emergency authorities.

A broad-guidelines approach, however, might increase the danger of a network breakdown under emergency conditions. "If they are really not specific (in writing the protocol), you're going to have stations that opt for RDS and stations that opt for the TFT system, TFT Marketing Manger Darryl Parker said. "Then you'll have an emergency and neither of the stations can talk to each other because there was not an agreed upon in-band signaling scheme."

## Protocol office

The FCC's intention, Mitchell said, is to write a set of protocols broad enough to accommodate not only the three proposed systems, but future new technologies as well.

Cost is one key reason for taking a broad approach, Mitchell said. The three systems vary significantly in implementation price. Each station can choose the system that fits into its budget, she said.

TFT's EIS decoders, for example, cost only \$750 and can be used with current EBS receivers. The company estimates average total installation cost at \$1,000.

Sage/RDS system implementation costs are estimated at \$2,200 for AM stations and \$3,000 for FM. But the Sage system is capable of sending longer, more detailed messages. The FM version can use radio data system signals over subcarriers to turn on an RDS consumer radio during an emergency or to interrupt a playing cassette or CD when the message is sent. (See story, page 10.)

But both companies base their prices in

part on the assumption that they will hold a large segment of the limited EBS equipment marketplace, which comprises about 24,000 broadcast stations and cable systems as well as a few thousand local emergency agencies.

The ISL system, for example, would cost little more to implement than the price of a PC and satellite receiver, assuming that several thousand customers buy into the system and share satellite time. The other two companies could also be affected by such economies of scale.

User-friendliness could be another key issue for the commission as it writes its protocol.

David Holm of the Colorado EOC and Arthur Botterell of the California Office of Emergency Services, who were the only two representatives of emergency-service agencies at the Denver tests, both said that the encode end was not scrutinized closely enough in the development of the systems. A system that allows the average firefighter or police officer to send an alert quickly and easily is needed, they said.

The proponents tended to agree and said they would make changes, some of which may be ready for next month's Maryland tests. But whether the systems can be made more user friendly without increasing costs or decreasing capabilities may remain to be seen.

## EBS Changes With the Times

Throughout decades of alerting the broadcast public, EBS has never been used for its original purpose, a national alert—a fortunate fact, since the only foreseeable reason for a national alert would be an imminent thermonuclear attack.

Long before the end of the Cold War, the emphasis of the EBS had shifted from national to local and regional alerts. New technologies and a recent rash of natural disasters, such as the 1989 San Francisco earthquake, Hurricane Andrew in 1992 and this summer's flooding in the Midwest, have driven home the need to perfect the system even more.

Some notable dates leading to the current FCC EBS proceeding include:

**1951**—The Congress creates the Conelrad (Control of Electromagnetic Radiation) system which allows the government to immediately reach the public over specially designated broadcast stations.

**1963**—In the aftermath of the Cuban missile crisis, the national alerting system is redesigned to deliver alerts over more frequencies, in case some frequencies are jammed by enemy attack. It is renamed the Emergency Broadcast System (EBS).

**1976**—EBS is overhauled to allow for activation during state and local emergencies. More than a dozen manufacturers, including TFT, are among the first to offer a new line of EBS receivers to broadcasters.

**1985**—Bosch develops an RDS-based national alerting system for the West German government. Sage Alerting later begins marketing the Bosch system in U.S. for specialized purposes, such as system connecting oil rigs in Gulf of Mexico to warn of major spills.

**1989**—The Colorado Association of Broadcasters forms a committee to

redesign the state's emergency alert system to explore ways to replace "daisy-chain" system, which is found to be inharmonious with the area's rugged terrain. The committee eventually adopts a system with a web architecture (similar to TFT proposal), but later suspends implementation, pending completion of the FCC's process.

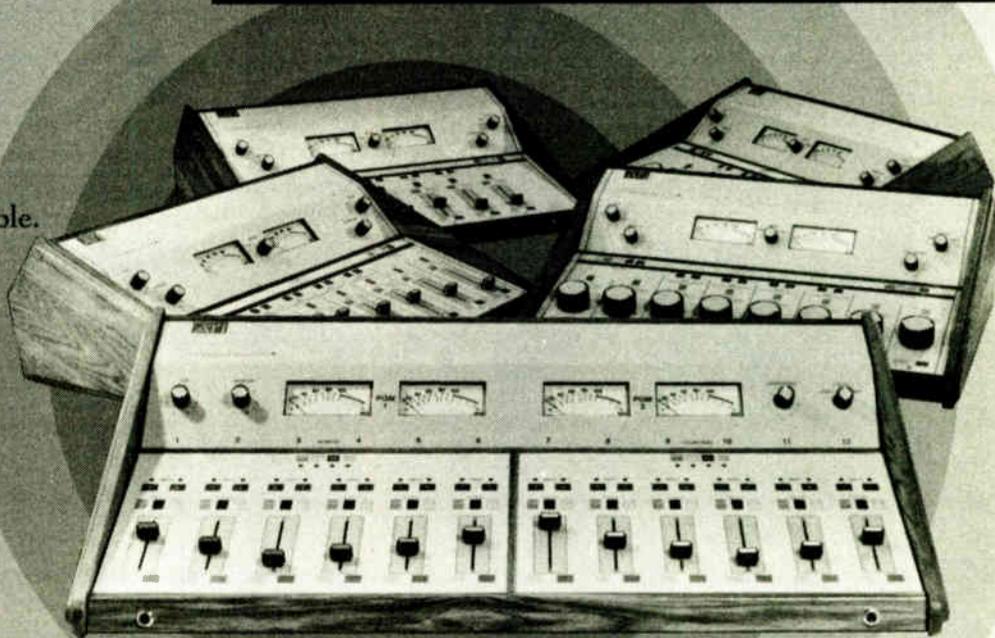
**1991**—The FCC begins its current proceeding on EBS reform following a letter to commission from the National Association of Broadcasters (NAB). Weekly EBS tests and the familiar 20-second test tone have desensitized the public to the system, the NAB said.

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## TFT Weaves Stronger Web

Low cost, user-friendliness and increased automation are the main selling points that TFT Inc., Santa Clara, Calif., stresses in its EIS 911 Emergency Information System. "The reason small broadcasters shouldn't complain (about new EBS equipment purchases) is because this is the last thing needed for total station automation," said Fred Baumgartner, one of the EIS developers.

EIS builds on the current EBS network by upgrading the "daisy chain" to a "web" network. Each station should receive the same alert from several

sources rather than from the one previous link in the alert chain. The EIS send and receive boxes (shown here during setup at the Colorado EOC) are designed for easy operation, especially the decoder, which has only two front-panel buttons for sending and interrupting messages.

A PC output in the back allows for logging of each EBS message received, while a tape in the front provides an instant hard-copy log of the alert originator, the nature of the emergency, the areas affected and the duration of the alert.

```

EIS MESSAGE SENT ON:
JUN 28 1993 09:03:36
FROM ID: E102-TFT
CODE: HUW
HURRICANE WARNING
COLORADO, ALL AREAS
ALL REGIONS
ONE HALF HOUR
MESSAGE SENT ON:
JUN 28 1993 09:03:36
MESSAGE EXPIRES:
JUN 28 1993 09:33:36

E102-TFT-HUW-008999+30-9
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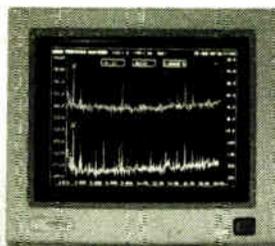
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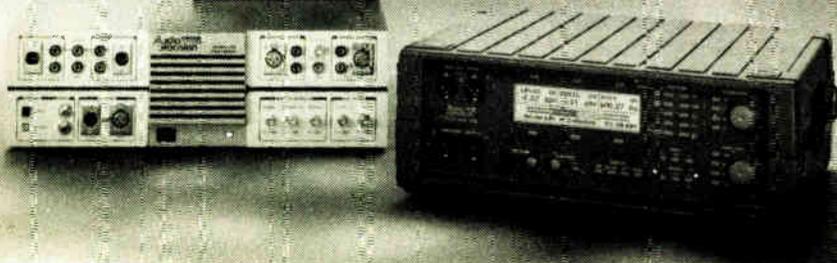
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## ISL Tries Orbital EBS

The Emergency Broadcast Satellite System (EBSAT), demonstrated in Denver by Information Systems Laboratories (ISL), Vienna, Va., is designed to link state EOC headquarters or mobile command centers to broadcast stations and cable systems by Ku-band satellite links.

ISL employs very-small aperture terminal (VSAT) technology to hold down the cost of receivers. "There's alot of Radio Shack technology in there," said Barry Shay, ISL's senior scientist during set-up of the EBSAT in a mobile-command-center application, shown in the photo. ISL claims the system will work with smaller antennas than the one shown here.

Point-to-multipoint networks potentially

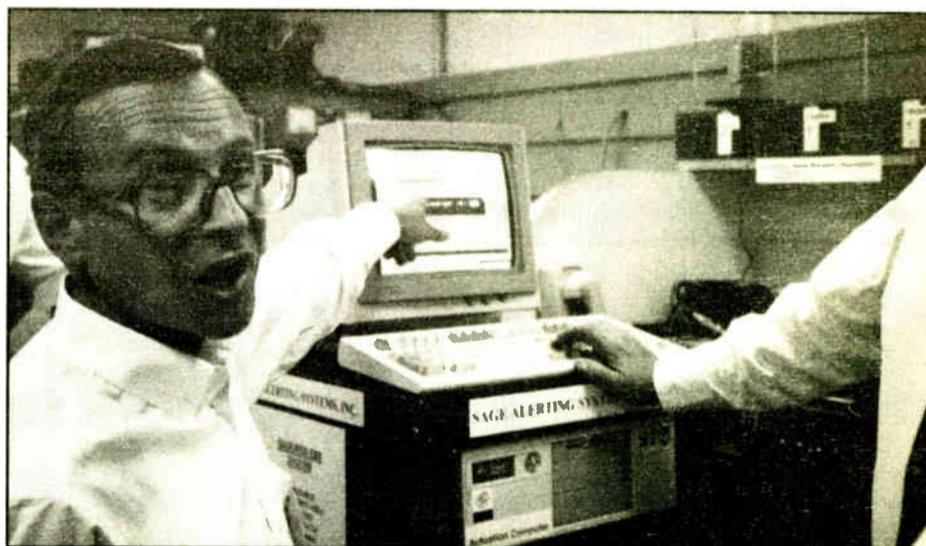
remove the need to use any broadcast stations as relays in the EBS network and increase reliability, regardless of weather or geographic obstacle, ISL says. After the Denver tests, Shay said he was disappointed that more tests of the system's robustness in Colorado's rugged terrain were not performed.

ISL says its system may also be used for other, non-EBS-related satellite networking among stations during everyday operations, which could be preempted for national or local emergencies. Networks of thousands of EBSAT users could further reduce costs.

Personal computers control EBSAT at both the send and receive points. A full record of all EBS alerts can be stored electronically on the PC.



## Sage Sets RDS Alarms



Sage Alerting Systems, Stamford, Conn., emphasizes the consumer-electronics aspects of future emergency alerting with its SAGE 1 Emergency Alerting System, which is endorsed by the Electronic Industries Association. Sage uses radio data service (RDS) features, such as data transmission of EBS alerts to RDS radios and automatic EBS alerting, even if the radio is turned off or a cassette tape or compact-disc is playing. Sage has also developed pocket pagers and smoke alarms with RDS receivers.

One of most important aspects of the system, Sage says, is its multiple actuation controller (MAC), which allows it to

send and receive several different codes and over several different pathways. It can be used in a one-way network from emergency-alert centers (like current system) or in a two-way application.

"We send over the phone lines, over 450 MHz and over the Weather Service transmission, and our (receivers) are able to grab it all, where the other systems only get one thing and have to throw away all the other things," said Sage President Gerald LeBow, shown here demonstrating the Sage/RDS system at the Colorado State EOC. The MAC computer is beneath the keyboard.

All EBS alerts sent and received are automatically logged by PC.

# FCC and Industry Develop EBS Coexistence

Shortly after the Denver-area tests were completed, **RW** gathered reaction and impressions from the key organizers of the tests and representatives of the most prominent manufacturers: Helena Mitchell, chief of the FCC's EBS office; Paul Montoya, president, Broadcast Services of Colorado; Gerald LeBow, president, Sage Alerting Systems; Darryl Parker, director of marketing, TFT; and Barry P. Shay, senior scientist, Information Systems Laboratories.

**RW:** How would you characterize the week's work? Did you accomplish all you hoped to accomplish?

**Mitchell:** I thought it was very successful. We now know, for example, that we might want to do some more lab testing. The field testing was good because we saw that with primarily prototype equipment, manufacturers were able to produce something that worked.

**Montoya:** We accomplished a lot, but I don't think we were complete. There are a lot of tests that probably don't have to be repeated in Maryland, but some additional tests need to be done before any decisions.

**Shay:** From the feedback I got, we are now a contender with TFT and Sage. We showed that a satellite-based system can essentially get information to where you want to get it very quickly and easily.

Because of the terrain in Colorado, I thought that would be a really good place

to have a satellite demo. It was unfortunate that all the stations were in spitting distance of each other in downtown Denver, which really didn't show anything.

**RW:** What then can we say about the quality of the data from these tests?

**Parker:** It all boils down to the quality of the observers' notes, and how they interpreted the tests, particularly with respect to the objectives of the test. One of the problems we had here in preparation was understanding the objectives. I think the Baltimore tests will be spelled out more clearly.

In defense of the volunteers in Denver, there had to be a first time. There was really no yardstick the Denver group could use. They did a very good job.

**LeBow:** I think there were three tests that were qualitatively and quantitatively significant, from which the FCC can draw some inferences: the signal-to-noise test, the distance test and the test where you send from the mobile van. A lot of the other stuff relies on value judgements (of the observers).

There is a huge amount of data (the FCC) is going to have a real problem digesting.

**RW:** The FCC says its goal is to complete this process with no specific winners or losers, but with all companies able to market their own systems linked by a common protocol. Is this possible? What will the

elements of commonality be?

**Mitchell:** That will be our job. It will be easier (to complete) because we have had these tests. We've already started thinking

going to work really well. The shorter tone will be very easy to do. The whole idea of both and video and audio override for broadcast and cable is going to be doable.

**Parker:** We are going to have to live together. There are some things that RDS is going to do well, and we ought to take advantage of it, but in-band signaling is the only way you can cover all the bases.

(The FCC) will have to specify the modulation type and data rate. That may be implicit in WRSAME (the National Weather Service alert codes, which all three major systems can decode). It may not be. But it has to be an agreed upon protocol that is not proprietary.

**Shay:** The requirements (a system) will



A demonstration of the ISL system using a Mobile Telesystems Inc. INMARSAT ultralight receiver. Pictured (l-r) are: FCC EBS Chief Helena Mitchell, test organizer Paul Montoya, and ISL's Alan Schnittman.

about what type of protocol it should be.

We can't talk about which systems will be in, but we do think RDS, in-band and out-of-band and systems for cable and satellite will all be able to coexist. We want to be flexible because we don't know what new technology is coming.

Obviously, the idea of silent testing is

have to meet are still a bit unclear to me. They use the word protocol a lot, but it's not exactly clear in my mind what they mean. Maybe they will say that FM subcarrier is a viable protocol, so somebody other than Sage can come along with an FM subcarrier approach.

continued on page 10 ►

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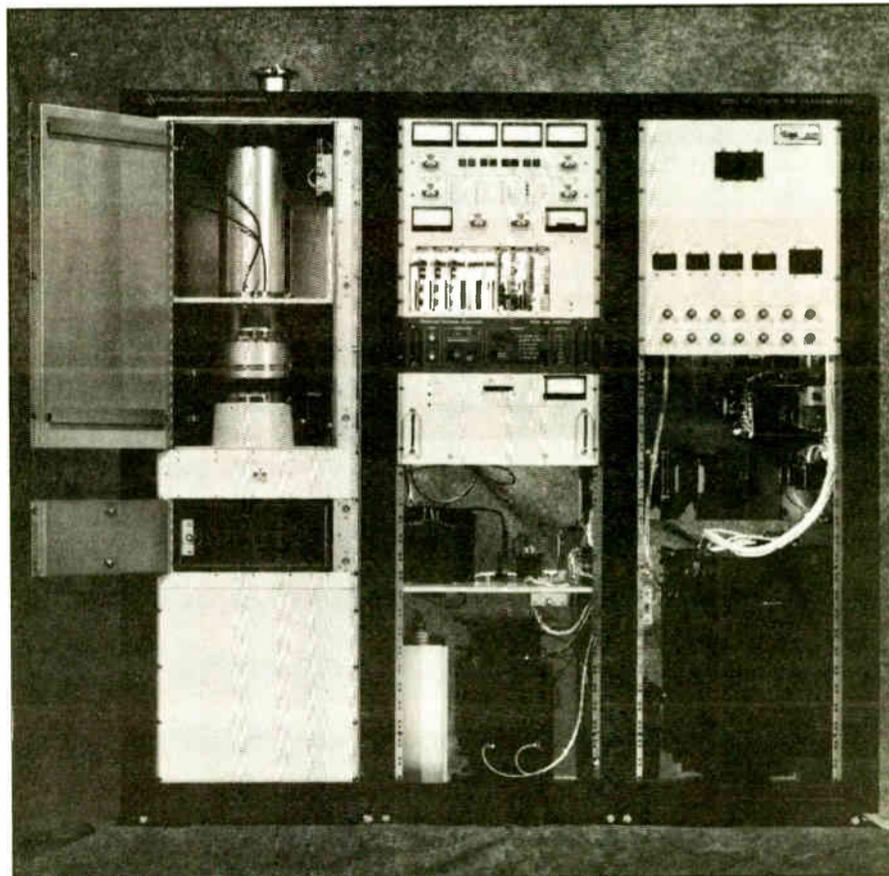
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# Consumer Tests Stir Controversy

**DENVER** The final test of the week—and by far the most controversial—was a test of the public's reactions to EBS alerts under normal, everyday living conditions.

It drew heavy criticism because it involved only one of the proposed alerting systems, Sage/RDS. Critics also complained that little follow-up testing is planned for other parts of the country, and that the final results would be based on a small sample, lacking in diversity.

For whatever the results were worth, the test tended to suggest that the public would react more quickly to some RDS-style alerts.

The FCC appointed Dennis Mileti, director of the Hazard Assessment Labs at Colorado State University, to organize the public-reaction tests. Mileti invited about two dozen people for a morning party (aware that they were to be part of a test

transmitted the Sage signal over The Weather Channel. (An estimated 140,000 households, or one percent of TCI's Denver-area subscribers, were tuned to that channel during the test.) Simultaneously, the CD on the third floor was interrupted by a preprogrammed, simulated EBS alert.

Following the test, many in the first-floor group said they did not notice the test at all, even after the volume of the TV set automatically increased. Some said they did not notice anything was going on until near the end of the test and even then did not disturb the conversation to point it out to the others.

The second- and third-floor groups, however, noticed the alert immediately. The second-floor TV sounded an alarm which prompted the participants to turn it on and watch the message. On the third floor, all

participants noticed when the CD was interrupted but only those sitting right next to the radio noticed the RDS message.

There were some small criticisms of the RDS system. "I have hearing-impaired people in my family," said a woman from the third-floor group. "This would have done little to help them. The (RDS) screen was not enough."

"We estimate that the

average household has five or six radios," said Denon's Philip Roberson. "If we can get them to buy (RDS radios) for their entertainment value and add on the RDS for delivery of emergency broadcast, we've done a really good job."

Mileti was not prepared for conclusions immediately after the tests, but he did make an initial, anecdotal observation: "Much to my surprise, it seems that the American public would be receptive to an EBS set of technologies that would,

without their will, intervene in their lives."

Paul Montoya, organizer of the entire week of Denver-area tests, stressed that "RDS is just one of the technologies that can turn on radios and turn on lights. There will be other manufacturers coming along to demonstrate other techniques."

TFT representatives were the harshest opponents of the Mileti tests. By using only the Sage system, "we're accidentally

sending out a message that Sage is the system," said Fred Baumgartner, who helped develop TFT's EIS before recently becoming chief engineer at KDVR(TV) Denver.

Helena Mitchell, the FCC's EBS chief, said that the tests were not meant to compare the strengths of the opposing systems, but to test the public's reaction to various types of EBS alert.

Mitchell also said the FCC did not choose the Sage/RDS system. The details of the test procedure were left to Mileti. She promised that a generic alerting system would be used for the next public-reaction test in Baltimore.

## Building a Better EBS

► continued from page 9

**LeBow:** It's hard to understand what the commission is going to put out, whether they lay out bare-bones requirements or lay out some global objectives. I think (the FCC) will say: "We want a system that's expandable so that we can grow into the 21st Century, and, therefore, dollars and cents are not going to be the only criterion." If that's the case, I feel very comfortable that they're going to look towards our technology.

**RW:** How important should broadcaster equipment-cost considerations be in the development of the new EBS rules?

**Parker:** Cost is no object when it comes to saving lives. But we must remember those who are going to bear the burden of that cost. We're trying to keep costs as low as possible because we know in the end the consumer is going to be paying for it, whether it comes from Congress in the form of new taxes or if it comes in increased advertising rates.

**LeBow:** We want them to make it price-reasonable as opposed to playing a numbers game. If you were to buy the top-of-the-line EIS encoder/decoder today, it lists in the catalogs for about \$2,600. We're saying that for \$400 more an FM station gets not only that, but RDS, and for \$400 less than that, an AM station gets the full capabilities of running the system.

**Shay:** We feel that our receive system is relatively low-cost. There are clearly costs associated with satellite access, but those costs, we feel, can be amortized, depending on the number of users in the system, by sharing the costs and possibly selling back the satellite time to commercial users for non-emergency uses. If there are thousands of users, the actual cost would really be very small.

**RW:** Some of the observers in Denver said user-friendliness at both the encode and decode ends could be improved for all the systems. Do you agree?

**Montoya:** It was well demonstrated that all of the proponents were very lacking from the encode end. That was probably some of the most valuable information they walked away with. From the decode standpoint, they did a splendid job and proved that their equipment was easy to preprogram and to decipher.

**Parker:** We've got more work cut out for us in that department. That's one of the valuable things we learned. Our focus has not been on the box that goes in the EOC, but on the box that goes to the broadcaster. It needs to be more flexible for the person who is going to initiate that alert.

**LeBow:** Because it is software driven, (RDS) is totally modifiable. There is nothing fixed. When one of the (observers) asked if we could put in touch-screen as opposed to a keyboard, we said: "Sure, it's simple." We may very well show the same thing with touch screen (in Maryland). The software is really easy to manipulate.

**RW:** If an owner of the lowest-class AM station were to ask you how and when the new EBS rules would affect him, what would your answer be?

**Mitchell:** If I'm a smaller station, I'm looking forward to the day I can automatically alert my station and my audience. I can carry a beeper with me that can activate my station if something is happening. I can use those times when we have audio on-air tests for something else. On-air, coordinated tests, will make me feel more like part of my operational area when a real emergency happens. Coordinated monthly tests are going to get (stations and emergency agencies) used to talking to each other.

**Montoya:** I would hope that person will be affected some time in 1994. I use that word "hope" because I think a lot of broadcasters are out of the loop and at a disadvantage. They are isolated and don't get good information on emergency alerts. Technology will affect them from a positive standpoint because they will not be tied down by the current regulations within EBS.



One of three focus groups listens to EBS alert on Denon RDS receiver (near window).

but unaware that it would be an EBS test) to his three-story Denver townhouse and divided them into three focus groups.

On the ground floor, the group was engaged in conversation while a television turned was on at low volume. The second-floor group carried on its conversation next to an RDS-equipped TV set that was turned off. The third floor group talked while a Denon RDS radio/compact disc unit played a Michael Jackson CD.

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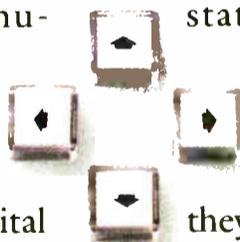
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World Radio History

# LMA a Nightmare for WNWZ(AM)

by Dee McVicker

**MEMPHIS, Tenn.** An LMA deal turned sour led to a four-month standoff between lease holder and license holder that included a midnight transmitter raid, hired armed guards, courtroom antics, and, according to those involved in the situation, a hostage takeover of WNWZ(AM) in Memphis, Tenn.

It was the first publicized incident of its kind to take place since the LMA ruling, and, according to WNWZ designated station manager Dave Beveridge, calls into question the FCC's rules governing LMAs (Local Marketing Agreements).

The ordeal began in August 1992, when Rev. Thaddeus Mathews, a self-described minister and broadcaster, entered into an LMA agreement with Ardman Broadcasting for the use of WNWZ's signal and studios.

According to the parties involved in the ordeal, tensions developed when Mathews, who had put up \$5,000 initially, didn't make the agreed upon monthly payments of \$7,500. By Jan. 1, 1993, he was \$19,000 behind in payments and Beveridge pulled the crystal on WNWZ's transmitter. WNWZ's licensee is Ardman Broadcasting, comprised of partners Adrienne and Meyer Feldman.

Two days later, having agreed to pay the owed amount by Jan. 31, Mathews was allowed back on the air. But when payment still hadn't been received by the evening of the Jan. 31, Beveridge made a late-night visit to the station's transmitter site.

## Key didn't fit

By then, according to Beveridge, the door locks to the station had been changed, and Mathews had hired armed guards to oversee the station's studios and transmitter.

Unbeknownst to the guards, Beveridge said he walked through swampland, used

a rope to climb up to a catwalk on the transmitter building, and "with a flashlight held in my teeth," put screws in the transmission cable to take the station off the air.

Six weeks later, Mathews was back on the air with cable from Radio Shack and a legal maneuver that would make it impossible to get him out of the studio and off the air for months to come. Mathews had filed bankruptcy, which froze all legal activity, including eviction.

Ardman Broadcasting Attorney Gail Mathes explained that the bankruptcy code is so powerful that someone can use it to gain an immediate stay of all legal activity.

Mathews admitted in an interview he used bankruptcy as a means to halt eviction, but he claimed he in no way took hostage of the station. The guards, he claimed, were put in place to "maintain his position" and deter Beveridge from pulling the switch on the station again.

"I can't agree that I kept him (Beveridge) away from the station. We had an agreement through the attorneys if he wanted to come, he could have..." Mathews said.

Beveridge sees the ordeal differently. "He essentially took over the radio station. He became a pirate. He denied us not only access, but he denied us complete control," Beveridge said, who questions whether or not the LMA rules are explicit enough to hold Mathews accountable.

## LMA rules vague

"The commission made a huge mistake in my opinion, and I know a lot of station owners would not like to hear me say this, but I believe they made a huge mistake in allowing the LMA to go forth in the first place, especially with vague, vague rules," Beveridge said.

But vague is not how Mathews describes the LMA rules. Said Mathews: "They would not call the FCC on me because calling the FCC on me would mean that it was like calling the FCC on yourself. As far as the FCC is concerned I do not exist."

Meyer Feldman, who also is a Washington attorney, however, did contact the FCC and kept the commission apprised of developments as they unfolded. He said his understanding of the commission's standing on the case was that if required, they would be able to unseat Mathews from the station on the grounds that he was broadcasting without authorization.

According to Feldman, Mathews was considered a trespasser because the arrangement was not a true LMA since Mathews had never made a monthly lease payment.

But dispatching an FCC representative to the station was a problem. Said Feldman: "What he (the FCC representative) said was that they did not have an office there (in Memphis)." They "hesitated" to send a person from another field office "if I was accomplishing the same thing," Feldman added.

Feldman concurrently pursued the matter under state law through Mathes, who obtained a restraining order and injunctive release in the local courts. The court order finally removed Mathews from the station, but not before at least two FCC rules had been violated, according to Beveridge.

"In Memphis, Tennessee, the F word is obscene, and I heard it a lot on the air (in continued on page 27 ►

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*Air* 2:37	Feelin' Stronger Every Day Chicago :25/4:03/F 1973 C12608 10:17:20	Recue Ins.	Guest Mic. 2	Jingles 7
Start F2	Back Announce - Linked to C12608 Dave Scott :00/0:08/C BAL VT0214 10:21:15	F6 Move Up	News Mic. 3	Music Library 8
Start F3	McDonald's 2 for \$2 Special JT Q: Now Thru Saturdays Only. :00/1:00/C COM DA1103 10:21:23	F7 Move Up	Marti 4	Spots 9
Start F4	Bob's Bargain Barn BW Q: At Westland and East Park. :01/1:00/C COM DA4310 10:21:50	F8 Move Up	Network 5	Options 0
Start F5	Uptempo Jingle - Linked to C02102 Q: Kiss FM. :00/0:06/C JIN DA1037 10:22:50	Move Up	More Events	Delete Event Del

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# Studio Sessions

Mixing  
Pavarotti For Live  
Broadcast,  
see p. 20

Equipment and Applications for Radio Production and Recording

## Digital Mixing Pervades Catspaw

by Dee McVicker

**ATLANTA** Catspaw Productions Inc. President and Founder Doug Paul likes good sounding pieces of studio gear that talk to one another, particularly if they're talking digital.

That's why five studios at Catspaw's sprawling recording and audio/video production house in Atlanta are all digital and why at least two have digital mixers and editing workstations that interface digitally.

Paul, who does voiceovers for Tribune Broadcasting, among others, recently introduced digital Yamaha mixers to the studios' three existing Studer Dyaxis editing workstations for the purpose of eliminating analog from the audio production loop.

Having a digital workstation that shakes

two tracks and four tracks and cart machines to be able to do your assembly of elements. Nowadays, in a digital domain, you have up to 200 tracks you can work with, and you load in as many different sound files as you want," he said.

Paul makes good use of Catspaw's large sound effects and music library, most of which is archived on CD, RDATA or other digital sources such as MiniDisc or DCC. "All of our raw voice is on DAT. Rather than cutting it to reel-to-reel analog tape, we use RDATA tapes," he said.

Sources such as these are directly interfaced to the Yamaha for post-production, which the console reserves two input channels for and facilitates through a SPDIF interface.

Occasionally, for some material stored

bells and whistles offered on the Yamaha mixers. "In the good old days, people used to fill out track sheets with specifics on EQ," he recalled. These days, Paul's work is much easier. EQ, pan, aux sends, and bus assignments are all programmed

into the DMC 1000, and stored on 3 1/2-inch diskettes so Paul can use the settings later.

"All you have to do is press a button and it remembers it for you," Paul said, who has a diskette for just about every recent production done by the studio. Storage of this information has proven helpful for half-finished projects that

continued on page 26 ▶



The Sonic Solutions Sonic Station II is a Macintosh Quadra-based digital audio workstation. For more information, see Product Guide, page 18.

hands with a digital mixer is a nice convergence of digital and digital, he said. The Yamaha DMC 1000's extend the digital chain from source to mix-down, eliminating conversion to analog when interfacing to a disk-based system such as the Dyaxis. Likewise, the Dyaxis II allows implementation of any digital I/O. The mixer and digital workstation speak the same language, and no DA/AD converters are required.

### Talking to each other

"The biggest change that has happened over the past five years is the dramatic price drop of digital workstations. Everybody's got one, but the DMC 1000 console and the Dyaxis are very hip because they talk to one another," Paul said.

This new communication link gives him the "ability to have clean first generation digital production," according to Paul, whose recording studio and production house is known across the country.

In this environment, Paul said he doesn't spend as much time dealing with the ergonomics of overlapping sound. "Years ago, when I used to work in a production room, and I had a traditional 2-track or 4-track setup, you would use

on reel-to-reel, Paul will have to create a digital-to-analog bridge with DA conversion.

"We have four new state-of-the-art facilities that are all digital, and then we have a fifth studio which is the best of the old stuff—the archival room. It's sort of our gateway to analog," Paul said.

A 24-track mixer also is still in service to give the studios access to 24-track material as well. "When we do jingles and we do music and sound design work, we will lock the digital editor with the 24-track to give us additional flexibility," he said.

But, he added, "Most of the material today is from DAT. So there's a likelihood that we'll only work from DAT and CD."

Occasionally, if it's material of a more esoteric nature, he'll produce it himself in the Foley studio. Catspaw is one of the few recording studios in the country with this kind of studio, which has sound props and Foley pits to create just about any audio effect in the universe, according to Paul.

### The good old days

When audio productions and recordings reach the mix-down stage, Paul doesn't hesitate to take advantage of the digital

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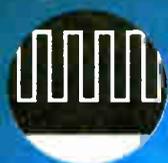
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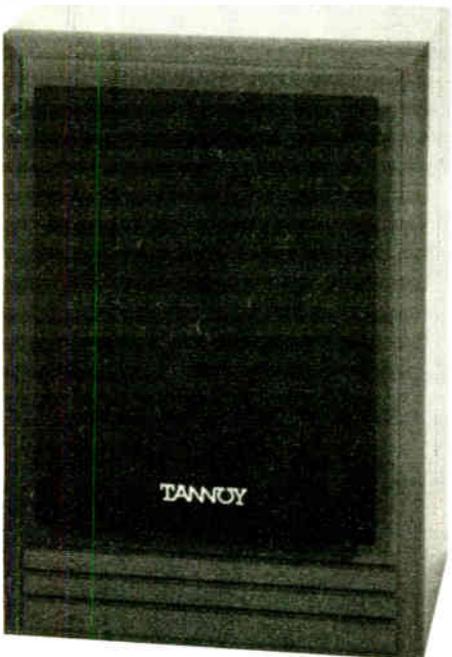
## MONITOR SHOOT-OUT

# Monitor Tests Reveal Sonic Differences

by Bruce Bartlett  
with Jenny Bartlett

**ELKHART, Ind.** Most pro recording studios use large monitor speakers which provide deep bass. However, they are expensive, heavy, hard to install, and are affected by the acoustics of the control room.

If you want to avoid this hassle and expense in your radio production or inde-



Nearfield monitors: (top to bottom) Yamaha NS-10M, JBL 4408A, EV Sentry 100A, and Tannoy System 6 NFM.

pendent studio that contracts for radio production work, consider using a pair of "nearfield monitor speakers." A nearfield monitor is a small, wide-range loudspeaker typically using a cone woofer and dome tweeter. You place a pair of them about 4 feet apart and about 4 feet from you.

This technique, developed by audio consultant Ed Long, is called "nearfield monitoring." Since the speakers are close to your ears, you hear mainly the direct sound of the speakers and tend to ignore the room acoustics. So the speakers tend to sound the same in any environment. You can save the cost and time of acoustically treating your control room. Plus, nearfield monitors sound very clear, need little or no equalization, and provide sharp stereo imaging.

Nearfield monitors are designed for close listening; they have enough bass to sound full when placed far from walls. The woofer and tweeter outputs sum for flattest response about a meter away. Although most nearfield monitors lack deep bass (below 70 Hz), you can add a subwoofer.

How do you place nearfields? On top of the console meter bridge, or just behind on stands or shelves. The speakers and listener should form an equilateral triangle. The speakers should be placed so that the tweeters are at eye height, and angle them in to aim at you. Orient the speakers vertically to get the most uniform dispersion in the horizontal plane. (Horizontal placement, though, works almost as well). If the speakers are not magnetically shielded, keep them at least 18 inches from video monitors.

## The contenders

RW asked me to review four popular nearfield monitors priced from \$400 to \$800 a pair. Each is a 2-way unit with a dome tweeter and a cone woofer (6.5 to 8-inches). Let's take a brief look at each model under test.

**EV Sentry 100A:** This is the industry-standard monitor in broadcast studios. Its 8-inch woofer is in an optimally vented cabinet with fourth-order Butterworth tuning. The dome tweeter handles 25 watts and offers wide dispersion. Around the tweeter is a foam damping ring which is said to reduce diffraction for flatter response.

**JBL 4408A:** This bookshelf-size monitor is claimed to have a smooth frequency response, low distortion, controlled off-axis response, and high power handling. Listening fatigue is said to be very low. Drivers include a 1-inch titanium dome tweeter and an 8-inch felt cone woofer with cabinet port. Speaker pairs are mirror imaged. JBL's entire 4400A Series monitors were developed with the

aid of extensive field tests in studios, according to the company.

**Tannoy System 6 NFM II:** In this unique Dual Concentric system, the woofer cone forms a horn for the tweeter. Since the woofer and tweeter are coaxial, there are no dips in the response caused by phase cancellations between the woofer and tweeter as you move off axis, the company said.

The 6.5-inch ported woofer is made of graphite-filled, injection-molded polypropylene. This ensures that the response will be the same from unit to unit. The cone is thickest at its apex and has a very rigid mount for the voice coil. The nitrile sur-

round is molded-on rather than glued. Other features include high sensitivity, high power handling, compact size, anti-diffraction ring, bi-wired gold-plated terminals, and high-quality capacitors.

According to Tannoy, the speaker's presentation of the midrange is very different from other speakers. It is meant to be a revealing, clinical tool for studios. Special attention was paid to linear group delay and coherent phase response.

## Listening tests

Before I auditioned each pair of monitors, I placed them four feet apart and four feet from me, just past a small mixing console. The speakers were 6 to 12

**If you want to avoid the expense and hassle of large studio monitors, consider a pair of nearfield monitors.**

feet from the walls. Grilles were off. My associated equipment was a Crown PL-4 power amplifier (165 watts per channel into 8 ohms), Crown PSL-2 preamp, Magnavox/Philips CDB610 CD player, and 12 feet of 14-gauge lamp-cord cable.

This review reflects my personal listening tastes, and is not an endorsement or critique by RW. For several years I have reviewed high-end audiophile loudspeakers, and I have been a recording engineer for two decades. Here are my listening impressions with a variety of CDs:

**CD No. 1—"Time On My Hands,"** John Scofield, Blue Note CDP 792894 (jazz quartet)

**EV:** Mellow upper mids, no edge to sax. Cymbals are pretty crisp but not airy. Bass is too loud.

**JBL:** Similar to EV, but with more definition in the mids. Bass is also too loud.

**Tannoy:** Similar to JBL, but with more definition in the mids. Bass is also too loud.

continued on page 21 ▶

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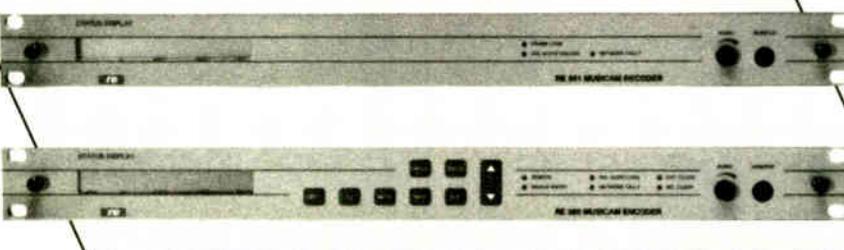
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# Arrakis System Does it All for WLWI

by Larry Wilkins

**MONTGOMERY, Ala.** When working on WLWI-AM-FM's budget for 1993, it was decided to include funds to replace our aging automation system on the AM. After a meeting with the general manager, we agreed to replace not only the automation with a computerized hard disk system, but go ahead and integrate the entire station with the same system.

We installed three Arrakis Digilinks, and connected all three plus our traffic computer together with a Lantastic network. I strongly suggest that if you plan to have more than one machine that you install the Lantastic. It is simple to install, just run RG-58 between machines. The ability to transfer audio files and schedules between units is a great help.

Our system runs with Darts traffic software. The traffic computer transfers a generated log to the AM or FM control room...the Arrakis "builds" the log and the next day gives the traffic computer a "played log" for Automatic Log Reconciliation.

The unit in the AM operates in a satellite mode, the FM operates in Live Assist, and the third in the production room is used to produce and archive audio files.

## Using the Trak\*Star

Production is done with the Arrakis Trak\*Star 8 software. This software runs

on the same machine and shares files with the Digilink.

WLWI has been using analog eight-track machines for quite some time, so the basics of doing multitrack recording

**You need not be afraid to try an edit or cut. If you don't like the way it sounded, just click on the "undo" button...**

was not new to the production staff. Trak\*Star offered the same features they were used to on the analog machines, plus a lot more.

The screen is laid out to be very user friendly. On the left side are buttons to select the operation and on the right are categories to place your audio files. The center is used to display the audio tracks that you are working with. The waveform display can be increased or decreased. The block of audio you are looking at can be changed to allow more or less time to be viewed as well. This is helpful on tight edits.

## Easy as multitrack

Operation is straight forward, following close to the way multitrack was handled with tape machines. Once you have loaded the individual pieces of audio for a session, you simply begin editing, not with a razor blade, but using operation

keys selected with the mouse or keyboard.

You can cut, copy, split, move, or delete segments at your pleasure. Those who are familiar with word processors

recognize these terms and they work the same way in Trak\*Star. Remember that with each edit in analog you normally add another generation. On the Trak\*Star, every edit is first generation.

You can listen to one track while editing another. This is the case when a sound effect needs to be placed at the right point with other audio. You need not be afraid to try an edit or cut. If you don't like the way it sounded, just click on the

simply mix down to a stereo audio file. If it is being used with the Digilink software, the file is already in the directory for Digilink. It can be compressed (if desired) and transferred from Trak\*Star without going back to Digilink.

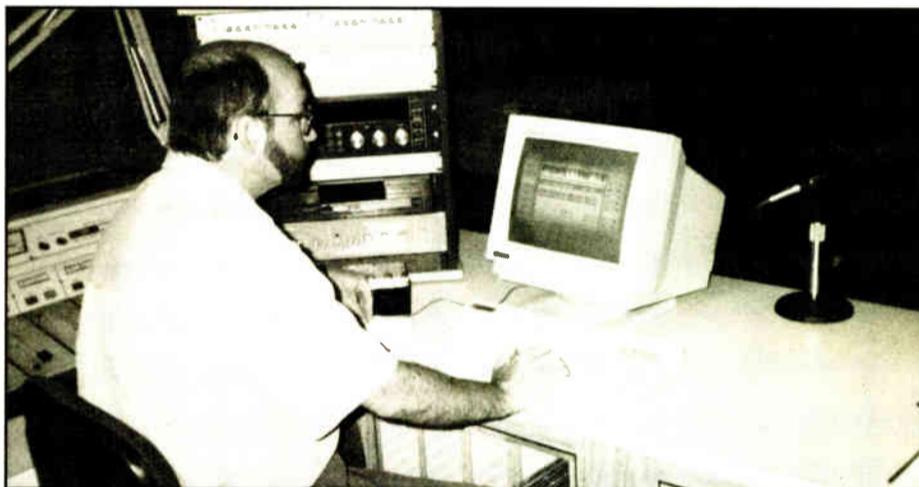
A non-technical feature is the price. There is no way to purchase an eight-track analog machine and console for the price of the Trak\*Star.

Here are some hints and items that stations need to be aware of—not just for the Arrakis system but any computer-driven production system:

1. It is a computer and you MUST do things the way the computer wants it done, not the way you think it should be done.

2. It is software driven, and we all know there will never be a perfect software. The Trak\*Star has not been without its "bugs," but I have been very impressed with the manner in which the programmers have worked out the problems.

Arrakis has taken the view that the end user has a pretty good idea of what they want the system to do; as a result, they listen and respond to their customers.



WLWI Production Director Al Mason editing on an Arrakis Trak\*Star.

"undo" button, and it's back like it was before the edit. Try that with your razor blade.

In fact, if you blow the whole session, you can start over, because all your original pieces of audio are sitting undisturbed in their category. We call that non-destruct editing.

## Back and forth scrubbing

Other nice features include a "scrub" mode which allows cuing to a precise audio mark, the same as rocking a reel

**Operation is straightforward, following close to the way multitrack was handled with tape machines.**

back and forth. Individual tracks can be turned on or off during editing and their respective levels adjusted for the right mix.

The levels and fade characteristics can be applied on each individual segment that you have edited. A nifty feature allows a mirror image fade to take place on an adjacent track. The demo had a jet plane flying from left to right. The left track faded down and the right track faded up, which is accomplished with one button.

Once you are satisfied with the mix,

3. When your unit arrives, don't take it out of the box, and hook it up and start using it the same day (although that's technically easy to do). Set the unit up and allow the operators to learn how to operate it before putting it on the air.

One of our main concerns was how the operators would take to this new technology. Several of them grew up with turntables and "maggis."

So I took the backdoor approach. Instead of installing the system and taking out all the analog equipment, I installed the Trak\*Star next to the analog equipment. I then went over the operation (one on one) with them as they had time to work with the new equipment.

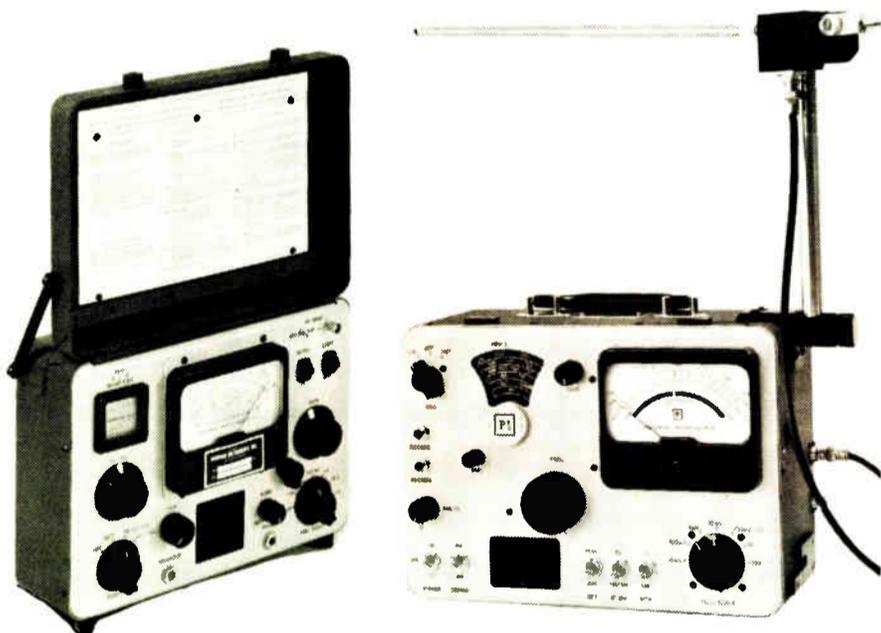
In talking to other stations, I now find more and more production and operation being done on the Trak\*Star and Digilink. Comments like, "this is a lot simpler than pulling carts" and "sure cuts down on edit time" are not uncommon.

Engineers like myself, that started out in the early '60s, should not be afraid of digital operation. Although the technology is changing at a very fast pace, I find it an exciting time to be in the business. It is also a lot easier. No longer do you have to be able to count from one to ten; now it just from zero to one.

□□□

Larry Wilkins is chief engineer at WLWI-AM-FM Montgomery, Ala., and Chairman of SBE chapter 118. He can be reached at 205-240-9274 or CompuServe 72134,2104. For more information on the Arrakis Trak\*Star, contact Jon Young at Arrakis, 303-224-2248, or circle Reader Service 163.

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## PRODUCER'S FILE

# Big Whoosh! Carries Small Price Tag

by Ty Ford

**BALTIMORE** It's been a while since I've written about a radio station's audio signature. You know, the complement of jingles, sounders, beds and other production bits that a station uses to "glue" all of the program and promo elements together. With the right package used the right way, even if no call letters are mentioned, a listener can still identify the station by these sounds.

These packages used to cost thousands of dollars. Not any more. The Big Whoosh! CD (WH00-1) from Promusic is available as a buyout for \$189. Since there are one hundred and eighty-nine cuts on the thirty-five minute long CD, that's a buck a cut. Granted not all the cuts are different. Sometimes you get a bed mixed with other effects, followed by the individual elements. It's not a bad way to put this kind of package together. You can use the pre-mixed stuff right out of the can if it works, or put it together a la carte.

## Quality sound

The producers did a nice job of filling the stereo spectrum and the tracks are recorded and well-mastered, with little extraneous noise on the tracks. Some of the sounds are analog and some are digital, some a combination. What struck me was that usually for this price range you get really cheesy sounds. There's nothing wrong with cheesy sounds per se. There are times when only a cheesy sound will work. They're great for comedy bits, parodies, etc. I found only the appropriate amount of cheese, just enough for an appetizer.

The Big Whoosh! is divided into nine categories: Sounders; Whooshes; Otherworlds and Aliens; Fly-bys, Take-offs and Landings; Accents; Sparkles; Hits; Zings, Zaps, Funny Stuff; and Often Needed. Because of the number of cuts, the CD relies heavily on index numbers, which is my only real criticism of the disk. Indexes are a pain to cue up on most CD players.

## The Menu

"Sounders" gives you nineteen audio logos, program and news opens and closes, bumpers and transitional elements like clock chimes, drone notes, and pulsing beds. They range from four to forty seconds in length and are all in the key of C.

"Whooshes" contains a collection of forty-nine widely varying er...whooshes; everything from the graveyard whoosh to the mega-low-frequency rocket

ship whoosh to the whoosh in lengths from one to forty-nine seconds long.

"Otherworlds and Aliens," comprised of subtitles like Star Showers, Spooky, Danger, Encounters, Zoomer, Short Space, Clanky Echo, Space Doors and Photons Firing, account for another nineteen cuts. Times range from one to forty-two seconds.

There are eighteen different cuts on "Fly-bys, Take-offs and Landings," ranging from two to twenty-two seconds in length; more than enough to fly-by anything in your imagination.

"Accents" holds a great collection of cymbal, gong, snare, tympani and rimshots, including a twenty-four second We-Will-Rock-You type instrumental

percussion bed that will get a lot of use.

## The cuts sparkle

"Sparkles" has arpeggiated and droned chimes, an assortment of choral "aahhs" and descending as well as ascending bell tree chimes, twelve cuts in all.

"Hits" holds an ample collection of twenty short percussive

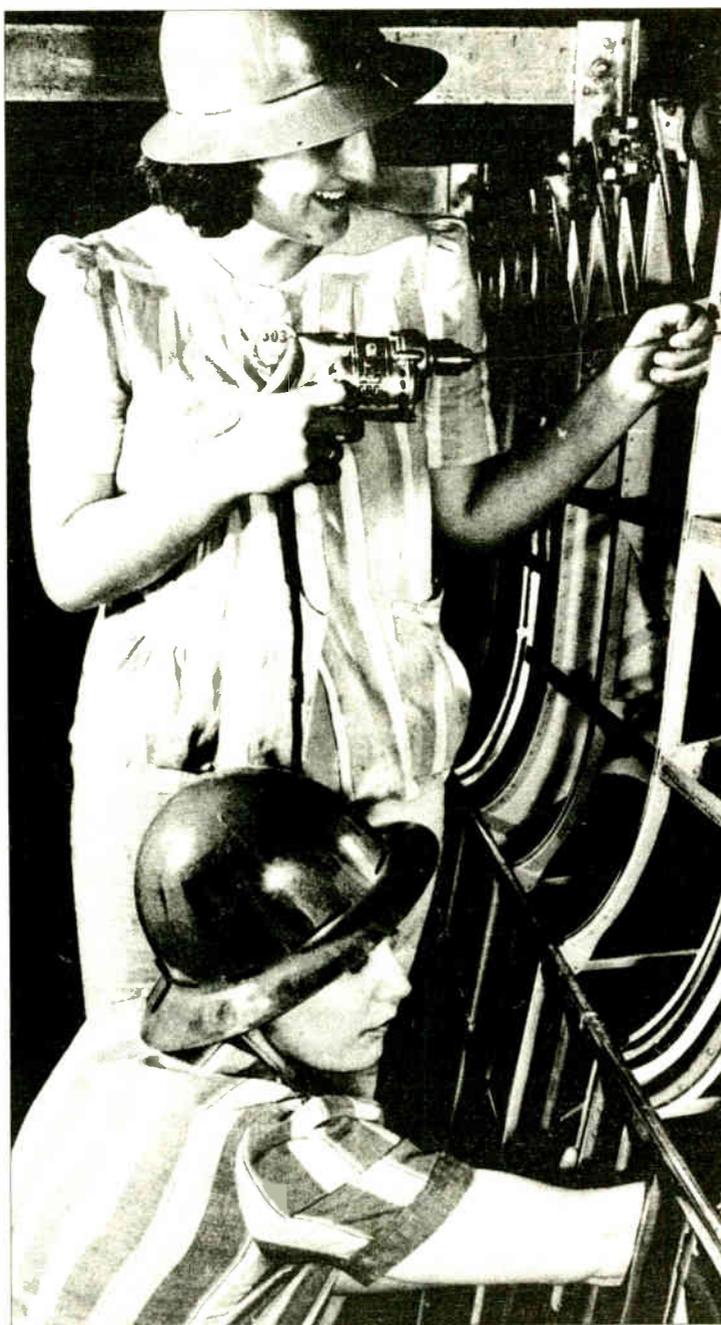
jabs, medium length powerful Ka-Pows, claps, clickers, jail doors and orchestra hits.

"Zings, Zaps, Funny Stuff" features xylophone glides, slide whistles, siren whistles, whip cracks, breaking glass and an assortment of odd ball synth sounds for a total of twenty-four sounds.

The last seventeen cuts, "Often Needed" include heartbeats, car horns (VW and V8), lightning crack, manual typewriter, refs ringing effects, a doorbell, water splash, golf and tennis ball hits and, finally, a nice mid-sized

continued on page 27 ▶

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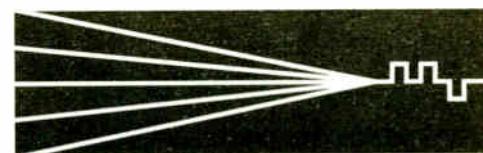
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# PRODUCT GUIDE

Companies with new product announcements for Studio Sessions Product Guide should send them to Radio World, c/o Studio Sessions Editor, 5827 Columbia Pike, Suite 310, Falls Church, Va. 22041

## Sonic Solutions Sonic Station II

The Sonic Solutions Sonic Station II is an affordable hard disk-based digital audio workstation that works with the Macintosh Quadra. The system is said to be an ideal entry system for radio production or multitrack production.

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For more information, contact Mary Sauer at Sonic Solutions, 415-485-4800; or circle **Reader Service 28**.

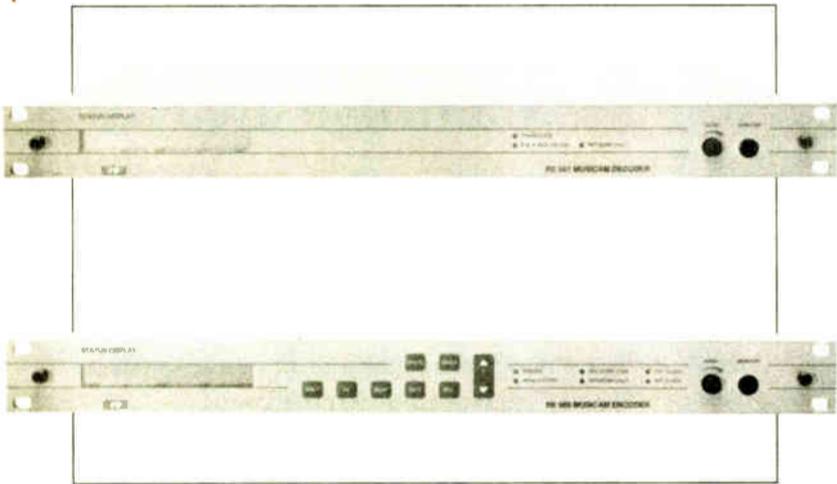


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For more information, contact TDK at 516-625-0100; or circle **Reader Service 123**.

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## Sony TCD-D7 DAT Recorder



Sony Professional recently introduced the new Sony TCD-D7 portable DAT recorder. Designed for field recording use including newsgathering, the D7 weighs 13 ounces, and runs on four double A batteries, AC or 12VDC car power.

The D-7 has a long play mode, and two-setting automatic level control or manual level control. List price is \$679.00.

For more information, call Sony Professional at 800-635-SONY; or circle **Reader Service 115**.

## Roland SRC-2 Dual Sample Rate Converter

The Roland SRC-2 provides a variety of digital conversion and mixing features.

The unit enables the user to mix two stereo digital signals at different sampling rates into one stereo output. It allows for any incoming sample rate between 30 kHz and 52 kHz. Selectable output rates include 48.048 kHz, 48 kHz, 47.952 kHz, 44.1 kHz, 44.056 kHz, and 32 kHz.

The two digital inputs and one digital output, each selectable between AES/EBU



Pro Format I (XLR) and AES/EBU Consumer Format Type II (coaxial or optical), allow the user to mix different sample rates together.

For more information, contact Al Dugas at Roland, 213-685-5141; or circle **Reader Service 76**.

continued on page 27 ►

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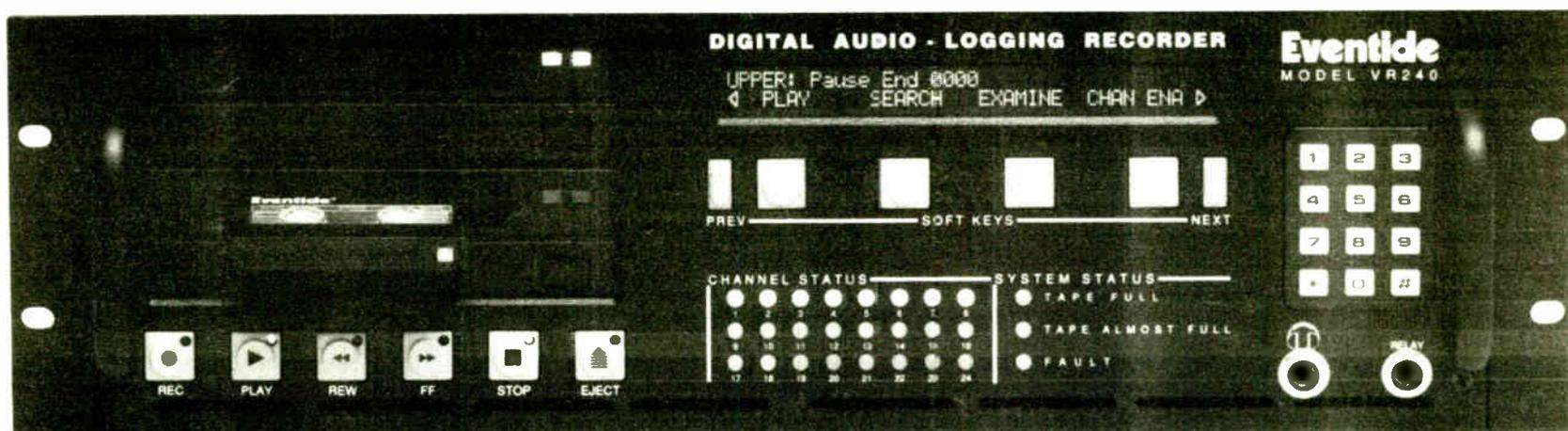
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## SIGNAL-TO-NOISE

# Mixing Pavarotti For Live Broadcast

by Frank Beacham

**NEW YORK** It was in 1983, just after Luciano Pavarotti was embarrassed by feedback from his sound system at a Miami concert, that James Lock got the phone call. "Come to Montreal immediately," an aide to the Italian tenor urgently requested, "Luciano needs you. He wants someone he trusts running the sound system at tomorrow's concert."

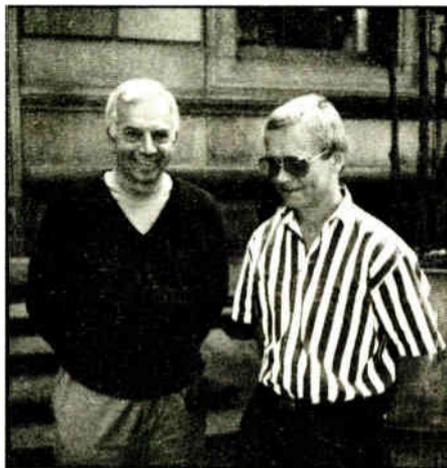
Although Lock was a veteran recording engineer who had often worked with Pavarotti in the studio, he had no experience with live concert sound. However, understanding the maestro's frustration, the request was honored.

Lock arrived in Montreal just as a pre-concert news conference was about to begin. As Pavarotti entered the darkened room, facing a glare of television lights, he scanned the crowd for a familiar face. "Suddenly, he spotted me sitting five rows back, pushed everybody aside, rushed up and put his arms around me," Lock recalled. "He said, 'I'm very happy to see you here my friend.'" A photograph of that warm embrace, published in a Montreal newspaper, was captioned: "Pavarotti Greeting an Old Friend."

#### The engineer/artist bond

Such a moment illuminates the delicate bond that often exists between artist and

engineer. Here was Luciano Pavarotti, one of the world's greatest voices, in desperate need of someone he could trust to navigate a merciless sea of technology that separated him from his audience.



Sound engineers James Lock (left) and John Pellowe (right) mix audio for about 18 concerts each year for Italian tenor Luciano Pavarotti.

Lock did the job well for Pavarotti at that Montreal concert a decade ago. So well, in fact, he's been in the sound cockpit for most major Pavarotti concerts ever since. These days, Lock and recording engineer John Pellowe, travel the globe, working on about 18 major Pavarotti concerts each

year. The rest of the time they engineer recordings for Pavarotti and other artists at the Decca Record Company in London.

At this summer's Pavarotti concert in New York City's Central Park, Lock and Pellowe were in their familiar roles. Lock mixed live sound for the estimated 500,000 concert goers on the Great Lawn, while Pellowe mixed the concert from a backstage mobile unit for a national PBS television audience. Both had the cool demeanor of seasoned pros with a well-honed routine that has repeatedly proven successful.

"We don't approach it from a rock and roll point of view," Lock said. "First of all, the dynamic levels of a classical concert aren't the same as rock and roll. Rock is normally peak level...loud as possible. We are using a system that can reach those levels but we use only about a third of the power. This makes the quality of the sound much cleaner. The peak level of the fortissimo of the orchestra is as clean as a whistle."

#### Minimalist approach

The goal, Lock said, is "minimalistic" sound reinforcement that rivals the audio quality of a commercial recording. Achieving it requires a match of the right combination of equipment and technique with each performance situation.

The equipment list on Pavarotti concerts include the tried and true. All microphones are Schoeps. The speakers are Meyer MSL-10As powered by Crown MA-5000VZ-MSL-10 amplifiers. The console is a 32-channel Ramsa. All the equipment is rented, with the exception of 25 of the Schoeps microphones, which are owned by the Pavarotti organization.

Lock, who swears by "the natural and consistent" sound of Schoeps microphones, uses the MK 4 cardioid and MK 21 wide cardioid Colette capsules as "lenses on a camera" to pick up the various sections of the New York Philharmonic. Pavarotti's voice is captured with a MK 4 cardioid capsule attached to a tube extension and a CMC 6 transformerless amplifier.

A second duplicate vocal mic setup is used for stage monitoring and as a backup. Wind and rain, Lock said, are the most severe threats at an outdoor concert. Thus, wind protection for the 30-plus stage mics got top priority. A new Schoeps wind-screen design, first tested on the famed "Three Tenors Concert" in Rome in 1990, was used here in its production version.

The new screens use a plastic insert to encase the mic capsules in air, rather than foam, resulting in a 12 dB or better improvement over traditional foam screens. Pavarotti's mics used the small, unobtrusive B5-D model while most orchestra mics used the larger W5-D.

The Central Park concert came off without a hitch. To this listener, stationed less than 100 feet from a speaker cluster, concert sound was never better. Lock and Pellowe did it again for their client.

"Our working relationship is one of mutual trust," said Lock of Pavarotti. "You have to speak your mind with him, and you've got to be consistent. There is no pulling the wool over the eyes in these situations."

□□□

Frank Beacham is a writer, director, producer and consultant. His address is 163 Amsterdam Ave. #361, New York, NY 10023.

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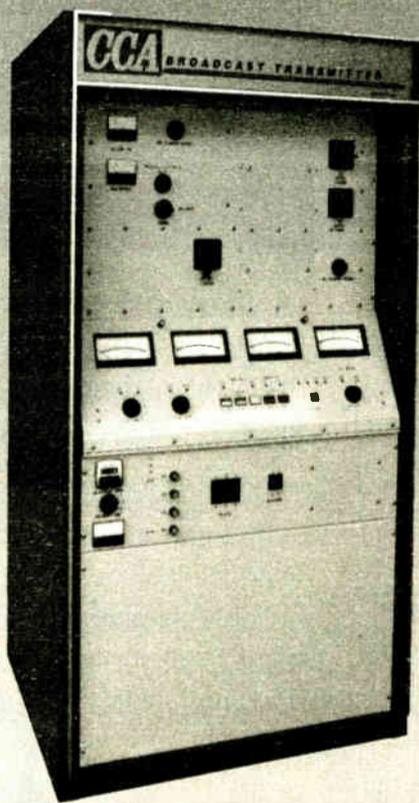
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# Nearfield Monitor Testing

► continued from page 15

**JBL:** Slightly honky due to midrange emphasis. Breathly sax. Good impact on drums and kick drum. Cymbals are a little harsh. Tight bass. Good tonal balance.

**Tannoy:** Cymbals are airy and realistic but too bright. Tight, mobile bass. Sax is breathy and hard.

**Yamaha:** Great! Good tonal balance. Not boxy. Full snare, airy cymbals. Just the right amount of edge and body on the sax. Kick drum is not as punchy as with JBL. Transients softened.

*CD No. 2—"Secret Story," Pat Metheny, Geffen GEFD-24468 (world music)"*

**EV:** Warm and smooth, but too much midbass, giving a tubby or puffy effect. No trace of harshness; listening fatigue is low. Voices sound realistic. At high volume, the sound becomes smeared and even more tubby.

**JBL:** Good tonal balance. Less midbass boom, more presence and impact than EV

Detail not as clear as Tannoy. The most human-sounding vocal of the four, not an over emphasis of midrange.

*CD No. 5—"The Firebird," Stravinsky, Telarc CD-80039 (classical)*

**EV:** The beginning bass-drum roll is just a whisper; it is not felt like when listening to audiophile speakers. No air or edge to the instruments; a rounded, covered effect. Low fatigue. Excellent sense of space or ambience. Often good realism on instruments. Strings don't sound as sweet and delicate as they do with high-end speakers.

**JBL:** The bass-drum roll is sensed more than heard. Good spatial depth. Impressive impact on bass-drum whacks. Timbres are not quite right, not as pretty as the real thing. There's a "cardboard" coloration to the timbres—maybe a midrange emphasis?

**Tannoy:** Bass-drum roll is absent. But you can hear individual hits in the tympani roll! Lots of production noises are audible, timbres are hard and aggressive rather than sweet or woody. Good dynamics.

continued on page 26 ►

	Manufacturer's Specs			
	EV Sentry 100A	Yamaha NS-10M	JBL 4408A	Tannoy Sys. 6 NFM II
Frequency response	45Hz-18kHz +/-3 dB	60H-20kHz (-6 dB)	50Hz-20kHz +/-2 dB	52Hz-25kHz +/-3 dB
Sensitivity SPL/watt/m	91 dB	90 dB	89 dB	91 dB
Power handling	30 W long 300 W peak	60 W pgm. 120 W max.	100W pink noise	175W peak
Dimensions	17x12x11 HxWxD	9x15x8 HxWxD	17x12x12 HxWxD	14x9x9 HxWxD
Weight, each	28 lbs.	13.9 lbs.	26 lbs.	12.6 lbs.
Connectors	Thumbscrews accepts wire or spade lugs	Thumbscrews accepts wire or spade lugs	5-way binding posts, accepts bare wire, spade lugs or banana plug	Gold-plated posts, accepts wire spade lugs, individual banana plugs
List price	\$710/pair	\$398/pair	\$650/pair	\$799/pair

**Nearfield monitors sound very clear, need little or no equalization, and provide sharp stereo imaging.**

Sentry 100A. Tight bass, and a sense of deep bass. Good dynamics. Guitar plucks are crisp but not tizzy. Not as realistic as EV.

**Tannoy:** Bright, top-heavy. There's not much bass, but the bass is tight. Crisp tambourine. Clear guitar strums, almost bristly. Detailed, superb transient response. You can hear felt-hammer thumps in the piano.

**Yamaha:** Sweet, delicate highs with cymbals, percussion and strummed guitar. Detailed bass plucks. Good tonal balance. Bass doesn't go deep but is full. Can play quite loud for a small speaker.

*CD No. 3—"On Every Street," Dire Straits, Warner Bros. 9 26680-2 (rock)*

**EV:** Warm, smooth and mellow. Chesty vocal. Kick and snare lack impact.

**JBL:** Tight and punchy kick drum. Tremendous snare impact at high volume. Vocals are breathy, not tubby.

**Tannoy:** Sizzly vocal. Tappy kick drum, lacks bottom. Extreme snare impact. The bright tonal balance becomes fatiguing.

**Yamaha:** Lacks deep-bass power. Vocal has some nice fullness or body. Pretty good snare impact, but somewhat smeared transients.

*CD No. 4—"Crossroads," Tracy Chapman, Elektra 9 60888-2 (folk-pop)*

**EV:** Lacks deep bass. Bass chords are tubby. Chesty vocal.

**JBL:** Not tubby. Pretty good tonal balance. Vocal has an emphasized midrange sound rather than warm and human.

**Tannoy:** Wonderful guitar detail, outstanding clarity in conga hits. Gets really loud without mushiness. No bottom, but hey, this is a tiny loudspeaker. Vocal sounds mechanical, not organic.

**Yamaha:** Full but not muddy bass.

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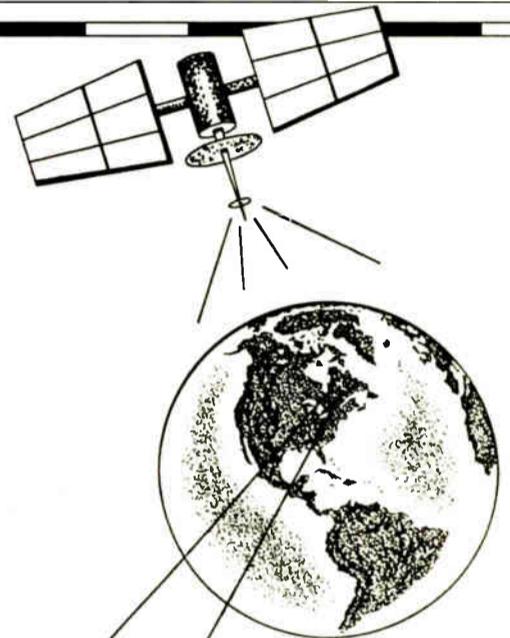
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## DIGITAL DOMAIN

# Understanding Your Digital Error Displays

by Mel Lambert

**LOS ANGELES** If analog was good then, so the adage goes, digital is infinitely better. In many ways this is true: linear frequency response at all recording levels; minimum signal degradation and noise build up during repeated copying; dramatically reduced wow & flutter and azimuth anomalies... the list goes on. In many respects, digital is just what the broadcasting doctor ordered.

But, as one colleague of mine was heard to observe, we have less understanding of the way most digital hardware functions,

compared to our more ready familiarity with analog recorders, consoles and effects units. (The same individual observed that, with a little patience, he could almost certainly fabricate a device that played back virtually any analog recording format, but would be pushed to build a device that would accommodate, for example, an early video-based format, let alone some of the contemporary multi-track precision, narrow-gap head designs. In that respect, we are very much at the mercy of the hardware manufacturers to continue their commitment to a variety of record/replay configurations.)

## Acceptable errors

One area that has often left engineers more than a little confused is the thorny subject of error rates for digital systems, including DAT machines. While all of us realize that no format will be perfect—it's an electro-mechanical world we live in, after all—but exactly how reliable a format is DAT?

Many recorders now come equipped with error-rate displays; we imagine that low numbers are good, but how low should they be, and how disturbed should we be if they advance to some threshold value?

Recently, I had reason to examine just such a situation, with fascinating results. During the past couple of years, I had heard from DAT users who were noticing that the error rate displays fitted to a well-known brand of DAT recorders were lighting up like the Fourth of July whenever older tapes were being replayed. Oxide shedding we mused? Natural degradation of magnetic tape? What could be the mechanism? (It turned out that the tapes in question

rectable; levels above might produce audible clicks, or something similar. (At SER levels greater than  $1.12 \times 10^{-1}$ , interpolation is used to reconstruct the missing data from information located before and after the lost material.)

## Error rate readout

Some DAT machines feature internal test points that produce a pulse every time that a Symbol Error is encountered; others offer front-panel lights that illuminate whenever a threshold value is exceeded; while others provide numerical Error Rate readouts.

The actual values being displayed on a well-known model DAT player are equivalent to the number of PCM data blocks that were found by the unit's DSP circuitry to have contained an error. As can be seen from the attached diagram (Figure 1), there are a total of 9,984 data blocks being played back by a DAT machine per measurement period of 39 DAT frames Q approximately 1.17 seconds.

(128 blocks/track x two tracks x 39 frames of information =  $128 \times 2 \times 39 = 9,984$ .)

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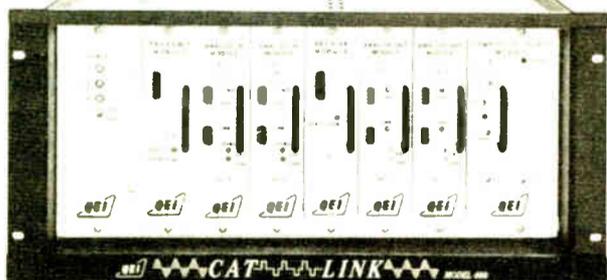
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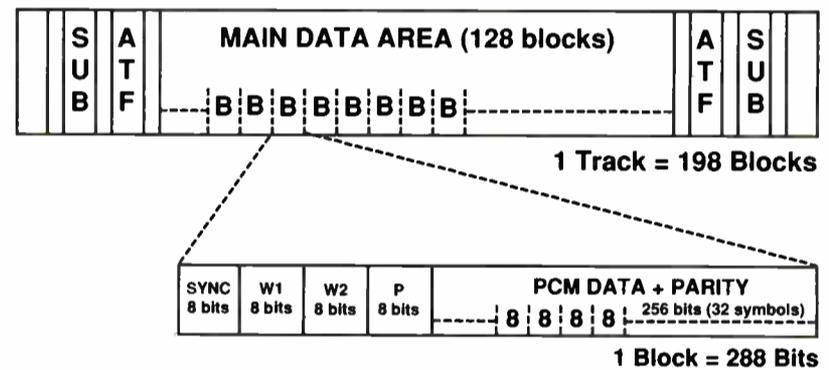


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Figure 1. Diagram of the data format used in a DAT recording.



were from a firm known to have experienced early manufacturing problems. The tapes were subsequently copied digitally to a newer, more reliable tape brand.)

## DAT robustness

But what exactly are these readouts and displays telling us about the DAT replay process? Because of its physical dimensions and operational parameters, DAT is incredibly robust. It has to be. Packing well over a gigabyte of audio data into a 120-minute DAT is a remarkable achievement; additional error-correction bits allow missing or incorrect data to be completely recovered from the bit-stream.

According to the DAT Conference (the document that fully defines the recording format, and ensures full compatibility between units), error-protection data added to the digitized audio information can completely recover burst errors of up to 792 symbols long (equivalent to 22 blocks, with 36 symbols/block; a symbol is a packet of eight channel bits that represent encoded data). Random errors can also be corrected, up to levels of two symbols per block.

In terms we might better understand, a burst error of 792 symbols is equal to an SER (Symbol Error Rate) of  $1.12 \times 10^{-1}$ . This is the threshold at which it becomes impossible to mathematically recover the missing or corrupted audio data. An SER below this number is completely cor-

As will be readily appreciated, a "perfect" DAT machine would produce no block or symbol errors. In the real world, however, we will encounter dirt and oxide particles that block DAT head gaps, and missed data resulting from less than optimal head/tape alignment. I have discovered that values between 50 and 100 correspond to extremely low Block Error Rates (BER), and represent normal operating conditions for a DAT system. Clean, fully-functional heads and new tape normally produce BER of less than 50; higher numbers are likely to be caused by dirt build-up on the heads. Such numbers should be checked at several points on the tape and averaged. If the BER is consistently higher than 150-200, a cleaning tape should be used; if this value does not now fall after a single cleaning, then the DAT should be taken to an authorized service center for repair and/or system alignment.

Armed with such information, it is now easy to monitor tape and head condition, and also ensure that master tapes are stored in conditions that minimize additional errors.

□□□

Mel Lambert has been intimately involved with the production and broadcast industries on both sides of the Atlantic for more than 15 years. Now principal of Media & Marketing, a Los Angeles-based consulting service for the professional audio industry, he can be reached at 818-753-9510.



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World Radio History

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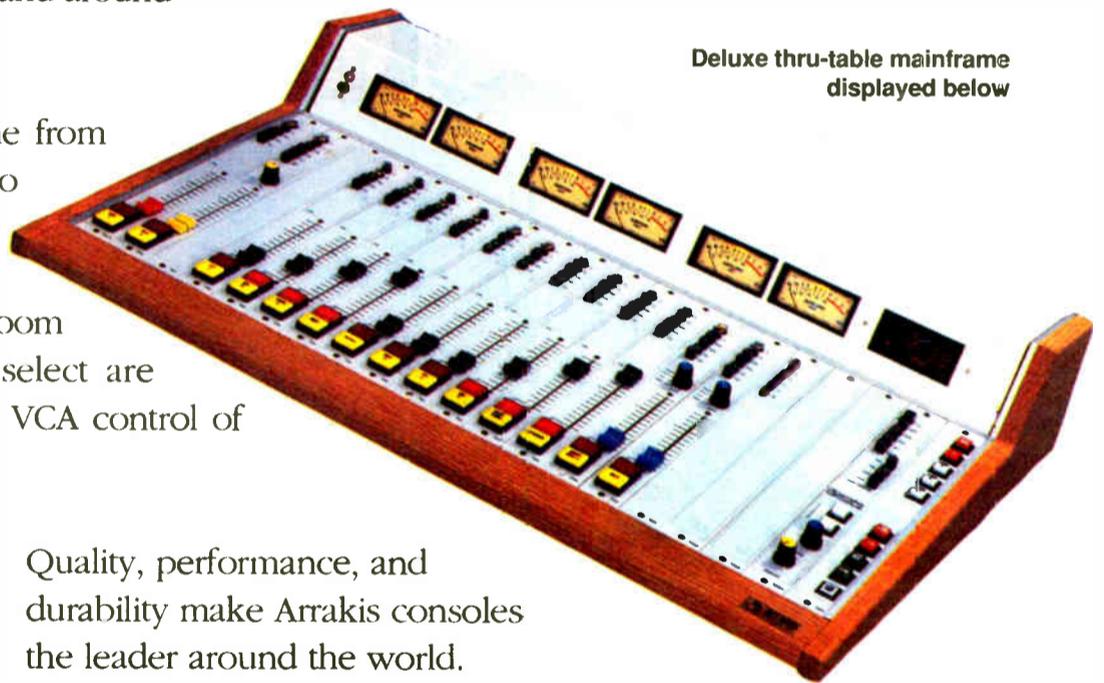
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# Nearfield Studio Monitor Testing

► continued from page 21

**Yamaha:** Bass-drum roll is a weak whisper, not felt. Gentle timbres, not edgy or covered. Good dynamics. Not too realistic.

## Author's mixes

I did mixes on each of the monitors, and tried to make the mixes sound the same on all of them. Since the monitors sounded different, I used different EQ settings depending on which monitor I listened to. Then I played the mixes on a variety of speakers, including boom boxes and car radios.

Mixes made with the EV tended to have too much treble and too little bass. Mixes made with the Tannoy were the opposite,

bassy and dull. Mixes made with the JBL and Yamaha translated well to most other speakers.

Results might have been different if I had lived with each nearfield monitor until I got used to its sound. Then I would have adjusted the mix to get a normal tonal balance for the monitor I was using.

## The awards

**Best tonal balance:** Yamaha NS-10M Studio, followed closely by JBL4008A.

**Deepest bass:** JBL 4008A. EV's midbass emphasis may have masked its deep bass.

**Best clarity and detail:** Tannoy System 6 NFM II. Outstanding.

**Best imaging:** They were all good! EV's

had a nice sense of space.

**Lowest listening fatigue:** EV Sentry 100A (low distortion, mellow sound).

**Best-translating mixes:** Yamaha NS-10M Studio, followed closely by JBL 4008A.

**Easiest to use:** Yamaha NS-10M. It's small and light, and has easy-access thumbscrew connectors.

**Hardest to use:** The EV and JBL were large and heavy (but the sizes contribute to their good bass). Tannoy had inscrutable connectors: you need to fully unscrew the plastic cylinder and insert a wire through the post. Tannoy's connectors were hard to get fingers into.

**Best construction:** Tannoy looked

impressive and high-tech. EV and JBL were well made, too. Yamaha looked the cheapest.

The overall winner? Sorry to be wishy-washy, but the best monitor for you depends on your sonic values. The Yamaha NS-10M costs the least, was easy to use, and had the best tonal balance. The EV Sentry 100A often had the most realism and least fatigue, but was too bassy when used nearfield. The JBL sounded tight and punchy, with the deepest bass, and had a good tonal balance. The Tannoy excelled at clarity and detail; it's a great analytical tool.

Makes you wonder. How can four loudspeakers, all claiming to be reference monitors, sound so different?

□ □ □

For more information, contact Jerry Andreas at Yamaha, 714-522-9011, or circle Reader Service 44; Bill Calma at Tannoy, 519-745-1158, or circle Reader Service 72; Rick Sanchez at Mark IV Audio (Electro-Voice), 818-442-0782, or circle Reader Service 96; and Bill Threlkeld at JBL, 818-893-8411, or circle Reader Service 179.

Bruce Bartlett is a recording engineer and the author of "Practical Recording Techniques," published by Howard Sams. Jenny Bartlett is a technical writer. Bruce can be reached at 219-294-8388.

## Digital Mix At Catspaw

► continued from page 13

Paul might want to complete at a later session, or when changes need to be done but can't be done immediately.

"If CNN comes over to Catspaw and wants to build a radio spot or sound design a TV promo, they can save their mix and instantaneously call it back up for a rainy day if they want to make a change," he said.

When the mixer recalls settings at a later date, often Paul will display equalization parameters and effects parameters on the console's LCD display to get a reading of the direction the session was headed.

If the spot production requires signal processing, which Paul has begun using the DMC 1000 for, he'll program these settings on the board as well. The DMC 1000 has two SPX1000 signal processors for this purpose, as well as other built-in production features that have eliminated a host of outboard gear in the two Catspaw studios that are equipped with Yamaha mixers.

Four-band EQ, two bands of which are switchable to either peak or shelf, and discrete channel delay and channel grouping are some of the board features that Paul has found useful.

Despite all the digital wizardry, Paul maintains that it's people—not machines—that are the mainstay of creative audio production. "You don't need digital to create a great spot," he's fond of saying. "But it helps."

□ □ □

For more information about Catspaw Studio, contact Doug Paul at 404-876-CATS. For more information about the Yamaha DMC 1000, contact Yamaha at 714-522-9011, or circle Reader Service 205. For more information about the Studer Dyaxis, call 615-391-3399, or circle Reader Service 61.

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# The Big Whoosh! CD

► continued from page 17

well behaved audience applause.

If you're a synthesizer wizard with an inclination towards sound design you've probably already spent hours creating much of your own material of this sort. If you're a production director with only a few cart machines, good editing chops

and no synth, The Big Whoosh! can be a valuable resource.

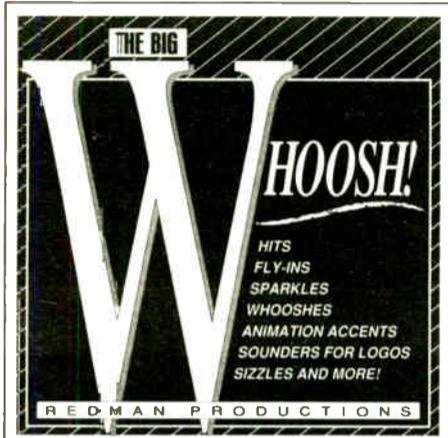
If you've got a multitrack studio and a sampler capable of editing and filtering (like one of the better Roland samplers or one of the Eventide Ultra-Harmonizers with the sampler card) you can have even more fun. By changing the pitch and playback time of a sample, you can create totally new sounds from these tracks. Hook the sampler up to a good keyboard controller and, well...that's a topic for another column.

If your station manager won't spring for the CD, consider getting a copy for your own personal kit. You do have a collection of sounds and gear that you bought and can't do without right? When your next job comes along, you'll be able to take these sounds with you. In fact, in the right hands, they might even help get you your next job.

For more information, contact Promusic at 800-322-7879; or circle **Reader Service 127**.

□ □ □

*Ty Ford's text book "Advanced Audio Production Techniques" is now available from Focal Press. Miraculously, even if you read it in a very quiet room, you will not be able to hear the agonizing screams that writing it caused him to make.*



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# WNWZ's LMA Nightmare

► continued from page 12

Mathews' broadcasts)," Beveridge said.

Mathews admitted that callers would sometimes say obscenities on the air during his three daily talk shows, which the local television media dubbed "shock radio" because of its controversial nature and handling of issues such as bestiality. He also admitted that he did broadcast the station's daytime pattern at night, but only at reduced power and only because Beveridge had disabled equipment for the nighttime pattern, he said.

Feldman said he was so concerned about Mathews' apparent disregard for FCC rules that he asked the Commission if he would be held responsible for Mathews' actions.

"They said 'not at all,' Feldman recalled.

## A court hearing

During the many court appearances, which numbered more than seven because of three bankruptcies held up in the federal courts and an inordinate comedy of errors, few were as memorable as that of a four-hour hearing in which Mathews' loyal listeners filed into the courtroom as a show of support.

Recalled Beveridge: "When we arrived in the courtroom, they had five bailiffs standing outside the judge's door because the individual (Mathews) had been giving out the judge's name, home phone number, and the thing was rising to such a fever pitch there was reasonable fear that the judge's life could be in danger."

This event and others lead Beveridge to believe that Mathews, whose religious congregation meets at a car wash on Sundays, "had developed a following much the same as any other religious group."

Tensions escalated days later when Mathews, faced with a local court order to leave station premises, asked listeners over the airwaves to show up with pickup trucks to help move equipment and furniture out of the studios.

Approximately 150 people showed up, according to Capt. Johnny Roberts with the Shelby County Police Department. The number of people and apparent tension created the potential for civil unrest and necessitated bringing in a SWAT team, according to Roberts.

Later, at a little before 6:00 pm on June 4, 1993, and without further incident, Mathews vacated the airwaves and WNWZ's studios.

□ □ □

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

# PRODUCT GUIDE



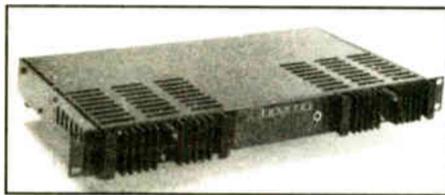
## Denon DN-720R Pro Cassette Deck

Denon is now shipping its DN-720R professional cassette recorder, which features Amorphous Alloy record/play head, non-slip reel drive, speed control (plus, minus 12 percent) and tape bias adjustment.

The Dolby HX (playback only), B and C equipped deck has a rated frequency response of 25 Hz-19 kHz (±3 dB with

metal tape).

For more information, contact Mike Stelts at Denon at 201-575-7810; or circle **Reader Service 14**.

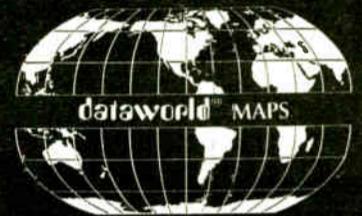


## Bryston 2B-LP Pro Amplifier

Bryston's 50-watt per channel (8 ohms) 2B-LP amplifier is a compact unit ideal for radio or recording studio environments, according to the company.

The amplifier measures 19 inches by 1.75 inches, and features separate stereo channels and gain controls, gold plated XLR balanced connectors, and gold plated binding posts. Internal components include 1 percent metal-fill resistors and polystyrene capacitors.

For more information contact Bryston at 1-800-673-7899; or circle **Reader Service 152**.



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## FEEDLINE

# AM Stereo Means RF Modifications

by W.C. Alexander

**DALLAS** We reviewed the history of AM stereo and discussed some of the unique audio processing requirements for C-QUAM stereo in the last Feedline installment.

There are a number of other things AM station operators getting into stereo should know as the FCC prepares to standardize C-QUAM, such as setting up studio-transmitter links (STL) and making the necessary modifications to AM transmitters.

## STL choices

Unless your station's studio and transmitter sites are co-located, it's a sure bet that the STL, whether it is a phone line or microwave link, is set up to carry only one channel of audio. After all, it would have made little sense for an AM station transmitting mono programming to invest in the extra hardware needed to carry two or more channels of audio, right?

So now the time has come to convert to stereo. How are you going to add the other channel to the link? For those using a phone line STL, the answer would seem obvious—just call up the telco and order another equalized circuit.

Well, it's not quite that simple.

When the additional line is installed, it may or may not be engineered in anywhere close to the same way as the existing line. You can easily wind up with a pair of lines that have a considerable phase shift between them. Remember that with a 140-degree phase difference between channels at 10 kHz, the mono (L+R) signal will be down almost 9 dB. That will make for a pretty muddy sounding radio station.

The best thing to do, if you are stuck with a land-line STL, is cancel the old circuit and order two new lines. The telco can then engineer them both alike

and optimize them for stereo in the tune-up process.

The best deal is to use a radio link STL on 950 MHz or 18/23 GHz. The radio station is in control rather than the phone company. If you are already using a mono 950 MHz STL, chances are that you can add a second channel of audio by purchasing an additional transmitter and receiver as well as a hybrid combiner and splitter that will allow the system to use a single antenna on each end.

There are some important considerations here. Just as with the phone lines, the STL transmitter and receiver you add

**Stereo preparation can be nearly impossible for older transmitters with exotic modulation schemes.**

to your existing system may have different phase and amplitude characteristics than your current system. You should generally only use equipment similar to what is already in use, and even then discuss with the manufacturer the intended use and expected results. It may even be worthwhile to send the existing unit in so that both units can be optimized for stereo use together.

Another approach—one we use at several of our AMs in the Crawford group—is the composite STL. An FM stereo generator is inserted into the audio chain ahead of a wideband, composite STL transmitter. On the receive end, a decoder is used to recover left and right from the composite signal.

This method has the advantage of single frequency operation, which is important in spectrum-crowded areas. It also generally costs less than two discrete STL systems. Phase and amplitude variations are kept to an absolute minimum because the left and right are encoded into a composite signal and transmitted over one path. Using a good quality FM stereo generator and decoder will keep crosstalk to a minimum.

The one disadvantage is that there is some loss in separation in the STL system.

## Transmitter preparation

Now that we have stereo audio delivered to the transmitter, the transmitter must be made ready for stereo operation. This can be a matter of "plug and play" for late-model transmitters designed with stereo operation in mind. Preparation can be nearly impossible for some older transmitters and some using exotic modulation schemes. The difficulty of the task will be somewhere in between for most.

(We will assume that before you ordered a C-QUAM exciter, you contacted the transmitter manufacturer to be sure it could be made to work in stereo.)

The first thing required, regardless of the transmitter, is the quality of mono transmission. You should start with a mono proof on the transmitter, correcting any problems you find. Frequency response, noise, distortion and carrier shift should all fall within the prescribed limits. If you have the time and resources, it will pay in the long run to make the transmitter perform better than what the FCC requires.

Once the transmitter is operating correctly in mono, the manufacturer should be consulted to see what is required to operate in stereo. Most manufacturers have some sort of modification data or kit to facilitate stereo operation. The required modifications will typically include a method for replacing the built-

in exciter's oscillator signal with the signal from the C-QUAM exciter (sometimes with a switch to select mono or stereo drive).

## Incidental phase modulation

Often there will also be some modifications designed to reduce incidental phase modulation (IPM), broadly defined as any undesired angular phase shift of the RF carrier. IPM is typically caused by either power supply ripple or envelope modulation. It can be tracked on a C-QUAM stereo modulation monitor by observing the detected L-R modulation without applying any phase modulation to the transmitter.

Ripple-induced IPM is usually caused by inadequate bypassing of the power supply. Before AM stereo, manufacturers didn't care about IPM (it's undetectable by envelope detectors), so little was done to transmitter design to reduce or eliminate it. Extra bypassing at strategic points along power supply busses may be required to get the ripple-induced IPM down to into the -50 dB range (below 100 percent L-R modulation). If the ripple-induced IPM is much higher, it begins cutting into the decoded L-R signal-to-noise ratio, making the decoded stereo signal noisy.

Modulation-induced IPM is more troublesome. Sometimes it is caused by poor neutralization of the driver or final PA stage. This can sometimes result in equivalent L-R modulation of more than 25 percent. With proper neutralization, IPM levels should be reduced to something better than -40 dB below 100 percent L-R modulation.

For solid state rigs, IPM can be caused by the nonlinear output capacitance of the solid state device in use. This capacitance is determined by the amount of voltage applied between the drain and source. Since this voltage varies at an audio rate with modulation, the capacitance and thus the RF phase angle will vary. It is possible that some swamping capacitors may need to be added to this part of the circuit to reduce the effect of changing the capacitance of the output devices.

Narrowband tuned circuits are another common source of IPM, particularly in older transmitters. For proper stereo operation, the amplitude and phase relationship of the L+R (envelope) information must match that of the L-R (phase modulated) information.

Tight-tuned circuits introduce a nonuniform time delay to the RF carrier, cause L-R high frequency response problems and alter the sideband structure of the phase modulation, which increases distortion. You may find it necessary to lower the Q of tight-tuned circuits in order to reduce IPM. But be careful—lowering the Q will result in a lower RF voltage at the network's output. This may result in inadequate drive to the following stage.

Finally, the antenna system should be as broadband as possible for good stereo operation. There have been several good articles written on antenna broadbanding right here in RW. If you suspect that your antenna system may be narrowband, I suggest you retain a consultant to check it out and make recommendations.

There will be more to say about AM stereo conversion next time, including ways to install the exciter and tune it up to work with the transmitter.

□ □ □

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

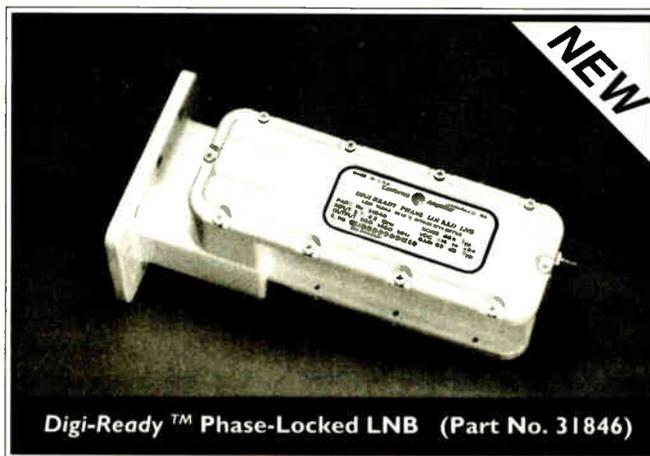
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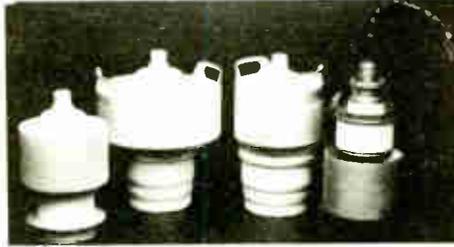
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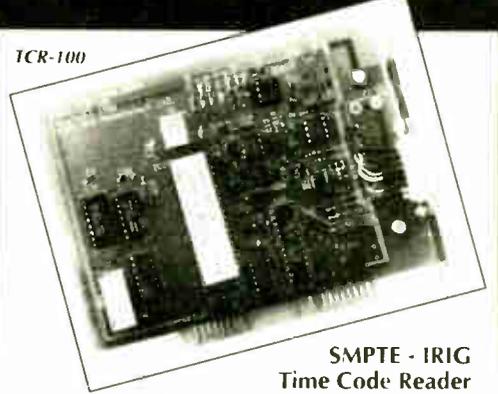
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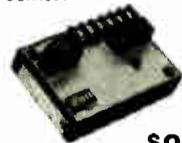
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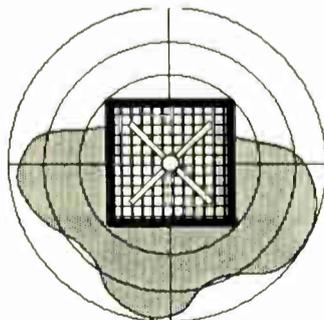
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READER SERVICE NO. 17

# Cellular Phones Cure Remote Ills

by Edwin Bukont

**GREENBELT, Md.** Traditionally, remote broadcasts have been done with either wired telco loops or with non-wired remote pickup unit (RPU) service. Both of these approaches are increasingly difficult to utilize in an effective and competitive manner.

For WPGC-FM, originating RPU remotes in an area of widely varying terrain, with hills separating our suburban Maryland studios from Washington and Northern Virginia, the cost would have been steep. We projected installation costs of roughly \$50,000 plus annual tower and backhaul telephone line rentals to amass the number of sites necessary to provide the regular remote coverage with short notice desired by the programming staff.

Additionally, there would be the cost of maintenance and technical personnel for the constant site surveys and preparatory work needed to accommodate the wide variety of venues in the Washington metro area.

## Never enough

Even so, we would only be able to do 60 percent of what we might desire. The remaining 40 percent would have to be done on telco loops. From a ratings and revenue standpoint, the numbers just did not add up. We considered bandwidth extension systems which would provide the portability and cost effectiveness needed for many venues, as long as the venue had available dial lines. Dial-line installation cost is quite high in our area and there is still the problem of surveys, wiring and outside venues. We needed another approach that offered fast, reliable, inexpensive remotes with reasonable audio quality.

Our sister station in Seattle, KUBE, had some success with integrating Comrex two-line gear with cellular telephones to achieve a user friendly 5 kHz link. We decided to try it. Four Oaks, N.C.-based Broadcast Services lent us the necessary equipment for trial. Cellular phones and airtime were provided by a local carrier.

While the audio performance of a two-line system may not equal that of a RPU or an 8k loop, it is still better than many two-way radios or a regular telephone line. The cost and customer service benefits that can be realized with a portable two-line system are an acceptable trade-off for the slightly reduced quality.

We have now had a "cellular-Comrex" hybrid system in service for 12 months and it has achieved excellent results. The remainder of this article will detail our experience with the testing and use of this system. A few caveats however—Comrex never intended its gear for use with cellular systems because there are many pitfalls inherent in the cellular network.

Please be sure that you will receive the cooperation of your cellular dealer for demo phones to try out the described system. Be aware that this system may not work in every market because of hardware and software differences between cellular systems. Even within a market, there can be differences of audio level and frequency response between cell sites. This becomes especially important when broadcasting from a

moving vehicle.

Also, buy the Comrex AutoLeveler unit—it is not optional in this system. The Comrex encoder (2XP) and decoder (2XR) are *line level* devices and will not directly accommodate a microphone. We use a Shure M267 mixer because it provides a very flexible platform for interfacing remote sources to the encoder and contains a built-in limiter which is a necessary item.

## Building blocks

The basic blocks of the system in use today are:

- Transmit: (mounted, but easily removed, in remote vehicle)
- One Comrex 2XP encoder
- Two Motorola Cellular Connection (R) RJ-11 interfaces
- Two Motorola TX-300B transceivers with cigarette lighter cords
- Two Antenna Specialists elevated mount cellular antennas
- One Astron Power Supply: 120AC-12DC/ 7A cont. for phones
- Receive: One Comrex 2XL AutoLeveler and One Comrex 2XR decoder

**While the audio performance of a two-line system may not equal that of a RPU, it is still better than many two-way radios.**

Aside from the Comrex products, the only critical item is the choice of cellular phone transceiver. We tested several models and came to the following conclusions.

Motorola products performed the best overall, but not all Motorola products performed satisfactorily. Ironically, the less expensive analog phones (TX300B or KS-30) performed the best. The "digital-ready" TVM series' quality deteriorated rapidly under poor signal conditions and introduced phase anomalies that produced a heterodyning noise in the decoded product.

We use Motorola's Cellular Connection between the handset and the base unit to obtain an RJ-11 jack that interfaces to the Comrex telco jacks with regular modular telephone cords. Be aware that Motorola also sells a DATA connection device, this will not work.

Unfortunately, our experience has been that cellular companies are not very knowledgeable about their own products nor the needs of their customers. Insist on speaking to someone in technical support about your needs, not just the salesperson. We learned an unfortunate lesson when we borrowed phones for an eight hour remote.

Even though we had told our vendor, in writing, that we wanted a power supply to run the phones from AC power, we were delivered chargers and one battery per phone instead. By the time the salesperson called an engineer, it was too late and the remote was lost.

We had similar experiences with phone programming and antenna problems.

Speaking of antennas, keep them fairly close together. We have had strange site-switching anomalies occur with the antennas more than 2-3 feet apart. Be careful of antenna adapters. Motorola uses mini-UHF connectors but most phones use a TNC connector for the antenna. The adaptor has proven a very weak link. In our final installation, we replaced the TNC cable ends with mini-UHFs.

You can use what ever power supply is available provided it can run a *continuous* load of 2.5-3.5 amps per cellular phone. Assembly is very straightforward. Operationally, both transmit and receive systems operate the same as a regular two-line setup.

## On the road

For our tests, the system was installed in a vehicle equipped with an AC power generator and taken to eight sites around the area from which we expected to regularly produce remotes.

The received product was recorded for later evaluation. We made note of weather, time of day, signal strength and dialing conditions (noise, delay, service problems) at each site and recorded an audio "slate" on the tape before the test transmission.

The only artifact of the cellular link that we noticed is a slight gurgling sound, about 20 dB down in the decoded product. We attributed this to differences in carrier tolerance between phones. This did not

cause us a problem as our breaks tend to be done over music which masks the noise well. The noise tends to be louder in weak signal areas and with digital phones.

We regularly use the system in a moving vehicle. Yes, occasionally one phone will hang up, so you redial. It is not that much an inconvenience since you can't even do this with traditional systems. We have successfully driven the vehicle for a morning show remote at 50 mph, for seventy miles, in rush hour, around the entire Capital Beltway and not had either phone disconnect.

Try that with an RPU in a major metro area!!

Every thing is mounted with screws or Velcro for easy removal in an emergency. Spare antennas, AC supply and cords are carried so the show can go on if the vehicle breaks down. While the competition is planning their next big remote, we have done as many as three remotes per day in the summer. See you in the ratings and have fun.

□□□

*Editor's note: Field modifications to equipment may invalidate the manufacturer's warranty. Before attempting any repairs or modifications, consult the manufacturer for advice and guidance.*

*Always use the utmost care and follow good engineering practices when working with or around electrical equipment. RW will not assume responsibility for any loss or injury.*

*Ed Bukont is chief engineer at WPGC-AM-FM Morningside, Md. (Washington), and a regular contributor to RW.*

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# WORKBENCH

## Beware Cut-Rate Transmitter Tubes

by John Bisset

**FALLS CHURCH, Va.** Most everyone has heard about using a "NERF® Ball" as a cheap microphone wind-screen or pop filter, but how about the 7 1/2-inch tape box as an emergency shock mount?

Steve Tunwall, chief engineer for KMA(AM) Shenandoah, Iowa, writes about a local remote broadcast the sta-

tion does with local high schools. The format involves miking a number of students using low-grade mics on desk stands. The show's not a real moneymaker, so it operates on a meager budget.

Steve's problem has been eliminating the low-frequency table noise that seem to wrap the VU meter needle around its peg. While packaging up after a broadcast, Steve happened to put one of the mic stands on a tape box. Attenuation of the low-frequency noise appeared to be as good as any shock mount he had tried, and it certainly fit within the budget constraints of the program.

A five-inch box doesn't work so well because the mic stand sits on the vertical edges of the cardboard box, offering little mechanical isolation. A seven-inch box provides better results.

Steve Tunwall can be reached at 712-246-5270.

★ ★ ★

I recently isolated a pair of speakers that had to sit on top of cart machine turrets, since the turrets were so tall they would have blocked a ceiling or wall mounted speaker. Using a two-inch-thick piece of packing foam, I fashioned an isolator. This is the same kind of foam that Delta Electronics uses for shipping their test instruments, and they were kind enough to cut the foam precisely to the outside speaker's dimensions.

I wrapped a piece of two-inch-wide, brown duct tape around the cut edge. The tape is a close match to the speaker and formica colors, and the isolation the foam provides is more than adequate. By the way, a little patience, and a sharp, single-edge razor blade is just as effective as the industrial cutter we used at Delta to precisely trim foam.

★ ★ ★

The best solution is not always the cheapest. Mervill Lawson with WMOR-AM-FM Morehead, Ky., lost \$150 to a cheap-tube scam. He ordered a brand new set of Russian-made 833A tubes, which were advertised to have "met or exceeded Eimac standards," of course.

After installing the tubes, he noticed a glowing blue color. He contacted the

distributor, who told him this was normal, and the color would disappear after a month. Two days later, the transmitter kept popping off the air. Mervill suspected the two tubes, which he replaced with the old ones.

The defective tubes were sent back and the damage report stated the tubes had been overheated and became gassy. This conclusion was reached by the distributor after observing the large silver spot on the side of the tube.

Mervill admits he has no engineering degrees, but he does know what the "getter" is, and remembers seeing its silvery signature on the side of the tube when he pulled it out of the box. Nevertheless, the company refused a refund, saying the BC-1G was a fault.

I think we all know better. Mervill's last word is "beware."

I'd like to add a few thoughts, some of which many managers or owners won't like. Transmitter tubes are a sore subject among most non-engineers. They are

you aren't saving any money.

Most engineers really do understand the importance of cutting costs. It's just that buying junk that's being peddled as an Eimac or Amperex equivalent is no bargain. If you've had good luck with off-brand tubes, I'll keep an open mind and be happy to air your experiences. It's been my experience and the experience of the stations we do work for that you get what you pay for.

Besides, if the major tube companies could find a way to build tubes as cheaply as those imports, but with the same quality, don't you think they would?

If you must succumb to the lowball prices, get the company's return policy in writing. Can you get a refund, or simply exchange merchandise? Can you pay by credit card so that if there is dissatisfaction, you can get a refund through the credit card company?

Before you buy, get the name of at least two satisfied customers, preferably with the same kind of transmitter as you are using. The more reputable companies maintain an extensive data base of customer's tube needs, so this request should not be an inconvenience.

If the tubes just won't work, can you apply the purchase price to better tubes (Amperex or Eimac)? And finally, for larger tubes, have you considered rebuilds? You can find ads for tube rebuilding companies in the back of this issue of RW. Use a little consumer awareness, and don't be bullied by a lot of engineering mumbo jumbo just because you're not technically inclined.

★ ★ ★

Have you ever dropped a small part or screw and not been able to find it? We look, crawl and even pat the floor feeling for the missing part. If you don't have a readily available replacement, and the part must be found, Larry Albert of Murray State University, Murray, Ky., suggests that you grab your flashlight and scan the floor.

Don't aim the light down to the floor while standing. Get down on the floor and hold the flashlight almost parallel to the floor. Sweep the beam back and forth. The near side of the lost part will be brightly lit with a deep shadow cast on the far side. You can increase the contrast in the room by turning off the lights. This really works.

★ ★ ★

Caig Laboratories, makers of Cramolin, have announced a new product called ProGold, a conditioner for gold surfaces, such as card edge connectors. Base metals often migrate through soft gold surfaces and thinly plated gold surfaces scratch easily.

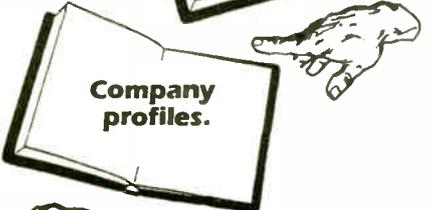
ProGold enhances conductivity characteristics while conditioning the gold surfaces. Pretreating connectors with ProGold will reduce intermittent connection problems. ProGold is available in a variety of sizes and containers. For more information, circle Reader Service 106.

□ □ □

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

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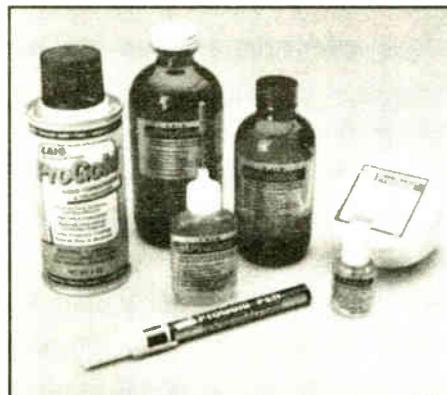
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Good tubes will work 24 hours a day for several months—even years. If you divide the tube cost over the lifespan of the tube, you'll see what a bargain you're getting. Conversely, if you consider how many times you have to call your contract engineer back to follow up on problems with defective tubes, you quickly realize

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# Unblocking Phone-Link Impedance

By Dennis J. Martin

**LOS ANGELES** Source impedance is the "impedance presented by a source of energy to the input terminals of a device, or network" ("IEEE Standard Dictionary of Electrical and Electronics Terms, Fourth Edition").

Stated differently, it is the impedance at the output terminals of a device not to be confused with load impedance, which the IEEE calls "the impedance presented by the load to a source or network."

When interconnecting equipment, consideration is seldom given to what

impedance the output of a device will present to the input of the following device. Rather, the typical question is whether the source will drive the intended load, such as 600Ω. The days of matching output to input impedance are largely gone, especially in line-level applications.

When telco equalizes a line, they generally use test equipment that provides an accurate source impedance of 600Ω. (A Pacific Bell installer's Hewlett-Packard 3551A Transmission Test Set measured

607Ω at 1 kHz.) Unless the device that feeds an equalized circuit presents an impedance of 600Ω to the line, unpredictable results can occur.

To illustrate what can happen in the field, we measured two circuits using source impedances of 50, 150, and 600Ω as provided by a Sound Technology 3100B Audio Generator. Figure 1 is a graph of frequency response for the line from our studios in Hollywood to our transmitter site on Mt. Wilson. As you can see,

response does not change much over a frequency range of 50 Hz to 15 kHz (we used 1/3 octave, ISO R10 recommended frequencies).

A source impedance of 50Ω produced a +0.23 dB rise at 10 kHz, a +0.73 dB peak at 12.5 kHz, and 15 kHz returned to +0.16 dB. When the impedance was increased to 150Ω, 10 kHz measured +0.09, 12.5 kHz was +0.50, and 15 kHz -0.15 dB. The most significant change occurred when we switched to 600Ω: 10 kHz fell to -0.50, 12.5 kHz dipped to -0.37, and 15 kHz dropped to -1.35 dB.

Frequency response appears to be the primary parameter affected. THD+N, IMD, and noise all remain mostly unchanged (THD+N and IMD measured <0.2 percent at levels above 0 dBm for the three source impedances tested). And varying the load impedance at the receiving end seems to affect only level.

## Variable response

As a climactic demonstration, we measured a 15 kHz circuit from the Queen Mary in Long Beach to our Hollywood studios. Frequency response, illustrated in Figure 2, changed radically as we changed source impedance. Driving the line at 50Ω, 10 kHz measured +4.55 dB, 12.5 kHz was +5.69, and 15 kHz was +5.08 dB, all referenced to 1 kHz. However, note that the level fell about 1 dB below 500 Hz. The overall response was -1.61, +5.69 dB, which represents a spread of 7.30 dB, and loosely resembles 40μs pre-emphasis.

Using 150Ω improved the situation somewhat: 10 kHz measured +2.92, 12.5 kHz +4.09, and 15 kHz +3.37 dB. Across the band, the response measured -1.46, +4.09 dB; a 5.55 dB spread.

When we switched to 600Ω, the line became remarkably flat: 10 kHz dropped to -0.31, 12.5 kHz was now +0.66, and 15 kHz was nearly perfect at -

0.03 dB. Overall, the circuit was -1.02, +0.66 dB, which is a spread of 1.68 dB. Quite nice considering the wiring on board the Queen Mary, the distance between the send and receive points, and the central offices involved. Even more surprising, the line passed through the territories of two phone companies: General Telephone and Pacific Bell.

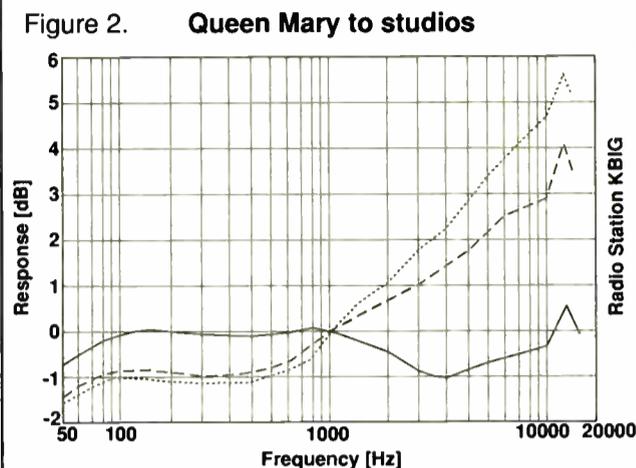
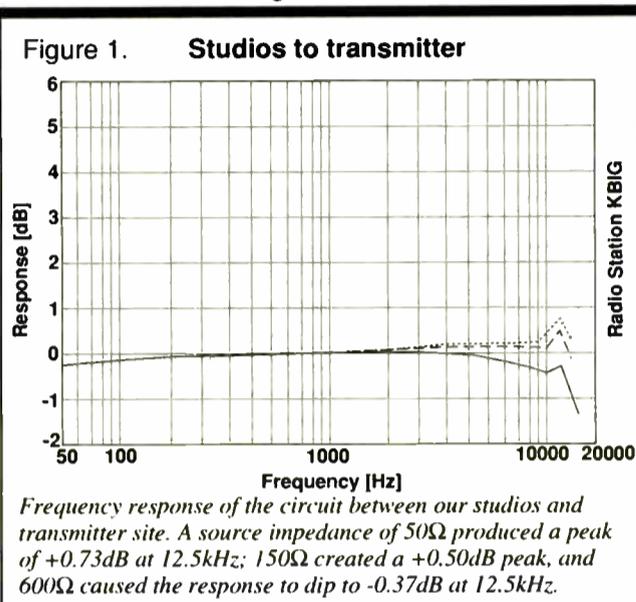
The reason for the anomaly is in part due to the complex load impedance presented by the phone line to the source device. Our studio to transmitter circuit measured 1.95 kΩ at 50 Hz, 1.97 kΩ at 1 kHz, and 1.02 kΩ at 15 kHz. In contrast, the Queen Mary link was 1.33 kΩ at 50 Hz, 961Ω at 1 kHz, and plunged to 219Ω at 15 kHz.

If we analyze the resulting circuit as a simple L-pad, where the audio generator (or other source device) is the series leg, and the phone line represents the shunt, we unveil the mechanism at work. Let's examine the Queen Mary's line, which measured 961Ω at 1 kHz and 219Ω at 15 kHz.

Using a source impedance of 50Ω, we calculate 0.44 dB of attenuation at 1 kHz and 1.79 dB at 15 kHz—a difference of 1.35 dB. If driven by 600Ω, the calculated attenuation rises to 4.21 dB at 1 kHz and 11.46 dB at 15 kHz—a 7.25 dB difference. We should therefore expect to see a 5.90 dB (7.25 - 1.35) change in level at 15 kHz between 50Ω and 600Ω, referenced to 1 kHz. Our field tests showed a 5.11 dB difference; considering all error sources, 0.79 dB is consid-

erably close to the 5.90 dB difference we calculated. To accomplish using an audio generator, one or two resistors, and an AC voltmeter (ACVM).

Connect the generator to the input of the device under test (DUT). Connect the ACVM to the unterminated output of the DUT. Adjust the generator's frequency to 1 kHz, and it's level to a convenient reference on the ACVM, say 0.00 dB or 1.00 V. Now terminate the output of the DUT with 600Ω and read the level (use a 604Ω 1 percent resistor, or construct a



Source impedance affected frequency response radically between the Queen Mary and our studios. A peak of +5.69dB occurred with a source impedance of 50Ω; 150Ω reduced the peak to +4.09dB, and at 600Ω the level dropped to +0.66dB.

600Ω load by connecting two 300Ω 5 percent resistors in series, or two 1.2 kΩ 5 percent resistors in parallel). If the DUT has a true source impedance of 600Ω, the level should fall by 6.02 dB when terminated. If the level change is less than 6 dB, the source impedance is lower; if it is more than 6 dB, the impedance is higher than 600Ω. Check it at different frequencies—ideally it will be the same even at band limits of 50 Hz and 15 kHz.

Figure 3 can be used to estimate source impedance by finding the closest level change value in dB and reading across to source impedance. If your measurements were in volts, calculate the percentage by dividing the terminated voltage by the unterminated voltage, then refer to Figure 3. Optionally, calculate source impedance using the formula:

$$R_S = R_L \left( \frac{V_1}{V_2} - 1 \right)$$

Where:

$V_1$  = Unterminated voltage

$V_2$  = Terminated voltage

$R_L$  = Load resistance

$R_S$  = Source impedance

For comparison, a studio console we tested had a source impedance of 32Ω, a limiter was 41Ω, and a popular mic mixer was 128Ω at low frequencies, rising to 175Ω at 15 kHz.

If the output measures significantly less than 600Ω, an isolation amplifier that has a true 600Ω output should be inserted to drive the line.

A final check is always a frequency sweep of the line. Make sure, though, to feed the audio generator through the device that will ultimately feed the line. Connecting the generator directly to the line will not prove how the system will perform unless the source device's impedance is known to match the generator.

□□□

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

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**Figure 3.**

**Level Change vs. Source Impedance**

Level Change (db)	Source Impedance (%)	Source Impedance (Ω)
0.70	92.31	50
1.34	85.71	100
1.94	80.00	150
2.50	75.00	200
3.03	70.59	250
3.52	66.67	300
3.99	63.16	350
4.44	60.00	400
4.86	57.14	450
5.26	54.55	500
5.65	52.17	550
6.02	50.00	600
6.38	48.00	650
6.72	46.15	700
7.04	44.44	750
7.36	42.86	800
7.66	41.38	850
7.96	40.00	900
8.24	38.71	950
8.52	37.50	1000

Use this chart to estimate source impedance. Find the closest level change in dB or percent, then read across to source impedance in ohms.

ered within tolerance. Thus, our calculations validate the L-pad model.

## Simple measurements

The minimum load impedance specification of a device usually does not provide a clue what the actual output stage source impedance is. Measurements are often necessary. Such a test is easy to

INSIGHT ON RULES

# NAB's Checklist is 'Good Outline'

by Harold Hallikainen

**SAN LUIS OBISPO, Calif.** The National Association of Broadcasters has done a very nice job putting together a readable interpretation of the most commonly violated FCC technical regulations in the "NAB Radio Broadcasters' Inspection Checklist" (L-9304).

The NAB checklist, based on discussions with FCC inspectors and FCC staff, compares well with the commission's own "Broadcast Service Checklist" (RW, June 9). There are a few minor areas where the NAB checklist's interpretation of the rules varies with mine.

### Transmitter control

The FCC once required transmitters to have a power control to adjust for power line voltage variations and other causes of output power variation (73.40(a)(8) in the 1980 version of the rules). That rule no longer exists. NAB perhaps overstates the case when it lists power and modulation as transmitter adjustments requiring availability to the operator.

Operators are not required to have access to power, modulation, directional array or other controls. They are, however, required to comply with the limits on various parameters. If the adjustment is not available to the operator and the station is causing interference, the station must be shut down.

The rules could be read to be requiring nothing more than an on/off switch for the entire transmitter control system.

In another section, NAB does not mention that the chief operator of high-power AM, directional AM or TV stations is required to be an employee as opposed to a contract operator (see 73.1870(b)(1)). The FCC usually does not push this requirement, but I did just see an FCC violation notice that cited a violation of this rule.

NAB also advises that stations designate an "alternate chief operator" in writing. The rules actually require a station to designate an "acting chief operator" to serve on a temporary basis when the chief operator is unavailable or unable to act (vacation, sickness). Stations might be cited for not making this designation, but the rules do not require that it be in writing.

The rules also do not require the station log to be in the Public Inspection File (PIF), as the NAB checklist suggests. The station log must be available for FCC inspectors (see 73.1225(c)(5)), but is not required for public inspection (see 73.3526).

The station-logs section fails to mention the required weekly station log entry by the chief operator, although this requirement is discussed in the section on chief operators. I believe this requirement should be stressed, because most rule violations can be avoided by having a competent chief operator make a thorough review of the station logs.

The checklist does not mention the directional antenna parameter logging required for stations not using an approved sampling system (although such cases might not exist anymore).

### Measuring up

NAB, in the checklist's measurement records section, does not mention that AM stations are required to make equipment

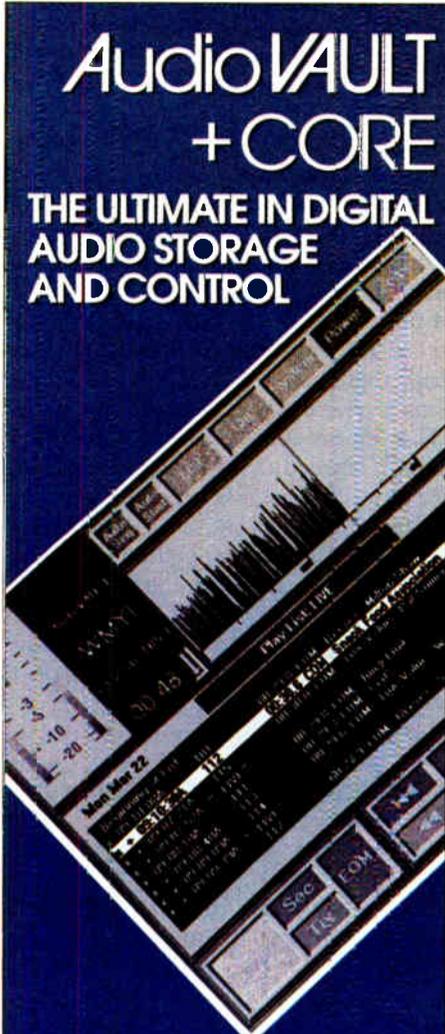
performance measurements once a year (no more than 14 months apart) and that stations using NRSC audio equipment are exempted from this requirement until June 30, 1994 (see 73.44). I recently saw an FCC violation notice issued to a station for not having AM equipment performance measurements, even though the station was exempt under 73.44.

A "field intensity monitor or high quality communications receiver," NAB says, are suitable for making these measurements. Rule 73.44(a) requires the measurements to be made with a spectrum analyzer or "specialized receivers or monitors." I

believe the FCC had equipment such as the Delta AM Splatter Monitor in mind for such measurements. A typical field strength meter or communications receiver does not have the necessary bandwidth or indicators to make the required measurements.

The section on AM directional-antenna parameter tolerance does mention that some station licenses specify phase indications tighter than three degrees, but does not mention that some licenses also specify a base current or loop current ratio tolerance tighter than 5 percent, a critical array.

continued on page 39 ▶



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## ROOTS OF RADIO

# Classical Grand Past Resonates

by James T. Wold

**MINNEAPOLIS** Classical music has a long, dramatic history on radio and its listeners are perhaps among the most loyal and stubborn of audiences.

One example is WEFM(FM) Chicago (current calls are WUSN), sold to Tribune Broadcasting in 1972. The station had programmed classical music since 1940, but Tribune planned to turn it into a rock station after the old owners contended that the classical operation lost money.

A group of listeners formed the Citizens Committee to Save WEFM and filed a petition with the FCC to either deny transfer of license or conduct a comparative hearing.

When that failed, the committee appealed to the courts. In spite of the fact that there were two other classical stations in Chicago at the time, the court ruled that the FCC had erred in approving the transfer without a hearing.

Tribune finally gave in. It transferred control of the station to a noncommercial licensee that kept the classical programming.

Two years later, a similar drama unfolded in New York City. WNCN(FM) changed hands and went to a pop format, prompting the formation of the WNCN Listeners Guild, which

led a similarly successful fight. WNCN continues to program classical music to this day.

## From the beginning

Some of the earliest demonstrations of the new radio technology featured classical music. Enrico Caruso sang for such a demonstration at the Metropolitan Opera House, New York, in 1910.

Live classical music was a staple of 1920's radio. Westinghouse's KYW (AM) Chicago aired little more than the Chicago Opera soon after it signed on in 1921. The station used a sophisticated 10-microphone set-up on the stage for the broadcasts.

WJZ(AM) Newark, N.J., brought an orchestra and singers into its studio in March 1922 for a 75-minute presentation of Mozart's "The Impresario." The New York Philharmonic began weekly broadcasts for WEA(AM) New York in November 1922.

As network radio grew in the 1930s, classical music was there. NBC even formed its own symphony orchestra in 1937, conducted by Arturo Toscanini.

The Rochester (N.Y.) Philharmonic has a distinguished history on network radio. It began playing on WHAM(AM) Rochester in the early 1930s and by 1933 was beamed nationwide on the NBC Blue Network. Today the orchestra can

still be heard on WXXI-FM Rochester, which carries the philharmonic's entire subscription series and five summer concerts from Vail, Colo.

## Technical advancement

The development of the long-playing, 33 1/3 rpm record by Columbia Records in 1948 was particularly beneficial for classical programming, as was the development of static-free FM radio.

FM stations throughout the country during the 1950s emulated WQXR-FM New York, which billed itself as "America's Number-One Fine Music Station." These early FMs went far in creating new audiences for classical and folk music.

WQXR-FM first went on the air in November 1939 as the first FM in New York City with experimental call letters W2XQR. The transmitter was borrowed from Major Edwin Armstrong, inventor of FM. The station continues to broadcast classical music today.

The FCC established the standards for stereophonic FM broadcasting in 1961, another vast improvement for classical music listeners. The "hi-fi" enthusiast was also receptive to serious drama, discussions of the fine arts and public affairs programs.

Several FM stations in America became the equivalent of England's "Third Program," and often rebroadcast BBC

cultural programs. In 1962, a noncommercial FM station—WFMT(FM) Chicago—won the Peabody Award for best radio entertainment.

## Classical boost

Sometimes introducing classical music into a market provides surprising reactions from the listenership. Classical music lovers in the St. Paul and Minneapolis in the early 1970s were forced to jump between several stations that programmed a few classical selections between public affairs programs.

That left the door open for KTWN(FM) (KQQL currently), a station that had earlier had little success with country and easy listening formats, to switch to classical. Grateful listeners poured donations into the station to encourage it to continue the format, even though it was a commercial station. One Minneapolis man even contributed his 100-album library, a major acquisition.

Classical music stations have diversified over the years. Many public radio stations program a fine arts/classical format. Others program jazz, talk, public affairs, black and progressive rock together with the classical standards.

But no matter how it is packaged, classical music plays on, often with popularity comparable to the other hot formats.

□□□

*James T. Wold is a free-lance writer based in Minnesota. He is author of "Minnesota Microphones," published by Northstar Press. Wold can be reached at 1106 South Seventh St., Minneapolis, MN 55415.*

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## OFFBEAT RADIO

# KEED Fights for Radio in the Park

by Dee McVicker

**EUGENE, Ore.** An arsonist's fire devastated McKenzie River Broadcasting KEED(AM) in Eugene last June 13. Now the station is taking heat from the Eugene town hall.

The message from the city, said McKenzie Broadcasting's Director of Engineering Chris Murray, is that radio should be heard and not seen.

Since the fire, KEED has been unable to broadcast due to the city's refusal to issue a building permit at the station's transmitter site located in a city park.

"The city doesn't care that we're off the air and can't get back on," said Murray, who so far has been unable to get authorization for even a temporary trailer to house a 250-watt back-up transmitter.

"They really don't like to have us there. I think it's a part of the fact that we as broadcasters... have not gotten together with city leaders, council members, mayors, the head of the parks department and sat down and formulated a philosophy that radio stations and parks can co-exist," Murray said.

## Property values

McKenzie River Broadcasting purchased KEED last January to form a four-station group in the Eugene area under the FCC's new duopoly rules.

Before the fire, a two-story transmitter building had been at the site, which also once served as KEED's studio site. The old building was built in 1940 when the area around it was zoned residential. The city later turned the adjoining land into the local landfill.

"So in 1949, that radio station existed on the edge of a place nobody wanted," Murray said. "(The landfill) has since been covered up and they located another landfill somewhere else. That property that's on the edge of the (former) landfill is now a pristine park environment, and it has gone from no value to an exceeding value."

The property is also valuable to KEED. "It's an ideal location for the fact that KEED is a directional station at night and it's strategically located between the two communities we serve, Eugene and Springfield," Murray said.

But the fire may have changed all that.

## Total loss

The blaze started early in the morning on June 13. Murray got a call at 3:15 from the station's overnight jock, who said that the station was off the air. Murray immediately suspected the transmitter building was on fire when another overnight jock monitoring the police scanner said he heard of a fire near the park.

"Sure enough," said Murray, "the fire department was there."

By the time he reached the blaze, the building had been engulfed in flames. "The second floor was completely charcoaled, completely obliterated. All the equipment in the rack dissolved. The only piece of equipment in the rack that didn't burn was a piece of CRL (Circuit Research Labs) equipment, because they used heavy-duty steel cases for their stuff," Murray said.

Two of the melted transmitters had used PCB capacitors. "We're going to do about \$10,000 worth of cleanup just

because of the PCBs," said Murray.

Fire investigators suspect arson, either by teenagers or transients trying to warm themselves.

Within 72 hours of the fire, Murray was able to get a temporary electrical drop from the utility company for lighting the towers, as well as an electrical inspection and an electrical permit from the city—but no building permit.

Alternative sites were considered, but all appear to be inferior. KEED could share a tower with McKenzie's other AM station, KKKO. But, said Murray, "we already have two stations on KKKO's stick."

Diplexing would be complex and, as a directional station, KEED would require another tower to be added to the site.

Moreover KKKO's tower is a quarter mile from a 1,000-unit apartment complex, limiting the amount of RF all three stations can put out from the location. KEED, which operates at 5 kW daytime and 1 kW nighttime, would have to cut its power to 1 kW at all times.

## Cooperation

"Our insurance company is protecting the revenue, so it won't be long before the insurance company starts pressuring

the city (for a building permit)," said Murray. "We hired a land-use attorney and we think we're probably going to get the ability to be able to put a small 12 by 20 foot trailer building."

He is confident of eventual settlement with the land planners. "We need to sit down and do what the city of San Bernardino (Calif.) did, as an example, where they wanted to build a golf course and they put four in-line (broadcast) towers between two fairways," Murray said.

Murray is not at all opposed to cooperating in the search for solutions to the continuing convergence of radio stations and sprawling metropolitan areas.

□ □ □

Dee McVicker is a freelance writer specializing in the industry. She regularly contributes to RW and can be reached at 602-545-7363.

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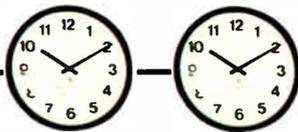
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## BOTTOMLINE BROADCASTER

# Beach Reading for Station Engineers

by Edwin Bukont

**GREENBELT, Md.** If you're like me, the local paper and those other trade magazines are not enough reading material to keep you entertained during that week-end-long remote.

I have compiled a list of books and catalogs that over the years I have found to be useful sources of either information or problem-solving techniques beyond what is found in the usual textbook or equipment catalog.

## Work smarter

As staffs get smaller or take on the added work of local marketing agreements and duopolies, working harder must give way to working smarter. The expense of technical guides and "black boxes" is often justified by the considerable savings in turnaround time, which improves your station's competitiveness

and customer service.

Take a pad, a pencil and one of these publications along to that next remote and save yourself some time.

Radio Shack has several useful guides.

The "Electronics Data Handbook" (62-1085) is a fine and inexpensive reference for computer cable pin-outs, color codes, radio frequency information, commonly used formulas and wiring standards.

You may already be familiar with the Radio Shack series of engineers' notebooks on timers, ICs, opto-electronics and other topics. Recent additions cover security systems, power supplies and telephone systems.

"Audio System: Design and Installation" by Phillip Giddings and published by Howard Sams is a must for every engineer. I believe it to be the finest, most exhaustive, most clearly written text on practical audio and studio design.

Unfortunately, there are not nearly as

many audio design texts and seminars available as there are for RF transmission. This book should be read by all equipment designers and manufacturers, as well as engineers at production and broadcast facilities.

Howard Sams also publishes the comprehensive "Handbook for Sound Engineers: The New Audio Cyclopedia," which covers audio for motion pictures, concert halls and other sites, but is somewhat short on the needs of broadcast and practical production environments.

## Telecommunications

Billed as a 'Catalog of Telephone Productivity Tools,' "HELLO Direct" offers a wide variety of headsets, telephone sets and systems, call-processing devices, toll and access restrictors, a pay phone, a conference system, data security, caller ID and other devices.

Particularly interesting, with enforcement of the Americans with Disabilities Act, are strobe lamp and super-loud ringers as well as a TDD (Telecommunications Device for the Deaf) terminal. "HELLO Direct" is available at 1-800-444-3556.

The next level, featuring intensive automation, security and telephone products is offered by "Home Automation Laboratories" (HAL) at 1-800-935-4425. Of particular interest from HAL is an inexpensive multiline voicemail system for use on a PC.

If you prefer to roll your own simple telephone projects, see "Customize Your Phone: 15 Electronic Projects" by Steve Sokolowski, published by TAB Books of Blue Ridge Summit, Pa. TAB Books offers an extensive catalog of technical books in every discipline.

Many parts, even for late-model equipment, are hard to find locally. This is especially true for cellular telephone, automotive and high-end consumer electronics which are becoming a regular part of the tools used by management, programming, promotions and on-air talent.

"Parts Express" (1-800-338-0531) carries batteries, parts, accessories and systems for cellular, automotive and building alarms,

sound systems, and telephone wiring needs.

"MCM Electronics" (1-800-543-4330) offers an extended range of ICs, tools, test gear, belts and other parts at reasonable prices for the repair of consumer audio/visual entertainment products.

"Russell Industries," available at local electronics shops, offers a wide variety of belts, idlers, gears and pinch rollers used in audio/visual/video equipment. If your local shop does not have a catalog, call Russell at 1-800-645-2202.

## General information

For a potpourri of electrical, mechanical and physical information, including automotive, carpentry, hardware, plumbing, rope, weights, conversion tables and much more, see the inexpensive "Pocket Ref," edited by Thomas J. Glover and published by Sequoia Publishing (303-972-4167).

Many manufacturers publish technical guides and provide quality documentation of general interest that leads to good audio and control system installation. Audio Technologies Inc., Telos, Aphex, Rane, Broadcast Electronics, Pacific Recorders & Engineering and RE America are among the prominent examples.

"EMERGENCY/STANDBY POWER SYSTEMS" by Alexander Kusko and published by McGraw-Hill Book Co. is a thorough introduction to the titled subject for most broadcast plant applications.

The National Association of Broadcasters, Society of Broadcast Engineers, Electronic Industries Association, Institute of Electrical and Electronic Engineers and the Government Printing Office all offer texts and guides covering the gamut of information a broadcaster needs to be competitive, legal and on-the-air.

There are also catalogs and publications available in related industries, (film, TV, theater, cable, recording and especially telephone and data), that are useful in the broadcast plant. Many publications are free or cost no more than a trip to the library and the photocopy machine.

□ □ □

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

# Check Out New NAB List

► continued from page 35

(For that matter, the rules don't either.)

NAB says stations must have a "fail-safe" way of shutting off the transmitter when necessary. This is certainly a good idea, but it is probably no violation if a station does not have it. The rules simply require a station to shut down the transmitter when it is causing interference (see 73.1410(e)).

The checklist provides a good explanation of "unattended" station operation. (I prefer the term "off-premises control" because the rules currently require an operator to be in attendance.)

Rule 17.21(a), which requires stations to have towers exceeding 200 feet painted, is correctly cited in the checklist. But NAB does not mention that many stations with shorter towers have lighting and painting requirements on their licenses. The FCC, it should be remembered, will enforce what is on the license, even if the FAA says lighting and marking are not required. Have your FCC license modified before removing marking or lighting.

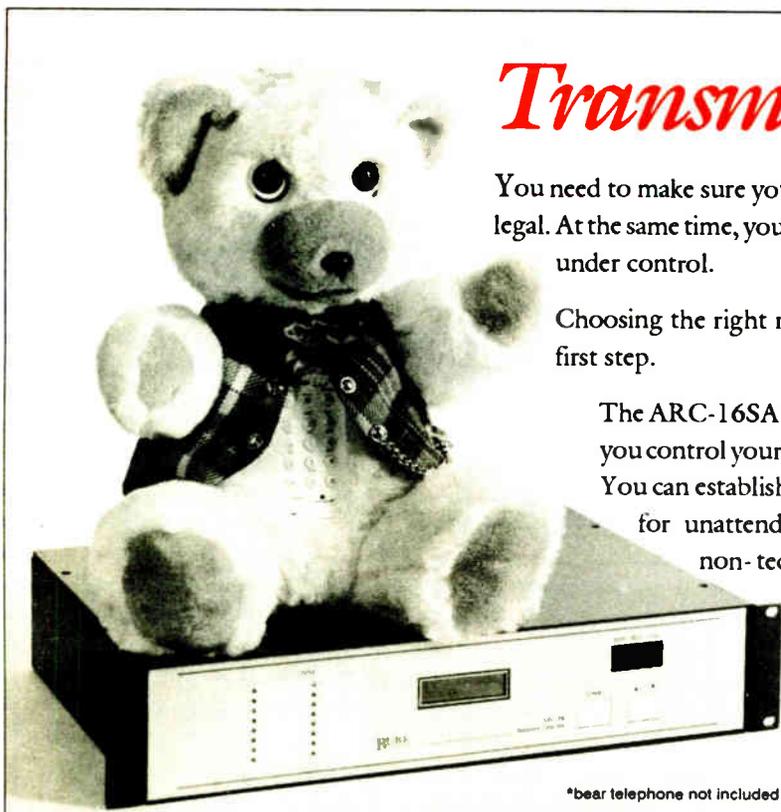
The NAB checklist is a very good station inspection outline with a wealth of leads to get more detailed information. My disagreements are with some of NAB's interpretations.

I'd certainly use the checklist to go through a station. Whenever the checklist prompts further questions rather than providing definitive answers, remember that the FCC rules are the final authority.

The NAB checklist is free to the association's radio members. I'd suggest they also make it available (at some reasonable charge) to nonmembers. NAB Publications can be reached at 800-368-5644.

□ □ □

Harold Hallikainen is president of Hallikainen and Friends, a manufacturer of transmitter control and telemetry systems. He also teaches electronics at Cuesta College, San Luis Obispo, Calif., and is getting better at Contra dancing. He can be reached at 805-541-0200. He can also be reached on Internet at ap621@cleveland.freenet.edu.pa



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Rene HC-6 headphone amp, new, \$250; Radix DA 1600 dist amp, new, \$325. G Grassie, RNTC Bdcg, POB 146, Dexter NM 88230. 505-734-5565 before 7AM/after 6PM.

Ramko DA-16BR/E dist amp, \$150. J Vavricek, KSYZ, Grand Island NE. 308-382-0108.

Marantz 8-B, exc cond, \$1350; pair of Marantz 9's, \$7500. David, 305-866-5401.

Shintron 220 audio DA card (1x6) w/manual, fits mdl 213 tray or may use mating connector to break out, new in box, never used, \$15. D Bailey, Rock Shoppe Prod, 3422 Beech St, Rowlett TX 75088. 214-475-9796.

Spectra Sonics 101-A 3-chnl line amp, ea chnl has input level control, rack mount setup, 3" high & bridge input, 600 ohm line out, 40 dB gain ea chnl, \$100. S Lawson, KAK Prod, 928 Hyland Dr, Santa Rosa CA 95404.

Dukane 17A350 100 W solid state, rack mount, vgc, \$75. A Ross, 8022 27th NE, Seattle WA 98115. 206-525-4624.

Crown D-75 power amp, \$300; Bogen C-100 100 W PA amp, \$125. J Parks, WCXN, River Rd, Middletown CT 06457. 203-347-2565.

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

#### Want to Buy

### WANTED:

Pultec EQ's; Fairchild, Teletronix, dbx, UREI, Sontec Limiters. Neumann, Telefunken, AKG and RCA mics. MacIntosh or Marantz Gear; Lang, Neve and API gear. Misc old tubes and guitars.

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Circle (92) On Reader Service Card

### ANTENNAS & TOWERS

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FM antenna, 12 bay, high power rototiller style, \$7500. EL Roskelley, KMRK, 4000 Rasco Ave, Odessa TX 79764. 915-363-9696.

Rohn SSV 100' comm tower, still standing, near Pontiac MI, BO. S Dewey, TCI, 4500 Delemere, Royal Oak MI 48073. 313-549-8288.

CCA Coamark 3-bay tuned to 92.7, good shape, BO. D Barron, KWJM, POB 777, Farmerville LA 71241. 318-368-3094.

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1983 Utility 30' face 280' hollow rod galvanized steel tower avail for no cost, you take down & remove. R Simmons, KRGT-FM, POB 50124, Austin TX 78763.

Hillomast NK9 pneumatic telescopic antenna mast for remote bdcg transmission, \$1500. D Hendricks, WBVN, POB 177, Boyertown PA 19512. 215-367-0673.

#### FM - ANTENNAS

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Harris FMC4-A 4 bay antenna, 2.1 gain, avail 9/1/93, has de-icers, \$2500 or trade for STL or ? T Hodgins, KLKY, 14 E Main, Walla Walla WA 99362.

ERI 403 isocoupler tuned & tested, gd cond, cmptly rebuilt, BO. D Barron, KWJM, POB 777, Farmerville LA 71241. 318-368-3094.

Shively Labs 4 bay 6813 medium pwr FM antenna with radomes on 98.9, we must change frequency, antennas are less than 3 yrs old, \$5500. R Ruff, WKHJ-FM, POB 2337, Mtn Lake Pk MD 21550. 301-334-4272.

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Cablewave CC300-50J, 3" 100', new, on spool, \$15/ft. S Wodlinger, WIXI, 3337 Tamiami Trail N, Naples FL 33940. 813-262-1000.

Andrew LDF 750A 1-3/8" foam Helix, new, any length, \$4/ft. M Gummer, Natl Audio, 7463 Canton St, Baldwinville NY 13027. 315-635-9310.

Large spool for 3" waveguide, new, \$500. S Wodlinger, WIXI, 3337 Tamiami Trail N, Naples FL 33940. 813-262-1000.

200', 6" hard line, 20' sections w/stainless hangers, connectors & elbows, in storage, \$4650. K Crosthwait, WTNN, 13206 Buttermilk Rd, Knoxville TN 37932. 615-531-2297.

Shively 3-bay cir pol, 92.7 MHz, 70' Andrew 1-5/8" coax, 4 years old, excellent condition. C Hall, KYKN, Box 165, Nephi UT 84648. 801-623-4010.

3-bay circularly polarized FM antenna, 105.3 MHz for Class A station with 260' of Andrew 1-5/8" line, excellent cond, \$3000. J Buffington, WWZQ, Aberdeen MS 39730. 601-369-4561.

#### Want to Buy

Any 1-3 bays of FM antennas tuned to or near 107.9 for back up. M Shafer, KEKB/KBKL, 315 Kennedy, Grand Junction CO 81501. 303-243-3699.

Icing researcher needs information on tower collapse, if your tower has collapsed, either partially or totally, because of icing, I would like to talk to you. Nathan Mulherin, Research Physical Scientist, Cold Regions Research & Engineering Laboratory, Hanover, NH. PH 803-646-4260; FAX 603-646-4644. Internet Email: mulherin@hanover-crrrel.army.mil

### AUDIO PRODUCTION

#### Want To Sell

BBE 402 stereo enhancer, \$150. P Cibley, Cibley Music, 138 E 38 St, NY NY 10016. 212-986-2219.

Delta Lab ADM 1024 digital effects with up to 1024 ms delay & LFO for modulation, good condition with manual. \$175. D Bailey, Rock Shoppe Productions, 3422 Beech St, Rowlett TX 75088. 214-475-9796.

Howe Tech Phase Chaser mdl 2300A stereo phase chaser excel cond, \$2395/BO. T Troland, 505-863-9391.

Orban 111B stereo studio reverb unit, \$400. M Rollings, WZNF, 400 N Broadway, Urbana IL 61801. 314-458-5595.

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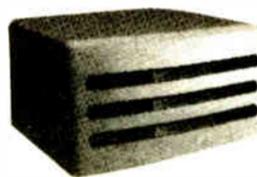
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MXR 129 pitch transposer & separate display unit, both rack mount units, excel cond, \$125. J Block, Prod Block, 906 E 5th St, Austin TX 78702. 512-472-8975.

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Pultec EQH2 passive equalizers (3), very clean with manuals, \$2000/ea or BO; ITI stereo parametric EQ rack mount, \$800/BO; Spectra Sonics 610 compressors (2), \$400/ea or BO. C Foster, WFOV FM, 727 Hammond St, Bangor ME 04401. 207-947-4487.

Eventide BD 955 delay unit for on-air use, \$1800. M Rollings, WZNF, 400 N Broadway, Urbana IL 61801. 314-458-5595.

Shure M-67 mic mixer, \$150; Shure M-675 prod master add-on for the Shure M-67 mixer, \$100. J Parks, WCNX, River Rd, Middletown CT 06457. 203-347-2565.

Shure M-610 feedback controller EQ, \$85. J Parks, WCNX, River Rd, Middletown CT 06457. 203-347-2565.

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ADC 48 patchbay. D Nelson, 619-758-0888.

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**AUTOMATION EQUIP**

**Want To Sell**

Conex CG-25 25 Hz gen. BO. J Vavricek, KSYZ, Grand Island NE. 308-382-0108.

Systemation QuickDisc digital audio storage satellite automation, excel condition, complete w/manuals, \$6995/BO; Format Sentry FS12C automation controller, \$2500/BO; IGM Instacart SMC \$350/BO. T Troland, 505-863-9391.

Control Design Corp CD-256 25 Hz tone generator, excel cond w/manual, \$100. D Bailey, Rock Shoppe Prod, 3422 Beech St, Rowlett TX 75088. 214-475-9796.

Sonomag Mini Pro, (4) PR 99, (2) 350 Carousels, RSC-100 random programmer, automation head & controller w/remote, 2 racks on casters, \$3500 you pickup. S King, KGFL, Box 33, Clinton AR 72031. 501-745-4474.  
 Colorado Magnetics Satcue 400 automation switcher, \$400. B Eustis, KTMC, POB 848, McAlester OK 74502. 918-423-1400.

MW Persons 3A 4 source programmer, \$180 plus shpg; MW Persons 25 Hz tone processors (2) 2-chnl 25 Hz tone decoders, \$100 ea plus shpg. J Rowland, WZIO, POB 478, Wheelersburg OH 45694. 614-574-6255.

Qwik Disk dig audio system from Systemation, leftover from doupoly deal, \$5800. D Miller, WINA, Charlottesville VA. 804-977-3030.

IGM/NTI Basic A includes (2) 48 tray Insta-Carts & (4) Otari ARS reel tape decks, \$3000/neg. S Spencer, KZ106, 99 W First St, Corning NY 14830. 607-962-2424.

Cetec 7000 w/B150 Series computer terminal, (5) ITC 750 reel tape decks & (6) Audio File trays, all in operation. S Spencer, KZ106, 99 W First St, Corning NY 14830. 607-962-2424.

Control Design Corp CD25S 25 Hz tone detector, 4 units, \$25/ea; assorted CDC manual, schematic, source cards, parts & assort 74 series chips, open. G Hoppe, WVVA/NHMH, 1010 2nd St N, Sauk Rapids MN 56379. 612-252-6200.

Broadcast Products AR-1000/2000 automation system incl audio control, programmer, pwr supply, time gate, R-R, 25 Hz detector, Carousels, encoder, decoder, logging code converter, logging decoder, triple player, single players, teleprinter, system taken off the air in gd working cond, will demo system to serious buyer, will also sell as parts. B Wolf, WFUN, 3226 Jefferson Rd, Ashtabula OH 44004. 216-993-2126.

SMC DP-2 '77 mdl, gd cond, usable or for parts, PDC-5 clock, DS-20 switcher, Extel printer & manuals, \$500/BO. B Christle, Grande Radio Group, POB 907, LaGrande OR 97850.

Arrakis Diglink II digital automation syst only used for 1 yr, great for live assist & satellite automation, CD quality sound, \$5500. D Murphy, WY2M-FM, 6313 Odana Rd, Madison WI 53719. 608-273-9774.

Schafer 901, complete system w/903 control unit keyboard, (5) random select Carousels, (5) R-R, (4) ITC cart players, (5) racks, cables, spares & manuals, ready for shipping, \$6000. B Crow, KINT, 2501 N Mesa #303, El Paso TX 79902. 915-534-0094.

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

IGM RAM 500 2K sequential mem, 6 inputs, Instacart random access interface card, gd cond, w/monitor panel, update clock, silence alarm, BO. C Gennaro, WJMS, 222 S Lawrence, Ironwood MI 49938. 906-932-2411.

**CART MACHINES**

**Want To Sell**

Audicord E-20 mono 1 slot, new, \$750. G Grassie, RNTC Bdctg, POB 146, Dexter NM 88230. 505-734-5565 before 7AM/after 6PM.

ITC PD2 cart machine, R/PB mono, very few hrs, like new w/manual, BO. N Alexander, Loomis Prod, 1015 N-35E Ste 200, Carrollton TX 75006. 214-242-7774.

BE 5300 triple deck works w/connectors & manual, \$700. B Oostenburg, KCKY, POB C, Coolidge AZ 85228. 602-723-5448.

**CART MACHINES:**

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 Recondition: \$150 per deck + parts. Call Mark @ 619-598-3311

ITC SP (2), 1 record amp, all work need minor repairs or adjustments, \$800/all. C Arnold, KIPR, 415 N McKinley Ste 290, Little Rock AR 72205. 501-663-0092.

BE 3000A mono delay rcdr, rack mount, never used, \$800; EB 3000A stereo R/PB, \$1325. D Kelly, KWPN, Box 84, West Point NE 68788.

Tapecaster 700 R/P mono units (2) in gd cond, one is tape delay, \$180 ea plus shpg. J Rowland, WZIO, POB 478, Wheelersburg OH 45694. 614-574-6255.

ATC/Gates Criterion 1, can modules, program amps, power supplies, 150 cue & 1000 cur, 11 modules total, Microset head Assy, \$50/lot; Beau motor, \$75; lot of misc switches (start/stop) some brand new, \$15; R/P interface cable, \$10; lot of misc parts free w/order; Japan Servo Motor for Criterion 90 machine, needs bearings, \$50. H Kneller, WKII, 3151 Cooper St #56, Punta Gorda FL 33950. 813-639-1112.

IGM cart machines, light use as automation backup, 2 PB, 1 rcdr, PBs probably 20 yrs old but sound quite good & run fine, rcdr similar vintage, runs but needs some TLC, PBs \$140/ea; rcdr, \$100; all 3 for \$330+ shpg. Marc, WDFH, Dobbs Ferry NY 10522. 914-693-3963 after 6pm.

Nortronics heads 2057, 2007, 2003, 2002, 3002, new; Gates Criterion 80 rack mount kits; Beau eraser/splice locator, rack mount kit for (3) Beau cart machines. H Kneller, WKII, 3151 Cooper St #56, Punta Gorda FL 33950. 813-639-1112.

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Collins Twin Tape dual mono units, (3) machines, \$35/ea, \$100/all; Collins mono record amp (2), \$25/ea, \$40/both. G Hoppe, WVVA/NHMH, 1010 2nd St N, Sauk Rapids MN 56379. 612-252-6200.

Tapecaster X700RP (2) stereo decks, R/P, all manuals, both gd cond, \$450/ea or \$800/both. J Winters, Winterssound, 45 E Washington St, Elizabethtown PA 17022. 717-367-1119.

Spotmaster 505C (3) R/P reconditioned, work fine w/manual, \$125/ea. G Gibbs, KMNS/KXEZ, 901 Steuben St, Sioux City IA 51102. 712-239-3966 pm.

Audicord A-50, dual R/P, mono, one cue, \$800; Audicord triple play, mono, horizontal, \$1250. B Eustis, KTMC, POB 648, McAlester OK 74502. 918-423-1400.

Fidelipac Dynamax CTR12 PB (3), CTR14 R/PB, rack shelves (2), excel cond, \$4000/set. Stu, First Take Recording, 301-963-7758.

Sonomag 590 R/P, rack mount w/drawer type sliders for servicing w/record manual, \$200. J Vukelich, Am Best Svc, 4551 Flag Ave No, Minneapolis MN 55428. 612-537-1431.

Spotmaster 505 mono desk top rec/PB, \$250; Spotmaster 500 PB mono desk top, \$200 or \$350/both. P Drake, 708-870-8252.

Spotmaster 2000 R/P, \$400. J Parks, WCNX, River Rd, Middletown CT 06457. 203-347-2565.

RCA RT 7A 19" mono PB (5), \$100 ea/\$375 all. P Drake, 708-870-8252.

BE Dura-Trak 90 stereo PB w/3 tones, \$1000/BO plus shpg. C Stalaker, KDDK, POB 100, Little Rock AR 72203. 501-372-7740.

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

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Technics RS-1520 2 track stereo, 3 speed, bal & unbal in/out, rack mount adapters, remote control, extra FT plug in head assembly included, good condition, \$700/BO plus shipping. E Helvey, Ed Helvey Prod, 461 Layside Dr #100, Winchester VA 22602. 703-877-2717.

Recordex 330 Series II 1x3 cassette duplicator, excel cond, \$600; Telex Copyette 2 stereo 1x1 duplicator, needs tweaking, \$200. G Grassie, RNTC Bdctg, POB 146, Dexter NM 88230. 505-734-5565 before 7 AM/after 6 PM.

Scully 288B 16-trk w/auto locator, new headstack, 15 & 30 ips, 2" format, excel cond, \$5800; Scully 280B 2-trk w/locator, excel cond, \$1325; Fostex mdl 20, 2-trk, excel cond, \$325. Music Prod Co, 318-636-0545.

Otari R/R ARS 1000 (2) with 25 Hz tone sensor & cue tone relays, \$300/each. R Chambers, 916-257-2121.

Otari MX 5050 MK-III-8 with cables & roll-around stand, excellent condition, \$2995. S St John, St John Productions, POB 641448, Kenner LA 70064.

Ampex 350 stereo R/P w/Viking elect tape hold downs, rack mount, long life heads, \$375. J Vukelich, Am Best Svc, 4551 Flag Ave No, Minneapolis MN 55428. 612-537-1431.

Tascam 234 syncaset, one new, \$700, one used, \$450; Tascam 32-2B (2), excel cond, \$600 ea/\$110 both; Tascam 22-2 (2), excel cond, \$450 ea/\$800 both; Teac X-300, new, excel cond, \$375; Revox B-77, one 1/4 trk, \$450, one 1/2 trk, \$600; Sony TC230 (2), TC 630 med belts, \$100/all. G Grassie, RNTC Bdctg, POB 146, Dexter NM 88230. 505-734-5565 before 7AM/after 6PM.

Ampex AG-350 2 track stereo, R/P. Inovonics 3 speed electronics, 3 speed reversible Beau motor, all mounted in AG-440 console, good cond, \$700/BO plus shipping. E Helvey, Ed Helvey Productions, 461 Layside Dr #100, Winchester VA 22602. 703-877-2717.

Telex 6120XTP stereo duplicator, new, never used, master & 7 slaves, all boxes & factory hardware, \$6800. J Block, Prod Block, 906 E 5th St, Austin TX 78702. 512-472-8975.

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American Indian Engineer/Manager, SR SBE, AAS Degree, 18 yrs exper, strong analog, digital, xmtr, FCC applications, consultant, design & construction. Former Owner/Operator. Write to: Radio World, POB 1214, Falls Church VA 22041. Attn: Box # 07-14-01RW.

Salesperson looking for a good list in a small town, NW, goal: management. J Wiegman, 208-753-0601.

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If your product is not selling...I'm not on your team. Broadcast equipment sales/mktg executive. Consider mgmt or staff, avail immediately, will relocate. Write to Radio World, POB 1214, Falls Church VA 22041. Attn: Box #07-28-01RW.

23 years of radio production exper, let me join your production staff, any market, any format, professional job done cheap. John Peace, 803-669-1719.

Experienced engineer, directionals, RF, studios, computers, seeks maintenance pos w/board shift, SW min area pref but not limited. Engineer, 7894 Palm Grove, Indianapolis IN 46219.

Engineer w/23 yrs of exper seeks a FT position, ideally within 8 hrs drive of Highland Park IL, N.E. Illinois, S.E. Wisconsin, N.W. Indiana or S.W. Michigan preferred, other areas considered. Call Jeff at 719-579-8651, leave message.

AAS grad, computer/electronic engineering, 6 mos exp announcer, FCC GRTO license, amateur radio license holder seeks ENG pos in SE med/lrg mkt, station to grow with. Fred, POB 453, Webster NC 28788.

1992 graduate working at IL radio station, 5 yrs of play-by-play & overall radio exper, incl news, seeks sports job, no geographic preference. Derek, 618-667-6169.

Unlimited potential! UNC grad, experienced, hardworking team player w/great voice seeks FT AT/production, any format, any time slot, any region. Ben, 407-351-3939.

GM for Florida small or medium market, 40 yrs exper in mgmt, sales, turnarounds & ownership. Jim Smith, 813-923-3684.

GM for Florida medium or large market, 29 yrs exper in sales, programming & engineering, turnarounds or start ups, avail immed. B Elliott, 813-849-3477.

Willing traveler looking for A/C or contemp Christian format as production, sales or FJ, avail ASAP, small to medium market, bass voice w/music knowledge. Kurt, 405-691-5402.

Experienced bdct engr, xmtr, studio installations, directional proofs, 100 kW FM, seeking FT position, presently 2-way radio tech. Dan, 206-387-3558.

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Nashville, TN 37203 (615) 244-6892

Ampex 440 reconditioned less than 9 mths ago, \$100. B Lacy, KARX Radio, 3611 Soncy 6-A, Amarillo TX 79121. 806-359-4000.

Ashland/Ampex capstan motor for 350/440 series 3-3/4 & 7-1/2 ips, \$50. H Kneller, WKII, 3151 Cooper St #56, Punta Gorda FL 33950. 813-639-1112.

Marantz PMD-201 (3) 1/2 trk mono, port cass recorders, 2 hds, 2 spd, mic/line/telephone in w/built in modular jack, mic pad, hi & lo pass filters, 1/4" phone jack, ferric/CrOs/metal tapes, AC or batt pwr, \$110 ea or \$300/all plus shpg. E Helvey, Ed Helvey Prod, 461 Layside Dr #100, Winchester VA 22602. 703-877-2717.

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3M 56 4-track in floor cabinet, \$1800/BO. C Foster, WFOV FM, 727 Hammond St, Bangor ME 04401. 207-947-4487.

Various R/R drive motors; 1-Scully, 1-UMC, 1-Nidex, 2-Ampex 440, 2-816 drive. \$200/ea; Revox RB 77 (2) machines complete, one may work, \$275/both; Ampex mdl 600, BO. C Arnold, KIPR, 415 N McKinley Ste 290, Little Rock AR 72205. 501-663-0092.

Otari hubs for 10" NAB reels, as new, \$25 ea/BO. L Snyder, Madera Bdcg Inc, Box 812, Floral Park NY 11001. 718-347-2940.

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Otari ARS 1000 PB stereo (2) with 25 Hz tone decoder in good condition, \$450 ea plus shipping; Technics 4-track 1506, needs work, \$200 plus shipping. J Rowland, WZIO, POB 478, Wheelersburg OH 45694. 614-574-6255.

Sony 800B prof portable with variable speed, built-in mic, switchable limiter, 5" reel capacity, never used, \$150. J Morinelli, 901 Fairfax Rd, Drexel Hill PA 19026. 215-789-5872.

Technics head set for Technics RS-1500 Series, 2-track stereo erase-record-play, plus 1/4 track play head, in box, never used, BO. L Snyder, Madera Broadcasting Inc, Box 812, Floral Park NY 11001. 718-347-2940.

Otari MX5050 Bll w/15-30 ips conversion which cost \$800, mint cond, \$1400. W Gunn, 619-320-0728.

Telex Series 235 open reel tape duplication system, 7.5 & 15 ips w/one master plus spare & four slaves, 2-chnl electr w/manual, mint cond, \$300 plus shipping. J Morinelli, 901 Fairfax Rd, Drexel Hill PA 19026. 215-789-7872.

Tascam 32 mint cond, barely used, BO. D Mayer, 603-466-3453.

Norton heads (3) new FT for Ampex 350, \$125/BO for all; (3) Norton 2-trk stereo tape heads for Scully 280, \$180/BO. L Snyder, Madera Bdcg Inc, Box 182, Floral Park NY 11001. 718-347-2940.

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Revox A77 stereo 2-trk (6) units, \$95/ea; Metrotech 8-trk logger w/rec amp, \$30/both. G Hoppe, WVAL/NHMH, 1010 2nd St N, Sauk Rapids MN 56379. 612-252-6200.

Ampex 350 gd cond w/solid state elect, work horse, mono, \$350 + shpg. G Gibbs, KMNS/KXEZ, 901 Steuben St, Sioux City IA 51102. 712-239-3966 pm.

Otari MX-70 16 trk 1" rcdr w/remote cntrl box & auto-locator on roll about stand, mint cond, \$1000/BO. M Wein, WIOW/WFLC, 1401 N Bay Causeway, Miami FL 33141. 305-759-4311.

Marantz PMD221 port cassette R/R, excel cond, BO. Davis, 803-276-0639.

Telex 235 3 to 1 cassette duplicator, mono, perfect shape, no notch in heads, \$600/you pay shpg. S Russell, 60410 Klett Dr, Decatur MI 49045. 616-782-9258.

Olympus L400 micro miniature recdr, smallest avail, auto reverse, voice activated, new in box, \$185. J Morinelli, 901 Fairfax Rd, Drexel Hill PA 19026. 215-789-7872.

Uher 4200 report monitor R-R stereo 1/2 trk portable, 3 hds, 4 speeds, new in box, \$500. R Sumner, CAUV Corp, 3322 Applegate Ct, Annadale VA 22003. 703-968-8894.

Ampex Bin Loop recorder w/Saki heads, 4 slaves, mastering sys w/Telefunken M215 PB, (2) King loaders, \$39,900. J Peluso, Quality Cass, 403 S Woodlawn St, Wheaton IL 60187. 708-668-2787.

Fostex 7-trk R-R rec/rep, with remote control, Dolby NR, metal reel, remote foot switch, original box with manual, BO. W Dougherty Jr, WLD Recording Studio, Music Valley Rt 1, Mill Spring MO 63952. 314-998-2681.

MCI JH110 R/P 2 trk (4), \$1500/BO; R/P 4-trk, \$1750/BO. D Sedge, WBAP, One Broadcast Hill, Ft Worth TX 76103. 817-654-6136.

Ampex AG440 in rollabout console, 3.75-7.5 ips 2-track PB, (2) repro amps, FT erase & record, remote control, \$200/BO; Teac, American Concertone 1/4 track stereo recorders, 3.75-7.5, remote controls, need some repair, BO; Uher 4000L portable R-R, mono, 4-speed, BO. M Muderick, Muderick Recording, 101 Earlington Rd, Havertown PA 19053. 215-449-6970.

Ampex ATR-800 1/4" FT head, 2 channel electronics, great condition, BO. G Gates, Comm Recdg Studios, 6001 W Creek Rd, Independence OH 44131. 216-642-1000.

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**AMEK BC-II32x4 Console \$14K**  
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Tascam 22-2 7" R-R, 1/4" 2-trk, 15 & 7.5 ips, mic & line inputs, \$600. J Ellingson, Jeff Ellingson Voice-Overs, 913 Warwick Dr, Cedar Falls IA 50613. 314-277-8535.

Technics 1500 1/4" 2 trk recorders, \$450. G Guarino, Sorcerer Snd, 19 Mercer St, Nyny 10013. 212-226-0480.

1/4" stereo mounted head assembly w/cables for Scully 280B, new, \$250. D Kocher, Digital Snd Makers, 1901 Hanover Ave, Allentown PA 18103. 215-776-1455.

MCI/Sony JH-110-C-8 & JH-110-B-8, 1" 8 trk w/remote, w/manuals, low mileage on heads, 7.5, 15, 30 ips, like new, BO. G Gates, Comm Recdg Sids, 6001 W Creek Rd, Independence OH 44131. 216-642-1000.

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

Ampex MM1200 16 trk R-R R/P, execkent condition. Mark, 619-758-0888.

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

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

Scully 280 1/2" 4-trk. D Nelson, 619-758-0888.

### Want to Buy

Sony EM-1 hand wind recorder plus portable 770 Pro; also miniature open reel recorders, prof & consumer type. J Morinelli, 901 Fairfax Rd, Drexel Hill PA 19126 215-789-7872.

Double-speed cassette recorders any make or mdl. J Garvey, 203-744-2476.

Ampex AG440C, need manual, original or will pay for copy; Ampex AG500, need 2-chnl electronics. A Ross, 8022 27th NE, Seattle WA 98115. 206-525-4624.

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

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

### CD's/PLAYERS

### Want to Sell

Denon 1200 F/C 200 disc player & controller will interface any IBM with software, new with all paperwork etc & warranty, will ship UPS, \$2700. Keith, ALI, 9 Roxbury St, Keene NH 03431. 603-352-8460.

Russca CD-100, new, \$50. G Grassie, RNTC Bdcg, POB 146, Dexter NM 88230. 505-734-5565 before 7AM/after 6PM.

## COMPUTERS

### Want To Sell

Yamaha MDF-1 disk drive for storing MIDI system exclusive info, \$100; NEC P6 24 pin dot matrix printer, \$125; TASCAM 38 8-track with 8 channels or dbx type I, \$1500, with out dbx \$1200, P Cibley, Cibley Music, 138 E 38 St, NY NY 10016. 212-986-2219.

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

Copyrite CR1 daisy wheel, wide carriage, exc cond, \$200; SPC-700C1 four color printer, std carriage, 9 pin, new, \$100; Epson RX-80 F/T std carriage 9 pin with tractor feed, exc cond, \$150. G Grassie, RNTC Broadcasting, POB 146, Dexter NM 88230. 505-734-5565 before 7AM/after 6PM.

## CONSOLES

### Want To Sell

Ramco DC-5RA radio 5 chnl mixer, unused, \$225. Marc, 916-334-9449.

Tascam mdl 15 mixing console, excel cond, \$2500. Music Pro Co, 318-636-0545.

BE 85150 8 chnl stereo board in gd cond w/new output cards, \$800 plus shpg; Harris Gatesway 80 8-chnl mono board in exc cond, \$800 plus shpg. J Rowland, WZIO, POB 478, Wheelersburg OH 45694. 614-574-6255.

Autogram LA-1 line amp modules (5) working. H Kneller, WKII, 3151 Cooper St #56, Punta Gorda FL 33950. 813-639-1112.

McMartin B502 5-channel stereo console, rotary faders, complete manual & schematic, good condition, \$700/BO; Shure M267 mixer, never used beyond testing, incl tone generator & AGC, \$275. J Winters, Wintersound, 45 E Washington St, Elizabethtown PA 17022. 717-367-1119.

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

Allen & Heath modular series mixing console, 8-chnl input 4-chnl output, slidepot console w/mixdown section, patch bay, booster line, expandable to 16 inputs, clean, \$750. B Sitzman, MFAS Prods, 110 County Rd 146, Trumansburg NY 14886. 607-273-2970.

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Rockwell/Collins IC 10A real good cond, BO. B Lacy, KARX, 3611 Soncy 6-A, Amarillo TX 79121. 806-359-4000.

Ramco 5-Chnl stereo mixer board DC-55, 2 inputs/mixer except #5 which offers 5 inputs, \$450. R Chambers, 916-257-2121.

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

BE BE-4M50A w/1/4" patch panel, new, \$625. G Grassie, RNTC Bdcg, POB 146, Dexter NM 88230. 505-734-5565 before 7AM/after 6PM.

Collins 212H 3-chnl mic in, switchable lin in on 2-chnl hophone amp, 3 tone generator roller faders, battery pwr, solid state, gd cond, \$275 + shpg; RCA BC8-A solid state, mono, dual output complete, all self contained w/manuals, BO. G Gibbs, KMNS/KXEZ, 901 Steuben St, Sioux City IA 51102. 712-239-3966 pm.

Ward Beck 26x9 fully parametric EQ, comp-limiters & patch bay, \$6000. R Friedman, 1137 Recording, 1137 Fillmore St, Baltimore MD 21218.

Consoles, \$500 & up. Call Mark at 619-758-0888.

### Want to Buy

Ampex MX10 or MX35 mixers for cash or trade. W Gunn. 619-320-0728.

Gates Solid-State Yard good cond, prefer transistorized but will consider tube mdl, no "for parts only" boards. E Allmon, WFIV Radio, POB 555519, Orlando FL 32855. 407-425-0623.

Arrakis 2000, 2100 SCT or similar Arrakis board in gd cond. D Koehn, KKPR, Box 130, Kearney NE 68848. 308-236-9900.

## DISCO & SOUND EQUIPMENT

### Want To Sell

SAE 5000-A impulse NR system, click & pop filter (2), \$100 both or \$80 ea. S Lawson, KAK Productions, 928 Hyland Dr, Santa Rosa CA 95404. 707-528-4055.

JBL D16R2405 brand new replacement diaphragm for JBL 2405 slot tweeter, as used in 4350, 4343, 4315, 4663, JBL speaker systems, \$50. E O'Brien, Imperial Sound, 383 N Studio St, Terre Haute IN 47803. 812-877-2663.

Technics SH-9010 stereo paragrahic EQ, rk mt, 2 chnl, 5 bands/chnl, adj freq & bandwidth ea band, .12 dB/band, unbal in/out, \$225/BO plus shpg. E Helvey, Ed Helvey Prod, 461 Layside Dr #100, Winchester VA 22602. 703-877-2717.

8-trk studio equipment, complete, call for all info. L Sawyer, Crossfire, 2001 Elton Rd, Haltom City TX 76117. 817-838-7623.

Duntech Sovereigns 2001, light oak, fine cond, \$6000/firm, local Miami pick-up or buyer pays shipping/packing. Insight Productions, 7441 Wayne Ave #10-D, Miami Beach FL 33141. 305-866-6048.

Sanyo stereo cassette deck fixer upper, needs belt, \$20; Realistic 12 band stereo EQ w/expander, like new, will trade for mic or de-esser or BO. W Dougherty Jr, WLD Recdg Std, Music Valley Rt 1, Mill Spring MO 63952. 314-998-2681.

Shure Prologue 250 8" 2-way speakers, portable, 8 ohms, \$25. J Ellingson, Jeff Ellingson Voice-Overs, 913 Warwick Dr, Cedar Falls IA 50613. 314-277-8535.

UREI 539 room EQ's (2), third octave, excel, \$375 ea; Teletronix LA-2A classic tube audio limiter, \$2300; BGW 750B prof pwr amp, excel, \$450. G Guarino, Sorcerer Snd, 19 Mercer St, Nyny 10013. 212-226-0480.

AKG BX-10; Eventide H969 Harmonizer/delay; Yamaha r1000 digital reverbs (2); ART Proverb; MasterRoom XL404 plate synthesizer, all reverbs in great shape, rk mntable, w/manuals, can sell separately, BO. G Gates, Comm Recdg Sids, 6001 W Creek Rd, Independence OH 44131. 216-642-1000.

UREI 530 9 band stereo EQ, rk mountable w/manual, BO. G Gates, Comm Recdg Sids, 6001 W Creek Rd, Independence OH 44131. 216-642-1000.

SAE 5000-A impulse NR system, click & pop filter, \$80. S Lawson, KAK Prod, 928 Hyland Dr, Santa Rosa CA 95404.

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**Want To Sell**

Alesis 3630 compressor/limiter, new w/warranty card, \$275. Music Prod Co, 318-636-0545.

CRL Systems PMC 450 peak modulation controller, \$500; Inovonics MAP-2 8 band AM processor, \$500. S Spencer, KZ106, 99 W First St, Coming NY 14830. 607-962-2424.

Orban 8000 stereo gen/procsr currently on air, \$1695. C Sigmon, WDKZ, POB 398, York SC 29745. 803-684-4241.

Mod Sci Stereo Maxx MYB-2 stereo enhancer, \$1900. B Dickerson, WEAG, 1421 S Water St, Starke FL. 904-964-5001.

dbx 155 4-chnl type I encode/decode NR, \$200/ea or \$350/2. P Cibley, Cibley Music, 138 E 38 St, NY NY 10016. 212-986-2219.

CRL Audio SPP 800 ABG & SEP 800 4 band limiter, \$300 per unit or \$500/pair. S Karwan, KPSI, 2100 E Tahquitz Way, Palm Springs CA 92262. 619-325-2582.

Aphex Type C 103A dual chnl aural exciter, audio signal processor, \$100. J Ellington, Jeff Ellington Voice-Overs, 913 Warwick Dr, Cedar Falls IA 50613. 314-277-8535.

dbx 166 limiter/compressor, \$500/BO. P Drake, 708-870-8252.

Compression limiting device for low power AM mono travelers info radio sVC in useable cond. 813-933-6009.

Optimod 8000A, excel cond, \$1700. R Micheals, KQFX, Amarillo TX. 806-355-1044.

CBS Labs Volumax 4110, 4300, 410 (2), Audimax 4440A, 4450A, \$125/ea or \$650/all. C Arnold, KIPR, 415 N McKinley Ste 290, Little Rock AR 72205. 501-663-0092.

**Want to Buy**

CRL SGC-800 limiter in good condition. B Barry, WAMB, 1617 Lebanon Rd, Nashville TN 37210.

Optimod 9100-B AM audio processor. K Thompson, WWIC, POB 759, Scottsboro AL 35768. 205-259-1050.

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Optimod fairly late-mdl AM in gd cond. E Allmon, WFIV Radio, POB 555519, Orlando FL 32855. 407-425-0623.

Optimod XT 6 band audio processor chassis for use w/8100-A. C Cage, WERK, 8510 S State Rd #3, Muncie IN 47302. 317-289-9375.

**MICROPHONES**

**Want To Sell**

Neumann U-67 tube mic w/power supply, vgc, \$2500. J Jackson, Sound Recorders, 9136 Mormon Bridge Rd, Omaha NE 68152. 402-465-3000.

Gefell Neumann UM57 tube mics, New capsules for SM2 & many others, New AC701 tubes for Neumann mics, \$275. W Gunn, 619-320-0728.

AKG 202E 2 element mic, excellent condition, \$120; Starbird 180 studio, boom extends 146" with tripod stand, \$250. D Kocher, Digital Snd Makers, 1901 Hanover Ave, Allentown PA 18103. 215-776-1455.

Neumann U67 re-tubed w/orig pwr sply & cable, \$1850. C Foster, WFOV FM, 727 Hammond St, Bangor ME 04401. 207-947-4487.

AKG 414's, \$695, original D12 like the Beatles used, \$295, Sony ECM54, \$150, Beyer M500 ilke new, \$300, Demeter 4-channel tube DI rack mount like new, \$875. W Gunn, 619-320-0728.

AKG D-900 dynamic shotgun mics (2), \$125 ea or \$225/both; AKG N46E 2 mic AC power supply, \$50; Lectrosonic quad box, new, \$1175. E Toline, Audio Etc, 525 W Stratford Pl, Chicago IL 60657. 312-975-6598.

RCA 77DX & 44BX, both in perfect cond, BO over \$800 for either. R Burns, R.F. Studio, 1326 High Meadow Dr, Garland TX 75040. 214-271-4386.

**Want to Buy**

Will trade (1) RCA 77-D for (2) used EV RE-20 or EV RE-27, RCA mic in gd cond w/complete yoke, will consider other cash/trade arrangement, send details. T Heathwood, Heritage Radio, POB 16, Boxtown MA 02167.

RCA 77DXs/44BXs ribbon, chrome/TV grey, good conditio n, BO. R Kaufman, Pams Productions, POB 462247, Garland TX 75046. 214-271-7625, after 3PM CDT.

77-DX's, 44-BX's, KU-3A's On-Air lights. Top price paid. Fast response. Bill Bryant Mgmt, 2601 Hillsboro Rd, G12, Nashville TN 37212. 615-269-6131.

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Katolite 12.5 kW 3 phase standby generator trailer, mounted w/3 phase transfer panel, runs on natural gas/gasoline, \$4500. R Shelar, WYWR, 710 Columbus St, Leetonia OH 44431. 216-427-2303.

Proco 16 chnl FBX snake, 12 xlr & 4-1/2" phone, all balanced connections, excel cond, \$265 firm. J Gill, Onetree PRod, 103 Redwing, Hot Springs AR 71913. 501-321-3080.

UTC A-20 audio transformers, primary 50, 125, 200, 333, 600 ohms secondary same (2), \$40. S Lawson, KAK Productions, 928 Hyland Dr, Santa Rosa CA 95404. 707-528-4055.

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Gates 30V PS module 994-6551-002; HP 120AR scope, no manual, no HV; Gates ACC-2 audio control ctr; Harris MSP-90 module extender, telephone type patch cords (3) & 5 plugs; RCA BA 33 amps & rack shelf; Lima 20 kW diesel power gen. H Kneller, WKII, 3151 Cooper St #56, Punta Gorda FL 33950. 813-639-1112.

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Baldwin EX-20 66 full size keyboard, w/pedals, new cond, \$300; Radio Lab stick-on attenuators, \$15 ea; Henry Matchbox interface, new, \$100. G Grassie, RNTC Bdctg, POB 146, Dexter NM 88230. 505-734-5565 before 7 AM/after 6 PM.

Ampex 15095 audio input transformers, plug in octal 8 pin type, 150/600 ohm input, 15K ohm output (4), \$10 ea; Ampex 4580116-20 audio input transformers, plug in octal 8 pin type, 600 ohm input, 15K ohm output (9), \$10 ea. S Lawson, KAK Productions, 928 Hyland Dr, Santa Rosa CA 95404. 707-528-4055.

Tip-sleeve patch bays wired to Xmas trees, 10 dbl row (48 jacks); rack mounted switch panel w/22 sets of 11-non-interlocking switch strips, all are 4PDT alternate action-lighted, wired to Amphenol 50-pin connectors. M Muderick, Muderick Recdgd, 101 Earlington Rd, Havertown PA 19053. 215-449-6970.

Onan 5 kW pwr gen, natural gas, only used 4 hrs, \$2200. C Arnold, KIPR, 415 N McKinley Ste 290, Little Rock AR 72205. 501-663-0092.

Assorted 1A2 telephone equip intercoms, KSU's, 6 & 10 & 20 button phones, 15 WE 52 headsets. M Muderick, Muderick Recdgd, 101 Earlington Rd, Havertown PA 19053. 215-449-6970.

**Want to Buy**

Broadcast clock desktop model to be used by state radio network, must keep perfect time. J Roberts, IL News Network, 312-943-6363.

Broadcast catalogs, promotional materials & sales literature from the '30's through '70's Collins, RCA, etc, any help appreciated. G Lee, POB 5786, Beverly Hills CA 90209. 310-696-0177.

Jazz record collections, 10" LP/12" LP be-bop, swing, dixie, highest prices paid. B Rose, Program Recdgs, 228 East 10th, Nyny 10003. 212-674-3060.

Radio transformers by Chicago, UTC, Triad, Peerless, Freed, Sola, send list. J Gangwer, 942 32nd St, Richmond CA 94804. 415-644-2363.

Ampex tube recorders and mixers. W Gunn, 619-320-0728.

**MONITORS**

**Want To Sell**

Belar FM RF amp; FMM II mod mon, FMS stereo mon, \$2700. R Williams, KQFX, POB 7762, Amarillo TX 79114. 806-355-1044.

Harris AM stereo 5TM-1 mod mon, like new cond, \$1000/BO. J Baine, KKMO, POB 1277, Tacoma WA 98401. 206-922-3345.

**Want to Buy**

Belar RFA-1 RF amp for 107.9 but consider any freq. M Shafer, KEKB/KBKL, 315 Kennedy, Grand Junction CO 81501. 303-243-3699.

McMartin FMR-1 FM mono monitor rcvr, working. S Keefe, WCNI, Box 4972, New London CT 06320. 203-439-2853.

McMartin (buy & sell) any model. C Goodrich, 11435 Manderson, Omaha NE 68164. 402-493-1886 or fax 402-493-6821.

**RECEIVERS & TRANSCEIVERS**

**Want To Sell**

Lafayette MA 8000B 6-band, 6-80 meters shortwave receiver, \$100. G Erway, EB Corp, 3450 SE Martinique Tr, Stuart FL 34997. 407-283-6871.

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Moseley 505 STL transmitter, does not meet new specs, \$750 or trade. T Hodgins, KLKY, 14 E Main, Walla Walla WA 99362.

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Gentner SPH-3A telephone interface system, exc cond w/manual, \$325. R Sumner, CAVU Corp, 3322 Applegate Ct, Annadale VA 22003. 703-968-8894.

Marti RPT 40; TFT 7610; Moseley TCS-2. D Nelson, 619-758-0888.

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Collins 30K or KW-1, any version in working condition. P Christensen, St Lucie Broadcasting, 11142 Raley Creek, Jacksonville FL 32225. 904-721-9111.

1 kW AM transmitter in good condition, CCA, CSI, Harris, Nautel, etc. B Barry, WAMB, 1617 Lebanon Rd, Nashville TN 37210.

WE 1935 era, 1000 W AM transmitter, 2 cabinet. R Steinberg, RC Comm, 3900 N River Rd, Schiller Park IL 60176. 708-678-7000.

LPB or other 10 or 20 W AM broadcast transmitter in good condition. E Allmon, WFIV Radio, POB 555519, Orlando FL 32855. 407-425-0623.

Gates BC-1T for parts, complete or not working & missing transformers OK. R Sheffer, KRIZ, 16009 7th SW, Seattle WA 98166. 206-433-2252.

AM xmtrs wanted: Collins 20V, 300J, 300G, TDO, also RCA BTA-500 and BTA 1, will arrange shipping for operational, restorable units. G Lee, POB 5786, Beverly Hills CA 90209. 310-696-0177.

McMartin AM/FM transmitter, any model, exciter or stereo modules. Goodrich Enterprises, 11435 Manderson, Omaha NE 68164. 402-493-1886.

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Se habla Español  
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Audophile EL-34, used Mullard four for \$30 postpaid; NOS Westinghouse, original boxes, \$60/four. D deForrest, 305-866-5401.

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Mercury vapor #575 (4) rectifier tubes, condition unknown, \$40/all. C Sigmon, WDKZ, POB 398, York SC 29745. 803-684-4241.



3CX10000A3, 3CX1500A7, 3-500G, 4CV100000C, 4CX1000A, 4CX1500B, 4CX1000D, 4CX250B, 4CX300A, 4CX35000C, 4CX350A, 4CX5000A, 4-400A, 4-400C, 572B, 6146B, PL328/TH328, PL347/TH347, 807, 813, 833A, 833C, and more...

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**JOLIDA INC.**

Annapolis Junction, MD

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### ELECTRON TUBES

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508-584-4500 X75

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**PHONE: 703-998-7600 FAX: 703-998-2966**



Call Simone Mullins, Classified Ad Manager, to reserve space in the next issue. Use your credit card to pay, we now accept VISA and MASTERCARD.

## Radio World

5827 Columbia Pike, Ste 310  
Falls Church, VA 22041

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| Acoustics                  | Consoles                  | Stereo Generators       |
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| Cameras (Video)            | Monitors                  | Tubes                   |
| Cart Machines              | Movie Production Equip.   | Turntables              |
| Cassette & R-R Recorders   | Receivers & Transceivers  | TV Film Equip.          |
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### Display Rates for Classified Advertising Effective January 1, 1991

	1x	3x	6x	12x
1-9 col inch (per inch)	\$55	53	50	45
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Distributor Directory	90	85	80	75
Professional Card	60	55	50	45

Classified Line Ad \$1.50 per word  
Blind Box Ad \$10 additional

To compute ad costs: Multiply the number of ad inches (columns x inches) by the desired rate schedule for your per unit cost. Example: a 3" ad at the 1x rate is \$165, at the 3x rate \$159, at the 6x rate \$150, at the 12x rate \$147, etc.

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We can meet all your FM transmitter needs!!



### SOLID STATE

Amplifiers and transmitters are available at the popular levels of 30, 100, 300, 500, 1000, 2500, and 5000 watts. All units are broadbanded and designed for local and remote operation.

### ZERO BIAS GROUNDED GRID TRANSMITTERS

#### SINGLE TUBE—MEDIUM POWER

Offered at 1.5, 3.5, 5.5, 7.5 and 12KW. These transmitters include a broadbanded solid state IPA, which can be used as emergency transmitters and a single zero biased grounded grid triode in their PA.

#### TWO TUBE—HIGH POWER

These transmitters utilize two grounded grid triodes and are available at standard outputs of 15, 22, 25, 30, 40 and 50 KW.

"The Transmitter People"



# Energy-Onix

752 Warren Street, Hudson, New York 12534  
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A Wise Enterprise

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FreeLand Products, Inc.

"If you don't need TO SAVE MONEY we can't help you."

However, if saving money interests you... WE CAN REBUILD YOUR DUDS (used tubes) for about 1/2 the cost of new tubes!

Call TODAY 1-800-624-7626 For a FREE Information Packet

WE BUY MANY TYPES OF USED TUBES

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### Want To Sell

Russco turntable good condition, \$75. R Chambers, 916-257-2121.

Technics SL1200 MK II with cover & vg cartridge, \$325. J Vukelich, Am Best Svc. 4551 Flag Ave No, Minneapolis MN 55428. 612-537-1431.

Russco Cue Masters TT's (2) in good condition, 3-speed, \$90 each plus shipping; Stanton 310 phono preamps (2) in good condition, \$100 each plus shipping; Micro Trak phono preamps (2) in good condition, \$100 each plus shipping; Russco Studio Pro mdl B TT's (2) in good condition, 2-speed with tonearms & cartridges, \$190 each plus shipping. J Rowland, WZIO, POB 478, Wheelersburg OH 45694. 614-574-6255.

JVC 4-DD-5 quadraphonic disc demodulator, never used, \$125/BO or trade for Teac or Tascam 2-channel cassette deck. D Pulwers, 703-751-9346.

SME-3012 & other 16" tonearms, rcd cutting lathes & heads, Fairchild 602/670 limiters, 45/78 records. Kim, 612-866-6183.

Sparta TEP-3 IC TT preamps (2), \$25 ea; Gates CB-77 TT, good condition, \$25 ea. H Kneller, WKII, 3151 Cooper St #56, Punta Gorda FL 33950. 813-639-1112.

Technics 1200 TT, \$200; (2) Audiometric TT pre-amps. Jerry, WLTO, POB 499, Harbor Springs MI 49740. 616-526-8730.

### Want to Buy

Technics base for SP-10 MKII, 1 or 2 bases with or without tonearm mount, buy or trade? T Alexander, WDOK-WRMR, 1 Radio Ln, Cleveland OH 44114. 216-696-0123.

Needed for 2 Technic SP10MKII: manuals, prepamps, prefer ATI #P-1000-1 or Logitek #BPA-200, Henry Univ TT cntrlr, bases, fancy or plain, SME Series IIS tone arm assembly or just the wand, arm & headshell section, any road cases fitting 1 or 2 TTs. E Barrett, 412-621-8000. FAX 412-682-2665.

# Radio World

Your Ad Will Reach Over 21,000 Subscribers

Advertise NOW!

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## ACTION-GRAM

### Equipment Listings

Radio World's Broadcast Equipment Exchange provides a FREE listing service for radio stations and recording studios only. All other end users will be charged. Simply send your listings to us, following the example below. Please indicate in which category you would like your listing to appear. Mail your listings to the address below. Thank you.

Please print and include all information:

Contact Name \_\_\_\_\_

Title \_\_\_\_\_

Company/Station \_\_\_\_\_

Address \_\_\_\_\_

City/State \_\_\_\_\_

Zip Code \_\_\_\_\_

Telephone \_\_\_\_\_

I would like to receive or continue receiving Radio World FREE each month.

Yes  No

Signature \_\_\_\_\_ Date \_\_\_\_\_

Please Circle only one entry for each category:

#### I. Type of Firm

- D. Combination AM/FM station
- A. Commercial AM station
- B. Commercial FM station
- C. Educational FM station
- E. Network/group owner
- F. Recording studio
- G. TV station/teleprod facility
- H. Consultant/ind engineer
- I. Mfg. distributor or dealer
- J. Other

#### II. Job Function

- A. Ownership
- B. General management
- C. Engineering
- D. Programming/production
- G. Sales Manager
- E. News operations
- F. Other (specify)

Brokers, dealers, manufacturers and other organizations who are not legitimate end users can participate in the Broadcast Equipment Exchange on a paid basis. Line ad listings & display advertising are available on a per word or per inch basis.

WTS  WTB  Category: \_\_\_\_\_

Make: \_\_\_\_\_ Model: \_\_\_\_\_

Brief Description: \_\_\_\_\_

Price: \_\_\_\_\_

WTS  WTB  Category: \_\_\_\_\_

Make: \_\_\_\_\_ Model: \_\_\_\_\_

Brief Description: \_\_\_\_\_

Price: \_\_\_\_\_

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This listing is provided for the convenience of our readers. Radio World assumes no liability for inaccuracy.

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Free Subscriptions are available upon request to professional broadcasting and audiovisual equipment users. For address changes, send current and new address to RW a month in advance at P.O. Box 1214, Falls Church, VA 22041. Unsolicited manuscripts are welcomed for review: send to the attention of the appropriate editor.

\*Closing for listings is the first and third Fridays for the next month's issue. All listings are run for 2 issues unless pressed for space or otherwise notified by listee.

## Broadcast Equipment Exchange

Phone: 703-998-7600 PO Box 1214, Falls Church, VA USA 22041 FAX: 703-998-2966

### SUBSCRIPTION/READER SERVICE FORM

## Radio World

### FREE Subscription/Renewal Card

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Signature \_\_\_\_\_ Date \_\_\_\_\_

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Name \_\_\_\_\_ Title \_\_\_\_\_

Company/Station \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

Business Telephone ( ) \_\_\_\_\_

Please circle only one entry for each category:

#### I. Type of Firm

- D. Combination AM/FM station
- A. Commercial AM station
- B. Commercial FM station
- C. Educational FM station
- E. Network/group owner
- F. Recording Studio
- G. TV station/teleprod facility
- H. Consultant/ind engineer
- I. Mfg. distributor or dealer
- J. Other

#### II. Job Function

- A. Ownership
- B. General management
- C. Engineering
- D. Programming/production
- G. Sales manager
- E. News operations
- F. Other (specify)

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August 11, 1993 Issue Use Until November 11, 1993

Please first fill out contact information at left. Then check each advertisement for corresponding number and circle below.

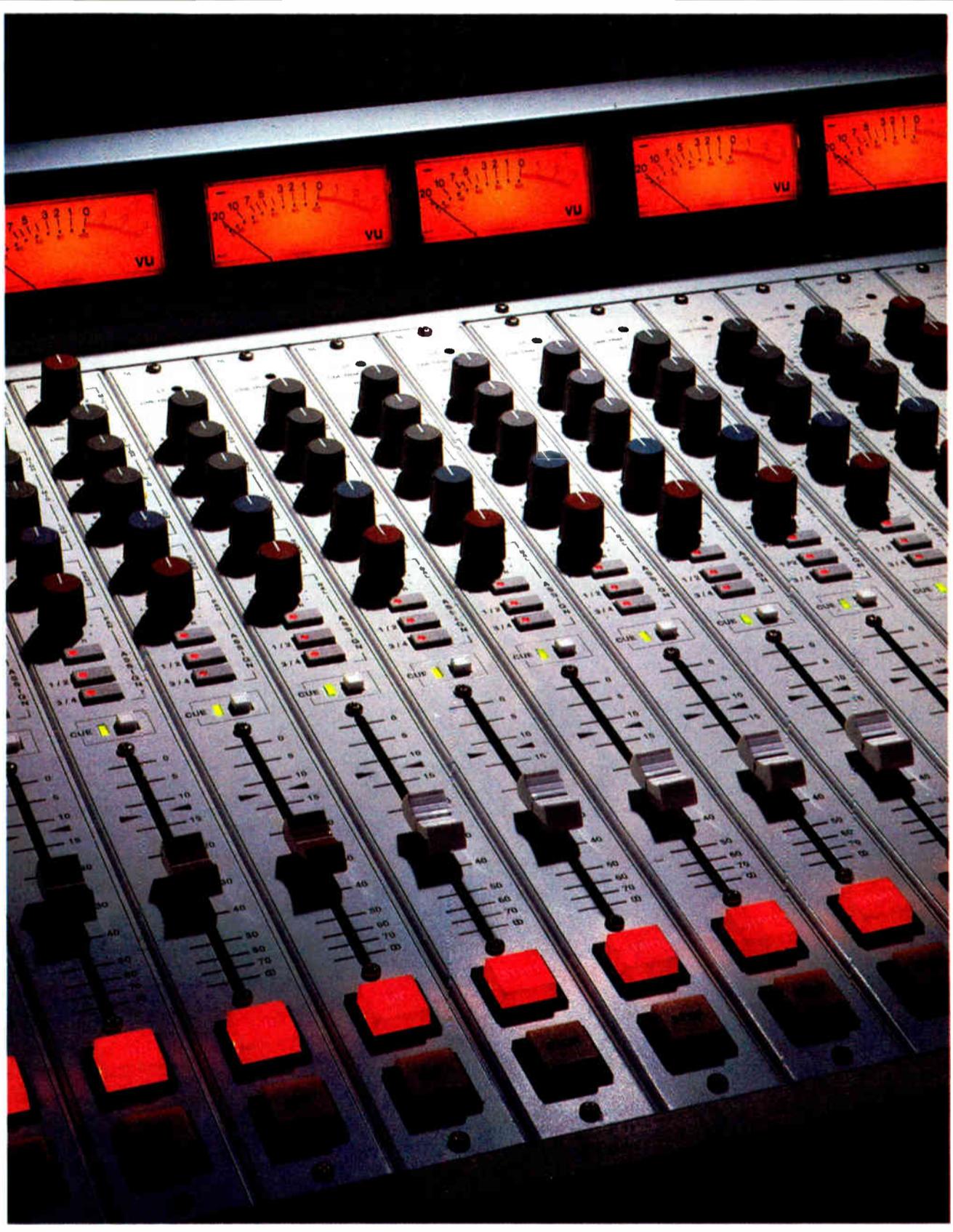
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1. Recommend 2. Specify 3. Approve

001	023	045	067	089	111	133	155	177	199
002	024	046	068	090	112	134	156	178	200
003	025	047	069	091	113	135	157	179	201
004	026	048	070	092	114	136	158	180	202
005	027	049	071	093	115	137	159	181	203
006	028	050	072	094	116	138	160	182	204
007	029	051	073	095	117	139	161	183	205
008	030	052	074	096	118	140	162	184	206
009	031	053	075	097	119	141	163	185	207
010	032	054	076	098	120	142	164	186	208
011	033	055	077	099	121	143	165	187	209
012	034	056	078	100	122	144	166	188	210
013	035	057	079	101	123	145	167	189	211
014	036	058	080	102	124	146	168	190	212
015	037	059	081	103	125	147	169	191	213
016	038	060	082	104	126	148	170	192	214
017	039	061	083	105	127	149	171	193	215
018	040	062	084	106	128	150	172	194	216
019	041	063	085	107	129	151	173	195	217
020	042	064	086	108	130	152	174	196	218
021	043	065	087	109	131	153	175	197	219
022	044	066	088	110	132	154	176	198	220

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# Just RIGHT!



**MR-40**

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 Wheatstone® Corporation

**A-300**

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