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**NAB RADIO 1991 WRAP-UP**  
 New Equipment and Technology, pp. 8-18

# Radio World®

Vol 15, No 20

Radio's Best Read Newspaper

October 23, 1991

## AM Improvement Package Adopted

**WASHINGTON** The FCC's long-awaited decision on AM improvement was unanimously accepted here Sept. 26, but preliminary information on the Report and Order offered no actual parameters for the proposed actions.

Adopted but not specified were increased first and second adjacent channel protection ratios, refined methodology for calculating nighttime coverage and interference and a 10 percent interference reduction "in some cases" when voluntary modifications are made to AM stations (the so-called "ratchet" provision).

Plans for migration of stations to the expanded band and consolidation of spectrum in the existing band were also adopted. Among the items agreed to in

those areas were expanded band eligibility preference for AM stereo broadcasters and a possible limitation of simulcasting on AM three years from now. Also, tax credits would be granted to "marginal" stations choosing to pull the plug on "final" stations.

Asked about specifics following the FCC's September meeting, Bill Hassinger, the Mass Media Bureau's assistant chief for engineering, said that numbers could not yet be provided because "final tweaking" is still in progress on the text of the decision. He said the bureau has a self-imposed goal of releasing the text no later than 30 days from the decision—with a possible best-case date of mid-October.

Hassinger characterized the new tech-



The NAB's Radio 1991 show featured a number of product introductions. For details, see p. 8.

nical proposals as "rigorous, but very workable," and said the numbers "don't go beyond the NPRM (Notice of Proposed

(continued on page 3)

## FBI Probes Alleged Equipment Scam

by Alex Zavistovich

**McCOOK, Neb.** Law enforcement authorities are trying to determine the whereabouts of Jerry Kautz, president of Imperial Transmitters Worldwide. A number of broadcasters allege that Kautz

defrauded them by accepting prepayment for used equipment that at press time still had not been delivered.

Kautz had been employed by Armstrong Transmitters—a well-known New York-based used equipment dealer—several years ago. In 1990 he returned to

his hometown of McCook, Neb., to form Imperial Transmitters Worldwide.

In the summer of 1991, Imperial Transmitters announced an inventory clearance sale. According to Imperial customers contacted by RW, Kautz took equipment orders on a 50 percent down, 50 percent basis, explaining that a company truck would deliver the orders to stations. Those deliveries have not been made.

Ironically, Kautz authored an article on used equipment for RW that ran in July of 1991, in which he warned broadcasters to "be cautious about sending money." Three months later, Kautz has disappeared, and state and federal authorities are investigating the man and his business.

### Complaints against Imperial

Detective Ike Brown of the McCook, Neb. police department would not comment on the specifics of his investigation into Imperial Transmitters. He confirmed, however, that his department has "received complaints of theft by deception or fraud" against Kautz and his firm.

No formal charges have yet been filed against Kautz, although such charges are pending on the local or state level and "appear substantial," Brown said.

A decision regarding whether to file charges on a state level now seems contingent on the degree to which the Federal Bureau of Investigation (FBI) becomes involved. According to Brown, the McCook police department has forwarded the case to the FBI field office in Omaha "because of its scope and (for) jurisdiction (reasons)." Charges may be filed on the federal level, Brown said.

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## AMAX Debuts At NAB

**SAN FRANCISCO** The NAB kicked off its campaign to promote development of improved-quality AM receivers carrying the AMAX certification mark during the Radio 1991 convention.

AMAX was jointly approved by the NAB and the Electronic Industries Association (EIA) last summer and a full scale promotion was to begin Oct 1.

Shortly after the initial announcement, members of the NAB's AM Receiver Manufacturer Liaison Task Force presented a session entitled "Join the AMAX Team." Task Force Chairman Ted Snider heralded the campaign as "the final link in getting AM to the point where listeners can hear something good for a change."

According to materials available during the show and to be mailed to stations later, the AMAX certification criteria for radios include wide bandwidth (7.5 kHz for home, 6.5 kHz for car radios), variable bandwidth to cut noise, noise blanking circuitry, a provision for an external antenna, expanded band (1605 kHz to 1705 kHz) and AM reception capability. For radios capable of receiving AM stereo, a separate AMAX Stereo mark is available.

Snider said some 1,500 radio

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# Madison Broadcaster's Clinic Planned

## Annual Clinic to Highlight Radio/TV Engineering and Equipment Displays

by Alex Zavistovich

**MADISON, Wisc.** The University of Madison's 37th Annual Broadcaster's Clinic will be held Nov. 6-8 at the Holiday Inn Southeast here.

As in years past, the clinic will offer the opportunity to meet

with colleagues, discuss day-to-day problems and learn about new technology in the radio and television engineering fields. Equipment manufacturers also will be exhibiting products during the conference.

Registration is \$115 for any two days or \$150 for all three

days of the clinic. Conference enrollees can earn up to 2.1 Continuing Education Units from the University of Wisconsin. Interested parties can register by phone: 608-262-2451, or by fax: 608-262-8516.

The clinic organizer once again is Don Borchert, director of engineering for WHA Radio and Television, University of Wisconsin at Madison. For more information, contact him

at 608-263-2157.

Following is a schedule of presentations slated for the clinic.

\*\*\*

### Wednesday, Nov. 6

7:45 a.m. Registration and Continental Breakfast

9:00 a.m. Broadcast Engineering Sessions

The Shoreview 8 Station Installation—An Overview *George Werl, Jr., Consulting Engineer, St. Paul, Minn.*

*Paul, Minn.*

Cable and Circuit Management *Rick Cabalka, ADC Telecommunications, Minneapolis, Minn.*

Cost Effective Approach to Solid State FM Transmitters *Jorgen Jensen, Nautel, Tantalton, Nova Scotia*

Halo Ground: From Heaven to Earth *Kenneth Drake, Madison Cellular, Madison, Wisc.*

12:00 noon Luncheon  
CCD Camera Technology *Bill Fleming, Sony Broadcast*

2:00 p.m. The New AM Rules—ANSI—EIA—TIA—RS—222E *Donald L. Markley, DL Markley & Associates, Peoria, Ill.*

MUSICAM and the World of Audio Compression *Dr. Larry Hinderks, Corporate Computer Systems, Holmdel, N.J.*

Analog Versus Digital FM Transmission Systems *Robert Surette, Shively Laboratories, Bridgeton, Maine*

4:00 p.m. Equipment Exhibits  
Open Reception and Cash Bar

7:30 p.m. Engineering Forum  
Moderators: *Gary Mach and Ken Dixon*

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### Thursday, Nov. 7

7:45 a.m. Registration and Continental Breakfast

8:30 a.m. Broadcast Engineering Sessions

Digital and Analog High Quality Audio Processing—What It Will/Will Not Do *Bill Ammons, CRL Systems, Tempe, Ariz.*

An Economical Replacement for the Audio Cart Machine *Scott Martin, Fidelipac Corp., Moorestown, N.J.*

10:30 a.m. Equipment Exhibits  
Open

2:30 p.m. Solving the Problems of Open Microphones *John Tatoes, Shure Brothers, Evanston, Ill.*

The Differences between Transmitted Audio and the Capabilities of the Human Ear *Michael Dorough, Dorough Electronics, Woodland Hills, Calif.*

(continued on next page)

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# AM Docket Adopted by FCC

(continued from page 1)

Rulemaking)" that initiated the AM inquiry.

## Target areas

During the meeting, Hassinger, who presented the proposal to the Commission, identified "technical standards," "migration" to the expanded band and "consolidation" as the target areas for reducing congestion and interference in the AM band.

Changes to technical standards, as detailed above, were proposed to more accurately measure interference effects, to gradually reduce the overall presence of interference and to promote development of higher-quality receivers.

Regarding migration, the FCC voted to have stations causing the most interference in the existing band to move to the expanded band, with an eligibility preference to AM stereo stations. The FCC approved adoption of allotments on the band based on "wide station separations and low interference levels."

Dual ownership and operation of ex-

isting and expanded band stations for a five-year period, with a waiver of duopoly and national ownership rules during that period, also was approved.

In the area of consolidation of the

current AM application freeze, pending Office of Management and Budget approval of the effective date of the new rules.

Finally, the FCC said that it might

## The Mass Media Bureau has a self-imposed goal of releasing the text no later than 30 days from the decision.

existing band, the FCC approved issuing tax certificates to licensees who voluntarily stop operating marginal stations. The FCC also would relax multiple ownership rules for stations proposing changes to facilities that would reduce adjacent or co-channel interference.

In addition, the Commission will relax rules for Travelers Information Stations (TIS) to allow them secondary authorization on any AM frequency and will encourage manufacturers to comply with new industry receiver standards. With the adoption of the new rules, the FCC will drop the

need to consider some restrictions on AM-FM simulcasting, but said that it would revisit that issue after three years to determine whether such restrictions actually are necessary.

## Recanting the evil genie

In comments preceding the FCC's vote, Commissioner Ervin Duggan praised the efforts to put the "evil genie" of signal degradation "back in the bottle." He noted, however, that "pain and sacrifice (by AM broadcasters) for the common good is never easy."

Duggan, as well as Commissioner James Quello, commented about restricting migration to the expanded band to incumbent broadcasters. Duggan said he had hoped for an "open door" for

new entrants and regretted that the Commission couldn't come to terms. Both he and Quello attached statements to that effect to the FCC decision.

Commissioner Andrew Barrett said he was not sure that those stations which cause the most interference will even apply for the expanded band, and questioned lifting the freeze on AM applications.

"How can we talk about interference reduction, then lift a freeze?" he asked.

All the commissioners, except for Chairman Al Sikes, expressed some reluctance to restrict simulcasting. Sikes, however, said the "line of least resistance is to let simulcasting go on indefinitely," adding that if no new programming is initiated, AM will "continue to die."

"By any sane analysis, AM is a very sick service," Sikes said.

Sikes commented on a comparison tape of AM service from the 1930s and today that made the rounds at the Commission, saying that the service of the 1930s sounded better, even though technology is better today. He expressed hope that receiver manufacturers will be willing to produce "full bandwidth radios" as recommended by the NAB and EIA.

# Madison Schedule Set

(continued from previous page)

Does Anyone Know How to Tune AM & FM Transmitters? *Mark Persons, Persons And Associates, Brainerd, Minn.*  
Solid State FM Transmitters *Harris Corp., Quincy, Ill.*

DAT's Enough and Digital Audio *Gareth Nelson, Sony Corp.*

The Shape of Digital Audio Recorders *Tim Valley and Bob Schellenberg, Macro-Media, Northfield, Minn.*

5:00 p.m. Reception and Cash Bar

7:30 p.m. Pizza-Engineering Forum and "Ask the FCC" Moderators: *Doug McDonnell and Ken Dixon*

## Friday, Nov. 8

8:30 a.m. Broadcast Engineering Sessions Considerations in the Design of High Efficiency UHF Transmitters with MSDC/ESC Type Tubes

*Harris Corp., Quincy, Ill.*

D3-The New 1/2-Inch NTSC Digital Recorder

*H. Van Dreel, Panasonic Broadcast Systems Automated Unattended Video Measurements with the Tektronix VM-700*

*Mel Infanzon, Tektronix Inc., Beaverton, Ore.*

Automation and Machine Control for the Broadcast Facility *Robert Odell, Utah Scientific, Salt Lake City, Utah*

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# A Frighteningly Good Show

by Judith Gross

**FALLS CHURCH, Va.** I feel like a fall convention sandwich ... squeezed in between one show and another.

I mean, you barely finish gobbling down those little cakes the airlines serve for dessert on the journey home when next thing you know you're slurping down the diet cola on the way to somewhere else.



A few more interesting morsels to wrap up the Radio 1991 show, before I forget ...

Just before things got underway in San Francisco, there was a Radio Operators Caucus meeting where DAB (what else?) was the subject of the day.

Y'see, the basic take on this is that a lot of broadcasters, worried about the way the economy is sloughing along, aren't eager to jump full feet into something that's going to make scrambled eggs of the radio biz for a while.

And now that many of the systems have at least surfaced with some details of how they work, it's clear we've got two fundamental types of DAB to consider.

There's the type of system that would need some sort of "new" spectrum allocation. That would mean L-band (like Eureka) or even first adjacents or sub-carriers or some other part of the FM band, except for the part now occupied by the FM carrier.

Then there's in-band, specifically in-band, on-channel (IBOC), which would center the digital signal right on the carrier at a much lower power level. Acorn wants to do this for AM and FM.

A lot of ROC members see the problems with new-band systems looming

large. For instance: what's to stop the FCC from allocating it to a whole bunch of new users, a la Docket 80-90? What's to stop the FCC from charging spectrum fees for the new allocations? What's to stop them from adopting a "use it or lose it" approach?

And what's to stop receiver manufacturers from making radios that get the new frequencies, but maybe not the analog AM and FM?

With IBOC, however, it's on your frequency, so it's like an enhancement, like stereo was. Like color TV was. If it's there, you get it, if not, you get what you would have gotten if it had never been invented.

So the ROC came within a hair's width of voting to endorse IBOC DAB. But then they didn't. I'm not exactly sure why, but it seems that they are once again placing their faith in the DAB Task Force, which is supposed to come up with some design parameters for an in-band DAB system.

The Task Force is still talking to in-band folks, so the jury is out, and it's going to be a long wait for the verdict.

I guess you might say that now that battle lines are drawn and we know what we're fighting about, we enter that time period of "hunkering down," as Hunter Thompson is fond of saying. Get cozy in those bunkers and don't let the explosions distract you from your day job, OK?

Also from the convention, some word on the Radio Broadcast Data System, or RBDS. The format IDs are getting to be a little sticky, as I thought they would. We started with some 20, now there's an alternate plan for nine of them, or how about, no format switching in the U.S. standard?

See, the problem is one of nuance. Although each individual station gets to control its own format, or PTY code, there's a wide difference of opinion on what to call them and how many we need.

Let's say you're in a large, viciously competitive market. Eight stations, all playing a variation of rock. Sixties oldies, classic rock, adult rock, metal rock, soft rock, pop rock, current hit rock and urban rock.

Naturally you'd want a listener who wants to hear, say, Jethro Tull on your station to not have to get socked with Prince on one of your rivals, especially at Arbitron time. So you want the subtle distinctions in format IDs.

But not so for those in the smaller market with fewer stations where the music might vary between Tull and Prince. That station would want just the category "rock" to cover all kinds and make sure its station was picked up no matter what kind of rock head you are.

So what to do? Well, the NRSC is tackling this one, and it isn't resolved yet, so if you want to get your two cents in, talk to Charlie Morgan (Susquehanna) or

mouse, doesn't it?

Anyway, WDW did it up right with a gala fest that included prerequisite activities: stuff the media full of goodies, let every press person on the rides for free and bring in the President of the U.S. to make sure all the major networks show.

Actually, it was great. There were about 160 or more radio stations each doing a remote show from various points in one of the three theme parks. From the looks of the mouse ears and colorful balloons that marked each station's station, they were about equally divided between MGM Studios, Epcot and Magic Kingdom.

Unfortunately, the weather wasn't in-



Real rain, not special effects, for stations celebrating Walt Disney World's 20th

someone else on the committee.

I mean, it could get kind of silly. How about the singing-offspring-of-once-hot-sixties-rock format, suggested code: Progeny.

Or the female (or male) singers-who-hit-ear-splitting-highs-for-effect format, suggested code: Screech.

The depressing, suicidal music of heavy metal stations? Suggested code: Death. Say, this is better than sniglets.

Heigh ho, Heigh ho, don't we love radio? Walt Disney World, Orlando, Fla., celebrated its 20th Birthday in September. Gee, time just flies when you're a

formed about the plans. (What? It never rains on the Mouse!) and things got a bit soggy. The folks in Epcot had tables with umbrellas, but the stations at MGM had to pull themselves under plastic tarps to keep from getting waterlogged.

So that reverb you heard on the interview with Roger Rabbit might have been just audio bouncing off the plastic. And wait a minute ... did I hear snoring coming from under that tarp or was the Duck clearing his throat?

Heard a juicy tidbit? Spill your guts to Earwaves by faxing JG at 703-998-2966 or writing to P.O. Box 1214, Falls Church, Va. 22041.

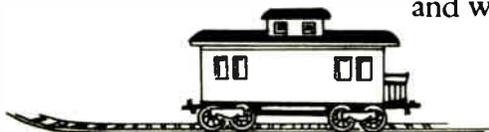


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## READERS FORUM

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

### Harmonic resonators

Dear RW,

I enjoyed Thomas Vernon's article on harmonic resonators in the June 26 issue. However, I feel compelled to make some comments. I was involved in the product management of AM broadcast transmitters at RCA from 1964 to 1969, and contrary to the article, in this country RCA built and sold the BTA-5T and BTA-5U five kilowatt transmitters and the BTA-10U 10 kW transmitter with third harmonic resonators in the plate and cathode of the PA tubes. I would guess that about 200 were sold.

The article was correct in that the resonators reduced peak plate current; however, later in the article it was mentioned that one of the problems associated with the resonators was high peak plate current, which could be hard on the filaments. In fact, the circuitry reduced the peak plate current considerably, which would cause a proportional reduction in the required peak emission from the filament.

The high efficiency resonators were parallel resonant at the third harmonic, which was a high impedance to the third harmonic energy generated in the tube. This reduced the amount of third harmonic

energy reaching the output network and made the filtering of third harmonic energy easier—not more difficult—than conventional circuitry.

The resonator circuits in the RCA transmitters were generally adjusted in the factory and seldom, if ever, needed adjusting in the field. I do not remember ever having one of the coils or capacitors fail during the warranty period, and the transmitters were very tolerant of load changes, as when changing patterns, or from seasonal changes in antenna impedance; and they easily met the required 80 dB harmonic suppression requirement.

In addition to ITA and RCA having built high-efficiency transmitters in this country, Harris built the VP-50. One of those units is operating daily, within three miles of my office, at WHYZ.

William A. Culpepper  
William Culpepper & Associates, Inc.  
Greenville, S.C.

### Multiband's dynamic effect

Dear RW,

In his *Readers Forum* letter (RW, Sept. 11, 1991), Frank Berry maintains that multiband processing will "preserve the dynamic resolution" of source material, at the expense of spectral balance.

I'd love to hear Mr. Berry's definition of "dynamic resolution." Regardless of whether a processor is acting on a portion of, or the whole of the the program, it is acting on the loudness profile of the material. The dynamic integrity is being compromised, not preserved.

In the 1812 Overture example he cites, is Mr. Berry applauding the multiband processor's ability to approximate the original dynamics of everything above 80 Hz while severely attenuating the canon shots? What about the "dynamic resolution" of the concurrent timpani, string bass, tuba or bassoon? Nowhere did the composer or conductor indicate that these instruments should be suddenly squashed to a *pianissimo*, to later ramp up to their original dynamic at some user-determined release rate.

"Preserve dynamic resolution"? Musically speaking, you have preserved nothing. You have imposed a new shape on the orchestra's dynamic profile as well as its spectral balance.

R. Hoover Ross, CE  
The Auditory Perception Laboratory  
Brooklyn, N.Y.

### No interactive free lunch

Dear RW,

It was with both excitement and trepidation that I read the article on "interactive" radio in the July 24 edition. I for one am a great believer in technology. In fact, both my businesses are dependent on it.

As the owner of a compute repair/installation business, I see how fast the technology advances. I know the efficiencies that can be gained through office/industrial automation. As the owner of a MIDI-based recording/commercial studio, I see how technology has allowed

Was the NAB's Radio 1991 convention in San Francisco a success? The verdict depends on who you talk to.

Some manufacturers complained of poor traffic on the exhibit floor while others seemed satisfied. Regardless, a number of products were introduced at the show, and many that were introduced at the spring show were shown refined and ready to ship at Radio 1991.

There still was quite a bit to be dazzled by at Radio 1991. Digital audio broadcasting clearly is growing past the chalkboard stage. The "DAB" acronym was on almost everyone's lips at one time or another.

And yet, many at the show felt that technical understanding among convention attendees seemed low. Indeed, some manufacturers implied that technical competence among radio station personnel in general seems to be at a low point.

## Balancing Act

Technical competence among broadcasters forms the basis of one criticism that may help the NAB improve its shows in the future: A better balance needs to be struck between engineering and programming sessions.

Traditionally, the NAB has called the fall show a programming and management conference, but that cannot absolve the association from advancing the technical expertise of its members. A closer look must be taken to ensure that important engineering-oriented sessions scheduled during the convention are not overshadowed by the allure of more glamorous programming panels.

Evidence of this imbalance was most clear on the last day of sessions, when a session on the FCC's FM translator regulations drew only a handful of interested spectators. A concurrent session on improving morning shows had people lined up out the door of the meeting room.

The NAB must start steering its members to issues of technical significance. More stations are relying on contract engineers to keep them on the air. Managers, then, must have more technical awareness—certainly if they expect to make educated decisions on budgetary allocations for engineering.

Programming and management are fundamental building blocks for success in radio. Ultimately, however, the radio broadcasting industry cannot prosper if a significant portion of its force believes its responsibilities begin and end with programming.

After all, the best radio programming and management skills are worthless if no one knows how to operate the equipment needed to get the signal to the audience. For a better show, the NAB must find a way to get that information to all its members.

—RW

me to score and produce spots that would be impossible or not affordable by any other method. So with a foot in each industry, I see a few negative possibilities to the consumer when faced with both technologies at once.

Now before everyone says, "So what?," I want you to think about the implications of "interactive" radio and television. This system would allow the consumer to communicate a variety of information back to the program originator (or others). Ordering a pizza from your car radio could become quite common. Also voting for politicians, playing contests, emergency road repairs and other helpful services would easily be possible.

So why the trepidation? The problem lies in what other information is telegraphed back. For instance, if a cellular talkback method is used, it will be possible to know the cell location of you and your radio any time you push a button. It could cause all receivers to announce their location. Big deal, right? Reread the book "1984" and add ten year to the title. Listening to a political broadcast? Now they'll know what you're tuning into. With so much information available, don't you think at least a few people will take unfair advantage of it?

I know I'm paranoid, but am I paranoid enough? This technology will be made so cheap and widespread that we will use it and love it. Take credit cards for instance. Twenty years ago they were almost unknown. Now without one you can hardly rent a car or stay at a motel—things that have very little to do with credit. They have indeed become a "plastic" currency. Without any effort at all we automatically tell credit card central our location every time we check in.

Paranoid yet? My local grocery store has a card slot on the register for your bank/credit card. Bar codes on each item tell the register not only the price, but the description as well. Now they know what you buy and how many.

Do you really want your local religious zealots finding out what dirty magazines you buy?

How about a weight loss clinic that advertises only to people that buy high cholesterol items? Since there will be lots of channels on DAB, you could have a number of data streams for advertising from each station. Now your "personal" radio will play only the commercials for products that you have shown interest in. By buying competitive items in the store the day before, you've updated your personal buying profile.

Think it's impossible? Look at how "Prodigy" operates. It's a computer bulletin service run by Sears. You can buy anything with your credit card and it will be delivered as if by magic. But the next time you sign on, you'll see an advertisement for accessories you can also purchase. Interactive radio goes a step further. A supposedly anonymous poll can have special propaganda targeted at you because you didn't vote correctly.

I suppose this sounds like a rather narrow view of things, but I for one value my privacy. With freedom of speech also comes the right to keep one's mouth shut when desired. With interactive, we will be shouting out our choices to anyone who will listen, or listen in. I'm not saying to abandon this technology—I don't think anyone or anything in this world can stop it. But as developers and users of these new systems, we need to act responsibly to both the consumer and the world as a whole. Ask questions, be skeptical, make sure you read everything and form your own conclusions.

TANSTAAFL (there ain't no such thing as a free lunch). Every meal has its price. Make sure that individual freedom is not the price of this banquet.

J. Michael Sokol  
Sokol Electronics Inc.  
Hagerstown, Md.

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World Radio History

# L-band Test Delays Likely

by Judith Gross

**SAN FRANCISCO** Eureka's L-band DAB tests will likely be postponed until next spring's NAB convention in Las Vegas, according to DAB Task Force Chairman Alan Box.

Box said the task force held a "brief meeting" at Radio 1991, and L-band tests were discussed.

"The original idea was to do the tests concurrent with Congressional hearings on DAB that we had heard would take place in October. Now it looks as if those hearings will be postponed," Box said.

Demonstrating Eureka on L-band during the spring convention would allow more preparation time and "afford more people the opportunity to hear it," according to Box.

Originally, the Task Force had asked four additional DAB proponents to make presentations in San Francisco. They were: Kintel, Synetcom, Lincom and Em-Cee. But a combination of schedule conflicts, short amount of time, and the concerns about some proponents about revealing details of their systems kept all four away.

Box said that lengthy meeting would most likely take place in October. "We'll have a full day meeting and hear from the remaining four," Box said. In July, the

group heard from Mercury Digital, USA Digital, American Digital Radio and Stanford Tele-

com. Box said that the new focus toward in-band systems is very much on the Task Force's agenda.

Box said, however, that NAB's pursuit of a licensing agreement with Eureka continues despite the Task Force's new policy toward in-band. "The DAB players know that we are open to it (in-band), but we're not going to sever our ties with Eureka," he said.

Box said he felt that the tensions about DAB have subsided, although some controversy over the NAB seeking an in-band solution from Eureka rather than a domestic company still exists.

"We weren't premature to endorse Eureka," Box said. "When we did it, satellite DAB was the news of the day. Our actions have shaped the entire DAB discussion."



# Radio '91 Debuts AMAX

(continued from page 1)

stations have committed to airing more than one million spots promoting AMAX radios. The spots, available through the NAB, were also included in the session materials. NAB Radio Board Chairman Dick Novik said he hoped the spots would be aired by FM stations, as well as AM outlets.

EIA representative Alan Haber said the campaign is "one of the most important and exciting milestones (for AM radio)." He said EIA's role in the program was to help develop an engineering standard through the National Radio Systems Committee.

The certification process will be wholly voluntary, Haber explained, adding that

EIA tests will verify compliance, and retesting at regular intervals will verify continued compliance of the receivers.

The promotional program, according to Snider, is slated for for a 60-day push starting Oct. 1, to be followed by another 60-day push in the spring, resuming again in the winter of 1992. The breaks in the promotion are to give manufacturers a chance to get the radios into production.

According to receiver consultant Almon Clegg, a number of receivers—notably Delco's—already comply with certification criteria. He noted, however, that while manufacturers are "intent" on producing the radios, there may be a "one-year cycle before you see a large quantity in the market."

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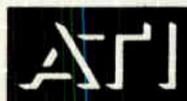
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## Dominates Radio 1991



**SAN FRANCISCO** The NAB Radio Convention and engineering conference achieved success D-A-B. The show, held here Sept. 11-14 at the Moscone Convention Center, again focused on advances and the potential advantages of digital audio broadcasting in tomorrow's radio world.

Forums for the burgeoning technology included an encore of the DAB bus, which demonstrated over the air the Eureka 147 DAB system and allowed comparisons in various reception conditions with standard FM broadcasts.

Daily sessions on DAB focused on transitions to the technology and how it will affect today's broadcasters. The fourth Digital Radio Station Seminar included both digital storage technology and an overview of DAB with presentations from each system proponent.

### Traffic slow but effective

On the 34,000-square-foot exhibit floor, some among the 175 vendors complained of slow traffic, but didn't question the value of the exposure to programming leaders that the show afforded.

"We're seeing a lot of people we nor-

mally wouldn't—GMs, management and owners," said Gerrett Conover with Radio Systems. "A lot of people drove to this show, and not being a West Coast company, that's good for us.

"More and more PDs are making decisions about audio," added Cutting Edge Technologies' Joe Foti. "One PD

As well, Bird was pleased with the level of international attendance. "It seems that a lot of those overseas are more willing to accept new technology."

NAB tallied international registration at 622, 10 percent above the 565 at Radio 1990 and nearly triple the Radio 1989 figure of 238. Overall registration at this year's show was 7,063, off 2.4 percent from Radio 1990's record of 7,241.

### Join the AMAX team

Among the session highlights was the heralded introduction of the AMAX campaign, which kicked off Oct. 1. The nationwide effort hopes to promote radios manufactured with superior technology.

Other sessions at the show informed attendees about RDS, FCC

regulations and advances in FM and AM technology.

Among the guests participating were recording industry executive Quincy Jones, New York Governor Mario Cuomo and Keith Reinhard, chairman of the



Radio 1991 attendance was down only slightly from 1990's record of 7,241.

can be as good as two engineers."

Don Bird with 360 Systems echoed that the exposure to programmers didn't hurt: "They seem to be real excited about what we have to offer. It's the same thing we saw (at Radio 1990) in Boston."

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# New Radio Products Flourish at NAB Show

by Alex Zavistovich

**SAN FRANCISCO** Encouraged by recent economic upturns, manufacturers exhibiting at NAB's Radio 1991 offered attendees a variety of product introductions, as well as some refinements of equipment introduced at last April's convention in Las Vegas.

While the buzzword was again "digital," new offerings were available in both the analog and digital domains.

Digital audio broadcasting (DAB) is becoming a more common sight at trade shows these days, as Eureka 147, USA Digital Radio (Project Acorn) and American Digital Radio (ADR) each had exhibits on the show floor. Both USA Digital and ADR are working on in-band solutions to DAB; Eureka showed its "new-band" concept.

In the RF arena, Broadcast Electronics



Comrex  
Talk Console

unveiled its AM-1, a one kilowatt solid state AM transmitter with a built-in C-QUAM AM stereo exciter. The solid state design utilizes power MOSFETs in a "hot-pluggable" design, and modules can be removed while the transmitter is operating. The AM-1 also uses a "Star" combiner network for uninterrupted operation without dummy modules.

Five preset power levels are available by local or remote control. Power output capability ranges from 1,100 watts to 100 watts. The AM-1 controller is a low power consumption CMOS design that also provides metering for tuning the transmitter.

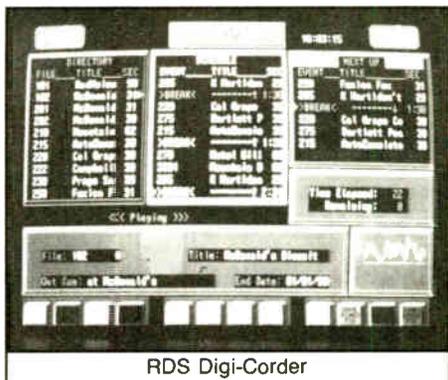
Harris-Allied exhibited two RF products introduced at the NAB's Las Vegas show last April. The Digital 50 FM exciter employs 18-bit Direct Digital Synthesis (DDS) and 0.6 Hz resolution; the PT 5FM is a 5 kW solid state FM transmitter that uses 1,350 watt solid state FET RF modules.

Harris also announced it would conduct 41 separate technical education programs in 1992 at its Quincy, Ill. Broadcast Technology Training Center. Six general RF training programs—not Harris-specific—are available, in courses ranging from three to five days.

For recording, Alesis, a company new to NAB shows, introduced ADAT, an eight-track digital audio recorder utilizing standard S-VHS tape. The projected shipping date is late 1991.

ADAT provides up to 40 minutes of eight-track digital stereo audio on a single tape, at a variable sampling frequencies of 42.7 kHz to 50.85 kHz. The unit is priced at \$3,995.

The optional BRC remote control (\$1,995) allows up to 16 ADATs to be daisy-chained together. Thus, Alesis claims, a



RDS Digi-Corder

32-track digital audio recording system can be assembled for less than \$18,000.

360 Systems' DigiCart Bernoulli-disk-based recording system is finally available. Shown in working form at last April's NAB convention in Las Vegas, the system lists for less than \$4,000.

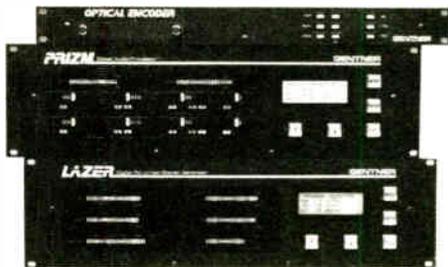
Fidelipac showed a production-oriented version of the 3.5-inch floppy disk digital recorder it introduced in Las Vegas. The unit featured a more streamlined chassis design.

Radio Systems, in addition to showing the RS 700 DAT controller (a lower-priced version of its RS 1000, both of which are based on Sony DAT decks), introduced an analog master clock system. The RS master clock driver and RS analog clock display comprise a low cost system with both external sync reference and one-second advance and freeze capability.

## Processing Introductions

Gentner introduced the Lazer 2.0 and the digital Prizm 2.0 during Radio 1991, a show that for Gentner marked a rebirth in the field of audio processing.

Lazer 2.0 is a 100 percent DSP digital limiter/stereo generator for FM radio stations; it incorporates a wideband AGC, a three-band limiter, a wide band limiter and a composite limiter, as well as a completely digital stereo generator. The Lazer features an improved wide-band AGC,



Gentner's family of  
audio processing equipment.

adding both 25 and 50  $\mu$ sec pre-emphasis positions.

Prizm is a 100 percent digital four-band preprocessor, according to Gentner. Similar in operation to the analog Prizm II FM, the Prizm 2.0 is designed to operate with the Lazer and offers an updated wide band AGC. Gentner also showed its Prizm AM for AM station processing.

Also on hand from Gentner was the Digital Audio Workstation Network (DAWN), a Local Area Network (LAN)-based digital audio record and playback device.

Circuit Research Labs (CRL) introduced the Amigo, a low-cost FM AGC, limiter and multiplex generator with stereo and

(continued on page 12)

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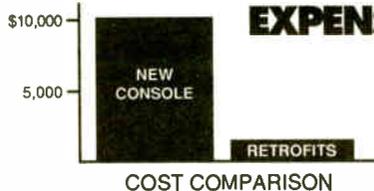
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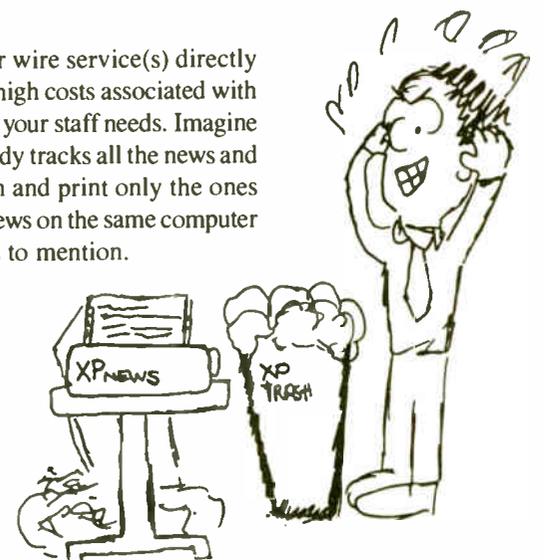
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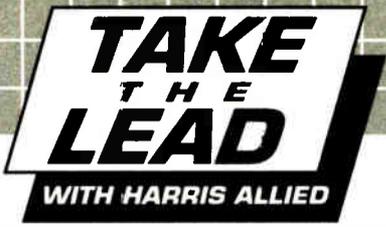
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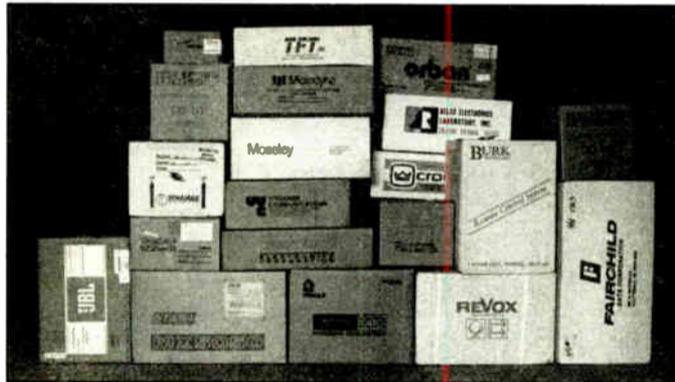
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# New Products Flourish

(continued from page 9)

low frequency enhancement functions. The digitally synthesized generator boasts stereo separation greater than 50 dB, and the dual band AGC is said to have better than 25 dB range.

Cutting Edge Technologies and Orban Associates each displayed the processing devices they debuted at the spring radio show. Orban's digital Optimod is still undergoing software refinements. At Radio 1991, it was still not ready for shipment.

Cutting Edge Technologies has been shipping its Unity 2000 processor since the Las Vegas show. The first customer was the company's New Zealand distributor. Several units are already in place at Kiwi radio stations.

The Paragon-transmission processor from Audio Animation was being shown at the Harris-Allied booth. The Paragon first appeared at last year's SBE convention in St. Louis.

### STLs and codecs

Digital technology also was in full swing in studio-to-transmitter links and codecs for telco applications.

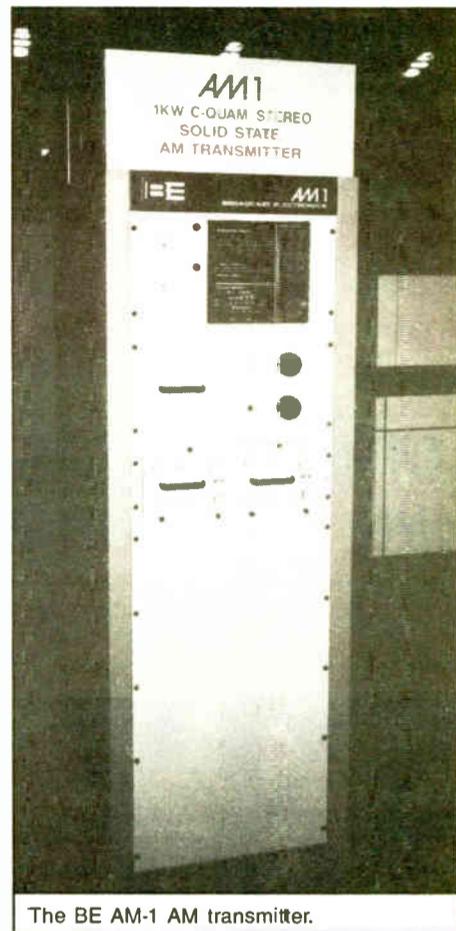
Corporate Computer Systems (CCS) introduced the CDQ/2000 multi-rate digital audio codec, available as an encoder only, decoder only or as an encoder/decoder in a single unit.

The CDQ can provide a standard single line digital interface for satellite, fractional T1 or terrestrial communications; it also offers a two-line interface that combines two 64K bit or two 56K bit physical data circuits into one data path. The CDQ allows for 20 kHz of stereo audio in as little as 112K bits of digital bandwidth.

The CDQ/2000 can access V.35, X.21 and RS422A interfaces, and employs ISO standard MPEG MUSICAM compression.

CCS also showed the Micro66i digital audio codec for international service, enabling users to transmit 7.5 kHz audio from international sites to the U.S. or vice versa.

ComStream displayed the ABR200 digital audio satellite receiver for Ku- or C-



The BE AM-1 AM transmitter.

band operation. The ABR200 uses MUSICAM digital audio compression for 20 kHz audio at 128, 192 or 256 kbps. The unit also features six TTL inputs for channel changes and equipment monitoring, and a relay control port with eight contact closures.

Moseley showed its DSP 6000 system, a digital STL first shown in Las Vegas, comprised of a source and channel encoder and decoder. The unit uses apt-X compression and has a frequency response to 15 kHz via a 32 kHz sampling rate.

Dolby exhibited the DSTL Model DP5502, the company's entry in digital STL technology. The Dolby STL includes source and channel encoding and decoding using the company's own AC-2 6:1 coding algorithm. The Dolby unit, like Moseley's, has a 15 kHz frequency response, although its sampling rate is 44.1 kHz.

In the analog domain, TFT introduced the Model 9200 series STL system, a lower-cost unit designed for single, redundant dual channel or stereo program transmission for studio to transmitter links or inter-city relays.

The TFT frequency synthesizer design provides low phase noise and low spurious output. The company maintains that the STL system can achieve greater than 70 dB signal-to-noise with  $\pm 22$  kHz FM deviation.

New from Comrex at Radio 1991 was the Talk Console, a 13" x 9.52" x 3.5" unit that includes a telephone dial pad, telephone couplers that connect to direct lines of a PABX, and two self-adjusting hybrids.

Two mic inputs are included on the rear panel; the second channel is also available for line level sources such as CD players and tape decks. A mix-minus feed is provided and the front panel has two headphone outputs with volume controls.

Comrex also showed its digital audio codecs for wideband two-way audio on switched 56 kbps or ISDN telco services.

Sharing booth space with ITC, AEQ (continued on page 18)

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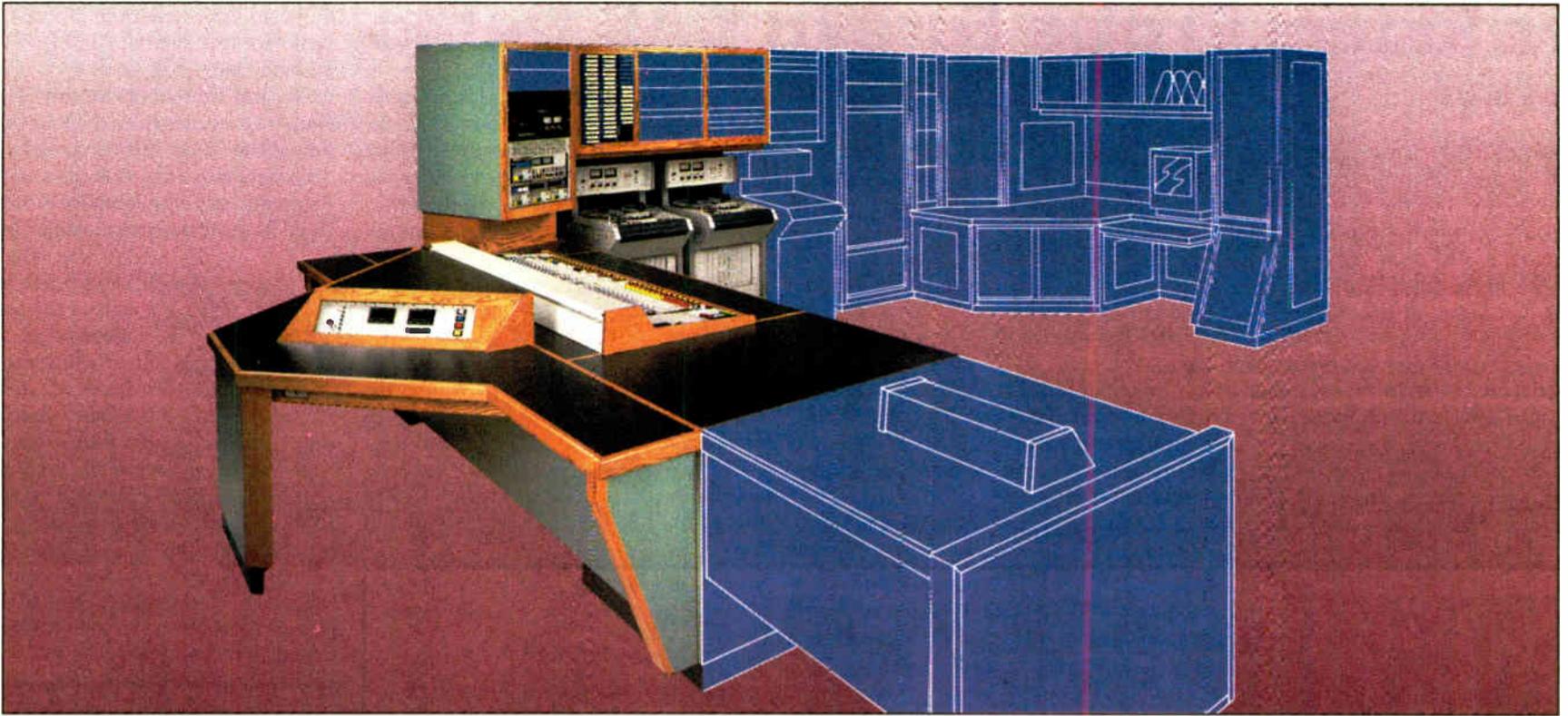
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# Bus Riders Praise Eureka DAB Demo

by Judith Gross

**SAN FRANCISCO** It wasn't at L-band frequencies and this time the gap filler was a necessity, but the second round of bus tours comparing the Eureka 147 DAB system to FM drew more positive responses here than the first one done in Las Vegas at the NAB spring show.

There were more direct A-B comparisons between the two signals and a less complicated description for a mostly non-technical audience.

In addition, a signal light added to the oscilloscope screen enabled listeners to determine when they were listening

to the digital signal and when it was analog.

But considering the heavy multipath and shadowing characteristic of the San Francisco Bay area, the light was almost unnecessary.

The Eureka 147 DAB took a 15 kHz line feed from KOIT-FM up to the DAB transmitter on Mount Sutro, a conglomerate tower for radio and TV reception in the area.

It was sent on 701 MHz to the Eureka DAB receiver in the special tour bus. There were tapes being broadcast on the other Eureka carriers, and the total transmitting power was 50 W.

The analog KOIT-FM signal—a Class B

—was also broadcast from Mount Sutro, and was picked up on a standard Delco receiver. Through headphones, those on the tour were able to hear receiver blending and multipath interference on the FM.

The switch to Eureka DAB brought not only an interference-free signal, but also one with lower noise and the sense of greater range, which some riders described as "a fuller sound."

It is interesting to note that while the FM audio was processed in the normal manner, the Eureka DAB signal was unprocessed, and suffered no loss of loudness.

The gap filler was put to work, with no audible switchover, for about one block of the 45-minute bus tour. NAB staff en-

gineer Kelly Williams explained that building shadows caused the loss of the DAB signal for that segment and the gap filler automatically took over.

The transmitter on Mount Sutro was about three miles from the tour bus route where the "drop-out" occurred.

Broadcasters who took the tour seemed impressed with the sound of Eureka. "You could hear the difference plainly," said one.

Another rider added, "It seemed to take care of the static and interference."

Broadcast engineers, many of whom heard the demo in Las Vegas, said the Eureka bus tour was an improvement over the spring show, where little difference between the DAB and the taped programs over FM were discernible.

But they are still waiting to hear Eureka on L-band frequencies, which may not take place until next spring's NAB convention (see related story).

## Spend Now, Save Later

by Nancy Reist

**SAN FRANCISCO** Spending now to save later may sound dangerous in these troubled economic times, but according to the Radio 1991 panelists espousing new technology, the payoff may come sooner than you think.

During the session entitled New Technology, the panelists said the increased efficiency of many new digital technologies may save a station thousands of dollars annually, enough to recoup the investment costs and start contributing to savings within two or three years.

Moderator Milford Smith of Greater Media, suggested that ignorance of these new technologies may be "hazardous to your fiscal health."

Solid-state digital AM transmitters can lead to significant savings through increased efficiency. Ron Frillman, Harris Corp.'s manager of advanced marketing for radio products, said Harris' digital 10 kW AM transmitters operate at 86 percent efficiency.

Glynn Walden, Group W's director of engineering for the Eastern Region, added that digital technologies are also space efficient. The move from a 16-track analog production studio to a computerbased digital workstation can save space while it enhances a station's creative potential.

The panelists agreed that new interlink technologies can be particularly important cost savers. Smith cited a Los Angeles station that broadcasts Howard Stern's New York show. The phone lines cost approximately \$6,000 a month. The station is investing in a small Ku-band satellite with up- and downlinks. The initial expense will be \$100,000, but they expect to save \$4,000 a month.

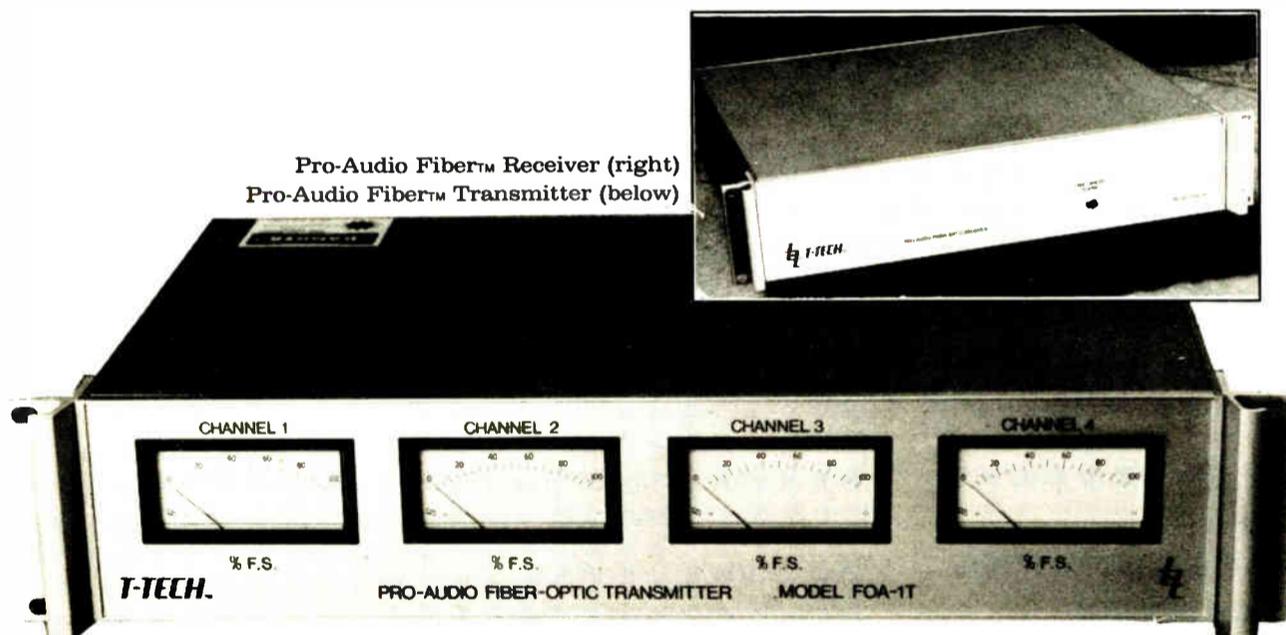
Walden commented that dependence on analog phone lines is dangerous these days because the lines are becoming increasingly expensive and difficult to get, particularly for long distance services.

"Basically, (the phone company) loses money in every audio line they install for you. They're not going to want to do it much longer," he said.

The phone company's move from analog  
(continued on page 17)

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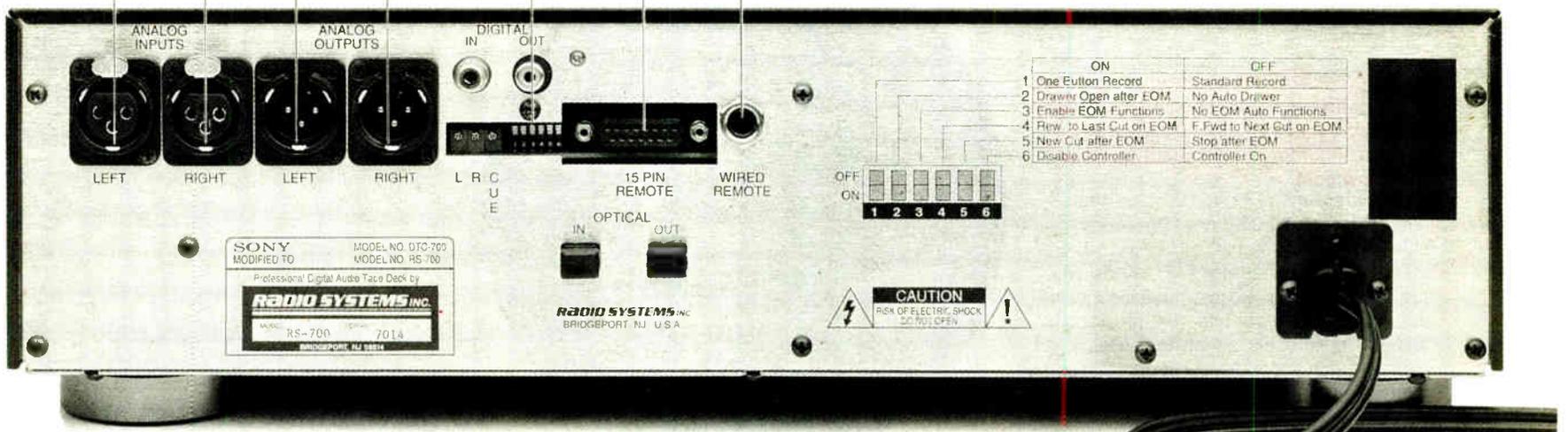
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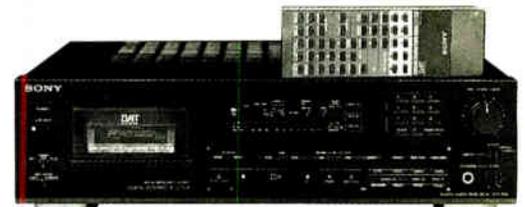
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**EXAMPLE #2**

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**EXAMPLE #3**

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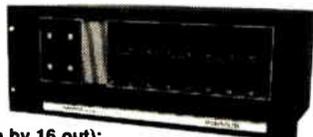
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**RAMKO RESEARCH**

# Know FCC Technical Regulations

by Nancy Reist

**SAN FRANCISCO** With the trend toward several stations sharing one chief engineer, it's more important than ever for managers to understand the FCC's technical regulations.

Unfortunately, this can be tricky, for as RW columnist Harold Hallikainen pointed out in a Radio 1991 panel, many managers find the rules unclear. The panel discussed both new FCC regulations and steps managers can take to better understand them.

The FCC is proposing a self-inspection form that managers would fill out with their engineers. If implemented, the form would replace inspections conducted by FCC personnel.

When asked whether this form could put stations into a precarious situation if they certified they were in compliance and

then were caught with violations, Serge Marti-Volkoff, the engineer in charge of the FCC's San Francisco office, said "unofficially" that he doubted it would be possible to prove that violations existed at the time of the certification.

Marti-Volkoff said he hopes this self-inspection will improve managers' knowledge of the rules, which he has often found to be lacking. "Quite often the stations will not be cognizant of the rules—they just won't know," he said.



The FCC considers tower lighting a particularly important safety issue, since unlit towers are very dangerous for aviation. According to the new forfeiture schedule, the penalty is \$20,000 a day for each violation. Tower lights should be checked every 24 hours, even if the station stops broadcasting.

### Adhere to requirements

Hallikainen warned that even if the FAA says tower lighting is OK, stations must adhere to the lighting requirements specified on their license.

Marti-Volkoff added that the environmental movement has focused a lot of at-

tention on the possible hazards of radio frequency radiation. Because this issue is likely to become increasingly important, he suggested that managers send for the FCC's document about tower radiation.

FCC Audio Services Division Chief Larry Eads outlined a set of changes in AM technical requirements, which the Commission dealt with in its Sept. 26 open meeting. The changes are designed to reduce AM interference, both by encouraging the stations causing the most interference to migrate to the new section in the band and by adjusting technical standards.

Eads also said he is expecting the imminent release of the reconsideration of the FM spacing rules, which may be less restrictive. Eads said the Commission is considering changes in FM modulation monitoring regulations, but he does not

(continued on page 18)

## Spend Now, Save Later

(continued from page 14)

to digital data transmission, however, does present some opportunities for broadcasters. AT&T's new Switched 56 service provides national and international digital connections.

Walden said that with two Switched 56 lines, you can get 15 kHz stereo at 12 cents a minute, a tremendous savings over analog lines. The drawback is that Switched 56 is not yet available in every community and it requires a preconditioned channel and a set-up fee.

Smith pointed out that digital technologies can improve a station's sound by increasing both the fidelity and the opportunity to produce creative spots and programs. This can give you a competitive edge, not only with other radio stations.

Digital workstations can reduce production time, while increasing a producer's creative options. Digital equipment often is much cheaper to maintain than its labor-intensive analog counterparts, such as cart machines.

It all sounds great, but is it time to make these huge investments when the prices are still dropping and the technology is improving? As one anxious audience member put it, "Is it worth being a pioneer and jumping in early?"

The panelists responded with an emphatic "yes." Smith said he believes "the giant jump in terms of efficiency has been achieved." He added that most of this technology is computer-based and governed by software that usually can be upgraded to include the latest innovations.

The panelists warned, however, that it's important to select equipment that meets the unique needs of your station and staff. The equipment should be user-friendly, or it could end up being a "very expensive doorstop." Frillman recommends bringing one of the operators in to help select equipment.

Of course, many of these operators mistrust the equipment because they fear that the savings in "reduced labor" translates to fewer jobs for them. But that's a topic for another panel.

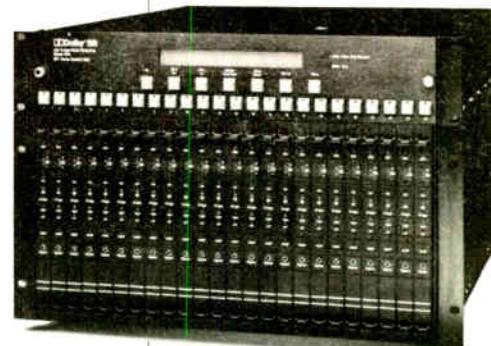
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Circle 58 On Reader Service Card

# New Products Flourish at Radio 1991

(continued from page 12)

debuted the Systel-3000 digital multi-hybrid telephone system, a signal processed system with microprocessor control using RS-232 or RS-422 interfaces. The system accommodates up to eight telephone lines. Each input module includes anti-aliasing and 16-bit sigma-delta A/D converters.

AEQ also displayed the MP-10 portable mixer for remote reporting over telephone lines. The unit has three headphone outputs and a front panel level meter.

Hard disk storage and replay devices were in evidence throughout the exhibit hall. Some manufacturers showed refine-

ments to devices that premiered at the Las Vegas convention, while others—including two foreign companies—introduced new products.

## Hard disk proliferation

The Arrakis Digi-Link, Wheatstone's Not-So-Hard-Disk, the DCS from Computer Concepts Corp., BE's AudioVAULT and CORE 2000, the Audio Prophet from Prophet Systems and the Smartcaster system each were on hand at Radio 1991.

ITC displayed the DigiCenter, a storage and replay device the company showed by appointment only in Las Vegas. The DigiCenter (formerly known as DigiForm)

is a touch screen system that uses a simplified screen displays in this showing.

New from Register Data Systems (RDS) was the Digi-Corder, a computer-based spot scheduler and playback system with menus for files, event scheduling and next-event ID. The screen layout features "buttons" for start, stop, pause and record, as well as file and break insert functions.

BASYS Automation Systems was marketing the D-Cart, a networked digital audio recording, editing and playback system originally developed by the Australian Broadcasting Corporation. It features touch screen interfaces, digital parametric EQ and expanded on-air console and automation interfaces.

Dalet Digital Media Systems, a Paris-based company, showed its Dalet Integrated Network, a PC-based system combining production, traffic, on-air digital playback and remote controlled, walk away, automated logging functions. Rewritable optical disk cartridges hold more than six hours of stereo audio from 20 Hz-15 kHz.

IGM Broadcast had one of the more unusual displays at the convention—a "construction site" announcing a product under development, the "AudioCenter."

According to IGM, AudioCenter will be a digital broadcast audio management system for audio library access and format operation from any location in the user's facility. The system will consist of one or more centrally located audio servers, each capable of handling up to 128 audio channels. All work will be done by the IGM Digital Audio Engine, with workstations providing only the user "front end."

No prototype of AudioCenter was available for demonstration, and system prices were unavailable because the company said each one must be individually tailored to specific operating requirements.

## New and improved

A variety of other new and recently introduced products were on display throughout the exhibit hall as well.

Electronics Research, Inc. (ERI) showed its lambda antenna mount sections, which debuted last year, and the company's medium power FM panel antenna system.

National Supervisory Network exhibited its satellite-based national off-premise control system for remote monitoring of station operations.

Burk Technology had its ARC-16 remote control system on display, and Data World introduced a ZIP code plotting service in addition to the other data services provided by the company.

Denon, Studer Revox and Yamaha each showed the recordable CD units they first introduced in Las Vegas.

Auditronics brought the 800 Series console to Radio 1991. First shown in Las Vegas, the console features removable EQ cards for jock "signature sounds," as well as a separate headphone EQ.

## Understand FCC's Rules

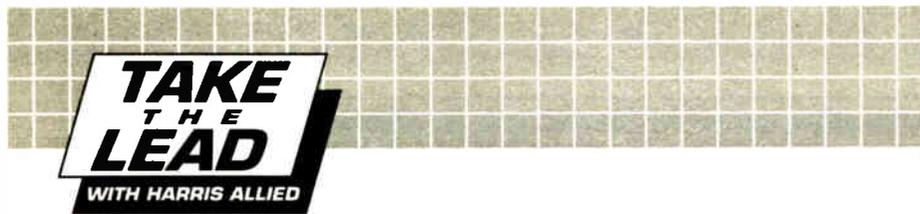
(continued from page 17)

believe the issue is "on the front burner."

Eads suggested that if a specific rule isn't clear, you should request a declaratory ruling, asking the Commission to interpret the rule. He said you also can petition for a change in the rule itself, though the FCC can dismiss the petition.

Marti-Volkoff remarked that managers who feel they have received unfair citations should protest. "You have every right to stand up and scream and say, 'Foul Ball,'" he said.

Attorney James Weitzman said that most stations would be reluctant to challenge an inspector out of fear of retribution. Marti-Volkoff dismissed this as "paranoia" and "nonsense." He maintained that most FCC inspectors are too professional to be vindictive. Weitzman added that cost often makes protests prohibitive since stations could end up paying thousands of dollars in attorney fees to protest a small fine.



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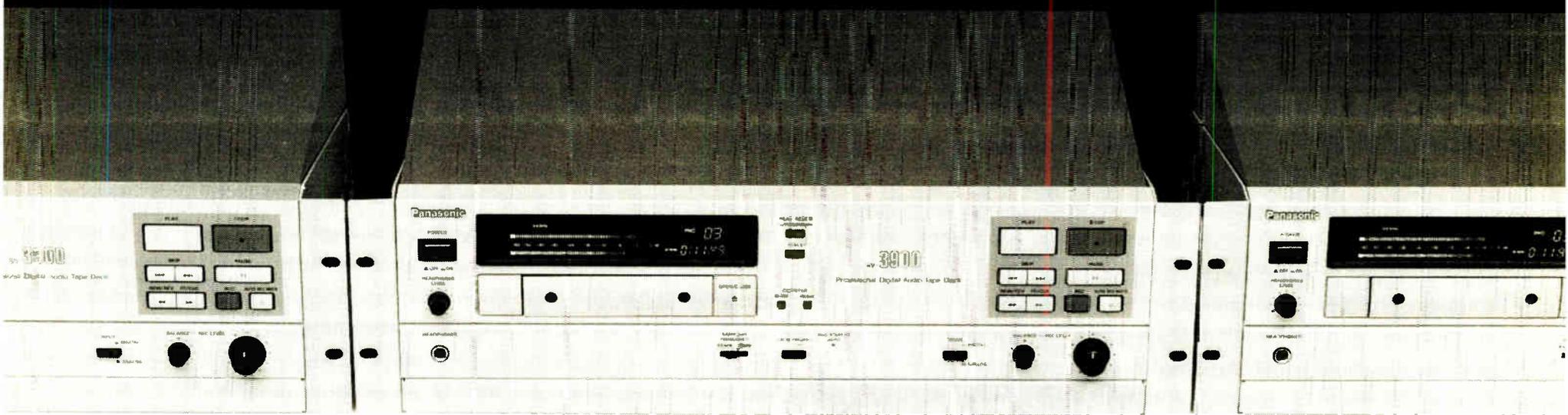
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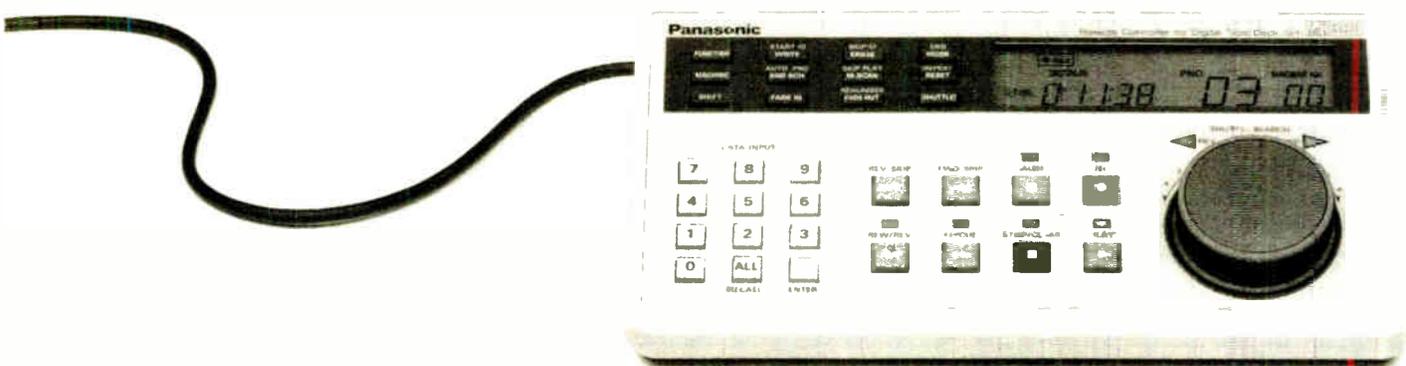
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World Radio History

# FBI Probes Alleged Equipment Scam

(continued from page 1)

A spokesperson at the FBI's Omaha office declined to comment, citing Department of Justice policy regarding pending federal cases.

Brown added that a number of other complaints have been filed against Kautz for "misuse of financial transaction instruments"—primarily credit cards. Because of the scope of those charges, that aspect of the case has been turned over to the Secret Service, he said.

David Layne, an engineer with WXJK in Farmville, Va., said he placed an order with Imperial for a three-bay antenna, transmitter and transmission line. He said his deal with Kautz was 50 percent down, with the balance on delivery.

Layne had contacted the Better Business Bureau in Kautz's area, and had discovered no complaints against Imperial Transmitters Worldwide.

## A discrepancy in terms

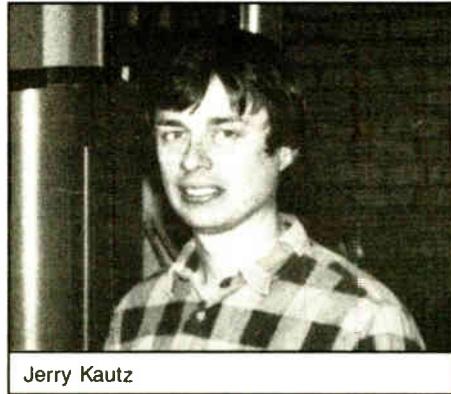
After placing his order, Layne said he received a fax from Imperial explaining that a company truck was planning to make deliveries in West Virginia and Maryland, and would stop by WXJK with his gear. The letter requested a deposit of \$6,415 by Aug. 31 and the remainder before delivery, according to Layne.

Contacting Kautz to point out the discrepancy in terms, Layne said he was told that he had received the "wrong fax" and was advised to mark out the discrepancy, writing in the agreed-upon terms. Layne

sent a check by Mail Express; the Post Office confirmed to him that Kautz had received the check on Aug. 31.

In subsequent calls to Imperial, Layne said he was told the truck had broken down and might be late for delivery; by mid-September, he suspected he had been defrauded.

Stanley Swanson is the engineer for KVVN, part of the World Radio Network



Jerry Kautz

based in McAllen, Texas. He said he placed an order with Imperial for a QEI monitor, a console, an STL unit and an Optimod. Swanson said he sent the company a check for \$12,200; he said he was promised delivery would be made Sept. 1.

Calling to verify his order, Swanson said he was told his equipment would be delivered by Sept. 9, via a company truck (to save on shipping charges). He then sent Imperial a second check for \$12,200.

On Sept. 9, Swanson said he was told

that delivery would take place later that week. After that, his repeated phone messages for Kautz were never returned; the only times the phone was ever answered at Imperial were by a cleaning lady and an answering service, Swanson said.

## Other complaints

Even a broadcast equipment manufacturer was attracted to Kautz's offer. Hank Landsberg, president of Henry Engineering, said he decided to deal with Imperial Transmitters because a friend had purchased equipment through Kautz both at Imperial and at Armstrong Transmitters, while Kautz was employed there.

Landsberg said he placed an order in June for a Harris exciter and PR&E cart recorder. He said he sent Kautz a check for \$1,350, and was told the equipment would be ready to ship by mid-August. On August 23, according to Landsberg, he received a letter saying the order would be ready to ship upon receipt of the second \$1,350. Landsberg said he made the payment, but rescheduled delivery so as not to conflict with the NAB's Radio 1991 show in San Francisco.

A week after the expected delivery date of Sept. 11, Landsberg said, he phoned the Imperial offices. There was no answer.

According to Landsberg, local authorities who inspected the headquarters building of Imperial Transmitters Worldwide said there appeared to be some transmitters and similar equipment housed there. As for Kautz, the answer-

ing service told Landsberg that he had left town, and would return in mid-September. By early October, he had still not returned.

Not all those affected by this story are as easy to identify, however. One company, Armstrong Transmitters, was used by Kautz in establishing his credibility as a salesperson. According to several sources, Kautz described his former affiliation with Armstrong in his sales pitch for Imperial.

For Armstrong Transmitters, that has meant having to field phone calls from broadcasters seeking help from a company that has had no involvement with Kautz for years.

Armstrong's Director of Operations, Gary Burrows, responded to the Imperial Transmitter situation by pledging his company's continued dedication to service.

People contacted by RW recognized that the agreement they entered into with Imperial Transmitters Worldwide was not unusual for equipment dealers.

Layne said that a number of Kautz's customers are considering a class action suit against him. He recommended that others who believe they have been defrauded by Kautz contact the McCook, Neb. police department, the Justice Department in Lincoln, Neb. and the FBI. If they sent checks to Kautz using Express Mail, Layne also recommends they contact the postal service to report possible mail fraud.

If you have information, contact Detective Ike Brown at the McCook, Neb. police department: 308-345-3450, or Kelly Patachek at the U.S. Justice Department in Lincoln, Neb: 402-471-2682. To contact the Better Business Bureau in your area, call 800-955-5100.

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World Radio History

# How Long Will Batteries Keep?

by Tom Vernon

**HARRISBURG, Pa.** Having a good stock of replacement components on hand is essential to running an efficient repair shop. But it's possible to have too much of a good thing.

Some components, notably batteries and capacitors, have a finite shelf life, and if you're overstocked, you're really wasting money.

This month's column examines some guidelines on the shelf life of capacitors and batteries, with some thoughts on extending their useful life span.

The maximum shelf life for ceramic discs, paper, dipped and moulded mica capacitors is about five years. The main

reason that these capacitors fail on the shelf is a gradual breakdown of insulation resistance. This deterioration is hastened by temperature cycling and high humidity environments.

## STATION SKETCHES

Capacitors should be stored in an area away from heat and moisture. For this reason, parts cabinets mounted on the wall over radiators or baseboard heaters are bad news.

Electrolytic capacitors typically have a shelf life of about two years. This can be extended somewhat by applying a polarizing voltage through a current limiting resistor every few months. Storage in a dry, temperature stable environment will extend component life by preventing a loss of moisture from the electrolyte.

Electrolytics have four major failure modes, any of which can occur from extended shelf life. The most common problem is dielectric absorption, also known as "battery effect." This shows up as retention of a charge even after the capacitor has been discharged.

Lytics also are prone to leakage current and a problem known as increased ESR, or effective series resistance. In this case, a high resistance forms inside the capacitor, often at the point where the leads connect to the foil.

It's good practice to check new capacitors with a reliable tester before installing them. This means checking for leakage at the cap's rated voltage, ESR, value and dielectric absorption. Checking for leakage with an ohmmeter can give misleading results, as many defective caps will only reveal themselves at higher voltages. Inexpensive testers that only check value also have limited usefulness.

If a good capacitor analyzer is beyond your budget, keep only a small quantity of capacitors in your shop. Resist the temptation to buy 500 assorted capacitors from a wholesaler. It's better to deal with a distributor who maintains fresh stock.

Many capacitors and batteries are

stamped with a date code. Most often this is in the form of a four-digit number, with the first two digits for the year and the last two indicating the week in which the device was manufactured. 8712 for instance, would indicate that a component was made during the 12th week of 1987.

Battery manufacturers have a fairly scientific definition for the term "shelf life." It's the length of time after which a battery retains 90 percent of its original charge at a storage temperature of 70 degrees.

Typically the shelf life of mercury and alkaline batteries is one to two years. Carbon-zincs are slightly less. These lives can be extended by storing batteries in a refrigerator. This is because the breakdown of a battery is a chemical reaction, and these reactions slow down with decreasing temperature.

There are some precautions that must be observed when placing batteries in

cold storage. Rough handling should be avoided, as this may damage internal seals, which are more brittle at reduced temperatures.

When removing batteries from the refrigerator to place in service, let them come up to temperature in their original cartons. By doing this, you'll avoid moisture condensation, which can increase electrical leakage.

Don't put batteries in service until they've come up to room temperature. The power capacity of batteries is reduced at lower temps.

Some people think that since batteries last longer when stored in the refrigerator, they'll last indefinitely in the freezer. Freezing destroys internal seals, crystallizes some chemicals and totally ruins the battery.

Buying capacitors and batteries from a dealer with fresh stock, intelligent storage practices and handling them on a first-in first-out basis can do a lot to reduce monthly parts expenses.

Tom Vernon can be reached at 717-367-5595.

# The Sounds of Silence Prevail Within WIBM

by Dee McVicker

**LANSING, Mich.** If a tree fell, and no one was around to hear it, would there still be a sound? The answer to that age-old question is no, not if it fell in WIBM-FM's new soundproof facility.

Described as "a room within a room" by Michael Bradford of Bradford Broadcast/Audio Services, an engineering firm specializing in studios and station maintenance, the station's new studio facility in a Lansing, Mich., mall is virtually sealed off from the outside world.

"There is a quarter-inch air gap around all rooms," explained Bradford, who helped design and install the studios. "And there is a suspended ceiling underneath a secondary ceiling." Even the quarter-inch plate glass windows, he said, are separated by an air gap and are angled to ensure that audio is not transmitted to adjoining studios.

Furthermore, said Bradford, "Air conditioning ducts do not share common sheet metal runs, so there is less chance of sound transfer through the sheet metal ducting. And the doors are solid

## FACILITIES SHOWCASE

oak, with what is called a drop—or sound—threshold. So when you close the door, that threshold is extended to the carpet, virtually sealing the door."

The almost 300-pound doors are each held in place with large, five-screw hinges.

These studio isolation techniques are a culmination of what Bradford refers to as his 25 years of trial and error in studio design. He also credits the facility itself for making his task easier.

WIBM-FM's V-shaped facility, located in a strip shopping mall, although unappealing to most retailers because of its narrow storefront, lent itself easily to the task of delivering quality audio.

Explained Bradford, "The studios do not have parallel walls. It turns out that the space in the mall provided us with non-parallel walls, which are obviously advantageous because it keeps sound reflections to a minimum."

The facility also proved ideal for the visibility requirements of the oldies station. The mall studios put the FM in the busy commerce of southern Lansing, Michigan's state capital and the heart of the surrounding metropolitan area. Separated from its sister AM in Jackson, 30 miles south of Lansing, WIBM-FM now is in a locale where the largest sales revenue is likely to occur.

In addition, the mall studios provide high visibility for station personnel. "All three studios have line of sight right out the front building," said Bradford. "So there is visual contact between all studios and the outside."

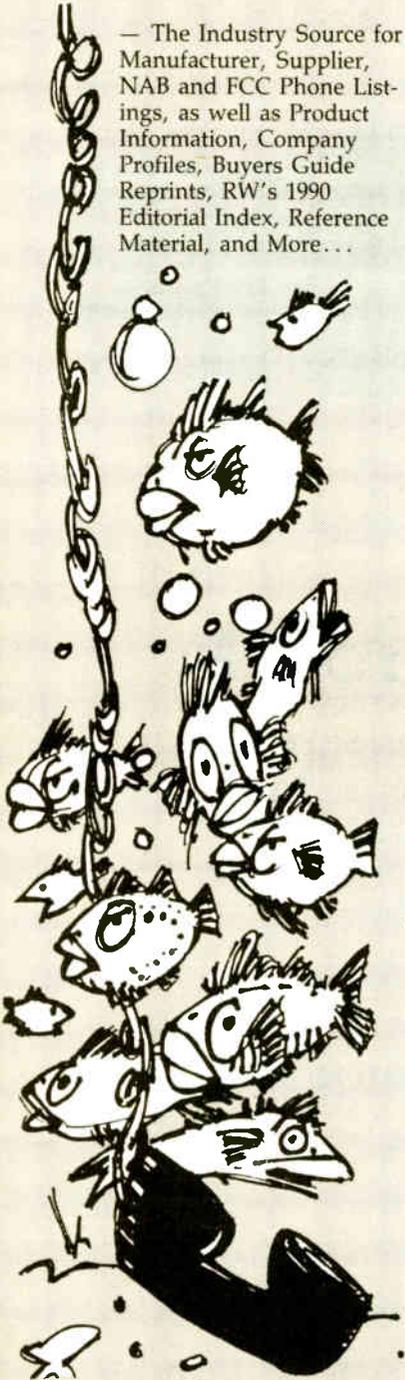
As the focal point of the station, the (continued on page 25)

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# The Main Studio Rule Revisited

## The Nitty Gritty of What the Often-Confusing, Ever-Vague Rule Says—At Least As Far As We Can Tell

by Harry Cole

**WASHINGTON** A couple of months ago, I wrote about a recent development or two relative to the FCC's main studio rule.

Much to my surprise, the telephone nearly rang off the wall with inquiries about that rule—inquiries that suggested there remains a fair amount of confusion about what the rule actually requires.

### COLE'S LAW

In the interest of making sure that we're all dealing from the same deck, this column is dedicated to the nitty gritty of what the main studio rule entails (at least as far as we can tell from what the Commission has said about it).

The main studio rule is found in Section 73.1125 of your FCC rulebook. All it says is that each AM, FM and TV licensee shall maintain "a main studio" in its community of license or, at a minimum, somewhere within the station's city-grade contour.

#### Very limited exceptions

There are a few very limited exceptions to this. An FM station can co-locate its studio at the site of the studio of a commonly owned AM station licensed to the same community, even if that site is outside the FM's city grade. Alternatively, any licensee can ask for a waiver of the rule based on a "good cause" showing.

Section 73.1125 also requires that each licensee maintain "a local telephone number in its community of license or a toll-free number."

Additionally, Section 73.3526(d) of the rules requires that each station's local public inspection file must be maintained at the station's "main studio" as long as that studio is located in the community of license. If the main studio is outside the community of license, it appears from this rule that the licensee must maintain its public inspection file at some other place in the city of license (for instance, at the library, city hall or an attorney's office).

While the public file rule does not appear to require redundancy (that is, a file at the main studio and a duplicate file in the community of license), in that latter situation, such redundancy probably wouldn't hurt.

If you find all of these guidelines to be a tad (how shall we say it politely?) sketchy, you might want to delve into the FCC opinions that were issued when the main studio rule was deregulated in the late 1980s.

#### Swell

There you would find that the FCC said that a main studio must have "the capability adequately to meet (the licensee's) function of serving the needs and interests of the residents of the station's community of license."

Swell. But the FCC continued, "To fulfill this function, a station must equip the

main studio with production and transmission facilities that meet applicable standards, maintain continuous program transmission capability and maintain a meaningful management and staff presence."

As we discussed in this column a month or two ago, that last phrase—"a meaningful management and staff presence"—has not been defined by the Commission. However, based on recent Mass Media Bureau decisions, it seems to require the presence, on a full-time basis, of at least one (and possibly more) management-level and one non-management-level staffperson.

And this is what the Commission has had to say about main studios: Each station has to have one (although the rules don't bother to tell you precisely what such a studio consists of); it has to be in the station's city of license or, at least, within its city-grade contour; and the public in the city of license must be able to telephone the studio on a toll-free basis.

As well: The local public inspection must be maintained there at least as long

### The main studio rule does not require any particular amount of programming.

as it's in the city of license; the main studio must have production and transmission equipment capable of allowing operation of the station from the main studio; and there must be at least two warm bodies (one of which must be a warm management-level body) on site full-time.

#### What don't they require?

So much for what the rules require. What don't they require? They do not require any particular amount of programming (or any program origination at all, for that matter) from the main studio.

They do not specify that any particular business activities (such as sale of airtime, program or spot production, personnel supervision or operation of the station's transmission equipment) be conducted from the main studio. They do not prohibit use of the main studio facilities for purposes over and above those merely involving the station—that is, the main studio building may be shared with other users and may be put to additional uses.

And there you have the main studio rule in a nutshell.

As we have previously bemoaned, the trouble with the rule as it presently stands is that it is far from well-defined. Rather, as far as we can tell, the rule is still in the process of substantive development as the Mass Media Bureau (subject, ultimately, to review by the full Commission) applies the rule on a case-by-case basis.

The result may be the addition of a lot of extra baggage well beyond what the strict wording of the rule itself now suggests. (The recent "interpretation" of the rule to require full-time management and staff presence is an example of the kind of thing that might be in store.)

Because of this, you may want to review your own operation to make sure that you are in compliance at least with the rule as it now stands. The apparent wave of regulatory fever the FCC seems to be suffering is not likely to go away

in the near future.

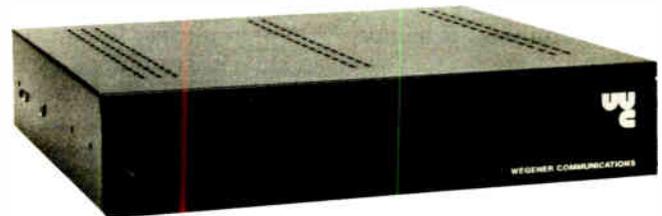
Since the requirements of the rule are only likely to get tougher, the less daring among you might be inclined to play this one conservatively for the time being. Your communications counsel should be able to help you decide whether you are in compliance and what further steps you might want to take, just in case.

■ ■ ■

Harry Cole is a partner in the Washington-based law firm of Bechtel & Cole, Chartered. He can be reached at 202-833-4190.



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# Current Flow Begins with Electronics

This is the first in a 10-part series called DC Fundamentals. Northern Virginia Community College will offer 1.2 CEUs (Continuing Education Units) to registered students who successfully complete the course and an examination mailed at its conclusion.

To register, contact the Director of Continuing Education, Annandale Campus, 8333 Little River Turnpike, Annandale, Va. 22003, or call 703-323-3159. The fee for the course is \$30.

by Ed Montgomery

## Part I of X

**ANNANDALE, Va.** A study of the fundamentals of direct and alternating current flow begins with the word "electronics." The root of this word is "electron," which is part of an atom.

If you recall what you have learned about atoms, you know an atom consists of a nucleus, which consists of protons and neutrons; electrons circle in orbits around the nucleus. This is illustrated in Figure 1.

Electrons have a negative charge or polarity, while protons have a positive charge or polarity. The neutron has no charge, but it almost equals the mass of the proton. The neutron sets the atomic weight of the atom.

Usually an atom has an equal number of protons and electrons. The proton and electron have equal but oppo-

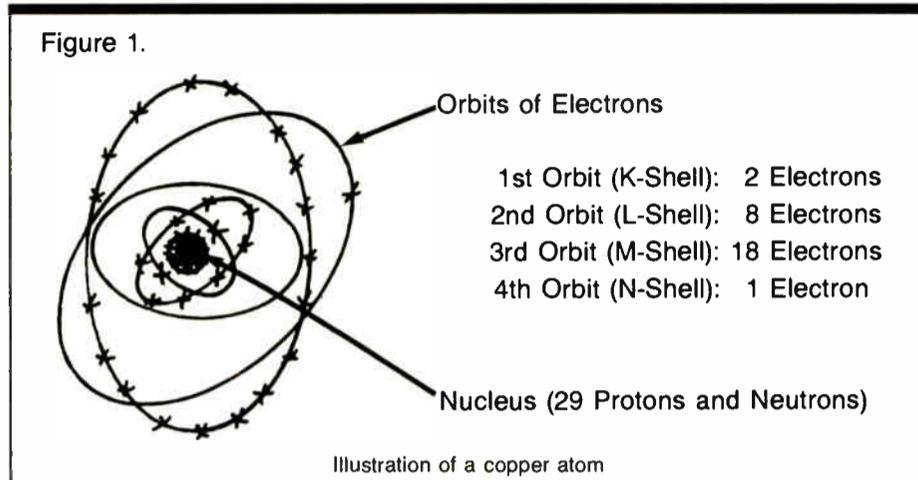
site charge, resulting in an atom that has no electrical charge connected with it.

However, atoms do exist that contain an imbalance of electrons. It is possible for them to have an incomplete outer shell—that is, the last orbit of

with too few electrons becomes a positive ion.

### Electron flow

Since the electron is the part of an atom that moves, the study of electronics begins with a look at the flow of elec-



electrons surrounding the nucleus. Certain atoms can accept giving up a few electrons in this orbit. This results in an imbalance of protons and electrons creating an ion: an atom that possesses a charge.

Protons are never lost in the nucleus, except in nuclear fission. The charge of an atom is determined by the excess or deficiency of electrons in it. For example, an atom with additional electrons becomes a negative ion, while an atom

trons.

To make electrons flow, or move from one atom to another producing a current flow, three things must be present: a supply of positive ions, a supply of negative ions and a pathway to pass the surplus of electrons from the negative source to the positive source. The flow of electrons will continue until all the atoms acquire the proper number of electrons and the charge is neutralized.

This is precisely what is happening in a battery or any other source generating a direct current. Batteries produce a chemical reaction, creating negative ions on one terminal and positive ions on another terminal. Negative ions are indicated by a minus (-) symbol and positive ions with a plus (+). A schematic diagram for a battery cell is illustrated in Figure 2.

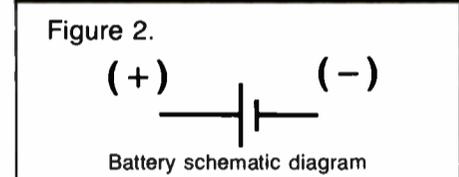
Conductors are atoms that have incomplete outer shells and will permit a finite number of extra electrons to pass through them. Each atom "hands off" the extra electrons as they travel from their more negative location to their more positive location. Materials that are good conductors include gold, silver, copper and aluminum. When these materials are connected between negative and positive terminals, electron flow will take place.

The number of electrons the conductor permits to pass is determined by the cross-sectional area of the conducting material. The larger the conductor is, the greater the number of atoms available to pass electrons.

The opposite of a conductor is a material that does not readily permit electrons to flow through it. Such a material is classified as an insulator.

Insulators play an important role in electronics. Insulating material is used to coat conductors, confining the movement of electrons to within a prescribed area.

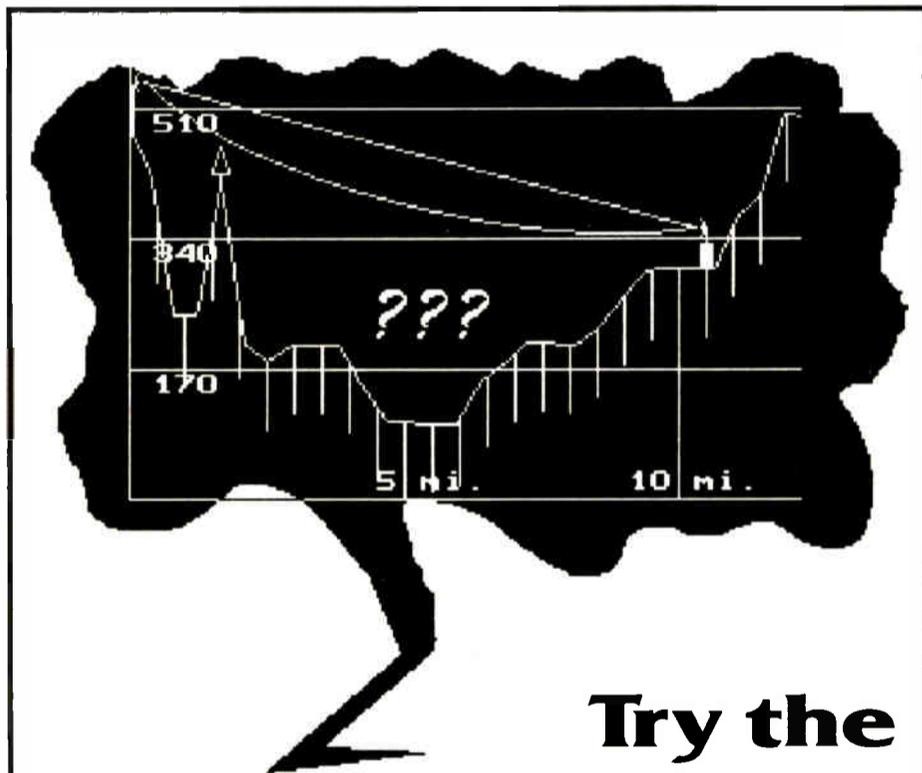
No insulator is perfect and its ability to inhibit current flow can be broken down. One of the best insulators is air, yet enough static charge can be built up during a thunderstorm to permit a bolt of lightning to break down air's insulating ability. Other common insulators include plastic, rubber, porcelain, glass and bakelite.



An excellent reference text for this study of DC electronics is "Basic Electronics" by Bernard Grob, published by McGraw-Hill. The ARRL "Handbook" also is a good source of further information.

■ ■ ■

Ed Montgomery is a communications teacher at Thomas Jefferson High School for Science and Technology. He has taught broadcast engineering at Northern Virginia Community College and worked as a broadcast engineer for several radio stations. He can be reached at 703-750-5090.



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### Conductors

A means must be provided to permit electrons to flow from the negative terminal to the positive terminal. A material that will permit electrons to pass through it is known as a conductor.

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# FROM THE TRENCHES

by Alan Peterson



## "Ay! You 'Ungry?'"

Dear Alex,

You noticed the "Connecticut" postmark, no doubt—yep, I'm still here. K92 Roanoke made me a pretty good offer, but there were a few points we had difficulty with.

So, all my best to Eddie Haskell and the gang in Roanoke, and I hope their new production genius does well by them.

Happily, this frees me up to take my annual autumn trip through the Northeast for foliage, wine tasting, apples and a peek at WSYR/Y94's new digital production suite.

If you ever head up through Central New York, there's a little nameless Italian restaurant you'll like; it was the scene of one of my earliest, most successful commercial campaigns ever.

I was kinda new at the game in 1980, and knew of this restaurant in my community. They only bought ads on the weekend Italian music hour, but decided it was time to aim a little higher to distance themselves from the other three places in town. For this, they needed a new ad.

The owner was a big, bald, *very* Italian gentleman with a giant black moustache. He shot down several demos done by other staffers and was ready to bail out on us.

Despite my newness, I could tell crummy specs when I heard them. Neither Billy Joel nor I appreciate "Scenes From an Italian Restaurant" as background music, "friendly and courteous staff" makes me gag even today . . . and honestly, Alex, have you ever eaten somewhere and told someone, "Gee, what a warm, friendly and casual atmosphere?"

Believe me, the place was anything *but*. Sure, the food was great, but when I went there one evening to find out, the decor was Post-Modern Budget Reception Hall. Heavy red velvet drapes, wallpaper way too opulent with those goofy plaster light candelabras set into the walls, and waitresses with blue eyeshadow applied by a Maaco spray technician. The only thing one could write about was the machine in the men's lounge that would dose you with Brut for a dime.

Nooooo . . . cliches weren't going to work for this guy (he hated them as much as I did). I couldn't write about the \*GACK\* atmosphere. Something had to happen to set him apart.

One of those moments happened that made the whole night—hell, the whole *week*—worth the wait. A young family came in for dinner that evening, and in tow was their son; about eight years old, giggly, and with a face like Billy Mummy from "Lost In Space." The owner caught sight of him, and with his big rubbery face as animated as you please, pointed and bellowed playfully to the youngster, "Ay! You 'ungry? Yooouuuu *better* be 'ungry!"

The kid laughed into Mom's dress, the owner grinned and took them to the table personally, and I sat there transfixed. A forkful of chicken parmigiana levitated between destinations, my smile bent my ears backwards and my cerebral cortex was on fire with that phrase.

To shorten a long letter, Alex, I showed up at the restaurant with the Pioneer 707 reel deck unbolted from production, a nice warm 77DX mic in hand and had him repeat that line about 24 times.

His other specs were butchered for copy ideas and an hour later he heard a new spot: whether or not you noticed you had an appetite, the moment you heard "Ay! You 'ungry?" you were. There was no doubt what restaurant owned that minute of airtime. He loved it, the flight was renewed several times and everybody was happy.

That would seem to have been enough for most stations, but something very funny began to happen. Listeners began calling to request that commercial. I didn't

realize it then, but "Ay! You 'ungry?" was such a natural thing to say, it had become a local catch phrase.

Outside of City Court, lawyers would say it to each other around lunchtime. I'd hear it mumbled on-line at other beaneries. "Ay! You 'ungry?" became the local equivalent of "Where's the Beef?"—at least three years before anyone heard of Clara Peller.

The truest test of success? When I heard the morning guy at *another station* slip and use the phrase. Following soon afterward was an amateur stand-up comic working it into his routine ("God, don't you just *hate* that commercial?").

Successful radio ads can be measured in any number of ways: increased traffic, increased sales, product recognition, brand loyalty, ad awards—you name it. When you hear everybody repeating a hook line or humming a jingle, it's a good bet you've got a winner carted up.

Beatles producer George Martin has a book out, titled "All You Need Is Ears." For anybody in the business of producing radio commercials, nothing can be truer. Listen for anything that can make audio work jump out of the speaker and come to life.

Eleven years ago, it was "Ay! You 'ungry?" Tomorrow, it could be who knows what?

I just hope I hear it before the competition does.

'appy 'allowe'en,  
—Al

Al Peterson is still producing for WLAD/98Q, Danbury, Conn. With winter coming, he'd better lay off the pasta.

## Scenes from a Mall

(continued from page 22)

studios are also where WIBM-FM shows off an entirely new concept in studio furniture.

Designed by BBC Custom Furniture in association with The Audio Broadcast Group (ABG), which provided the turnkey studio package for WIBM-FM, the new studio furniture features rounded corners instead of the more traditional squared corners found in radio stations.

The furniture design appeared in The Audio Broadcast Group's NAB '91 booth display and is now being offered in the company's furniture line-up.

To accompany the new furniture design in WIBM-FM's on-air studio, Bradford and ABG recommended a new Audiotronics 200 console. Inset into the furniture and surrounding the console are a new variable speed and variable pitch Otari MX series reel-to-reel recorder, Denon DN-950FA compact disc players and ITC Delta cart machines.

For WIBM's newsroom/backup on-air studio, at approximately one-third the size of the on-air studio, ABG and Bradford suggested a new 200 series Audiotronics console, as well as source gear similar to that found in the on-air studio.

For the station's new four-track studio, a new Tascam M-600 multitrack board was recommended and installed, along with Otari MX5050 recorders and Revox PR99B cart machines. An Aphex Compellor processor also is used in the four-track for effects production, as well as a Yamaha harmonizer.

In addition, the four-track includes an adjoining studio referred to as the creative room. As elaborately isolated from

the outside world as the other three studios, the creative room is described by Bradford as "a mobile creative center."

With a Denon CD player and Otari MX5050 recorder inset into cabinetry on wheels and a full library of sound effects, as well as a computer for scripting commercials, the creative room has cut down unnecessary traffic in the four-track studio.

Here, said Bradford, is where the sales staff can audition sound effects, time commercials and experiment with audio without tying up the four-track production studio.

In all studios, Bradford installed multiple shielded pair cable linked to a central frame room. Gentner telephone-type punch blocks terminate the studios' cable in the frame room, allowing each studio access to off-air. Should catastrophe strike, Bradford said, "It should be easy enough to patch around."

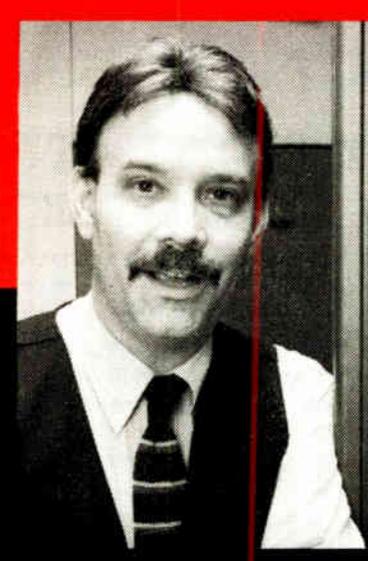
Although Bradford hasn't eliminated the future possibility of installing a routing system, for the present he has been able to bypass this expense. "At this time we have enough capability in our studio design that putting in a switching system doesn't make monetary sense," he said.

The new 3,700-square-foot facility began airing WIBM-FM's programming at the beginning of the year and, according to station GM Mike Topoll, made the transition without a hitch. Topoll credits the smooth transition with good planning, equipment, professionalism and, of course, ample soundproofing.

Dee McVicker is a free-lance writer and regular contributor to RW. She can be reached at 602-899-8916.

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# The ElectroVoice RE-27N/D

## New Dynamic Microphone Design Offers High Output Consistent with CD-Like Brightness

by Ty Ford

**BALTIMORE** "We were trying to design a microphone for broadcast that was consistent with the brightness apparent on most CDs."

That's the way ElectroVoice's Ivan Schwartz describes the RE-27N/D, and that's exactly what they've done. If you've been thinking your on-air voices have been sounding a bit soft when compared to CD sound, get your hands on an RE-27N/D and try it yourself.

I became aware of ElectroVoice's design

efforts for the RE-27N/D almost two years ago. Then, in a typical "what's new" chat I was having with Ivan, I mentioned that while I had recorded voice tracks with RE-20s, they were not my first choice for a dynamic mic.

My specific problem was (and is) that the RE-20 is too "boomy," "soft" or "warm" on the bottom. It's not that I have been gifted with the Voice of the Heavens. There are a lot of other guys out there with deeper voices than me. It's just that, in my opinion, an RE-20 in the flat position made my voice tracks sound muddy.

### Serious ankle biting

This was less of a problem when I was doing serious "ankle biting," hard-sell deliveries. Then, the voice projection comes mostly from the upper register where there are fewer bottom tones produced. However, anywhere from down-the-middle projection to soft-spoken passages lost intelligibility due to the overabundance of low frequencies.

Obviously, the immediate remedy would be to back off the mic, reducing the proximity effect and consequently the bass response. While that solution works—sometimes—it also can create two other problems.

First, if you're doing that really intimate read, you need to be as close to the mic as you can get. That's part of the psychoacoustics that create the intimacy. The listener's brain senses the distance between the mouth and the mic via a number of subtle cues. For example, low-level mouth sounds become much more apparent when your mouth is closer to the mic.

Second, working a "close mic" also means the mic gain can be run at a lower level, which reduces the amount of early reflections contributed by the room in which the recording is done. Instead of be-

ing perceived as a voice in a room, the listener's perception is that you are speaking to him at a much closer distance.

Given that the content of a script may demand a delivery of implied intimacy, the only way to do it properly is to be close to the mic. My experience with the RE-20 was that as I got closer for an intimate

## PRODUCER'S FILE

delivery, the increased lower frequencies created by the proximity effect bottomed out the mic, decreasing overall intelligibility. Using the RE-20s, bass roll-off reduced the lows a bit too much for my personal taste.

### External EQ

External EQ provides another possible solution. This works much better in the recording studio environment. The talent

WBAL-AM to arrange for a comparison session. Our comparisons included a Sennheiser 421, Shure SM7, and the ElectroVoice RE-20 and RE-27N/D. Allowing for the fact that the RE-27N/D had a noticeably higher output than the other mics, here are some of our one-line observations:

- The RE-27N/D seemed more open sounding and brighter than the RE-20.
- The RE-27N/D voice tracks cut through better than the RE-20s.
- The RE-27N/D had a larger hot spot (wider pattern) than the other mics.
- The Shure SM7, which was set with no roll-off on the bottom but with the presence peak on, sounded thinner than all of the other mics, but was also less susceptible to pops.
- The RE-27N/D, with both the top and bottom rolled off, sounded similar to the Shure SM7.
- The RE-27N/D, in its flat position, sounded somewhat like the Sennheiser 421. The Sennheiser 421 was a little fuller on the bottom in its "M" position, and not quite as full on the bottom with its EQ set one click toward the "S" position.

The RE-27N/D has several advantages

**If you've been thinking your on-air voices have been sounding a bit soft when compared to CD sound, get your hands on an RE-27N/D and try it yourself.**

is in the studio and the engineer or producer is in the control room making EQ adjustments while listening to the voice over good studio monitors. Of course, this also means you need good EQ and should know how to use it. Left in untrained hands, EQ can do much more harm than good.

But I digress. Due to the stronger neodymium magnet used, the RE-27N/D is about 5 dB hotter than the RE-20. This means your mic pre-amps can be backed off, which may reduce some circuit noise.

Unlike the RE-20, which has a slow rise of about 2 dB between 6 kHz and 10 kHz, the RE-27N/D has a rise of nearly 5 dB between 1 kHz and 6 kHz. This provides a much crisper sound, which helps in cutting through heavily processed audio chains and should also improve intelligibility for AM stations.

The RE-27N/D also has a high-end roll-off switch, which is useful in controlling sibilance, and two bass roll-off switches, which increase your choices on the bottom.

### Comparison session

After being impressed by the power and clarity of the RE-27N/D, I called Jackson Whitt, production director of

over the Sennheiser 421. In addition to having a higher output, its hum-bucking coil, steel case and screen keep stray electromagnetic fields from being amplified by the mic circuit.

I ran into this problem while using the 421 near my digital audio workstation. The 421 picked up an amazing amount of hum from the field generated by the video monitor of the workstation. While I found that placing the 421 directly in front of the monitor lessened the hum, it put the mic in an inconvenient position.

Although the RE-27N/D still picked up a little of the hum, it was substantially less, allowing me to position the microphone pretty much wherever I wanted.

At a list price of \$625, the RE-27N/D isn't the cheapest dynamic on the market, but it's a lot less expensive than the premium condenser mics like the Neumann U87, U89, TLM170 and AKG 414, all of which require some EQ and/or a healthy working distance.

For information, call Rick Sanchez at Vega at 818-442-0782.

■ ■ ■

Ty Ford can be reached at 301-889-6201.

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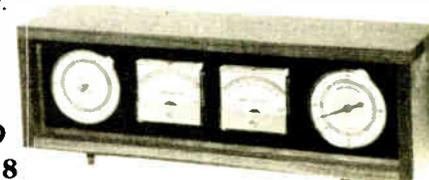
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# WORKBENCH

## How to Hear an LED

by John Bisset

**FALLS CHURCH, Va.** Most stations that operate by remote control have status LEDs that are really important—smoke alarms, high VSWR, intrusion or temperature sensors—all indicators that usually trigger one of the status LEDs on the remote control.

Unless the operator "hears" a problem, however, the status indicators can go unnoticed. Getting the operator to look at the indicators can be a real challenge. One solution is to flash the LED. In most cases, this calls for installing some kind of stable circuit that will alternately open and close a status channel contact when triggered, and thus cause the status LED to blink.

Dan Ryson, CE of WJFK in Washington, came up with a cheaper and faster solution as we discussed this problem recently—replace the LED with one of the self-blinking types sold by Radio Shack.

Such simplicity. Granted, a 555 will also do the trick, but by the time you've breadboarded the circuit and put it in some kind of enclosure (no fair hanging it on the back of the remote control barrier strips), you're talking a serious investment in time. Dan's idea eliminates the additional circuitry at the transmitter site and you can't beat the price. Dan can be reached at 703-691-1900.

★★★

Special effects boxes are finding their way into practically every production studio. As prices keep dropping, few stations can do without them. The cheaper units do make some compromises, how-

brought into the stereo mike preamp. The preamp was strapped to give two mono mic outputs. One preamp output (labeled Raw Mic) was fed into the "A"



Figure 2—For too many years, engineers have bent and deformed spade lugs to get them to fit binding posts (inset). Now Kimber Kable has developed a lug designed specifically for the five-way binding post.

input on the mic channel module.

The second mono mic output from the preamp was routed to the input of the special effects box. The output from this box was run into the "B" input on the mic channel module and labeled "Effects."

Now, when the talent wants pure "unprocessed" mic, input "A" is selected. If the special effects box is desired, input "B" on the same module is selected. Patch bays, switching panels and the like can be eliminated; and the selection of special effects is as simple as pushing a button.

★★★

Most of us have either deformed the fork of a spade lug or cut one of the forks off (see inset, Figure 2) in order to get the lug to fit onto one of those five-way binding posts. We probably lie awake at night wondering how good a connection we made. Well, Kimber Kable announces a new patent-pending connector called PostMaster.

Shown in Figure 2, this spade-like crimp terminal has radial ridges to intensify contact pressure. A compressible spring wafer damps vibration, if the post is on a speaker.

Two sizes are available. Kimber Kable is located in Ogden, Utah. If you'd like information on the PostMaster terminals, circle Reader Service 144.

Next to getting spade lugs to fit on binding posts, perhaps the most frustrating chore is trying to drill a hole through copper strap. A nail will work, but it leaves jagged edges. The drill idea is OK if you are careful.

If not, you'll find your hand cut and your drill wrapped in a tight spiral of copper. The solution is a metal punch set; but who has \$50 to \$75 to spend on something used so infrequently?

Dave Garner, CE for WTOP/WASH in Washington, D.C., recently showed me

the "Under \$20 Solution." It came from a company called Harbor Freight. This is a discount mail order tool company, which offers, among other things, its part number 1105 "Hole Punch Kit" (see Figure 3).

The cast tool comes with a variety of punches and seats to neatly punch holes in copper strap or thin gauge aluminum. To either order the punch set or get a free catalog, call Harbor Freight toll free at 800-423-2567.

★★★

If you maintain a remote vehicle with a collapsible mast, you are probably familiar with the Nycoil when the Nycoil is formed into such a tight spiral that snaking the cables through is impossible.

A fishtape isn't much help either, with the Nycoil in this tight spiral. A solution was offered by WHBO/WNLT CE Ben Umberger. All that is needed is a long

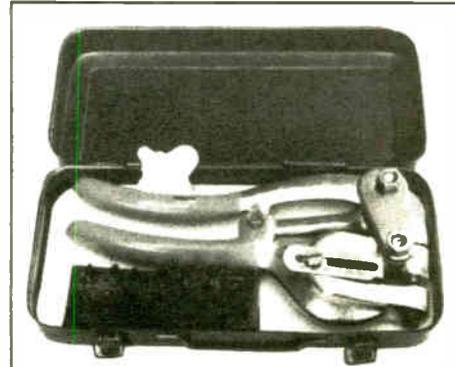


Figure 3—This reasonably priced (under \$20) hole punch kit makes routing and securing copper ground strap a breeze.

fence. With a helper, one end of the Nycoil is wire-tied to the fence. The Nycoil is gently stretched out straight, anchoring the straightened lengths every six to 10 inches to the fence with additional wire ties.

When you are done, the Nycoil has been stretched horizontally along the length of the fence, your helper has ensured there are no kinks and you are free to snake your cables. Ben Umberger can be reached at WHBO/WNLT in Tampa, Fla. His number is 813-446-0957.

■■■

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

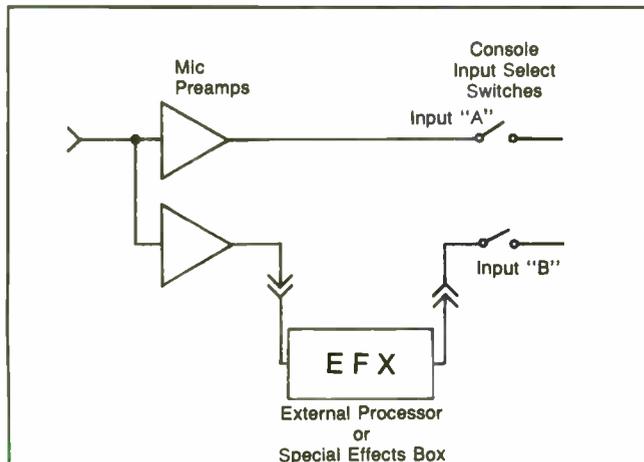


Figure 1—Strapping the console mic preamp to give two mono outputs permits routing one mic feed directly to the processor or special effects box.

ever, such as switches that do several things, such as choosing an effect and bypassing the unit.

In some cases, the "bypass" isn't really a "bypass the input to the output." The result can be some interesting and irritating effects on what is supposed to be a clean unprocessed mic when operated in the "bypass" mode.

There are several solutions—patch bays, switches, etc.—to make sure the effects box is really out of the circuit. However, in today's facility, with the growing lack of technical knowledge among air staff, keeping it simple may be the best strategy.

Figure 1 offers such a suggestion. Using a Wheatstone console, the mic was

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# Looking for a Place in the Band

## American Digital and Mercury Digital Prepare Models of In-Band Proposals

by Steve Crowley

**WASHINGTON** We end our overview of the six announced in-band DAB systems with a look at proposals of American Digital Radio and Mercury Digital Communications.

American Digital Radio (ADR), in Haddon Heights, N.J., is developing ADR

2000™, a DAB system that combines frequency diversity, space diversity and data coding to mitigate multipath.

The extent of frequency diversity employed by the system—obtained by using unused channels between FM stations in each market—is a distinguishing feature of this in-band system. ADR 2000 would combine

three to five programs at each transmitter and operate within the FM band.

Under ADR's conversion plan, several pioneer stations would be constructed in each major market with more stations making the digital conversion as digital receiver penetration increased. In smaller markets, all AM and FM stations could make the digital conversion immediately.

Other features of ADR 2000 are low transmitter power, mul-

tipl main and booster transmitters to optimize service and in-

## CONSULTANTS CORNER

telligent radios that can be programmed by format. ADR also intends to provide digital broadcasters with overhead data capacity for ancillary data services.

The principals of ADR are Ed-

ward Schober, Bill Spurlin and Peter Moncure.

Schober is a registered professional engineer and consulting engineer who has conducted research and published papers on multipath and other areas of broadcast engineering.

Spurlin is a technical manager at the Christian Science Monitor, and has extensive experience with audio source coding techniques. Bill conducted some of the original DAB experiments (using wideband PCM) at WGBX-TV in Boston a few years ago.

### Primarily his work

Moncure is president of Radiosoftware, a software development company. The allocations software ADR had on display at Radio 1991 was primarily his work.

ADR hopes to have an on-air demonstration at the 1992 NAB

**In smaller markets, all AM and FM stations could make the digital conversion immediately.**

convention. Regarding ultimate costs to the consumer, ADR predicts that after an initial price of \$1,000, DAB receiver prices will be comparable with AM/FM stereo receivers.

Mercury Digital Communications (MDC) of Monterey, Calif., includes as principals Dr. Paul Moose, Dr. John Wozencraft and Tom Duffy. Moose and Wozencraft are renowned communication system researchers.

The MDC system is designed to operate in FM channels adjacent to those of existing stations. The design is expected to allow low-power VHF transmission of 256 kilobit per second (kbps) data for CD-quality audio, plus six 16 kbps subcarriers—all in a single 200 kHz wide channel.

### Modulation techniques

Sending all this data in such a small bandwidth requires special modulation techniques. Those techniques include special coding for the data and multi-frequency modulation (MFM). MFM transmits a large number of radio frequencies very close to each other, yet without interfrequency interference.

By splitting the data up on so many frequencies, the data rate for each frequency is low—so low that the length of time a piece of data is on a carrier can be longer than the spread of

(continued on page 31)

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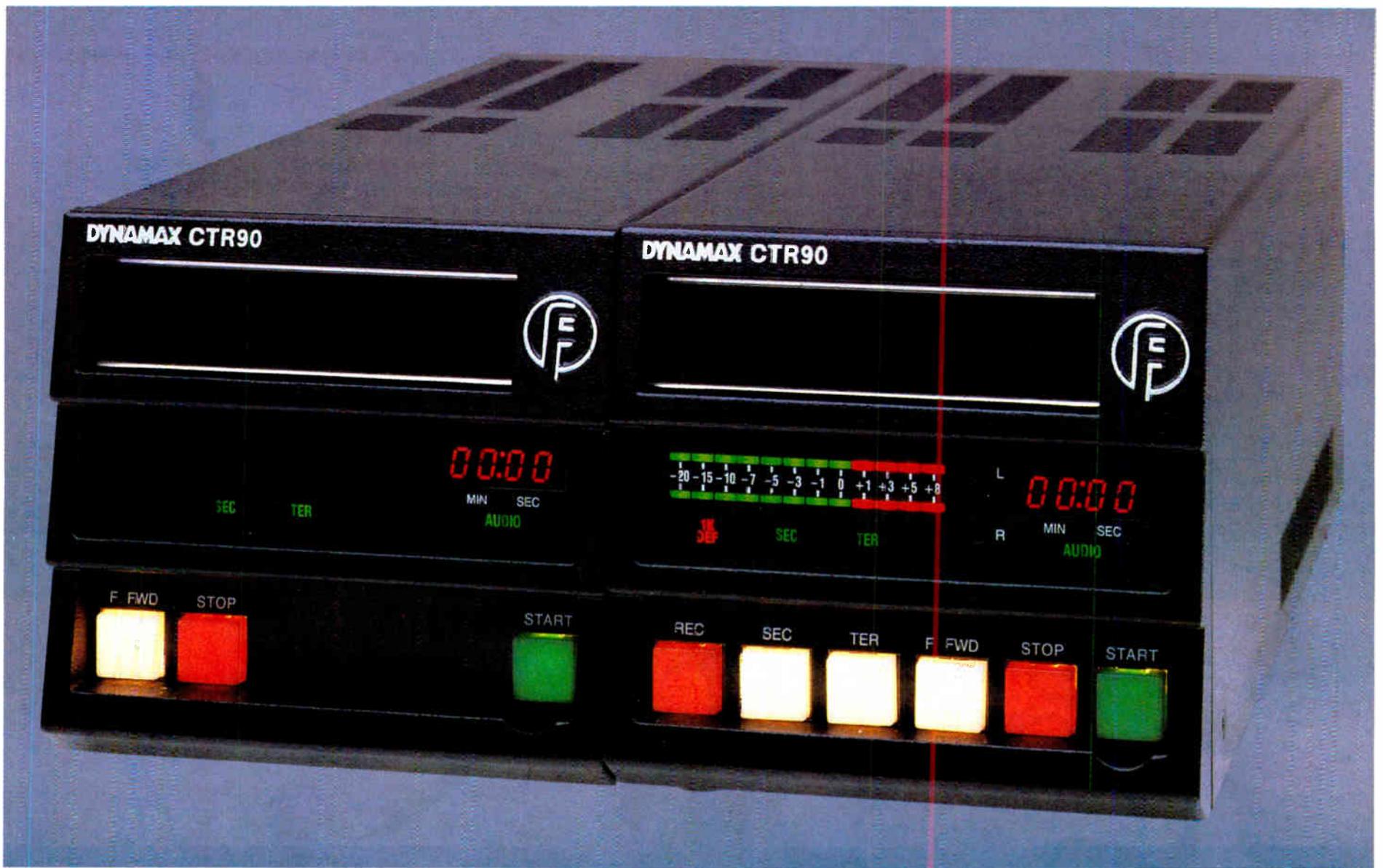
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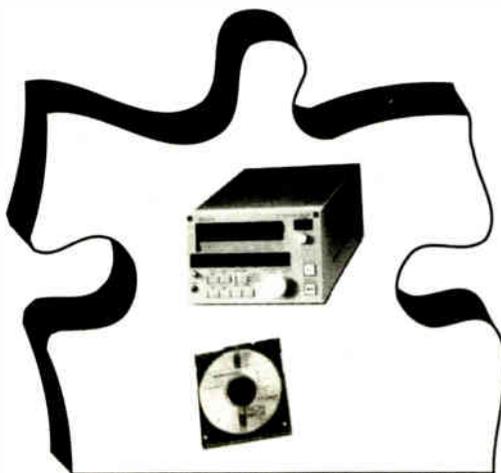
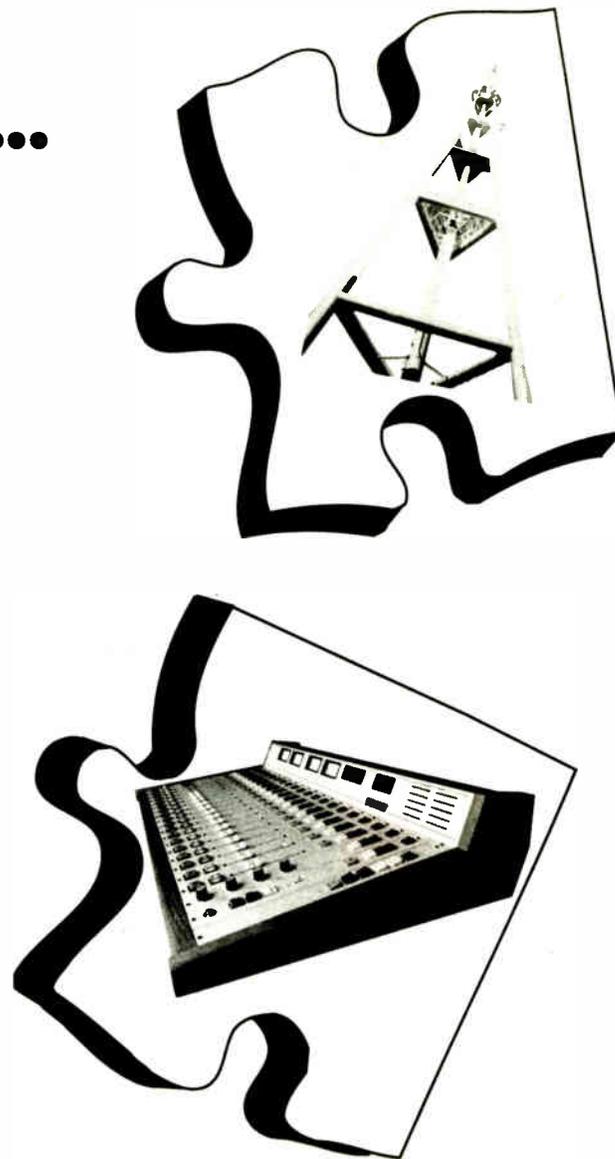
-81 dB, "A" Weighted, referenced to 250 nWb/m, with DNR active. -70 dB, "A" Weighted, referenced to 250 nWb/m, with DNR inactive.

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# The Power of Word Processing

## From Clay Tablets to Pencils to Word Processors Making the Most of Today's Newest Technology

by Barry Mishkind

**TUCSON, Ariz.** In early days, man used clay tablets to record history, family lines, tax records and local gossip. In the pursuit of better ways to record such information, society has seen the invention of paper and books; pencils, pens and ink; and printing presses and moveable type.

Perhaps the greatest invention, however, was attached to pencils, in recognition of our imperfection: the eraser. Just think what life would be like without an eraser. (Or Wite-Out™, for that matter.)

Those conditions might be too horrible to contemplate. Whole forests wiped out as each mistake would waste a sheet of paper. Secretaries would spend all day typing one letter. Some of us would become unintelligible.

### Eliminated the typewriter

And if the eraser was the key invention, the highest application of the eraser must be in the word processor. Although the makers of Wite-Out need not de-

## KEYBOARD CONNECTION

spair, because government forms will exist for a long time, today's computer-based word processors have eliminated the typewriter in many offices.

The productivity gains are truly amazing. Not only can words and thoughts be rearranged rapidly, but correcting spelling or grammatical errors is much easier when built-in checkers come to your aid.

Best of all, even if you find a misspelled word *after* printing out the page, it takes just a few seconds to fix it and print it again. That's a far cry from hav-

## A Place in The Band

(continued from page 28)

propagation delays of interfering multipath. The receiver then has enough time to make a decision as to what a particular piece of data is.

To overcome signal fading, Mercury Digital takes advantage of data interleaving, coding and receiver movement. If all the data is lost for an instant, perhaps when driving under a bridge, that missing data can be spread out and interleaved with known data. The effect of the lost data will be less noticeable and, if enough data get through, will not be noticeable at all due to the error correcting circuitry in the receiver.

■ ■ ■

Steve Crowley is a consulting engineer with the firm of du Treil, Lundin & Rackley in Washington. He can be reached at 202-223-6700; or by fax at 202-466-2042.

ing to manually type the entire document all over again.

If that were all you could do with computers and word processors, it still would be a bargain in terms of convenience and productivity. But, just consider all the offshoots that have appeared in the past several years.

### Tapping computer power

All but the most basic word processors give you the ability to instantly

## Not only can words and thoughts be rearranged rapidly, but correcting spelling or grammatical errors is much easier when built-in checkers come to your aid.

customize any form or document for any client or turn your computer and printer into a desktop publishing center. It may be as simple as personalizing a sales letter or as complex as producing a custom sales brochure, complete with the logo of your prospective client.

Indeed, as you look into the wide array of software programs and hardware options, you may find that much of what you send out to the printer can be done quicker, better and cheaper right at the station (using "desktop publishing," as it's come to be known).

Over the next few months, we plan to look at several of the more popular word processors, from the industry-leading Word Perfect™ to Microsoft Word for Windows™ to inexpensive but powerful programs like PC Write™. While these may be powerful enough for all that you want to accomplish, we'll also look at some of the other options that allow you to make distinctive letters and sales brochures, as well as internal communications.

For example, many of you have modems on your computers and know about the information that can be accessed that way. But, what about the fax/modems we discussed last time? Faxes have become a fact of life in business today. Fax/modems are a convenient means to use the incoming information in the best ways.

Scanners, both the page scanner and the hand scanner types, are another input device that will allow you to import information, logos and other drawings directly into your documents. Coupled with a good optical character recognition (OCR) program, a scanner can reduce the amount of retyping that has to be done.

### Info at the press of a button

Other new technology in desktop publishing is CD-ROM and CD-ROM readers. CD-ROMs look like music CDs (some even have music on them), but contain digitally stored programs and pictures.

The capability of CD-ROMs to give you flexible tools to work with while

not filling up your hard drive is astounding. One CD-ROM can hold up to 680 megabytes of files. To illustrate: The CorelDraw!™ CD-ROM in my machine at this moment has well over 4,000 clip art images that can be dropped into any document—this in addition to the program itself.

Naturally, the content of your documents and in-house research is also of concern. And some of the other resources we'll look at include an entire encyclopedia on one CD-ROM, complete with a search program to find the references you need for a news report or a talk show.

isn't the whole game. To really exploit the power of your computer, you need to get it back out. That means a good printer.

### Dot matrix

A good printer, by the way, is not always a laser printer. For many uses, a dot matrix works perfectly and is much cheaper than the three to five cents a page the laser printer typically costs to produce. An inexpensive nine-pin printer might be just right for logs and billing, while a 24-pin dot matrix can produce letter-quality output.

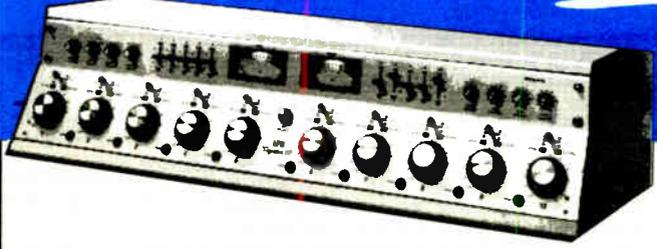
Of course, many offices are moving from dot matrix to laser printers. While the newer 24-pin printers do very well, a letter or presentation prepared on a laser printer has a quality look and feel all its own.

As we look at these areas over the next few months, I welcome your input and experiences—what has worked for you and what you have found useless. Just call or drop me a line via computer, or at 2033 S. Augusta Place, Tucson, 85710. Thanks.

■ ■ ■

Barry Mishkind, aka RW's "Eclectic Engineer," is a consultant in Tucson, Ariz. He can be reached at 602-296-3797, or 1:300/11 on FidoNet, or "barry@coyote.datalog.com" on Internet.

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## AMPLIFIERS

### Want to Sell

**WE 16575-L1 (2)**, made by McIntosh Lab, grt shape, rack mount, \$200; Audionics 0.3, 100 Wchnl, rack mount, silver & black, excel cond, \$125; Sherwood AD260 100 Wchnl integrated amp, black & gold, new in box w/manual, \$115. R Glenn, WJGR, 1718 Shannoa, Wimauma FL 33598. 813-634-1940.

**Langevin AM138G tube amp**, \$150; (2) AM2138 amp, \$125 ea; Altec 1568 tube amp, \$200; RCA BA-33A, \$75; BA-74C, \$100. M Heleak, Milwaukee Sound, 610 N Water St, Milwaukee WI 53202. 414-272-7085.

**Perma Power S-102 amp** w/S1420 batt holder, mobile/portable PA unit, 12 W out, SS, excel cond, \$100; Altec 1591A compressor amp w/15095 & 1578A matching xformers, all SS, mint cond, \$125. R Sumner, CAJU Corp, 3322 Applegate Ct, Annandale VA 22003. 703-560-0233.

**Carvin FET900 200 Wchnl stereo pwr amp**, fan cooled w/variable compressor, subsonic filter, ultrasonic filter, bridge switch, 3 space, 10" deep, 35 lbs, as new cond, \$400. B Fisher, KPOK, Box 477, Bowman ND 58623. 701-523-3883.

**Quad/English 50E 50 W mono amp**, near new cond w/wide range of output impedances, w/manuals, cords, etc, \$500 pair/BO/trade, shipping xtra. J Thornton, Maple Island Music, 703 12 E Minnesota Ave, Glenwood MN 56334.

**Crown D60 stereo amp**, vgc, \$200. L LeBlanc, WKXL, 603-225-5521.

**Marti PGM-20 line amp**, \$40. P Wells, KJOY San Diego, 619-238-1037. FAX: 619-238-6157.

**Henry Eng INF-Pro/Pro-Inf interface amp**, never used, \$85. J Lee, JL Prod, 208 Hampton Circle, Jupiter FL 33458. 407-575-1828.

**Crown Micro-tech 1200**, 2 rack stereo power amp, 320 watts per chnl at 8 ohms, 495 watts per chnl at 4 ohms, excel cond w/balance of 3 yr transferrable warranty remaining. B Fisher, KPOK, POB 477, Bowman ND 58623. 701-523-3883.

**McIntosh MC2500**, black, factory sealed, \$3975; (2) MC240, \$1175 ea; (3) MC40, (2) MC-225, \$575 ea; (2) Krell Altair w/outboard pwr supply, \$3375 ea; (2) Spectral DMA50, \$1475 ea; Spectral SMA100 Mk II, \$2975; Threshold S500, vry sim to S550E, \$2475/BO/trade. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 213-859-5543.

**McIntosh MA-320 preamp & amp w/7591** output tubes, wrking cond, cracked glass, \$225/trade; Leak Point 1 stereo vacuum tube preamp, classic English sound, \$125/trade. J McLane, Oddeo Eng, 115 W Gutierrez, Santa Barbara CA 93101. 805-963-3941.

**Heath W-7A tube pwr amp (2)**, vgc & excel cond, \$150/pair+shipping; Scott 121-C mono hi-fi preamp, mint cond, minor input mod for stereo cartridge, \$75+shipping. B Leslie, Pro Rcrding Service, 13709 Maple Leaf Dr, Cleveland OH 44125. 216-662-1435.

**Altec 361 & 1593A**, need fuse holders, \$100 both/BO. M Muderick, 101 Earlington Rd, Haver-town PA 19083. 215-449-6970.

**Dynakit PASII pre-amp, new & used cable w/Canons 3 prong; manuals for Ampex 351/350/601 & mixer MX-35; Pultec EQP1A; Univox headsets, new, stereo or mono guitar; monitor panel for 8 trk recorder through speakers to stepdown to 2 trk, or whatever. Mr. Oliver, 212-874-7660.**

**RCA BA-21A mic tube pre amps (9)** w/connectors & racks; (2) RCA BX-21A tube pwr supply's w/connectors & racks; (6) RCA tube program amp BA-23A; (2) RCA tube pwr amp SA-354; (3) RCA tube pwr amp SA-751; Altec A-326; (6) Altec 1564A; (3) Altec 1567A; (8) Altec 1561A; Altec tone pre amp 1562A; Altec 1520A; Dynaco stereo 70, mint. Tracy Eaves, 615-821-6099 (evenings before 10PM EST).

### Want to Buy

**Mono feedback amp** for cutting vinyl records, must work on Gramphin cutter head. H Sewell, Oakridge Music Rcrding, 2001 Elton Rd, Ft Worth TX 76117. 817-838-8001.

**Westrex RA-1474 line amp modules**. J Roberts, ENCORE, Box 19302, Alexandria VA 22320. 703-683-2955.

**Harmon, Kardon, Marantz, Dynaco tube hi-fi gear**, working or not. R Glenn, WJGR, 1718 Shannoa, Wimauma FL 33598. 813-634-1940.

**Denon POA8000 (2)**; Sansui B2301, BA5000, C2301; Marantz x-overs; Crown DL2 phono module; Burwen TNE7000; Hartfields. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 213-859-5543.

**Langevin AM-101 series pwr amp (tube)** schematic & data. B Leslie, Pro Rcrding Service, 13709 Maple Leaf Dr, Cleveland OH 44125. 216-662-1435.

## ANTENNAS & TOWERS

### Want to Sell

**Cablewave FLC-7850J solid conductor AM line**, 100', 78", BO. B Graham, WYMK/WEMR, RR#3 Box 1460, Tunkhannock PA 18657. 717-836-1460.

**Andrew ADF7-80A 1-5/8" foam dielectric xmission line**, 197', \$6/ft. S King, KATP-FM, I-40 W, Amarillo TX 79110. 806-355-9777.

**Andrew 194' antenna**, 1-5/8" semi flex w/connectors, you ship, BO. J Harper, KQMC-FM, Box 44, Brinkley AR 72021. 501-734-1570.

**Celwave 6-bay FM**, 10,000 W bay, 105.1 MHz, \$4000. R Murphy, 602-855-1051.

**EZ Way 350', 16" face at bottom, 12" at top**, all lights, you disassemble & move, BO. C Jones, WQBS, 2525 Dio Nona Ave, Macon GA 31206. 912-781-1063.

**Jampro JHPC 5 bay antenna**, tuned for 104.3 MHz, unused, \$6000 FOB. D Peluso, KJUL FM, 2880 E Flamingo Rd Ste E, Las Vegas NV 89121. 702-732-2200.

**Beam antenna (2)**, 160 MHz. T Noordyk, 616-924-4700.

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**Redco Audio (203) 256-0532**  
917 Post Road, Fairfield, CT 06430

**PI-Rod 320' solid steel twr & lights**, 24" face, new in '82, you take down & haul, \$3000. C Jennings, WQLA, Box 1530, LaFollette TN 37766. 615-566-1000.

**ERI/Harris FMXL-3E 3-bay FM antenna**, rototiller style, on air at 93.5, w/15588 pwr gain, 1-5/8" end input, you ship, \$4000/BO. S Mattingly, WWWO, 5216 Bradburn Dr, Muncie IN 47304. 317-289-9500.

**Potomac AM-19 (204) 3-trw AM antenna mon**, excel cond, \$850. J Salov, SHGR/WJUPS, 517-740-1165.

**Rohn 80, 41" face w/guys & lighting**, BO. O Eatmon, Mega Comm, 19 W Hargett St, Raleigh NC 27601. 919-990-1906.

**Utility 340, 300' of 18" tower** near Enid OK, \$5000. Brian, WWNH, 603-742-8575.

**Kintronics AM-3 twr phaser w/3** weatherproof tuning units & mainiaux switch, all new, never used, \$8000. J Salov, SHGR/WJUPS, 517-740-1165.

**Dielectric 6-1/8" xmission line**, rigid copper, 75 ohm w/EIA flanges, (25) pieces of 20' line on grid now, BO by 10/15. FAX: 419-229-7091.

**Solid dielectric coax**, 200', 1-5/8"; also, 3-bay CP antenna, tuned to 93.9; negotiable. D Jordan, WDTM Inc, POB 3417, Jackson TN 38303. 901-668-1153.

**Andrew HJ8-50B 3" Helix air dielectric xmission line**, 350', w/gas pass connector & gas barrier connector installed, slight leak may be traced to faulty connector O-rings, call for details, BO. K Eiler, KWED, 609 E Court St, Seguin TX 78155. 512-379-2234.

**Phelps-Dodge CFM-LP4 4-bay circ FM antenna** on 95.9 MHz, gd cond, \$1500. J Ingram, WBLE, Box 73, Batesville MS 38606. 601-563-4664.

**Phelps-Dodge FMHP-8 8-bay on 93.3 MHz**. C Springer, KSEC, Box 890, Lamar CO 81052. 719-336-2206.

**Used galvanized towers on ground in West Texas**, 450', 365', 210', 110', 40-52" faces, all with torque arms, lights, etc. 915-685-3000 or FAX 915-685-0101.

### Want to Buy

**High pwr FM antenna**, 10 bay, 94.7. T Noordyk, 616-924-4700.

**Circular 6-7 bay, lw pwr** tuned to 103.3 MHz. R Murphy, 602-855-1051.

**Grid dishes**, 6', 8' & 10' for 950 MHz STL systems, reasonably priced; (6) pieces 7/8 helix in at least 300' lengths w/connectors, reasonably priced. K Austin, Austin Brdcst, 1101 Hwy 81 N, Marlow OK 73055. 405-658-3330.

**FM CP antenna**, 10/12 bay, on/near 98.5 MHz; also, 500' of 1-5/8 or 3-1/8 coax, must be gd cond; 450' of 24" tower, w/light kit, prefer on ground but will consider take down. Brian, WWNH, 603-742-8575.

**UHF TV brdcst/translator antennas on old chnl** 70-83 band; Scala parapannels, any chnl; Scala SL-8 chnls 19-23, 32-36, 60-64; Bogner B series, chnls 20-30, 31-42, 55-69; Bogner LPS 1, 2 & 4; Thomas UHF panels, any chnl; Emcee DGA-10 corner reflectors. J Powley, WJIM TV, 1536 Logan Ave, Altoona PA 16602. 814-944-8571.

**Circular FM med pwr 8-bay antenna on 107.5 MHz**; also, 350' tower on ground w/lights. J Ingram, WBLE, Box 73, Batesville MS 38606. 601-563-4664.

## AUDIO PRODUCTION

### Want to Sell

**Lang PEG-2 EQ**, \$500; Orban 672A, \$500; Gates Sta-Level, \$300; dbx 160, \$350; dbx 166, \$350; Yamaha GC2020 2-chnl compressor, \$150; Yamaha R1000 dig reverb, \$125. M Heleak, Milwaukee Sound, 610 N Water St, Milwaukee WI 53202. 414-272-7085.

**Radio Design Labs pods** to make (2) control boards, modular design, new, unused, request list, \$10,000 all FOB. D Peluso, KJUL-FM, 2880 E Flamingo Rd #E, Las Vegas NV 89121. 702-732-2200.

**Universal Audio 175 tube limiting amp**, vgc, \$600; dbx K-9-22 card for Dolby A-360 main-frame (2), BO. J Guilbeaue, Deer Tree Grp, 2165 E Clairborne St, Springfield MO 65804. 417-883-0120.

**Digital LED up timer (5)**, 2", resets to 0 when 9:59 is reached or momentary closure made, self-pwrd, \$57.50 ea, prepaid UPS. D Peluso, KJUL FM, 2880 E Flamingo Rd Ste E, Las Vegas NV 89121. 702-732-2200.

**Yamaha SPX-90 Series II digital audio effects processor**, vgc, \$285+shipping. B DeFelice, DeFelice Prod, 93-2R Fowler St, New Haven CT 06515. 203-397-2595.

**Auto answering circuit box**, home made, & Sparta mono PB tape deck used to provide weather forecasts on dedicated phone #, \$350/BO. B Williams, KPSM, 2009 W Gary, Broken Arrow OK 74012. 918-455-9522.

**Orban 245E stereo synthesizer**, gd cond; Ibanez AD202 analog delay output processor. C Freinwald, KBSG, Seattle. 206-343-9700.

**Howe 2100 Phase Chaser wall connectors & manual**, \$550. S Schweiger, WXLO-FM, 146 Worcester Cir, Worcester MA 01608.

**Universal Audio 1008 tube mic preamps**, \$200 ea; Langevin AM-16 mic preamps, \$150 ea; AP-SI 559 graphic EQ, \$300 ea. M Linett, Yr Place or Mine, 1600 Las Flores Dr, Colendale CA 91207. 818-244-1909.

**Orban 536A 2-chnl de-esser**, excel cond, \$225+shipping; Crown UFX stereo crossover, \$75+shipping. B Seifried, Eclair Eng, 101 Prospect St, Northampton MA 01060. 413-584-6767.

**Aphex Type C single rack space aural exciter**, stereo unit w/unbalanced TRS & RCA connections, owners manual, excel cond, BO. B Fisher, KPOK, POB 477, Bowman ND 58623. 701-523-3883.

**Eventide 1745M digital delay line (2)**, need work, \$200. S Russell, 60410 Klerr Dr, Decatur MI 49045. 616-782-9258.

**Tapco EX18 active x-over**, 3-way mono, 2-way stereo, new, \$150. E Davison, 135 N Illinois, Springfield IL 62702. 217-787-0800.

### Want to Buy

**Yamaha/Eventide harmonizer/effects unit**. T Noordyk, 616-924-4700.

**Ham radio operators** looking for surplus audio processors, mixers & mics, as well as other inexpensive gear that could help bdc engrs play radio at home among enthusiasts for vintage AM. Please write w/offerings. WA3VJR, Box 73, West Friendship MD 21794-0073.

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## AUTOMATION EQUIP

### Want to Sell

**IGM Rampart Satellite System**, brain, controller cards, 72-tray Go-Cart, 48-tray Instacart, Carousel Plus/parts, SMN controller & clock system, complete manual set, mono but capable of stereo, in service & working, \$6500/BO. M Johnson, 2745 Alexander Ln, NE Albany OR 97321. 503-926-3994.

**Harris System 9000**, complete w/all assoc equip incl (4) Otari PB, (2) Go-Cart Carousel, data terminal, keyboard, printer, gd wrking cond, \$7000/BO. R Cressman, WJMA, POB 271, Orange VA 22960. 703-672-1000.

**Tone detectors from diff mfrs (8)**, 25 Hz, some spare units for parts, \$50 ea/trade all. S Callahan, WCEG, 1120 Pinellas Bayway, St Pete FL 33713. 813-821-9549.

**Schafer 903E**, complete in fair cond, (3) wrking Audiocfiles, (3) Audiocfiles need repair, keyboard, RAS cards updated, new PS battery, \$5000, you haul/pay shipping. M Hoffman, KNCK/KCKS, RRI W 11th, Concord KS 66901. 913-243-1414.

**Otari ARS-1000 R-R tape transport (2)**, \$675 ea. S King, KATP-FM, I-40 W, Amarillo TX 79110. 806-355-9777.

**SMC system**, (4) 350 RSB mono Carousel, (2) double cart transport, PDC-5 clock, DS-20 switcher, DP-2 programmer & racks, will part out, BO. D Blankenship, WTKT AM/FM, 2600 Iron Works Rd, Georgetown KY 40324. 502-863-1580.

**Otari ARS-1000DC (4)**, PB only w/brackets, tone sensor & auto rewind, excel cond, \$900 ea. B Christie, Grande Radio, POB 907, LaGrande OR 97850. 503-963-4121.

**SMC TS-25 tone sensor**, new, w/spare chips & manual, \$300/BO/trade; Gates FA-25 25 Hz tone filter, passive, gd cond, no manual, \$100/BO/trade. D Willey, Life Brdcstg, POB 96, John Day OR 97845. 503-575-1840.

**Harris 9000 w/R-R**, 48-tray Go-Cart, (2) 24-tray Go-Cart, (6) other source cards, spare boards, you ship, \$2600. G Faltus, WZMX, 100 Executive Dr, Farmington CT 06032. 203-677-6700.

**Complete automation pkg**: BA1 brain, (3) Otari reels, (3) Carousels, single play, all new or rebuilt, w/music, used less than 3 yrs on Sundays only, \$12,500 incl shipping. J Alsip, KSCC, Box 1528, Silver City NM 88062. 505-538-3396.

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**Instacart (2)**, 48-hole, '84, w/Sentry IBM compatible firing system; also, a R-R, Dale, 503-774-0459.

**Broadcast Auto 2501-G tone gen (2)**, need little work, \$30. P Barzizza, KJBR, 603 Madison, Jonesboro AR 72401. 501-935-5598.

**Shaffer 903 brain, keyboard & (4) Shaffer R-R**, xtra source cards for carts, etc, w/manuals, wrking when removed, BO. P Delaney, WOSK, Box 921, Marshfield WI 54497. 507-895-2065.

**SMC automation system**: SSP 3060 stepper, AS-10 switcher, (2) SMC 250 Carousels, SMC 350 Carousel, (3) RSC-50 50-step random access controllers for Carousels, (2) SMC 700 series sngl P cart machines, SMC 700 series R/RP cart machine, (2) system real time clocks, plus much more, all equip listed is stereo, wiring harnesses & manuals incl, \$7000/BO. B Williams, KPSM, 2009 W Gary, Broken Arrow OK 74012. 918-455-9522.

**SMC SSP 3060 automation stepper w/AS-10** audio switcher, controls 10 sep sources, \$2000/BO; (2) SMC 250 Carousels, stereo PB, \$350 ea/BO; SMC 350 Carousel, stereo PB, \$475 ea/BO; (3) SMC RSC-50 50-step Carousel controllers, \$200 ea/BO; SMC mounting rack, \$200; all of above for \$1500 incl cabling. B Williams, KPSM, 2009 W Gary, Broken Arrow OK 74012. 918-455-9522.

**ATC Harris SP-10 system**: (3) Scully, (5) Carousel, cart, RA-5, SP-10, gd wrking cond, w/spare RA-5, SP-10 & Carousel, \$2000/complete, will consider selling items separately. G Williamson, WASK, POB 7880, Lafayette IN 47903. 317-447-9504.

**SMC DP-2 (4) Carousels**, (4) reels, DS-20. C Springer, KSEC, Box 890, Lamar CO 81052. 719-336-2206.

**Schafer 903-E (4) racks**, all but R-R equip, gd wrking order, spare parts, manuals, BO. K Browall, KTRZ FM, Box 808, Riverton WY 82501. 307-856-2922.

**SMC 350RS Carousel (4)**, fair cond, \$1000; DP1 & DP2 for parts, \$500; Instacart interface, \$100; Schafer 903 w/Revox input cards, \$1500; (4) Scully R-R, new heads, \$500. D Rose, KAAA-KZZZ, 2534 Hualapla Mtn Rd, Kingman AZ 86401. 602-753-2537.

**Harris System 9000**: event controller for 12 sources, source cards, system computer cards, pwr supply, cables for (4) Otari ARS-1000 stereo reel decks, (4) Carousel 24 cartridge units which may need work, data entry CRT workstation, (2) standard system equip racks, BO. cashiers check, buyer ships. K Eiler, KWED, 609 E Court St, Seguin TX 78155. 512-379-2234.

**SMC 350RS Carousel**, \$400+freight. D Vernier, KUNI, Univ N IA, Cedar Falls IA 50614. 319-273-6400.

**Otari ARS 1000**, in use, tone sensors, 5 yrs old, clean; also, MW Persons Programmer 3A, recently overhauled, \$600; (4) R-R, \$850 ea; \$3700/comp package. B Hickman, WFMF-FM, POB 16928, Hattiesburg MS 39404. 601-545-1063.

**Schafer 903-E Deluxe**, w/Extel logger, (6) Revox I/O cards, (3) ITC/UMOC I/O cards, studio/net I/O card, (2) Audiophile 2-A, (3) blue Schafer racks, manual control panel, spare parts, all manuals, wrking, \$4000. B Kingman, KRLT/KOWL, Box 15460, S Lake Tahoe CA 96151. 916-541-6681.

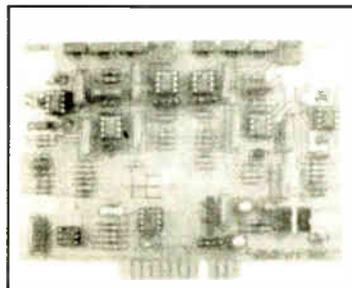
**SMC 250 Carousel (3)**, in rack, \$200+shipping. D Morgan, KNZZ-KJYE, 1366 E Sherwood Dr, Grand Junction CO 81501. 303-241-9230.

**SMC TG-25 25 Hz tone gen**, BO. L Penke, WKTT-FM, POB 26, Cleveland WI 53015. 414-693-3103.

### Want to Buy

**Small automation system** or Carousels in gd cond, note: lw budget. Brian, WWNH, 603-742-8575.

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Modulation Associates mutual network tone decoder cards. T Fernandez, WKXY, 2500 10th St, Sarasota FL 34237. 313-366-4422.

**CAMERAS (VIDEO)**

**Want to Sell**

Hitachi FP-10 industrial color ENG camera w/pwr supply, shotgun mic, road case, manual, \$1800. D Bailey, Rock Shoppe Prod, 3422 Beech St, Rowlett TX 75088. 214-475-9796.

Sony DXC-6000 k/1, high resolution, motorized 10x 11.6 zoom lens, lw light, pro brdct ENG, excel cond, w/case, tripod bracket, cable, battery pack, \$5000. Jaye, Nimbus Prod, POB 5903, Takoma MD 20912. 301-507-3358.

RCA TK-760 studio camera (2), w/lens, CCUs, cables, cases, new tubes, complete, \$3500/pair. C Potorti, Potorti Video, 10005 Lucy, Morrisville PA 19067. 215-945-3990.

JVC KY-2000 3-tube camera w/pwr supply & case, \$800; Hitachi FP-10 1-tube camera w/pwr supply & case, \$500. J Soyk, Soyk Adv, 525 Main, Lewiston ID 83501. 208-746-8134.

**Want to Buy**

Sharp XC-A1 camera control unit & multi-core cable. K Knowles, Knowles Video, POB 12127, Tallahassee FL 32317. 904-878-2298.

**CART MACHINES**

**Want to Sell**

Spotmaster 2000 RPS stereo R/P, needs minor cue tone adjust, \$195. Davis, MCP, POB 521, Newberry SC 29108. 803-276-0639.

ITC SP stereo PB, gd cond, no manual, \$450. S Kowalski, 407-695-5553.

ITC sngl play (5), mint cond; (3) ITC sngl R/P, mint cond; (2) ITC 3-shelf machine; (2) ITC BE-2100 R/P mono; (4) Criterion sngl P, gd cond; (2) ESL bulk splice finder eraser. T Noordyk, 616-924-4700.

Tapecasters incl: X700RPS, gd cond, \$695; X700PS2, gd cond, \$495; 700RP, gd cond, \$450; 700P, \$195. A Ishkanian, 9723 Riggs Rd, Adelphi MD 20733. 301-439-7222.

Sono Mag 352 Carousel (3); (5) Sono Mag 350 Carousel; (2) Audicord 101R cart machine. G Gilbert, CSRG, POB 50539, Denton TX 76206. 817-380-0229.

ITC Delta I stereo (2), in use, w/manual, \$1250 ea. D Donovan, KCGR FM, 1620 American Bank, Corpus Christi TX 76226. 512-888-8555.

Tapecaster X-701 RPS tape cart machine, used less than 1 yr, nearly new, \$650. L LeBlanc, WKXL, 803-225-5521.

ITC R/P-0004 Premium series, stereo, 3 tones, excel cond, gd heads, vly little DSP, \$1600/BO. C Jennings, WQLA, Box 1530, LaFollette TN 37766. 615-566-1000.

SMC 700 series stereo cart PB (2), 3 tones, \$500 ea/BO. B Williams, KPSM, 2009 W Gary, Broken Arrow OK 74012. 918-455-9522.

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ITC SP record amp for use w/SP series cart equip. C Freinwald, KBSG, Seattle. 206-343-9700.

Spotmaster TP1-B cart tape reloading machine w/timer; Spotmaster S-302 3-deck, mono, excel cond; (2) Spotmaster 500C open top mono cartridge recorder. C Freinwald, KBSG, Seattle. 206-343-9700.

Spotmaster 505, (2) R/P, (1) P only, gd cond, \$200 ea; Sparta cart delay, like new, \$500. R Meyer, Benchmark Comm, 4700 SW 75 Ave, Miami FL 33155. 305-264-5963.

ITC 99-B stereo R/P deck w/manual, new, \$3600. Donovan, KSKS, 5265 W Magill, Fresno CA 93722. 209-233-9393.

Collins PB150 & ORK 301, both need repairs, \$50/both. M Muderick, 101 Earlington Rd, Havertown PA 19083. 215-449-6970.

Spotmaster 500 P/B (3), all gd cond, free shipping, \$300/all; (4) Beaucart P/B, (1) needs minor work, (1) for parts, (2) gd cond, \$100 all+shipping. J Deering, Great Com, 114 Walton Ferry Rd SE #8, Hendersonville TN 37075. 615-264-2886.

UMC 11-113 mono repro, 3 tones, \$295; set LEL alignment gauges for Ampro cart decks, \$15. P Wells, KJOY San Diego, 619-238-1037. FAX: 619-238-6157.

ITC SP (2), late model w/3 tones, 99B style head block & improved cart hold down, recently relapped, \$775 ea. P Hess, 134 Deroyent Dr, Pittsburgh PA 15237.

**Want to Buy**

Tapecaster 700 RB & RP, poor-gd cond. A Ishkanian, 9723 Riggs Rd, Adelphi MD 20733. 301-439-7222.

ITC Omega series R/P cart machine, excel cond. K Conlin, WJKC, 449 Caromar Dr, Madison WI 53761. 608-233-6185.

**CASSETTE & REEL-TO-REEL RECORDERS**

**Want to Sell**

Ampex PR-10 stereo rack mounted R-R, w/some spare parts & manual, excel cond, \$250/trade. S Callahan, WCEG, 1120 Pinellas Bayway, St Pete FL 33713. 813-821-9549.

Tascam RC-71 wired 12-pin remote for model 38 & similar equip, \$55. B DeFelice, DeFelice Prod, 93-2R Fowler St, New Haven CT 06515. 203-397-2595.

Tascam Mini Studio Porta II, 4-chnl, like new, wall papers & instructions, \$399. Dan, 206-546-1498.

ITC 750 2-trk stereo rcrdr, metal roll-around cabinet, gd cond; ITC 750 2-trk stereo rcrdr, rack mount, fair cond; ITC 850 2-trk stereo rcrdr, metal roll-around cabinet, gd cond; Tascam A2300S 2-trk stereo rcrdr, wood cabinet, looks gd; MCI JH-140 4-trk 1/2" rcrdr, excel cond, heads recently re-lapped, roll-around cabinet. C Freinwald, KBSG, Seattle. 206-343-9700.

Tascam 38 8-trk R-R, brand new, w/(4) reels Ampex tape, all manuals, in box, new cond, must sell, \$1700. B LeCato, WKRE, POB 220, Exmore VA 22350. 804-442-5000.

Ampex 300, 350, 351, 440 NAB spring-type hold down adapters (6), as new, \$20 ea. M Saady, 1st City Rec, 141-60 84 Rd 3E, Briarwood NY 11435. 718-876-2062.

Ampex AG-440C stereo, fair cond, \$400. G Faltus, WZMX, 100 Executive Dr, Farmington CT 06032. 203-677-6700.

MCI 110B, several; also, 110As, Otari 50/50Bs; all gd wrking cond, plus many spare parts; \$500-1500+shipping. M Shea, Precision, POB 723, NY NY 10276. 212-989-2684.

Otari R-R PB (3). G Gilbert, CSRG, POB 50539, Denton TX 76206. 817-380-0229.

Ampex 601, w/out cover, many spare parts & manual, excel cond, \$150. S Callahan, WCEG, 1120 Pinellas Bayway, St Pete FL 33713. 813-821-9549.

Ampex AG-440 2-trk stereo, console mounted, w/manual & all cables, gd cond, \$750. D Harbour, KISI, 212 S Main, Malvern AR 72104. 501-337-9000.

Revox PR-99 MK II 1/2-trk stereo P (5), \$1200/each FOB. D Peluso, KJUL FM, 2880 E Flamingo Rd Ste E, Las Vegas NV 89121. 702-732-2200.

Telefunken M15A 1/4" stereo in console w/meters, 15/30 NAB, w/manual, \$4000/BO; Otari 5050B rebuilt capstan motor w/PC board, \$125/BO. R Rhodes, Rhodes Music, POB 1550, NY NY 10101. 212-245-5045.

Otari MX-5050, wood cabinet, manuals, wrking when removed, gd cond, \$475 incl shipping. J Alsip, KSCQ, Box 1528, Silver City NM 88062. 505-538-3396.

Teac A-3340S, 4-trk, 4-chnl simul-sync, built into factory travel case, incl wired remote, like new cond, \$850/BO. D Deuth, Audio Prod, 1801 Commerce Blvd, Mound MN 55364. 612-472-1619.

Ampex 351 FT, excel cond, transport w/tube electronics, \$300; w/Inovonics, \$450. L Beigel, On-Cue-Rcrdng. Call/fax: 800-726-9813.

Scully 270 R-R PB only (4), \$300/BO; Scully 270 R-R PB only for parts, \$200/BO; all (5) for \$1200; also, (2) dual 25 Hz tone sensors for above decks, \$200/BO; (2) SMC mounting racks, \$200; buy all for \$1500. B Williams, KPSM, 2009 W Gary, Broken Arrow OK 74012. 918-455-9522.

ITC 770 2-trk PB (4), rack mount, almost new heads, gd cond, BO. P Lierman, KCSP, 601 W Collins Dr, Casper WY 82601. 307-265-5414.

Tascam 40-4, grt shape, BO. S Winthrop, Winthrop Prod, 10 W 94th St, NY NY 10025. 212-662-8685.

Otari MX-5050 QXD 4-trk, mint heads, vgc, \$1500. B Hanson, 314-449-8433.

Metrotech 400 logger w/books & months worth of tapes, gd wrking cond, \$500. M Vanhooser, KSKY, 4144 N Central Exp #266, Dallas TX 75204. 214-827-5759.

Revox A-77 1/4-trk, in walnut case, excel cond, \$500; (2) Tascam 22-2 1/2-trk stereo, 75 & 15 ips, excel cond, \$400 ea. C Jennings, WQLA, Box 1530, LaFollette TN 37766. 615-566-1000.

Ampex AG440 1" 8-trk rcrdr, 10 hrs on relapped heads, excel cond, \$3800. B Seifried, Eclair Eng, 101 Prospect St, Northampton MA 01060. 413-584-6767.

Telex 300 stereo w/master & 5 copiers in 3 cabinets, blowers in ea cabinet for air circ, excel cond, BO. G Kristiansson, Villa Skansen, 122 Fairmount St, S Burlington VT 05401. 802-864-9779.

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SMC 700 series stereo cart R/PB (2), 3 tones, \$650 ea/BO; Sony TC-580 7" 1/4-trk, 7 ips max, ESP auto rev, \$250/BO; Teac 2300-A 7" 1/2-trk, 7 ips max, \$350/BO; Pioneer RT-1050 10" 1/2-trk, 15 ips max, \$500/BO; Pioneer cassette deck, hi-speed dubbing, Dolby B-C, \$75/BO; (3) Otari ARS-1000 R-R PB only, w/tone sensors, \$750/BO; Gates mounting rack, \$200; buy Otari decks & Gates rack for \$2100. B Williams, KPSM, 2009 W Gary, Broken Arrow OK 74012. 918-455-9522.

Tascam 34 1/4" 4-trk rcrdr, \$650/BO. J Lang, PSI, Box 4085, Anchorage AK 99501. 907-333-2221.

MCI JH-110B FT stereo for 14" reels, in metal roll-around cabinet, \$1875/trade for computer, etc. P Wells, KJOY San Diego, 619-238-1037. FAX: 619-238-6157.

Ampex AG-350 in console, \$400; AG-440, \$500; Sony TC-854-4S w/dbx 4-chnl, \$900; Crown SX-701, \$250; Crown 800TX w/4-chnl elec, lots of parts, \$200; Telex 235, (1) master, (1) slave, R-R 2-chnl duplicator, new, \$500. J Krepol, RNDL, 7 Dustin Dr, Wilmington DE 19703. 302-798-4076.

Teac X1000R 1/4-trk R-R, top shape, \$600/BO. J Messenger, KZMX, Box 611, Hot Springs SD 57747. 605-745-3637.

Tascam 112 w/manual, new, \$400. Donovan, KSKS, 5265 W Magill, Fresno CA 93722. 209-233-9393.

Audiotronics AV123-4TS 1/4-trk; Infonics RR-1, 73M, FT; Infonics RR-2, 74M, 2-trk; all gd cond, all/part, \$200 ea. R Meyer, Benchmark Comm, 4700 SW 75 Ave, Miami FL 33155. 305-264-5963.

Magnecord PT-6, (2) stereo, (3) FT mono, amps, cases, parts, manuals, all/part, fair-gd cond, BO; RCA 2" tape transport components, (1) capstan motor, (2) reel motor w/plat-forms, brakes, guides, pinch rollers, gd cond, BO; Shafter logging recorder, 10-1/2 reels, 3/6 ips, 1/4-trk, 2-chnl, gd cond, \$200. R Meyer, Benchmark Comm, 4700 SW 75 Ave, Miami FL 33155. 305-264-5963.

Ampex 440-B R-R in Ruslang cabinet, runs grt, mono, \$325. J Lee, JL Prod, 208 Hampton Circle, Jupiter FL 33458. 407-575-1828.

Studer/Revox HS77 Mk IV FT mono, 10 hrs use, as new, \$975/BO/trade; portable case for A77 w/mon spkrs & pwr amps, excel cond, \$375; Nakamichi 1000ZXL computer-controlled cassette deck, top-of-line, w/RR100 Dolby C, rackmount w/rosewood case, lw hrs, \$1375/BO/trade. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 213-859-5543.

Akai 4-chnl R/PB, 10.5" reels; Pioneer 2-trk R/PB, 10.5" reels, 7.5/15 ips; Revox A-77 R/PB; all gd cond; \$750/all+shipping. J Deering, Great Com, 114 Walton Ferry Rd SE #8, Hendersonville TN 37075. 615-264-2886.

Otari MX 7308 1" 8-trk, 15/30 ips, lw hrs, w/remote, excel cond, \$4500. L Wagner, ARN, 407-299-1299.

Revox PR-99 MK II 1/2-trk stereo P (5), \$1200 ea FOB. D Peluso, KJUL FM, 2880 E Flamingo Rd Ste E, Las Vegas NV 89121. 702-732-2200.

Presto 800 R-R, 7.5/15 ips, mono &/or stereo, perfect cond, \$500. B Rose, Program Rcrdngs, 228 E 10th St, NY NY 10003. 212-674-3060.

Revox A77 1/2-trk stereo, 7.5/15 ips, wood cabinet, carrying case, needs work but gd heads, motors & output elec, \$300. P Paquin, Sound Dynamics Assoc, Box 132, Acushnet MA 02743. 508-763-3447.

Teac 6010 1/4-trk stereo & American Concertone 605-4R 1/4-trk stereo, both need repairs, \$100/both. M Muderick, 101 Earlington Rd, Havertown PA 19083. 215-449-6970.

Ampex 352 (3), w/remote start; (2) 350, (1) OK, (1) for parts; manuals incl; \$50+shipping. D Morgan, KNZZ-KJYE, 1360 E Sherwood Dr, Grand Junction CO 81501. 303-241-9230.

Ampex AG440 w/console, 4-trk record, 2-trk P/B, once in Johnny Cash studio, needs VU meter, \$450+shipping. J Deering, Great Com, 114 Walton Ferry Rd SE #8, Hendersonville TN 37075. 615-264-2886.

Sony TC-42; Superscope C106; Martel UHER 4000L 5" R-R; \$150/BO. M Muderick, 101 Earlington Rd, Havertown PA 19083. 215-449-6970.

**Want to Buy**

Stellavox SP7 stereo; ABR Irg reel adaptor for SP7; Stellavox TD88. R Cummins, 212-219-3670.

Ampex PR-10 manual & schematic. L Johnson, 3928 Red Oak Dr, Doraville GA 30340.

ITC-750 stereo R-R PB, gd wrking order. K Brown, KTRZ FM, Box 808, Riverton WY 82501. 307-856-2922.

Stellavox SP7 stereo; ABR large reel adaptor for SP7; Stellavox TD88. R Cummins, 212-219-3670.

Rheem Califone SS 70-TC in gd wrking order. E Ford, KBPK, 321 E Chapman, Fullerton CA 92634. 714-992-7418.

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

MCI/Sony capstan & reel motors, any cond., recd heads, most mfgs, machines, new, used. Relapped then sold. Amp Services, 224 Datura St No 614, W Palm Beach FL 33401. 800-826-0601, in FL 305-659-4805.

Scully '100' recorders, record/play amplifiers, 8, 16, 24 track heads. Sequoia Electronics, 1131 Virginia Ave, Campbell CA 95008. 408-866-8434.

**CD's**

**Want to Sell**

Studer A727 studio CD player w/balanced XLR outputs, rack mount & complete doc, excel cond, \$1175+shipping. B DeFelice, DeFelice Prod, 93-2R Fowler St, New Haven CT 06515. 203-397-2595.

**COMPUTERS**

**Want to Sell**

IBM Proprinter dot matrix, \$40; Proprinter II for parts, \$15; (4) TAB 132/15 editing terminals, 15" screen, \$25 ea. P Russell, Bowdoin Coll, Sills Hall, Brunswick ME 04011. 207-725-3066.

Apple II+ w/2 disk drives & monitor III; w/Mountain Computer Music system & Alpha Centuri cards, \$50 ea. P Russell, Bowdoin College, Sills Hall, Brunswick ME 04011.

Laser Compact XT, 640K RAM, 10 MHz, 5.25 & 3.5 drives, CGA color mon, DOS, all manuals, like new, \$400. M Martin, 507-454-2918.

**CONSOLES**

**Want to Sell**

Harris Medalist 12, gd cond, recently removed, \$2900. G Faltus, WZMX, 100 Executive Dr, Farmington CT 06032. 203-677-6700.

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**CONSOLES . . . WTS**

Shure M267 mic mixer, vgc, \$250; Shure M268 mic mixer, new, used once, \$150. A Smothers, 803-365-9268.

Shure M67 & M675 mic mixer & prod master, excel cond, \$300. M Saady, 1st City Rec, 141-60 84 Rd 3E, Briarwood NY 11435. 718-876-2062.

Audix MXT1000 8x2 mix down board; Yamaha PM700 12x2x2 PA board; Shure 8x1 rack mount mixer; UREI Cooper time cube delay line & MXR flanger doubler; all BO. J Krepol, RNDL, 7 Dustin Dr, Wilmington DE 19703. 302-798-4076.

Shure SR101 Series 2 portable audio mixer, SS, 8 chnl mixer/preamp w/verb, rack mount in port case, excel cond w/manual, \$395; Collins 212T-1 audio control system, 28 inputs, 2 wrkg chnl out, 2 aux, 2 mon, mint cond w/manual, \$595. R Sumner, CAUV Corp, 3322 Applegate Ct, Annandale VA 22003. 703-560-0233.

Ramsa WR-8210A, 10x4, XLR mic-ins, RCA line-ins, 3-band EQ/chnl, effects I/O, like new, \$995. M Friend, WTJU, 804-924-0885.

RCA 8-chnl stereo, circa '65, SS, wrkg when removed, \$1500/BO. Don, KCKN-KBCQ, POB 670, Roswell NM 88202. 505-622-6450.

LPB Signature II. G Gilbert, CSRG, POB 50539, Denton TX 76206. 817-380-0229.

CCA Ultimate 10 10-chnl dual mono console, \$400+shipping/BO; Ramko DC-5M 5-chnl mono console w/touch control, BO. B Graham, WYMK/WEMR, RR#3 Box 1460, Tunkhannock PA 18657. 717-836-1460.

Sparta AS-10 stereo console, (5) pots control (2) mics & (8) sources, \$300/BO; Gates Stereo Statesman, (5) pots controlling (2) mics & (9) sources, \$650/BO; Realistic battery-operated mixer for remote use, \$15/BO. B Williams, KPSM, 2009 W Gary, Broken Arrow OK 74012. 918-455-9522.

Collins 212, 9 chnl, tube type, mid 60s vintage, complete, will sell cheap. P Delaney, WOSX, Box 921, Marshfield WI 54497. 507-895-2065.

LPB S-12 Signature II series, 5 chnl, stereo, step attenuators, excel cond, vry cin, \$975. C Jennings, WOLA, Box 1530, LaFollette TN 37766. 615-566-1000.

Tascam M-30, 8x4x2x2, gd cond, \$350/BO. J Lang, PSI, Box 4085, Anchorage AK 99501. 907-333-2221.

Micro-Trak 6618 6-chnl stereo, wrkg when removed, \$375 incl shipping. J Alsip, KSCQ, Box 1528, Silver City NM 88062. 505-538-3396.

BE 4S150A 4-chnl, 12 input stereo console, in use 4 months, grt cond, \$1100; (2) BE 8S150A 8-chnl, 16 input stereo consoles, 2 yrs old, gd cond, \$1000 ea; Orban 8100A/ST studio unit, gd cond, w/cards, \$500. R Clemons, 9485 Regency Sq Blvd #93, Jacksonville FL 32225. 904-727-0933.

Peavy 720 7-chnl pwrld mixing board, 120 W/chnl, \$300. P Barzizza, KJBR, 603 Madison, Jonesboro AR 72401. 501-935-5598.

Gates Diplomat w/books, \$500; Ramko DC8M, touch control, w/books, \$1000; both in gd wrkg cond. M Vanhooser, KSKY, 4144 N Central Exp #266, Dallas TX 75204. 214-827-5759.

Micro Trak Sport III remote, great for remote w/dial pad w/manual, \$100. Donovan, KSKS, 5265 W Magill, Fresno CA 93722. 209-233-9393.

Otari MX-5050 Mark III 1/2" 4-trk, compact table top console rcdtr, dynamic braking motion sensing & transport logic, DC servo capstan system, 15/75 ips, excel cond w/road case, \$4250. G Fern, POB 2366, Van Nuys CA 91404. 818-778-6756.

Opamp Labs 2008-4E, 20 inputs, 8 subs, stereo mix out, gd prod board, vry clean, \$3500. L Wagner, ARN, 407-299-1299.

Autogram AC-6 stereo console, never used, mint cond, \$3500/BO. W Blackwelder, 903-581-0606.

Classic British Helios 24/16/24, circ 70s, many updates/models, w/documentation, discrete mic preamps, (9) sep pieces, w/wood rack cab, mahogany desk, \$9500/BO/trade. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 213-859-5543.

Ramsa WR8816 16x4x2 mixing console, lw hrs, like new, \$2950/BO. G Jones, SW Mediacast, 110 Sierra Rd, Kerrville TX 78028. 512-367-4587.

Yamaha PM-700 12x2x2 stage mixer, \$400; Shure 8x1 rack mount audio mixer, \$200; Audix MXT-1000 8x2 recording studio board, \$1400; UREI Cooper Time Cube, vintage, delay line & MXR flanger doubler, \$500/both. J Krepol, RNDL, 7 Dustin Dr, Wilmington DE 19703. 302-798-4076.

Ampro AC6SB 6-chnl control board, stereo/mono, vgc, \$475. J Lee, JL Prod, 208 Hampton Circle, Jupiter FL 33458. 407-575-1828.

Shure SE30 mixer, mic/line inputs, gated compressor, VU meter, gd cond, \$225; Ramko DA6 R/E audio DA 1x6 processing mixer, clean & perfect, \$65. E Davison, 135 N Illinois, Springfield IL 62702. 217-787-0800.

Harris Executive 8-chnl, '81, needs work, fair cond, BO; QRK-CCA Futura 6, slide pots rebuilt to half stereo, xtra parts, \$300. G Erway, KKSJ, POB 40309, Santa Barbara CA 93140. 805-568-1444.

McCurdy SS 8500 custom 10 mixer dual stereo brdct console, excel cond, \$4500. D Vernier, KUNI, Univ N IA, Cedar Falls IA 50614. 319-273-6400.

Collins 808A-1 disco/remote brdct console, (2) TT, \$50+shipping. D Morgan, KNZZ-KJYE, 1360 E Sherwood Dr, Grand Junction CO 81501. 303-241-9230.

**Want to Buy**

RCA BC3, BC5 & 76B2 spare parts. L Scott, POD 1449, Highland City FL 33836. 813-533-4654 eve.

Shalloco stereo pots w/cue. B Arnold, 700 Prod, 105 Dorado Court S, Middle Island NY 11953. 516-924-9020.

Langevin AM4A w/documents. J Gangwer, 942 32nd St, Richmond CA 94804. 415-644-2363.

**DISCO & SOUND EQUIPMENT**

**Want to Sell**

SAE 5000 impulse NR, removes clicks & pops, excel cond, \$125. R Glenn, WJGR, 1718 Shannoa, Wimauma FL 33598. 813-634-1940.

Phase Linear 1000 Series II NR, removes tape hiss, \$150; Burwen DNF 1201-A dynamic noise filter, removes record/tape noise, \$200. D Bailey, Rock Shoppe Prod, 3422 Beech St, Rowlett TX 75088. 214-475-9796.

Peavey 19-10 Flite case (2), 6-space road case w/front & rear removable covers, laminated 3/4" construction w/steel corners & handles, vgc, \$125 ea/BO; Aphex Type C aural exciter, 1-rack-space unit in excel cond, \$150/BO. B Fisher, KPOK, Box 477, Bowman ND 58623. 701-523-3883.

Dyma Engineering Resonator 2 audio reverb, \$50. Don, KCKN-KBCQ, POB 670, Roswell NM 88202. 505-622-6450.

dbx 21 Type II NR decoder, \$25. D Bailey, Rock Shoppe Prod, 3422 Beech St, Rowlett TX 75088. 214-475-9796.

Auratone Super Sound Cubes, trade industry stand sm ref mon, like new, \$75/pair. Davis, MCP, POB 521, Newberry SC 29108. 803-276-0639.

Ramsa WS-A 200 & WS-A 240 portable hi pwr bi-amp PA speaker system w/WS-SP2A subwoofer processor, pair 2-way 12" WS-A200 full-range cabinets & pair 12" WS-A240 subwoofers, as new cond. B Fisher, KPOK, Box 477, Bowman ND 58623. 701-523-3883.

JBL 4312 (2), latest version of L-100, 4311, etc, deluxe studio 3-way mon, new, under warranty, will ship UPS, \$550/pair; Yamaha NS-104 2-way studio mons, pair avail, will ship UPS, \$280/both. C Keith, ALI, POB 313, Keane NH 03431. 603-352-8460.

dbx 150X NR (2), vgc, \$325; Yamaha SPX9011 special effects box, 99 presets, mint, \$500. B Hanson, 314-449-8433.

Roland DEP-3 effects processor, \$225; Yamaha SPX-90, \$275; Roland DEP-5 effects processor, \$275. J Lang, PSI, Box 4085, Anchorage AK 99501. 907-333-2221.

CRL DX2 NR or Symetrix 511A, excel cond; Symetrix SX201 parametric EQ (2), excel cond. B Tidwell, WAFT, POB 338, Valdosta GA 31603. 912-244-5180.

Fostex 3030 dual 10-band EQ, \$170; Yamaha E1010 analog delay, rack mount, remote foot switch, \$225; Lt Sound Thompson Vocal Eliminator D2, \$200; dbx 224 Type II NR, recording tech series, \$200; Sony NR-115 stereo Dolby unit w/CAL tapes, \$95; dbx NX40 NR, \$85; Ultimate Support Systems TS-33 tripod, 9'+base unit, w/8' ext & case, \$175. D Deuth, Audio Prod, 1801 Commerce Blvd, Mound MN 55364. 612-472-1619.

Oberheim DX drum machine, lots of alternative sound chips, BO; Shure PA system, (2) jrg columns, (2) mon & PA head, gd cond, BO. S Winthrop, Winthrop Prod, 10 W 94th St, NY NY 10025. 212-662-8685.

Rane ME-15 stereo EQ, excel cond, \$200/BO. M Osborne, WKSQ, POB 9494, Ellsworth ME 04605. 207-667-7573.

EMT 240 Gold Foil reverb, needs work, you ship, \$500. S Russell, 60410 Klerr Dr, Decatur MI 49045. 616-782-9258.

Snake 16 phantom-pwrld inputs w/xt ps, 250' Belden 19-pair cable w/mil connectors & stnss-steel strain reliefs, 10' Neumann XLR snake mates w/box or Belden snake, excel cond, \$775/BO/trade. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 213-859-5543.

Bose 802 Series II spkrs & 802/302 EQ. Ultimate 12' stands, like new, excel cond, orig cartons, lifetime warranty, \$1600 firm. P Paquin, Sound Dynamics Assoc, Box 132, Acushnet MA 02743. 508-783-3447.

Nova NCM 508 8 chnl PAR & RAIN light controller w/memory, audio chase, program chase, fade, blackout, etc. includes pair of Sunn PS-300 1200 watt digital dimmer packs, BO. B Fisher, KPOK, POB 477, Bowman ND 58623. 701-523-3883.

Studio Sound S-305 passive filter sets, matched pair, consec #, rack mount, very rare, \$375 ea. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 213-859-5543.

RCA BCM-2A aux mixer, (5) pots & (6) preamp cards, no pwr supply & upper front panel, orig RCA blue paint & vry clean, \$500/BO; RCA 243471 PA tuning screw for BTF-10E, black nylon, new, \$75/BO. K Eilert, KWED, 609 E Court St, Seguin TX 78155. 512-379-2234.

Shure SR-107 graphic EQ, 10 band, rack mount, excel cond, \$125; DOD-Digitech 831-C 31-band graphic EQ, as new, \$150; DOD-Digitech 855 4-chnl mixer, as new, \$150; Rane PE-15 5-band parametric EQ, as new, \$250; buyer pays shipping. B Leslie, Pro Rcdng Service, 13709 Maple Leaf Dr, Cleveland OH 44125. 216-662-1435.

Gemini 6-chnl stereo mixer (2), almost new, \$250/both+shipping. J Deering, Great Com, 114 Walton Ferry Rd SE #B, Hendersonville TN 37075. 615-264-2886.

Fairchild 658 spring/rack mount reverbs (2 ea), BO. B Arnold, 700 Prod, 105 Dorado Court S, Middle Island NY 11953. 516-924-9020.

Dolby 361 Type A NR, new stereo pair, \$1400; dbx K9-22 cards for above, \$250 pair. E Davison, 135 N Illinois, Springfield IL 62702. 217-787-0800.

**LIMITERS**

**Want to Sell**

Durrough DAP-310 tri-band audio processor (2), for AM/FM brdct use, vgc, \$325 ea+shipping. B DeFelice, DeFelice Prod, 93-2R Fowler St, New Haven CT 06515. 203-397-2595.

Spotmaster CLA 20/40A compressor/limiter (2), w/manual, \$275/both. K Gutzke, 7134 15th Ave S, Minneapolis MN 55423. 612-866-6183.

Howe Phasechaser Series 2000, corrects phasing probs in stereo tape sys & phone lines used in EQ prog lines & STLs, BO. D Donovan, KCGR FM, 1620 American Bank, Corpus Christi TX 76226. 512-888-8555.

**Optimod 8000A \$1495 & UP 414-482-2638**

CBS Stereo Volumax peak controller, older creme-colored unit, no front covers, manual, \$150. S Callahan, WCEG, 1120 Pinellas Bayway, St Pete FL 33713. 813-821-9549.

Audio Design Transdynamic stereo brdct limiter, can control up to 6 add'l limiters for 3-band limiting, never used, w/user-service manual, \$650+shipping. M Shea, Precision, POB 723, NY NY 10276. 212-989-2684.

Audltronic 201 rms/peak limiter, \$500 ea; API 525 limiter, \$340 ea. M Linett, Yr Place or Mine, 1600 Las Flores Dr, Colendale CA 91207. 818-244-1909.

CBS Audimax stereo compressor, \$200/BO; CBS Volumax stereo limiter, \$200/BO; \$350/both; also, (2) Marti CLA-40H compressor-limiters, mono, \$75 ea/BO. B Williams, KPSM, 2009 W Gary, Broken Arrow OK 74012. 918-455-9522.

Orban 464A Co-operator transparent AG/Comlifier, excel cond, \$600/BO; Texar RCF-1 replacement card 5, \$350. M Osborne, WKSQ, POB 9494, Ellsworth ME 04605. 207-667-7573.

Quad-8 Cleg compressor/limiter/expander/gate modular units, console/rack mountable, not used, \$150 ea/trade. J McLane, Oddeo Eng, 115 W Gutierrez, Santa Barbara CA 93101. 805-963-3941.

CRL SEP400B, lw hours, clean, excellent shape, w/manual, \$350. P Hess, 134 Derovent Dr, Pittsburgh PA 15237.

Gates Solid Statesman, needs parts, \$50. G Muse, KMRF, POB K, Marshfield MO 65706. 417-468-6188.

Pacific Recorders ML-FM multi-limiter, works, BO; CBS Volumax 400, BO. B Schloss, KRRO, Sioux Falls SD. 605-335-6500.

Gates Solid Statesman, \$275. P Wells, KJOY San Diego, 619-238-1037.

Optimod 8100A/ST audio processor, BO. L Penke, WKTT-FM, POB 26. Cleveland WI 53015. 414-693-3103.

CRL FM4 system, SPP-800, SEP-400A (2), SMP-800, Dynaflex DX-2 NR unit, \$2600; Valley People 440, gd cond w/manual, mic processor, \$250; UREI 535 stereo EQ w/manuals, gd cond, \$200. Donovan, KSKS, 5265 W Magill, Fresno CA 93722. 209-233-9393.

dbx 165 comp/limiter stereo pair (2), new, \$350 ea. E Davison, 135 N Illinois, Springfield IL 62702. 217-787-0800.

**Want to Buy**

Gentner Audio Prisms stereo pair, late generation pref. P Christensen, WIVY-FM, 3101 University S, Jacksonville FL 32216. 904-721-9111.

Urei LA-3A/LA-2A compressor/limiter, prefer operating cond, need (2). R Kaufman, Pams Prod, POB 462247, Garland TX 75046. After 3PM: 214-271-7825.

CRL PMC-200-800-900 AM limiter, mono. P Palagona, WSKW, POB 159, Skowhegan ME 04921. 207-474-5171.

Greg Labs 2530 tri-band compressor/limiter, check your junk rooms. J Mauk, KMJ/KSKS, 1110 E Olive Ave, Fresno CA 93744. 209-266-5800.

Orban 8100A, fair/gd cond, will pay cash. F Vobbe, WLIO TV, 1424 Rice Ave, Lima OH 45805. 419-228-8835.

Optimod 8000A, will pay cash, leave message at 703-276-0125.

**MICROPHONES**

**Want to Sell**

Arrakis MK-5 5 mic amp to 5 line-level 600 R outputs, will mix to snlgl 600 R out, requires ±15 VDC. M Friend, WTJU, 804-924-0885.

RCA 44 vintage ribbon mic, late 50s model, works well, \$375/BO; Shure SM-7, used few hrs, like new, in case, \$350. Davis, MCP, POB 521, Newberry SC 29108. 803-276-0639.

RCA 77DX vintage ribbon mic, excel cond, \$400 ea. R Kaufman, Pams Prod, POB 462247, Garland TX 75046. After 3PM: 214-271-7625.

AKG D190ES dynamic cardioid, on/off switch, new cond, complete, \$100; (4) Altec C71 omni condensers, flat response, excel for recording, 0-30 db attenuator selector, vgc, \$125. A Allegra, Calvary Baptist Church, 1360 Valley Forge, Lansdale PA 19446. 215-368-4444.

Neumann U67 (5), various cond, \$1500-2400; also, U87, \$1250; SM2, \$2400; accessories. M Heleiak, Milwaukee Sound, 610 N Water St, Milwaukee WI 53202. 414-272-7085.

Altec 639 (2), classic ribbon Y dynamics, \$400 ea. L Beigel, On-Cue-Rcdng. Call/fax: 800-726-9813.

EV RE-20, mint cond, \$275; Valley People 400 mic compressor, vgc, \$300. B Hanson, 314-449-8433.

Shure 530 omni-dynamic (5), w/12" long barrel, built for interviews, guaranteed wrkg, \$25 ea, \$100 all+UPS. E Davison, 135 N Illinois, Springfield IL 62702. 217-787-0800.

Electro Voice 644 shotgun mic, \$140; Electro Voice 664A variable D dynamic, indust standard, \$100; AKG D-310 dynamic, \$100; all like new, complete, no blrms. C Keith, ALI, POB 313, Keane NH 03431. 603-352-8460.

Sennheiser 421 w/case, \$200. J Lang, PSI, Box 4085, Anchorage AK 99501. 907-333-2221.

EV 635A, as new, orig box & access, \$50+shipping. B Leslie, Pro Rcdng Service, 13709 Maple Leaf Dr, Cleveland OH 44125. 216-662-1435.

Electro Voice 644 shotgun mic, \$140; Electro Voice 664A variable D dynamic, indust standard, \$100; AKG D-310 dynamic, \$100; all like new, complete, no blrms. C Keith, ALI, POB 313, Keane NH 03431. 603-352-8460.

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CRL PMC-200-800-900 AM limiter, mono. P Palagona, WSKW, POB 159, Skowhegan ME 04921. 207-474-5171.

Telefunken/Schoeps CM-61 tube mic, vry rare, uses std 6AU6 plug-in tube, w/o cables/pwr supply, mint cond, \$975/BO. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 213-859-5543.

Beyer 101 omni mic, gd cond in case, \$100. P Paquin, Sound Dynamics Assoc, Box 132, Acushnet MA 02743. 508-763-3447.

EV 1776; RCA 44DX; Altec Salt Shaker; \$225/all+shipping. J Deering, Great Com, 114 Walton Ferry Rd SE #B, Hendersonville TN 37075. 615-264-2886.

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### MISCELLANEOUS . . . WTS

Sony RMM501 rack mount kit (5), new Type 5, never used, (2) in orig boxes, \$800. D Jordan, WDTM Inc, POB 3417, Jackson TN 38303. 901-668-1153.

Several audio xformers: Ampex 15095 & 4580116-20, Triad A10J & A11J, \$15/ea. S Lawson, KAK Prod, 928 Hyland Dr, Santa Rosa CA 95404. 707-528-4055.

GKI K80 1 1/2" tape eraser, rack mount, top shape, \$450. Gene Sive Prod, 619-749-7662.

### MONITORS

**Want to Sell**  
 TFT 723 AM mod mon w/presselector, \$600/BO. S King, KATP-FM, 1-40 W, Amarillo TX 79110. 806-355-9777.

McMartin 4500A FM stereo mon. G Gilbert, CSRG, POB 50539, Denton TX 76206. 817-380-0229.

McMartin TBM3700 FM mod mon & matching TBM200A stereo mon. B Schloss, KRRO, Sioux Falls SD. 605-335-6500.

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Blower, BVD B25A, rack mounting, 2 speed, gd cond, \$35. E Davison, 135 N Illinois, Springfield IL 62702. 217-787-0800.

Radio Design Labs pods to make up (2) audio control boards, modular design, new, unused, \$10,000 FOB; Sparta Elec Corp misc audio & RF tech manuals; call/write for compl list. D Peluso, KJUL FM, 2880 E Flamingo Rd Ste E, Las Vegas NV 89121. 702-732-2200.

**Want to Buy**  
 Belar AMM2/3 or Harris AM90. George, WNQM, 4647 Old Hydes Ferry Pk, Nashville TN 37218. 615-255-1300.

FM mod mon, late model, tuned to 93.5, reasonably priced. B Crane, WLIL, POB 340, Lenoir City TN 37771. 615-986-7536.

FM mod mon. D Van Zandt, WJLU, 2596 SR 44, New Smyrna FL 32168. 904-427-9000.

Gates & RCA 1950 AM mod freq mon service manuals. L Scott, POD 1449, Highland City FL 33836. Eve: 813-533-4654.

Any older McMartin mod monitors. C Goodrich, 11435 Manderson, Omaha NE 68164. 402-493-1886.

### MOVIE PROD EQUIP

**Want to Sell**  
 Cinema Products GSMQ, 16mm reflex, Ang 15-150 zoom, batts, chargers, 2 mags, hand-grip & shoulder pod, Zero case, excel cond w/manual, \$4995. R Sumner, CAVU Corp, 3322 Applegate Ct, Annandale VA 22003. 703-560-0233.

Cine Kodak Special II, 100' mag lens & case, vgc, clean, 16mm, \$250. C Potorti, Potorti Video, 10005 Lacy, Morrisville PA 19067. 215-945-3990.

Bolex H165 (2), w/400' mag port, drive & mag motors, battery packs, 17-85mm zoom w/rt angle view finder, voltage regulators. K West, SRSU, Dept Fine Arts/Comm, Alpine TX 79832. 915-837-8219.

**Want to Buy**  
 Mitchell 16/35mm, other pro 16/35mm incl Arri, Aaton, CP; optical prntrs esp Research Products 1000, 1001, Acme, Oxberry; cine lab equip incl sensitometers; sm to med 16 or 16/35mm processing machines; optical rcdrs; Steenbecks; gd cine optics, Zeiss, Ultra-T, Angenieux, Cooke; Zeiss 95mm Distagon, reasonable, fair cond; will consider any film equip. J Kreines, DeMott/Kreines Films, 5330 Kennedy Ave, Millbrook AL 36054. 205-285-6179.

Javelin sm night vision device, or equiv, pre-fer 2nd generation C-mount, anything considered. J Kreines, DeMott/Kreines Films, 5330 Kennedy Ave, Millbrook AL 36054. 205-285-6179.

Records from 50s & 60s, 45 & 33 rpm, esp obscure non-chart items, \$50-\$1 ea, references avail. B Berry, Karavan Brcdstg, 13 Montgomery Pl, Conroe TX 77384. 409-273-2801.

### RECEIVERS & TRANSCEIVERS

**Want to Sell**  
 Fairchild Dart-384 digital audio rcvr, Satcom 1-R cards, \$5000. WKTT, 414-693-3103.

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Motorola Pagecom & Director pagers (18), on 154.25 MHz, w/3 spares, parts, chargers, reeds, & batteries, xmtr & pager manual incl, \$400; Yaesu FT-4 touch tone pads for hand-held FT-23, FT-73, FTH2005, FTH7005, FTH2008, FTH7008, \$10 ea. P Russell, Bowdoin Coll, Sills Hall, Brunswick ME 04011. 207-725-3066.

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Marti AR-10 receiver (4); (3) 2-way radio at 161.64 w/base. T Noordyk, 616-924-4700.

Wacom WP-641 VHF duplexer, on 154 & 155 MHz, will tune to 150-156 easily, like new, \$350. P Russell, Bowdoin College, Sills Hall, Brunswick ME 04011.

Yaesu FRG7700 comm rcvr, 10 kHz-30 MHz, w/o memory freq, digital readout, AM/FM/SSB, mint cond, \$350; Kenwood R1000 comm rcvr, 10 kHz-30 MHz, digital readout, mint cond, \$300. E Davison, 135 N Illinois, Springfield IL 62702. 217-787-0800.

Motorola Moxxy 25 W SS under-dash mobile radio (3), on 161.640 MHz, w/base station mic & pwr supply, base station vertically polarized antenna w/6 dB omni-directional gain & adjustable radiation pattern, much more, \$1000/BO. B Williams, KPSPM, 2009 W Gary, Broken Arrow OK 74012. 918-455-9522.

High quality micro-miniature 67 kHz SCA decoder, about 1" square, prewired and ready to install, \$15. D Jackway, Background Music Eng, 5742 Fair oak, Springfield MO 65810. 417-881-1846.

GE MPI (2), UHF hand-helds, 2 W, 2 chnl, xtra batteries, chargers, \$150 both. P Russell, Bowdoin College, Brunswick ME 04011. 207-725-3066.

Precision PE112A AM/FM tuner, rack mounting, SS, gd cond, \$35. E Davison, 135 N Illinois, Springfield IL 62702. 217-787-0800.

### Want to Buy

Sony SRF-A100 AM stereo radio. Ralph, 55 K-USA, St Louis MO. 314-997-5594.

Realistic STA-2100D FM/AM tuner w/full controls & 240 W amp, 120 Wchnl. L Van Luvan, WGMCM, 60 Rochelle St, Rochester NY 14612.

### REMOTE & MICROWAVE EQUIP

#### Want to Sell

Moseley 600 system, excel cond, rcvr recently tuned by mfr, \$3600. G Fallus, WZMX, 100 Executive Dr, Farmington CT 06032. 203-677-6700.

Moseley PBR-30 30-chnl wireline remote, wrking when removed, \$600/BO. R Brace, WGY AM/FM, POB 1410, Schenectady NY 12301. 518-381-4800.

TFT 7601 digital remote w/SCA gen for control via STL/wire line (any voice-grade chnl from 300 Hz-3 kHz), w/manual, BO. D Donovan, KCGR FM, 1620 American Bank, Corpus Christi TX 76226. 512-888-8555.

Moseley TRC 15AW remote control system, gd cond, \$500. G Gilbert, CSRG, POB 50539, Denton TX 76206. 817-380-0229.

Marti RMC-2AX 25-chnl, gd cond, manuals, \$500/BO/trade. D Willey, Life Brcdstg, POB 96, John Day OR 97845. 503-575-1840.

Telephone equip: ADC 109D & 109H repeat coils, 4 primary & secondary terminals, 600/900 ohm, use bridged/terminated, \$10 ea; Wescom 2/4 wire balanced hybrids, gd null features, make grt talk show phone syst, \$50 ea. R Weaver, WHEVAM, Creech Rd, Garner NC 27529. 919-552-9357.

Microtrak 6444 3-chnl stereo audio mixer w/TTS, needs tone arms, \$1000/BO. Don, KCKN-KBCQ, POB 670, Roswell NM 88202. 505-622-6450.

Hallikainen DRC-190, brand new deluxe R/C w/computer, printer, CRT, all manuals, \$1200; Moseley TRC-15 studio & xmtr units w/manuals, set-up for Teko, wrk grt, \$400. J Salov, SHGRA/WUPS, 517-740-1165.

Hallikainen PCC180 processing control computer, permits automatic logging operating w/Moseley TRC-15 remote system, wrkd grt when removed in '89. C Freinwald, KBSG, Seattle. 206-343-9700.

Gates RDC-10 remote, plus 1 for parts, \$100; (2) Comrex telephone coupler with 1/4" line out jack, \$50 ea. B Williams, KPSPM, 2009 W Gary, Broken Arrow OK 74012. 918-455-9522.

Moseley MRC1600 remote w/16 chnl control/telemetry/status, gd cond, BO. P Delaney, WOSX, Box 921, Marshfield WI 54497. 507-895-2065.

TFT 7601 systems: (2) 7601-C & (2) 7601-R, both complete, excel cond, vry cln, \$1600/BO. C Jennings, WQLA, Box 1530, LaFollette TN 37766. 615-566-1000.

Moseley TRC-15 remote control system, 12 yrs old, wrking fine, gd cond, \$750. M Clites, WCBC, Box 1290, Cumberland MD 21502.

RCA BTR-30A remote system, suitable for parts, make offer. B Schloss, KRRO, Sioux Falls SD. 605-335-6500.

Gentner SPH-3 Phone System telephone interface, never used, \$380. B Hickman, WMFM-FM, POB 16928, Hattiesburg MS

**REMOTE . . . WTS**

Moseley PCL-606/606C manuals (4 sets), new, \$35. K Eilert, KWED, 609 E Court St, Seguin TX 78155. 512-379-2234.

Moseley PCL 505C STL system, w/xmtr, receiver & antennas, on 951.0 MHz, gd cond, upgraded to comply w/FCC STL rules. Dan/Paul, KRDI, Decorah IA 52101. 319-382-4251.

Moseley SCG-8 FM subcarrier gen & SC8-8 FM subcarrier demod, 110 kHz, like new. P Baillon, 612-222-5555.

Moseley MRC-1600 digital remote, \$2000. L Penke, WKTT-FM, POB 26, Cleveland WI 53015. 414-693-3103.

Marti RMC-20 remote system, cosmetically lacking, functionally perfect, w/(4) RY5T relay panels, all manuals, \$500. S Schweiger, WXLO FM/AM, 146 Worcester Ctr, Worcester MA 01608. 508-752-1045.

**Want to Buy**

Moseley STL system for FM. T Noordyk, 616-924-4700.

Marti STL 8 stereo STL system, reasonable. J Ingram, WBLE, Hwy 6 W, Batesville MS 38606. 601-563-4664.

Moseley PCL 505C, Marti or TFT 950 MHz STL equip for export, priced right. K Austin, Austin Brdcast, 1101 Hwy 81 N, Marlow OK 73055. 405-658-3330.

Marti 26 MHz xmtrs & receivers w/manuals, will consider 161 MHz w/right price. F Vobbe, WLIO TV, 1424 Rice Ave, Lima OH 45805. 419-228-8835.

**SATELLITE EQUIPMENT**

**Want to Sell**

Scientific Atlanta 7300/7325 wideband BPSC rcvr & digital processing unit, (2) 15 kHz decoder cards, 75 kHz card, excel cond, \$4500. Tom/Harry, KTMC, POB 848, McAlester OK 74502. 918-426-5300.

Scientific Atlanta satellite rcvr system w/Voice Cue, Data, SEDAT & 15/7.5 kHz DAT cards installed, used by NBC Talknet/ABC/CBS sports affiliate w/switchable crystals, \$5500. J Zecherle, WKTS, 414-457-5561.

Scientific Atlanta DAT-32 receiver, 15 kHz stereo audio card for use w/all major networks, like new cond, \$1000/BO. Chip, KCPS, POB 946, Burlington IA 52601. 319-754-6698.

Wegener 1601, w/SMN cards, ready to wire up, \$800. G Muse, KMRF, POB K, Marshfield MO 65706. 417-468-6188.

Drake ESR 2240 satellite receiver, receives AV signals. P Baillon, 612-222-5555.

CA Microwave satellite receiver mainframe w/PS 01 pwr supply module, SQ 01 cue chnl module, (3) SD 153 prog chnl modules w/freq of 64.0 MHz, 64.4 MHz, 76.7 MHz, 77.9 MHz (primary), wrking when removed, \$1500/BO. K Eilert, KWED, 609 E Court St, Seguin TX 78155. 512-379-2234.

Wegener 1601 satellite receiver for SMN Stardust, compi wall cards & manuals, \$1200. S Schweiger, WXLO FM/AM, 146 Worcester Ctr, Worcester MA 01608. 508-752-1045.

Fairchild DART-384 digital audio rcvr, Satcom 1-R cards, \$5000. L Penke, WKTT-FM, POB 26, Cleveland WI 53015. 414-693-3103.

CA Microwave AD-2 downconverter for satellite system, \$200/BO; Amplica CD-304302, LNA, 120° s/n 558, \$75/BO. K Eilert, KWED, 609 E Court St, Seguin TX 78155. 512-379-2234.

**Want to Buy**

Fairchild Dart 384 receiver w/down converter. M Rollings, Rollings Comm, POB 882, St Louis MO 63006. 314-726-9595.

Varian or MCI pwr supply for Klystron TV uplink, need 8200 V at 1 amp, 3 phase reg; also, 5 meter TV uplink dish antenna, C-band, folding on trailer OK. U George, Ugly George Satellite TV, 314 W 52 St, NY NY 10019. 212-969-0240.

Satcom 1-R 7325 7.5 kHz decoder, will trade Satcom 1-R 7325 digital processing unit, 15.0 kHz, dual audio decoder, never used. J Swartz, WCSM AM/FM, Meyer & Schunk Rds, Celina OH 45822. 419-586-5133.

Scientific Atlanta 6600 satellite receiver. J Wagner, WMBI AM-FM, 820 N LaSalle Dr, Chicago IL 60610. 312-329-4279.

Scientific Atlanta Unistar AM-only format receiver. C Tarkenton, WCOH/WMMKJ, 154 Boone Dr, Newnan GA 30263. 404-253-4636.

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**STATIONS**

**Want to Sell**

50 kW AM clear daytime, 500 Watts DA night southern gospel in bible belt, some financing. 919-734-8000.

Radio/TV combo: old dependable AM & new LPTV in gd market in E NC, nice buildings & acreage, new twr & new TV studios, \$450,000 w/\$100,000 down, owner financing. 919-965-5328 after 7PM.

Class A, WIST 94.3 FM, Lobelville TN w/50 kW CP on hand is once again being offered at a reasonable price of \$150,000. We will consider \$50,000 down, balance on easy terms w/references required. Located 1/2 way between Jackson & Nashville TN, just 10 miles south of I40 & the famous Loretta Lynn's Dude Ranch. Call for appointment today & inspect this nice facility. Bill Coleman Jr. 615-593-2294.

AM daytimer in NE TN serving 5 counties, 1 kW, county of license population: 45,000+, vry lw operating overhead, relatively new studio facilities in modern mall, Continental 314R, AM xmtr, less than 5 yrs old, station owns satellite facilities, terms neg w/sm down payment, shown only by appt, ref req'd, serious inq only. B Mountjoy, POB 1240, Elizabethton TN 37644. 615-543-5849.

**SHORTWAVE STATION**

Shortwave Radio Antenna/Transmitter site in New Jersey Wetlands next to Station WOO, Ocean Gate, NJ. State approval for 6 towers & transmitter building. Information: Mr. Knox, POB 250, Toms River, New Jersey 08754 or call 908-349-1100.

AM & FM in stable TX market, owner financing possible, grt opportunity for owner operation, real estate & home incl. 216-331-8012 or 305-296-7575.

1000KW AM Station in Eastern Ohio, will serve Ohio, Penn, WVA markets (overlaps Wheeling, WVA, only 35 miles west of Pitts, PA). R. Dawkins, POB 970, Steubenville OH 43952. 614-264-2566 or 614-282-1046.

**New 50K FM in Southern Missouri Lakes area.**  
417-273-4308  
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AM/FM Radio station for sale in Kentucky. Is making a profit. For more information call 502-756-6463, 502-828-2343, 502-828-3619 or 502-828-2130.

**Want to Buy**

10 yr+ broadcaster seeking to take over FM station in KY, OH, WV, looking for no money down/debt assumption, any pwr OK. Mike, Star-Comm, 8078 Lyon Circle #103, Manassas VA 22110. 703-368-2955.

FM CPs wanted in sm, med, lrg markets, college/resort preferred, will consider dark/bankruptcy. E Polleek, 1st Brdcastng, POB 691, Wilmette IL 60091. 312-263-6868.

AM/FM/combo wanted to take over who down, owner financing. L Haber, POB 136, Woburn MA 01801. 617-246-5634.

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AM, FM, AM/FM combo, no cash down w/some owner financing, prefer an owner ready to retire or pursue other interests, all areas considered. K Weiss, POB 550515, Jacksonville FL 32255. 904-928-3257.

LPTV CPs, in AZ, CA, CO, FL, TX, exper brdcstr seeking gd father/daughter operation, send compl details w/\$. J Powley, WJIM TV, 1536 Logan Ave, Altoona PA 16602. 814-944-8571.

**STEREO GENERATORS**

**Want to Sell**

AEL 2213, gd cond, no manual, \$100/BO/trade. D Willey, Life Brdcastng, POB 96, John Day OR 97845. 503-575-1840.

McMartin SCA gen on 67 kHz, like new, \$750/BO. B Williams, KPSM, 2009 W Gary, Broken Arrow OK 74012. 918-455-9522.

Marcom/Rood SC 203 w/manuals, new, \$2000. Donovan, KSKS, 5265 W Magill, Fresno CA 93722. 209-233-9393.

**Want to Buy**

Optimod 8000A, will pay cash, leave message at 703-276-0125.

**SWITCHERS (VIDEO)**

**Want to Sell**

American Data Corp 553 w/onboard digital spec effects gen w/(9) effects, colorizer, (7) inputs w/TBC ports, excel cond, \$850. Pinetucket Rdring, 747 Wire Rd, Auburn AL 36830. 205-826-0390.

JVC KM-2000 w/special effect gen, almost new, 8 video inputs on A/B/C buss, use w/1/2 or 3/4", genlock, \$2400. Jaye, Nimbus Prod, POB 5903, Takoma MD 20912. 301-507-3358.

**TAPES/CARTS & REELS**

**Want to Sell**

Comedy music show, 30 min weekly, well done feature, audio tape \$1, subscription \$2/week. R Schoedel, WMCR-AM, 6630 Monclova, Maumee OH 43537. After 3PM EST: 419-693-7968.

Reels w/NAB hubs, 10", many avail, come w/box, \$1 ea & you ship. J Harper, KOMC-FM, Box 44, Brinkley AR 72021. 501-734-1570.

7" reels (125), 1 mil tape, played once, in boxes, you ship, \$300/all. A LoPresti, AJL Soundwave, 21 Carter Rd, Geneva NY 14456. 315-789-4019.

Scotchcarts (500) & (60) Scotchcart II, 3.5-5.5 min, vgc, little use, all/part, \$1 ea. R Young, KSNL, Santa Maria CA. 805-925-2582.

Plastic reels of audio tape in box, 10", 100s avail, recorded only once, some old/new, \$150/roll. B Williams, KPSM, 2009 W Gary, Broken Arrow OK 74012. 918-455-9522.

Christian music library w/over 2,200 record LPs, 12" sncls, & a few-45s & CDs, some never opened, several collectors items, \$3000. E Finley, KNYN, 2015 W Cactus Rd #193, Phoenix AZ 85029. 602-861-0311.

U-matic cassettes (400), 1 pass only, like new, incl library cases, some shipping cases, 5/10/15 min lengths, \$2 ea; 20/30/60 min, \$3 ea; shipping xtra. J Powley, WJIM TV, 1536 Logan Ave, Altoona PA 16602. 814-944-8571.

Grey & Blue carts (500), various lengths, \$1 ea. T Noordyk, 616-924-4700.

**Want to Buy**

Old 45/7" station collections, promotional otherwise. S Groff, Yesterday & Today Records, 1327 Rockville Pike, Rockville MD 20852. 301-279-7007.

Large collections of 45s, '50s, rock, R&B, country. K Gutzke, Custom Rdring, 7134 15th Ave S, Minneapolis MN 55423. 612-866-6183.

**TAX DEDUCT EQUIP**

Youth radio station in public housing seeking donations of radio brdcstng equip, tax deductible. Frank/Julie, ARHA, Alexandria VA. 703-549-7115.

Portable PA system needed for missionary work in Ghana; also, need (4) Utility towers, 80-100'. C Riddle, World for Christ Radio, 703-878-4141.

Brdcst Training School for Underprivileged in need of any AM brdcst equip, will pay shipping on sm items. F Smith, 615-624-7126.

Educ/college station seeking wrkng A-size mono P cart machine, BE, ITC, UMC 100 series, etc, will pay shipping. E Ford, KBPK, 321 E Chapman, Fullerton CA 92634. 714-992-7418.

Christian radio ministry needs AM xmtrs, wrkng/not, any & all appreciated, will pay shipping. R Schoedel, WMCR-AM, 6630 Monclova, Maumee OH 43537. After 3PM EST: 419-893-7968.

Educ radio/TV needs cart R/P & player; 78 rpm TT; stereo R-R for prod; all wrkng cond; will pay shipping. K West, SRSU, Dept Fine Arts/Comm, Alpine TX 79832. 915-837-8219.

Private college seeking studio equip for campus radio station in the works, ie console, cart decks, TTs, CD players, etc; also, donors sought for funding. E Finley, KNYN, 2015 W Cactus Rd #193, Phoenix AZ 85029. 602-881-0311.

Monte Vista Christian School, would appreciate any donations of used TV broadcast equipment. T Quinn, 408-475-0423.

Eng student desiring donation of old bdct equip (anything in repairable cond, will pay all shipping charges, EE student at Purdue. C Gill, POB 371, Indianapolis IN 46206. 317-923-2800.

**TEST EQUIPMENT**

**Want to Sell**

Tektronix 323 oscilloscope, portable, SS, 4 MHz single trace, AC/nicad pwr, 7 lbs, mint cond, w/manual & probe, \$450; Bruel & Kjaer 2033 high res signal analyzer, FFT sound & vibration analyzer, 0-20 kHz, 11 baseband ranges, ampl of 40 db, 80 db & linear, excel cond w/manual, \$4995. R Sumner, CAVU Corp, 3322 Applegate Ct, Annandale VA 22003. 703-560-0233.

Bird 6154 dummy load/wattmeter, 150 W, 25-1000 MHz, excel cond w/manual, \$335; Bird 434/275-100 RF wattmeter/variable sampler, 20-1000 MHz, 1 kW, requires element, excel cond w/manual, \$225. R Sumner, CAVU Corp, 3322 Applegate Ct, Annandale VA 22003. 703-560-0233.

Coherent Communications 1/3 octave analyzer for use w/scope, \$50+shipping. B Seifried, Eclair Eng, 101 Prospect St, Northampton MA 01060. 413-584-6767.

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10 kW FM	1972 Collins 830F1	5 kW AM	1972 CCA AM5000D
10 kW FM	1975 RCA BTF 10ES1	5 kW AM	1977 RCA BTA 5L
20 kW FM	1973 RCA BTF 20E1	10 kW AM	1972 Harris BC10H
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**B&K 667** SS tube tester, grt shape, \$70. P Russell, Bowdoin College, Sills Hall, Brunswick ME 04011.

**HP 334A** THD analyzer w/broadcast options, mint cond., \$1100; Boonton 81A EC AM/FM mod analyzer, \$500; HP 651A 10 MHz test oscillator, vgc, \$125; Tektronix FG504/TM503 40 MHz function gen & 3-hole mainframe, mint cond., \$1400; HP 8708A phase lock sync for 600 series RF gens, \$150; HP 202H 50-216 MHz AM/FM gen, vgc, \$200. J Friih, WLNG, POB 804, Bridgeton NJ 11932. 516-725-4683.

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**Gorman Redlich CM** antenna phase mon, 2-twr, digital display. C Freinwald, KBSG, Seattle. 206-343-9700.

**Leader LAG-120B** audio gen, BO. L Penke, WKTT-FM, POB 26, Cleveland WI 53015. 414-693-3103.

**B&W distortion meter** & audio oscillator, both work, \$50 both. G Muse, KMRP, POB K, Marshfield MO 65706. 417-468-6168.

**Kinematics/Truetime 60-DC** WWVB sync digital clock, mint cond., \$1000; Kinematics/Truetime 60-TF WWVB rcvr freq comparator, excel cond., \$1200. A Ross, 8022 27th NE, Seattle WA 98115. 206-525-4624.

**Tektronix 529 188D** TV waveform mon, response to 8 MHz, multi-standard version, PAL frame selector, excel cond w/manual, \$525; Phillips PM3266 oscilloscope, portable transfer storage, 100 MHz, dual trace, excel cond, \$1995; HP 200CD audio gen, 5 Hz-600 kHz, at 600 ohms, excel cond w/manual, \$295. R Sumner, CAVU Corp, 3322 Applegate Ct, Annandale VA 22003. 703-560-0233.

**HP 206** audio sinewave gen, uses tubes, \$300/BO; HP 330B audio distortion analyzer, uses tubes, \$350/BO. K Eilert, KWED, 609 E Court St, Seguin TX 78155. 512-379-2234.

**TTI/Tautron 1120** xmission test set (2), (1) AC only, (1) AC/battery, digital display of dBm & freq, 35 Hz-23 kHz, -40 to +10 dBm, 600/900 ohms, full duplex testing w/C-message, much more, call for details, \$1000. T Wright, WJJD/WJMK, 180 N Michigan Ave, Chicago IL 60601. 312-977-1800 X100.

**B&B Systems AM-2** audio phase mon, CRT X/Y display, w/calibrated graticule for phase, ANSI calibrated VU meters & peak meters for every chnl, magnetic & EMI/RF shielding, excel cond, \$2000. G Fern, POB 2366, Van Nuys CA 91404. 818-778-6756.

**Tech Materials Corp** 5 kW dummy load, convection cooled, 50 ohms, up to 30 MHz, in 6'x4'x2.5' ventilated weather-proof fiber glass cabinet, new, \$1000/BO; ITT 17" oscilloscope w/manuals, fair cond, \$500/BO. R Meyer, Benchmark Comm, 4700 SW 75 Ave, Miami FL 33155. 305-264-5963.

**Leader LPM880** RF wattmeter, 3 scales: 0-5 W, 0-20 W & 0-120 W, new, \$150. S sawsp. KAK Prod, 928 Hyland Dr, Santa rosa CA 95404. 707-528-4055.

**Delta 01M** impedance bridge, vary little use, \$1600/BO. Yombo, 213-923-4012.

**Potomac FIM-41** field strength meter for AM station antenna proofs, quality pre-owned equip from our rental inventory. Call Steve or Chuck, Radio Resources, 1-800-547-2346.

**Potomac FIM-72** field strength meter for UHF-TV & Hi-band STL measurements, quality pre-owned equip from our rental inventory. Call Steve or Chuck, Radio Resources, 1-800-547-2346.

**Patchbays (4)**, 24 single inputs, also patch cords; Edital splicing block, 1" tape, audio-head alignment tape for Ampex 75-15 ips, 14" tape. Mr. Oliver, 212-874-7660.

**Want to Buy**

**Freq counter** to measure AM & FM freqs, gd cond & cheap. B Crane, WLIL, POB 340, Lenoir City TN 37771. 615-986-7536.

**AM field strength meter.** D Van Zandt, WJLU, 2596 SR 44, New Smyrna FL 32168. 904-427-9000.

**Tektronix 1L10, 1L20, 3L10, 3L20** spectrum analyzer modules, send price & cond to: Booker Elec, 2120 S Brownell, Joplin MO 64804.

## TRANSMITTERS

**Want to Sell**

**CSI 25 kW AM** xmtr, tuned to 1200 kHz, like new, 200 hrs, can be modified for HF, avail immed, \$30,000, you ship. G Arroyo, WOEQ, W Palm Beach. 407-687-9350.

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**Marti xmtrs:** (2) 2 W, (2) 40 W. T Noordyk, 616-924-4700.

**Bird 3128** Wattcher, alarm/RF pwr mon, up to 10 kW, 450 kHz-2300 MHz, requires line section, mint cond w/manual, \$350. R Sumner, CAVU Corp, 3322 Applegate Ct, Annandale VA 22003. 703-560-0233.

**Collins 820** hybrid exciter & stereo gen, \$200. S King, KATP-FM, I-40 W, Amarillo TX 79110. 806-355-9777.

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Charlotte, VT 05445

**Collins 831-G** 20 kW FM, all new capacitors in pwr supply, no PCBs, parts to convert to 25 kW, vgc, \$25,500. D Dayton, Dayton Brcdst, 1907 Lincoln Ave, Mendota IL 61342. 815-538-4681.

**Henry 4.5 amp DC** filter choke (3), mfr'd by Peter Dahl Co, new in shipping crate, \$525+shipping. D Dodd, KKTZ, 107 W 9th St, Mountain Home AZ 72653. 501-425-5100.

**RCA BTF 3A**, wrking when removed, \$500. Karen, KYKA, 509-453-6296.

**Alcon-Bauer 690-B**, programmable, in use, w/manual, \$1200; Harris MS-15 revision D, programmable, in use, \$1200. D Donovan, KCGR FM, 1620 American Bank, Corpus Christi TX 76226. 512-888-8555.

**Harris TE-3** stereo exciter tuned to 103.1, \$1000. Mr Dolgoff, 904-386-5141.

**Continental 27.5 kW FM** xmtr, '87 model, excel cond. Kevin/Corey, 512-345-9300.

**Gates BC-1G 1000/250 W AM** xmtr, 1010 kHz, freq determined components on hand for upper 2/3 of band, \$2350. S Wilson, KZRC, 111 SW 5th Ave #1550, Portland OR 97204. 503-226-6731.

**BE FM 30 kW** xmtr minus driver, BO. O Eaton, Mega Comm, 19 W Hargett St, Raleigh NC 27601. 919-990-1906.



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**Gates TE-1** exciter & stereo gen, \$500/BO; Collins A-830 exciter & stereo gen, \$750/BO. B Williams, KPSM, 2009 W Gary, Broken Arrow OK 74012. 918-455-9522.

**RCA BTE 15A** wextender board. Dale, 503-774-0459.

**Collins 20V3** 1 kW xmtr, wrking when removed, needs re-tubing, \$2000. G Erway, KKSBB, POB 40309, Santa Barbara CA 93140. 805-568-1444.

**B-300**, 300 W SS RF amp, full metering, remote control. C Springer, KSEC, Box 890, Lamar CO 81052. 719-336-2206.

**Nautel 1 kW** xmtr, new, never on air, w/xtras, ready for shipping, \$17,500 firm. T Wayne, 800-477-8273.

**Collins 831-D1** 2 kW FM xmtr, avail 1/92 due to pwr upgrade. J David, KMPL/KSTG, 314-471-1520.

**TTC XL10FM2** 2010 W dual amp translators w/audio & ID cards; (4) Scala 10-element Yagis; (4) 50' lengths 1/2" coax w/connectors; receive antenna; \$7000/all. D Rose, KAAA-KZZZ, 2534 Hualapia Mtn Rd, Kingman AZ 86401. 602-753-2537.

**Ronk Rotoverter** rotary xformer, converts 240 snl-phase to 240 3-phase, 10.5 KVA, used only 1 month, \$2000 FOB Syracuse NY. 813-576-0647.

**RCA MI-560719** module extender for BTE-15A exciter, new, \$75; RCA front door fingerstock for BTF-10E FM xmtr, never used, silver-plated, tarnished, \$50/BO. K Eilert, KWED, 609 E Court St, Seguin TX 78155. 512-379-2234.

**FM TRANSMITTERS**

300 W QEI 675T  
2.0 kW Collins 831-D1  
10 kW Harris 10K  
10 kW Collins 830-F

**FM EXCITERS**

QEI 675  
BE FX 30

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**McMartin B-910** exciter. B Schloss, KRRO, Sioux Falls SD. 605-335-6500.

**McMartin BF3.5K-3.5KW** or 5KW FM xmtr, used, tuned & tested on your freq, guaranteed, excel cond. Goodrich Enter, 11435 Manderson, Omaha NE 68164. 402-493-1886.

**Bird 8926** 5 kW dummy load for transmitter testing, quality pre-owned equip from our rental inventory. Call Steve or Chuck, Radio Resources, 1-800-547-2346.

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**Harris FM-35K**, 3 years, like new. 816-635-5959.

**Bext has some show units** at sale price. Full 2 yr warranty, like new. Exciters, amplifiers, STL's. First come first served only. Call for details. Bext, 619-239-8462.

**Gates/Harris FM-2.5H3**, gd cond, 1975 mdl w/spares. 816-635-5959

**Want to Buy**

**Low pwr**, 3-10 W. J Benjamin, JC Enterprises, 3923 E Thunderbird Box 139, Phoenix AZ 85032. 602-493-5312.

**FM xmtr**, 25 kW. T Noordyk, 616-924-4700.

**Late model FM xmtr**, 500 & 1000 W, stereo gen. R Murphy, 602-855-1051.

**Continental** for 10 kW TPO, might consider clean 10 kW Harris in gd cond. D Dayton, Dayton Brcdst, 1907 Lincoln Ave, Mendota IL 61342. 815-538-4681.

**FM exciter**, any make/model, must work & have manual, offering \$100+shipping. B Elliott, 6709 Ridge Rd 300B, Ft Richey FL 34668. 813-849-3477.

**FM xmtr**, 10/20 K, gd wrking order, remote control wired, sm budget but will consider leasable box. Brian, WVNW, 603-742-8575.

**Used 10 K xmtr**, '80/late preferred, all makes considered. B Aldeich, WLNG AM/FM, Box 2000, Sag Harbor NY 11963. 516-725-2300.

**CCA/McMartin 5-10 kW FM** xmtr, up to 15 yrs old, units in disrepair accepted at lwr negotiable cost. R DuFault, WSBY, 1308 White Way, Laurel MD 20707. 301-792-0851.

**UHF/VHF TV translators**, 10-100 W, will consider old UHF band 70-83 equip; RCA TTU-2A/TTU-10A UHF TV xmtrs for parts; GE TT-24-A, 100 W, or TT-20-A, 1 kW, UHF TV xmtr for parts. J Powley, WIIM TV, 1536 Logan Ave, Altoona PA 16602. 814-944-8571.

**RCA BTF-10E1 & BTF-20E1** wanted for parts. W Florian, WNIB, 1140 W Erie, Chicago IL 60622. 312-633-9700.

**McMartin AM/FM** xmtr, any model, exciter or stereo modules. Goodrich Ent., 11435 Manderson, Omaha NE 68164. 402-493-1886.

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## TUBES

**Want to Sell**

**Eimac 4CX10,000D/8171** xmting tube, s/n 2DV825D, new in '82, never used, bright silverplate w/no marks, in orig box, BO. K Eilert, KWED, 609 E Court St, Seguin TX 78155. 512-379-2234.

**Penta premium output tubes:** KT88, \$25; KT99, \$49, EL34(HD), \$12; custom match & quan \$ avail; also, fabled 12AX7B. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 213-859-5543.

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**RCA/SYL/GE**, 32 pieces, also carbon resistors; Canon plugs, 3 prog male & female, new; Lafayette TE22 audio gen; Sencore transistor & diode tester. Mr. Oliver, 212-874-7660.

**Tubes, Transformers**, filter capacitors, receiving tubes, \$5.00+up; 500 watt modulation transformer, \$50.00. Madison Electronics, 1-800-231-3057.

**Want to Buy**

**6072/6072A**, any quantity, send brand # & \$. R Katz, Allegro Sound, 15015 Ventura Blvd, Sherman Oaks CA 91403. 213-859-5543.

**RCA 6181 & 8501**, & GE GL-6183, used as final in RCA & GE UHF TV xmtrs. J Powley, WIIM TV, 1536 Logan Ave, Altoona PA 16602. 814-944-8571.

## TURNTABLES

**Want to Sell**

**Russco Cue Master** TT pair, incl tone arms & cart, \$245/both. Davis, MCP, POB 521, Newberry SC 29108. 803-276-0639.

**Technics SL-3200** direct drive manual TT (2), w/arms, \$75/BO; (2) Russco stereo broadcast preamp, \$150 ea/BO; all for \$400; also, (2) Russco TT w/arms, no cartridges, \$40 ea/BO. B Williams, KPSM, 2009 W Gary, Broken Arrow OK 74012. 918-455-9522.

**SP10 MK 2A** TT, PS, 16" Rek-O-Kut tone arm, Stanton carts, for custom mounting, \$400; Op Amp Labs TT preamp for (2) TTs, to +4 dBm, w/pwr supply, \$200. L. Beigel, On-Cue-Rcording. Call/fax: 800-726-9813.

**Technic SP-15** w/EPA-A501H tonearm & solid cherry based dust cover, excel cond, \$900/BO. P Barzizza, KJBR, 603 Madison, Jonesboro AR 72401. 501-935-5588.

**Russco 2-speed** (2), \$100 ea/\$175 both; (2) QRK 3-speed, \$100 ea/\$175 both; \$300/all. G Erway, KKSBB, POB 40309, Santa Barbara CA 93140. 805-568-1444.

**Russco (2)**, vgc, w/tone arms, \$50 ea+shipping. D Morgan, KNZZ-KJYE, 1360 E Sherwood Dr, Grand Junction CO 81501. 303-241-9230.

**QRK w/Micro Trak** arm, \$125+shipping. J Deering, Great Com, 114 Walton Ferry Rd SE #B, Hendersonville TN 37075. 615-264-2886.

**Presto 6N** disc cutter, 78/33-1/3, perfect cond, \$600. B Rose, Program Rcrding, 228 E 10th St, NY NY 10003. 212-674-3060.

**Want to Buy**

**Fairchild disc rrdng equip**, #740 & similar, Gramplan/Gotham, Neumann, Presto, Rek-O-Kut, RCA; also, accessories incl amps, limiters, heads, manuals, needles; also, disc cutting equip by same mfrs. K Gutzke, 7134 15th Ave S, Minneapolis MN 55423. 612-866-6183.

**Micro-Trak 303** tone arm in wrking cond. J Kimple, WMCO, Stormont St, New Concord OH 43762. 614-826-8376.

**RCA 70-D** spare parts & service manual; Gates CB-11 floor cabinet; RCA BQ2A 76 & Gates CB11 spare parts & manuals; Gray SP-800 tone arms. L Scott, POD 1449, Highland City FL 33836. 813-533-4654 eve.

**Rek-O-Kut CVS 12/125**, prefer w/16" arm. R Caldwell, WTVF, 474 Jas Robertson Pkwy, Nashville TN 37219. 615-244-5000.

**Ramco ESP38** pickup preamp EQ, want (2). R McDonald, Mission Rcrding, 5231 Horton, Mission KS 86202. 913-722-2677.

**Technics SP-15** 3-speed TT in excel cond, w/ or w/out tone arm. L Van Luven, WGMC, 60 Rochelle St, Rochester NY 14612.

**Fairchild disc rrdng equip**, #740 & similar, Presto, Rek-O-Kut, RCA, etc; also, accessories incl amps, limiters, heads, manuals, needles. K Gutzke, Custom Rcrding, 7134 15th Ave S, Minneapolis MN 55423. 612-866-6183.

**Technics SL-1200**, cartridge not nec. J Messenger, KZMX, Box 611, Hot Springs SD 57747. 605-745-3637.

**Rabco SL-8E** straight-trking tone arm in gd cond. R Meyer, Benchmark Comm, 4700 SW 75 Ave, Miami FL 33155. 305-264-5963.

## TV FILM EQUIP

**Want to Sell**

**RCA FR35** 35mm film proj, variable speed, gd cond, \$7500. J Kiss, Multi Video Grp, 50 E 42 St, NY NY 10017. 212-986-1577.

**Strand Century '81** lighting pantograph (4), new, \$40 ea; Sylvania studio lamps: (9) EGK, (1) BTL, (1) EHK, (4) Colortran 176-018, (1) 176-022, \$5 ea. A Ross, 8022 27th NE, Seattle WA 98115. 206-525-4624.

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Want to Buy

ND Filter Wheel assembly for automatic light control on telecine film chain, must reference to video output of film chain for level control & have optional manual override. K Knowles, Knowles Video, POB 12127, Tallahassee FL 32317. 904-878-2298.

VIDEO PROD EQUIP

Want to Sell

Sony CUM1250 12" color video mon w/UHF-VHF tuner, A/V I&O, excel cond, \$300/BO. R Glenn, WJGR, 1718 Shannoo, Wimauma FL 33598. 813-634-1940.

VIP Hybrid-8 SEG, video dup-proc w/hybrid digital video effects, A/B, split screen, wipes, dissolves, 6 spec effects, auto fades, enhance, more, \$395. Davis, MCP, POB 521, Newberry SC 29108. 803-276-0639.

Klieg lrg studio lights (100), 2 & 5 K, fresnels & scoops, w/hooks, \$150 ea. U George, Ugly George Satellite TV, 314 W 52 St, NY NY 10019. 212-969-0240.

Panasonic 2022 laser video disk recorder, uses 5" laser disk, 1 side records up to 12,000 images, digital read out, excel cond, \$3000; Aquastar III bright projector, 500 lumens, remote, extended cable, \$2800. Jaye, Nimbus Prod., POB 5903, Takoma MD 20912. 301-507-3358.

QVS Mini Prompter tele prompter, portable, almost new, carrying case, tripod & camera bracket, cable control, pwr supply, built-in light, \$1500. Jaye, Nimbus Prod., POB 5903, Takoma MD 20912. 301-507-3358.

Channematic Spotmatic Jr (3), w/Net-Share 4-chnl switcher, cable & insertion equip, \$1150 ea; Tele-Engineering Ad Cue Jr cable ad insertion controller, \$1000. R Stone, W-AIR, 322 Bay St, Petroskey MI 49770. 616-348-2000.

Trompeter JSI-24W/J3, RCA type, 24-jack video patch panel w/(12) looping plugs & (4) patch cords, excel cond, \$200. A Ross, 8022 27th NE, Seattle WA 98115. 206-525-4624.

Laird CG-7000 charac gen w/(3) fonts, \$1000. J Soyk, Soyk Adv, 525 Main, Lewiston ID 83501. 208-746-8134.

Want to Buy

Sony BVE-500 & RM-430 edit controllers. U George, Ugly George Satellite TV, 314 W 52 St, NY NY 10019. 212-969-0240.

VIDEO TAPE RECORDERS

Want to Sell

Sony 3/4" U-matic top loaders: VP-1000, VP-1200, VP-2000, VO-2630, VO-2800; editing controllers BVE 500, BVE 500A (A/B roll); (6) 1/2" EIAJ recorders & players; Ampex Quad VR1200B parts inventory; all BO. J Krepol, RNDL, 7 Dustin Dr, Wilmington DE 19703. 302-798-4076.

Sony VO-5600 3/4" U-matic R/P, excel cond w/manual, \$900. R Sumner, CAVU Corp, 3322 Applegate Ct, Annandale VA 22003. 703-560-0233.

Sony LDP-1000A indust laser video disk player for CAV & CLV disks, RS232C serial port for computer interface, w/remote & flight case, excel cond, \$500. J Krepol, RNDL, 7 Dustin Dr, Wilmington DE 19703. 302-798-4076.

JVC CR-4400-LU portable 3/4" U-matic, \$600; Sony SLO-340 portable industrial beta w/pwr supply & soft case, lw hrs, \$500. D Bailey, Rock Shoppe Prod, 3422 Beech St, Rowlett TX 75088. 214-475-9796.

JVC RM-86U VHS pro editing system, edit controller, edit deck BR-8600U, hi fi stereo video recorder BR-7700U, cables, lw hrs, \$3000. Jaye, Nimbus Prod., POB 5903, Takoma MD 20912. 301-507-3358.

JVC RM86U, CR8250, CP5550 3/4" edit system, w/(2) JVC TM41 mon, cables & manual, excel cond, \$4000. Gene Sive Prod, 619-749-7662.

Panasonic 3/4" edit system: NV-A950 controller, (2) NV-9500 edit machines w/cables, fair cond, \$1000. J Soyk, Soyk Adv, 525 Main, Lewiston ID 83501. 208-746-8134.

JVC RM86U, CR8250, CP5550 3/4" edit system, w/(2) JVC TM41 mon, cables & manual, excel cond, \$4000. Gene Sive Prod, 619-749-7662.

IVC (B&H) 800 1" helical, excel cond, \$100. A Ross, 8022 27th NE, Seattle WA 98115. 206-525-4624.

# Remember to Protect Primary Station Signals

by Howard L. Enstrom

**MOUNT DORA, Fla.** I talk with a lot of people around the country about translators, discussing in particular coverage provisions of the FCC Rules.

I have to be careful not to mislead, because translators must not interfere with protected contours of other stations. Callers also want to know about costs. Cost is variable, depending on the kind of antenna hardware needed to serve a community, yet afford protection to other signals.

Many seem preoccupied with attainment of the greatest coverage, while assuming too much about reception of the primary station signal.

This month I will discuss that matter.

## Primary station signal

First, it pays to be sure about the primary station signal, especially with long paths. Field strengths over a site can fluctuate widely with the time of day, season and under weird propagation conditions. The unpredictable may be fascinating for experimenters, but not for serious public service.

In field studies, I have seen signal disappearance begin with a long, slow fade as the sun appears more overhead. The signal field may drop 30 dB or 40 dB to 1/100th, or more. Meanwhile, reflections from whatever moves in the atmos/strata/troposphere affects the signal, causing fluctuations.

As the noise floor is approached, other stations may jump in and out—or just stay a while. Whether the translator carrier stays on depends on the muting control setting. This can be a difficult adjustment decision to make when a primary signal's level is unstable, because the translator can be triggered back on by too strong a sporadic undesired signal.

Shorter pathed reception—direct, or by reflection from a fixed mass—is at least, dependable. But the erratic can be misleading ("Now you see it, now you don't."). Checking a longer haul primary station during a high can be a real joker.

## A climatic circus

We radiate and receive wave energy within a terrestrial corridor between earth and the ionosphere, the stage for some of the greatest shows on earth.

In warmer seasons, slow-moving masses of air may entrap and redirect wave energy, as if by a conduit. Ocean areas have what is called "the coastal effect," or "signal ducting."

In polar regions, earth charging creates those magnificent auroral displays, familiar to you who live nearer such latitudes.

Then there is sporadic propagation, when signals reflect from the ionized shower trails of a meteor falling into the earth's atmosphere. Plus, of course, well-known reflections from artificial surfaces in the atmosphere: aircraft. While those may not be a problem, such reflections also come from the moon.

Without that layered corridor surrounding our planet, there'd be no propagation disturbances—nor long-distance radio. We wouldn't need it, though, because we wouldn't be here, either.

So, if recovered audio isn't academically

sterling, think of how hard radio waves try to travel. We perceive that a signal weakens with distance, as if energy is lost. Although while within the atmosphere some energy is changed to another form, none is lost in space.

A signal is said to weaken as distance increases. This is a perception, because the "capture" area of a receive antenna is a smaller percentage of the larger illuminating area—a smaller sample of energy.

## LOWPOWER LOWDOWN

An example of the opposite is the contained wave energy in fiber optics, or concentrated as in laser beam technology. If a translator antenna intercepted such signal field, I expect it would become a vapor, if even that.

In VHF FM propagation, waves of infinitesimally low power density, having countless frequencies and sources, cut across a receive antenna. Antennas that recognize and extract the most energy from one frequency have certain physical dimensions to provide "high Q" for narrow frequency bandpass characteristics.

## A band of signals

A translator receive antenna accepts and delivers energy from a band of signals, desired or not. It's up to the translator to provide further discrimination against unwanted signals through its RF and IF selectivity characteristics.

You can see why site location strategy is very important for directional receiving antennas, yet the site has to be good for transmitting, as well. Of course, natural terrain shielding can be a plus, if it happens to shadow an undesired incoming signal.

Mounting a translator's receive and transmit antennas too closely can be risky, particularly if the input/output frequencies are only a few channels apart, and/or the primary signal level tends to be low.

Now, all transmitters and translators produce at least some spurious RF output products, called "dirt." When this happens to land on the primary station frequency, operation may cease. The same effect may be experienced by intermodulation products. This, and blanketing by higher power stations, occurs more commonly at multi-use sites. Its effect can reduce amplification by the translator.

A helical resonator or cavity-type bandpass filter is used in the translator's output to clean up its signal, if necessary. These and other types of steep-skirted filters may be used in the translator's input to narrow bandpass frequency centered on that of the primary signal.

While these considerations pertain to translator reception, FM listeners can have the same problems.

Next month—the subject of permitted outgoing interference caused by translators, and how FCC rules are structured to regulate their operation.

■ ■ ■

Howard L. Enstrom is president of FM Technology Associates. He can be reached at 904-383-3682 or by fax: 904-383-4077.

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# BUYERS GUIDE

STL, Remote & Telco Equipment

## Moseley STL Enters Digital Age

by David Chancey  
National Sales Manager  
Moseley Associates

**SANTA BARBARA, Calif.** With digital audio tapes, CDs, digital cartridges and other digital storage media making inroads toward an "all digital" radio studio, manufacturers of transmission equipment have

### TECHNOLOGY UPDATE

had to devise a means to broadcast digital audio. The ability to digitally link all key elements of the broadcast chain has made a digital STL one of the driving forces towards an all-digital radio station.

At the NAB show in Las Vegas this spring Moseley introduced the DSP 6000, a spectrum efficient CD-quality digital STL. Show attendees heard a demonstration of a working unit under simulated fade conditions, and were impressed enough to bring friends and colleagues back to hear the demo. Why? Because the DSP 6000 provides solutions to common STL concerns:

- 1) Digital transmission keeps antenna costs to a minimum, without having to upgrade to expensive antennas for longer signal path lengths. Compared to analog systems, the DSP 6000 requires 25 dB less signal to deliver 90 dB dynamic range.
- 2) Fades have no effect on signal to noise ratio (SNR). The DSP 6000 delivers its full dynamic range all the way down to the digital threshold.
- 3) The DSP 6000 can operate in existing channel allocations from 100 kHz to 500 kHz, coexisting with already established radios.

- 4) Multiple signal hops have no effect on a digital signal. With the DSP 6000, SNR, frequency response, distortion, stereo separation and crosstalk remain consistent throughout the entire signal path—no matter the number of hops. Conversely, an analog signal gains at least 3 dB of noise and distortion per hop.

At a midpoint in a repeater configuration, the DSP 6000 permits digital regeneration and/or audio to be dropped off and inserted. This makes possible a cost effective digital network with multiple program and transmission points.

- 5) The use of international standard digital I/Os allows the DSP 6000 to utilize other digital hardware and source material such as basic rate ISDN or MUSICAM. Open architecture gives the user the power to make appropriate choices, and to make these solutions work with both existing and future investments.

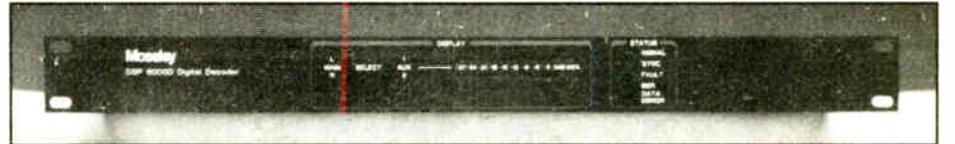
- 6) A built-in V.35/RS 422 interface opens the way for utilizing the DSP 6000 with digital circuits leased from the phone company.

The limited number of RF channels in the STL band, coupled with the need for a digital link to the transmitter, have forced some broadcasters to use digital circuits as an alternative to a traditional RF STL. Use

of digital circuits (full T1 or fractional T1) entails a monthly payment dependent on the number of time slots used for the transmission.

per channel at 32 kHz sampling rate.

A typical STL configuration might require two 15 kHz channels for stereo and one 7.5 kHz SCA channel, yielding an ag-



Moseley's DSP 6000 decoder offers XLR and AES/EU connectors, as well as data ports.



The DSP 6000 uses only a quarter of the number of time slots used by conventional digital systems. A lower data rate offers substantial savings over leased line cost. 7) The DSP 6000 accepts up to four audio program inputs, either 15 kHz or 7.5 kHz bandwidths through active balanced XLR connectors and two RS-232 data channels.

Traditionally, excessive bandwidth requirements have made the transmission of digitized high-quality programming impossible with narrowband STLs. Linear 16-bit PCM for broadcasting (15 kHz audio) requires 512 kbits per second (kbps)

gregate data rate of 1280 kbps. It is this high data rate that has made previous attempts at digital STL usage in the 500 kHz (and 300 kHz) bandwidths impractical. The required spectral efficiency suggests that complex coding techniques are necessary to squeeze the data into standard STL channels. The DSP 6000 is partitioned between source and channel encoders and decoders to reduce the burden of complexity on each component.

The DSP 6000's source coder was selected for its ability to accommodate

(continued on page 40)

## Comrex's Digital Remote Alternative

by Tom Hartnett  
CE, Comrex Corp.

**BOSTON** In the past, if you required wideband remote audio feeds, your options were limited to satellites, RPU radios, dedicated phone lines (a dying breed) or dial-up phone lines with frequency extenders.

Recently, new techniques of high-quality audio transmission have been introduced using digital audio compression. The Comrex 7.5 Digital Audio Codec uses digital networks and carries 7.5 kHz bandwidth audio in full duplex.

### TECHNOLOGY UPDATE

For those not up on digital audio compression, the heart of the codec is a digital signal processor. This high-speed computer chip converts Pulse Code Modulation (PCM) to Sub-band Adaptive Differential PCM. The net result is more audio information in less data.

The Comrex codec uses CCITT G.722, the only internationally standardized, non-proprietary audio compression algorithm of this type to date. This means the codec can communicate with any other device using the same standard.

The most common application for the codec requires installation of special digital telephone lines. The Integrated Services

Digital Network (ISDN), the much touted and long awaited "telephone system of the future," has yet to be realized in most places in the U.S. What is available is a

"pre-ISDN" service called Switched 56.

Once installed, these services can be dialed and connected much like your

(continued on page 52)

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Also: A Special Report from In-traplex; and information from Dolby Laboratories.

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# Burk ARC-16 Solves WTIC Woes

by Thomas R. Ray III  
CE, WTIC-AM/FM

**HARTFORD, Conn.** WTIC's Burk Technology ARC-16 remote control consists of a studio head and two remote units. The studio head is eight-channel capable, while each transmitter head is 16-channel capable. The studio head sends its commands via wired modem to a Moseley 152 kHz subcarrier generator, and is carried to the transmitter site on the FM STL. The FM control head takes the recovered 152 kHz signal directly from the STL.

The FM control head communicates

with the studio via its own internal 152 kHz subcarrier generator, which is sent to the studio via our second Inter-City Relay Link. The AM control head communicates to the studio through the FM control head via wire link between rooms.

The studio head interfaces to our studio complex through a standard PC. The program provided with the ARC-16 loops the data from the studio head through to a second computer.

One computer is dedicated to the AM, and provides a CGA composite output to the Channel 2 modulator, while the other is dedicated to the FM, and provides a

CGA composite output to the Channel 4 modulator.

Since we look at two sites, the display also tells the operator that he or she is

## USER REPORT

looking at the "AM-1080" site. Operation of the control head is easy, and the operator can easily switch between sites to accomplish the tasks.

The computer interface module allows you to connect the ARC-16 to the serial data port of any IBM-compatible running the program provided with the ARC-16. We initially had a few headaches because of this.

We connected the first computer to the ARC-16, and it ran and interfaced all sites with no problems. We attempted to perform dual operation, and found that the second computer could neither send nor receive data. Burk provided us with the source code of the compiled executable program. By studying the program, I discovered that a typo had been made. DOS is not case sensitive, but Quick-Basic is.

The variable created in the DOS environment that tells the Quick-Basic program to go into dual operation had not been capitalized in the original Quick-Basic program. When the program looked at DOS for this variable, it was there, all right, but in upper case letters.

The remote modem capability and voice synthesizer have already come in handy, and have saved me several trips to the mountain. I can access the remote modem at either the transmitter (toll-call from home) or the studio, and get into any site. The voice synthesizer came in handy on a family outing when the FM took a lightning strike, locking out the plates on the transmitter.

From a pay phone, I was able to reset the transmitter, bring it up into the dummy load, interrogate the readings and put it back on the air, saving me an hour-long

trip to the transmitter site.

Being able to access the remote control with my home computer was a blessing when a power hit one morning wiped out the fuses for the main FM transmitter. I was able to access all readings (at both sites) with the computer, determine that the main AM transmitter and auxiliary transmitter were operating properly and discovered that the generator had come on line.

Engineering-wise, we can set the logging intervals for one, five, 15, 30, 60, 120 or 180 minutes between readings. If we have an intermittent problem, we can log at shorter intervals to determine which readings change when the problem occurs. By having the upper and lower limits set on key readings, such as tower current, we can tell whether the transmitter popped off momentarily during a lightning storm—the printers will print a set of readings when a limit is exceeded or when status changes.

Two-man RPU remote setups are a thing of the past. We mounted a 10 dB gain Yagi with a rotor on the roof of the building, and connected the rotor controls into the ARC-16. The signal meter from the RPU receiver is connected to the ARC-16.

One person can call the ARC-16 from a remote location and access the voice synthesizer. Once in the system, he can check signal levels to aim the transmit antenna, then use the asterisk or pound keys on the touch-tone pad to aim the antenna on the roof of the building.

This has helped free up lots of manpower and, by looking at the signal level with the ARC-16, we can determine from the remote location if the signal will be too noisy for air.

At the transmitter site, if we're working on the AM transmitter and the FM dumps, we can put it back on the air from the AM transmitter control head, instead of running across the building to the FM room. We can also switch STL transmitters from the transmitter site to see if a noise problem is coming from downtown or somewhere on the mountain.

Aside from a couple of minor start-up problems, typical with computer-based systems, the ARC-16 has performed very

(continued on page 47)

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## Moseley's DSP 6000 STL

(continued from page 39)

several application-specific requirements: quality, bit rate, delay, bit error protection, post processing capabilities and hardware implementation complexity. For "live" transmission purposes, the coding delay is a critical parameter.

The maximum tolerable delay for these applications is on the order of 10 ms. Longer delays present problems for off-air monitoring, such as when using IFB or cueing channels. The source coding used in the DSP 6000 is based on an implementation of sub-band ADPCM with linear prediction and backward adaptive quantization.

This algorithm makes no assumptions about the spectral content of the source material; others remove components based on subjective psychoacoustics. In addition, sub-band coding has excellent bit error immunity and gentle error handling.

The DSP 6000 channel coder was designed to modulate with efficient spectrum utilization. Out-of-band spectral energy is suppressed to avoid interference of the digital carrier with existing analog services.

Linear modulation formats such as QPSK or QAM will regenerate sideband

energy when confronted with non-linear Class-C amplification found in conventional FM STLs, thereby limiting their usefulness. In contrast, the DSP 6000 uses continuous-phase frequency shift keying (CPFSK), a broad class of digital frequency modulation particularly well-suited to FM transmission with non-linear amplification. This allows the user to retrofit the system to his existing Moseley STL system.

Along with high spectral efficiency, duobinary CPFSK signaling has good error performance and speed tolerance. It also enables error detection to be rapidly obtained without adding redundancies into the data stream.

With so many source choices available to the consumer, radio broadcasting's future is increasingly dependent on reaching target audiences with CD-quality audio. The DSP 6000 digital STL system allows the progressive radio broadcaster to maintain the digital audio sound he's worked so hard to develop at the studio and to convey it digitally to the transmission facility.

■ ■ ■

For more information, contact Dave Chaney at Moseley: 805-968-9621; fax: 805-685-9638; or circle Reader Service 135.

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nent quality, and superior circuit design that clearly indicates a "no guts, no glory" mentality on the part of our design team.

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World Radio History

# Call-In Technology Takes Talk Shows on the Road

by **Steve Church**  
President  
Telos Systems

**CLEVELAND** Many radio shows that make use of call-in phones are taking to the road. We see Talknet's Bruce Williams and Mutual's Larry King on location at the NAB convention each year.

"Rockline" often conducts interviews with the rock celeb subject located at a distant affiliate station. Local "Morning Zoos" take advantage of Disney World's studios and satellite link for a unique promotional opportunity, and many others use their network's facilities for far-flung origination.

These remote broadcasts have been made possible by the ubiquity and relative low cost of satellite links. While the ease of obtaining satellite connections has drawn programmers to these distant remotes, they bring some new challenges to those of us who are charged with creating the required engineering magic.

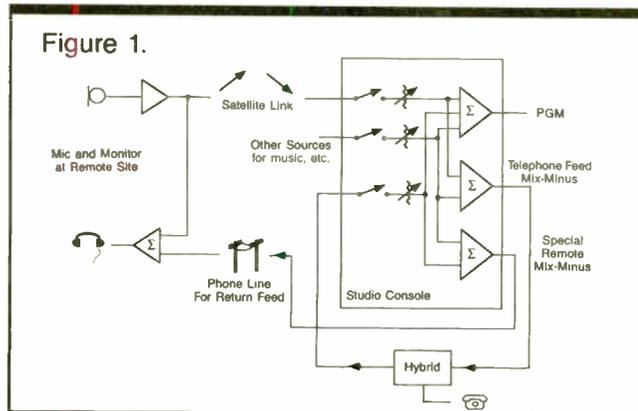
Generally, it is preferable to integrate the remote to allow the existing studio phone system and lines to be used. When the in-place system is used for the airing of telephone calls, we don't have to install special phone lines at the remote site for what is likely to be a one-shot affair. As well,

tance between the endpoints.

As you have probably observed at one time or another with the aid of the production studio MCI, when the delay reaches hundreds of milliseconds, it becomes very difficult to speak coherently. That means that we must create a return-to-talent feed that lacks the talent audio, so that the local non-delayed audio can be used for talent headphone listening. A mixing bus in the studio console dedicated to summing all of the fader sources

that are active to the program output, but which excludes the remote talent, is required.

In sophisticated consoles, an auxiliary send bus could be pressed into service for this function. With others, the audition bus could be put to the task, but only when it is possible to assign a fader to the audition and program channels simultaneously. A Henry Engineering Co. MixMi-



nus Plus adapter is another option. One input of this unit is fed the program output, while the other is given the remote feed, and the two signals are subtracted to create the desired signal.

(continued on page 44)

## TECHNOLOGY UPDATE

programmers don't want callers to have to learn a new number for each remote origination and we certainly don't want to uproot the studio telephone system.

### Discussing goals

Our goal, then, is to find some way for the telephone audio to be sent to the remote talent. At the same time, the talent audio signal has to be sent back to the callers. While this would seem a simple enough proposition, there are some complications. Let's start with the basic set-up (see Figure 1).

At the remote site, an audio mixer feeds the talent audio to the uplink. At the station end, the audio is received and brought up on a studio console fader. Since the station off-air signal is not available for monitoring, a return audio path also is required. This is generally provided by a standard dial-up telco circuit, as fidelity in the return direction is not a concern.

Here's where it starts to get a bit tricky. Because of the time delay inherent in satellite transmission, we must ensure that talent do not hear themselves "round-trip" from the studio via the delayed path. It is a generally accepted rule of thumb that a talker hearing himself via headphones will find delays of greater than 10 ms objectionable.

### Coherent speech

At the nearest, our earth-bound satellite transmitting and receiving dishes are 22,300 miles from the orbiting "repeater." At 186,000 miles per second, an up-and-down trip takes about 300 ms, a delay that varies only slightly with the surface dis-

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# Talk Shows on the Road

(continued from page 43)

This special remote "mix-minus" arrangement provides a very similar function to that of the usual telephone mix-minus bus, which continues in the normal fashion to send to the telephone hybrid interface all of the sources the callers must hear, but which now also must include the remote feed from the satellite. In consoles that have assignable sends for the phone interface system, this is no problem.

In other cases, it will be

necessary to provide some external method for accomplishing this. An additional mixer or summing system may be required. Regardless of the method, it must be made certain that the telephone hybrid's output is prevented from reaching its input.

Back at the remote site, the talent is mixed to headphones locally with a full-fidelity, non-delayed mic signal. This same mix may be used for loudspeaker monitoring for the audience at the site, or a separate

mix for the audience monitor could allow independent adjustment of relative levels with-

**It is a generally accepted rule of thumb that a talker hearing himself via headphones will find delays of greater than 10 ms objectionable.**

out disturbing the talent headphone balance. Assuming success in creating the various audio mixes and paths, we're now

ready to consider some of the more subtle issues.

A significant problem results when the telephone hybrid isn't doing a good job of preventing the send audio from leaking to its output. When this happens, the spe-

cial remote send mix-minus is corrupted. Therefore, the better the phone interface's trans-hybrid loss, the less the possi-

bility that talent is going to be confused (by engineering-related problems, anyway). If the hybrid has variable caller ducking, it could be increased to enhance effective isolation.

Another lurking trouble spot is acoustic feedback, as are the

two feedback paths in our setup. One is the usual path from the talent mics to the audience monitors; the other is the loop involving the talent mics, the audience monitors and the telephone hybrid. Again, maximizing trans-hybrid loss helps. If the hybrid has a ducker in the send direction path, this should be switched in.

## Ducking and old tricks

Particularly effective is a ducking system that has the send and receive sections linked so that a minimum loss across the hybrid is maintained. Another is the old PA trick: insert a 3 Hz or 4 Hz pitch shift at some point in the loop to prevent sustained feedback from building up by damping out any oscillations as they develop. An improvement in feedback margin of around 10 dB can be expected from this procedure.

An equalizer also can be a very good tool for reducing feedback. The acoustic path usually has a few pronounced nodes where gain is at its highest and these are the frequencies where feedback will occur. Finding and notching the appropriate frequencies can have a dramatic beneficial effect.

With a fiber optic link from the remote site to the studio, there is, of course, no satellite delay. However, MUSICAM and other similar higher-order compression schemes proposed for the encoding of audio into the digital domain have significant delays that can cause similar problems to those created by satellite links.

ISDN digital telephone lines are coming. These lines permit a "four-wire" connection to be made with the two required independent opposite direction paths being obtained with a single dial-up call. Since these are most likely to be conveyed on fiber optic cables rather than by satellite, delay will be a problem only when created in the audio-to-data coding process. Feedback will be with us for the foreseeable future.

Steve Church is president of Telos Systems, a phone interface manufacturer. For information, contact him or Trisha Ristagno at 216-241-7225; fax: 216-241-4103; or circle Reader Service 9.

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# Diplexers Reduce Costs for STLs

by Bob Paul  
Broadcast Design Engineer and  
Elizabeth Buck  
Marketing Research/Publicity  
Microwave Filter Co.

**EAST SYRACUSE, N.Y.** You may be able to cut the expense of adding STL service to your radio station by adding diplexers to your transmission line.

Say your plan is to utilize an auxiliary service band to relay data from your studio to a transmission site located 30 miles away. A low frequency service is preferable in such situations because of signal integrity over long distances. An STL, therefore, is the logical choice.

However, if you own a broadcast tower that's 500 feet high, running another coax line to add STL service could be a costly proposition. Generally, 7/8-inch flexible transmission line costs around \$8

a foot. The expense of just coax alone, excluding other materials and labor, would cost \$4,000.

In such a case, for a fraction of the cost, diplexers can be utilized to add STL service

outputs of the mobile radio and STL transmitters to combine both signals onto the transmission line. The second would be installed at the top of the tower on the end of the transmission line to split both signals to their respective broadcast antennas.

Multiband combiners provide a means of multiplexing auxiliary broadcast bands with the lowest possible insertion loss. The use of high Q cavities and components creates devices that can combine these bands with a typical loss of less than 1 dB. The units' mobile radio band features power passing capabilities. These units are fully tested and weatherized for a variety of environments.

Multiband combiners allow a single transmission line to be used for several frequency bands. The cost of the combiners must be weighed against the cost of a separate transmission line.

Where transmission line runs are long, a combiner-decombiner may be a more cost-effective approach. Since the combiner will add only a fraction to the overall system insertion loss, owners of long transmission line runs can expect no degradation of performance.

Model 6027 has dimensions of approximately 3" x 5" x 19". It is weatherized and

comes panel mounted. Connectors are type N and impedance is 50 ohms.

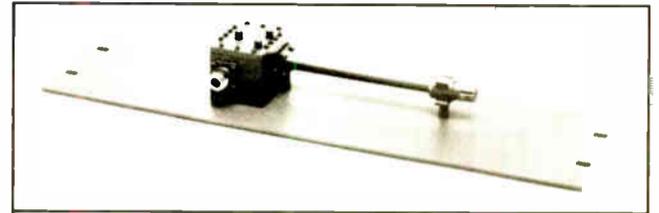
Microwave Filter Co., manufactures a variety of other diplexers and triplexers for combining multiple services to one tower. These products will combine or split any of the following band combinations: VHF/UHF radio, 0 MHz to 500 MHz; transmitter telemetry, 450 MHz to 456

## TECHNOLOGY UPDATE

to an existing transmission line. This eliminates the need for a new coax line, in addition to all the accompanying expense and hassles.

Microwave Filter Co., manufactures a Model 6027 diplexer, which combines 947 MHz to 952 MHz STL band with the 450 MHz to 470 MHz mobile radio band. The cost of the diplexer is \$990.

Two diplexers would be used at the tower site. One would be installed at the



Microwave Filter's STL diplexer may help cut the cost of adding STL service.

MHz; FM-STL, 920 MHz to 970 MHz; ENG, 1990 MHz to 2110 MHz; and ITFS, 2500 MHz to 2686 MHz.

Naturally, before adding any new service, check your options. Not all broadcast facilities are identical; neither is the installation of broadcast services. Plan carefully.

The distance between your studio and transmitter, tower height, application and cost of equipment and installation will determine whether to choose STL or another auxiliary broadcast service for communications between your studio and transmitter. If STL is the service you choose, a similar review will determine the feasibility of diplexing at the tower.

■ ■ ■

For information from Microwave Filter Co., contact Vince Cupples at 315-437-3953; fax: 315-463-1467; or circle Reader Service 141.

## BUYERS BRIEFS



**SAN FRANCISCO** Dolby Laboratories' digital aural DP5500 Series DSTL link features an all-new design, combining state-of-the-art audio coding, digital modulation and RF circuitry.

The DP5500 Series is based on a low-time delay implementation of Dolby AC-2 audio coding, resulting in superior audio quality. AC-2 provides contribution-quality audio, exceeding the requirements of distribution-quality systems.

In a spectrum comparable to narrow-band FM composite systems, the DP5500 accommodates two audio channels and two auxiliary channels.

The unit employs modular construction techniques, which permit the future provision of digital inputs and outputs and the inclusion of new developments, such as DAB technology. A "hot standby" feature will enable the broadcaster to use an existing FM STL as a back-up.

For information, contact Dolby Broadcast Technology Manager Kevinn Tam at 415-558-0200; fax: 415-863-1373; or circle Reader Service 64.

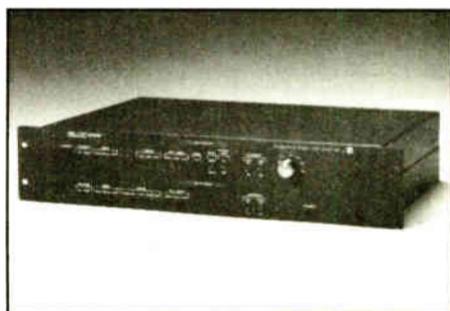
**HOLMDEL, N.J.** The CCS CDQ/2000 multirate digital audio codec combines digital signal processing technology with proven non-proprietary ISO MPEG MUSICAM audio compression.

Features allow the user to completely manage the classic digital bandwidth versus audio quality problem by matching audio bandwidth with available digital facilities.

The CDQ can provide 20 kHz of high-quality stereo audio in as little as 112 kbits of digital bandwidth. Unlike fixed-rate digital codecs, the CDQ provides eight-switch selectable digital rates, each designed to optimize the use of available digital facilities.

The CDQ/2000 is available in encoder, decoder and encoder/decoder pair configurations.

For information from Corporate Computer Systems (CCS), contact David Lin at 918-946-3800; fax: 908-946-7167; or circle Reader Service 74.



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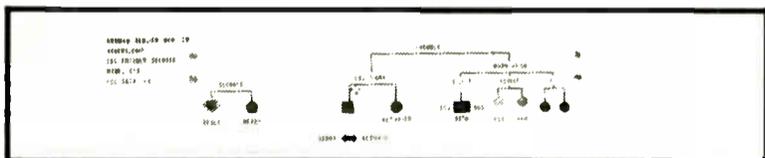
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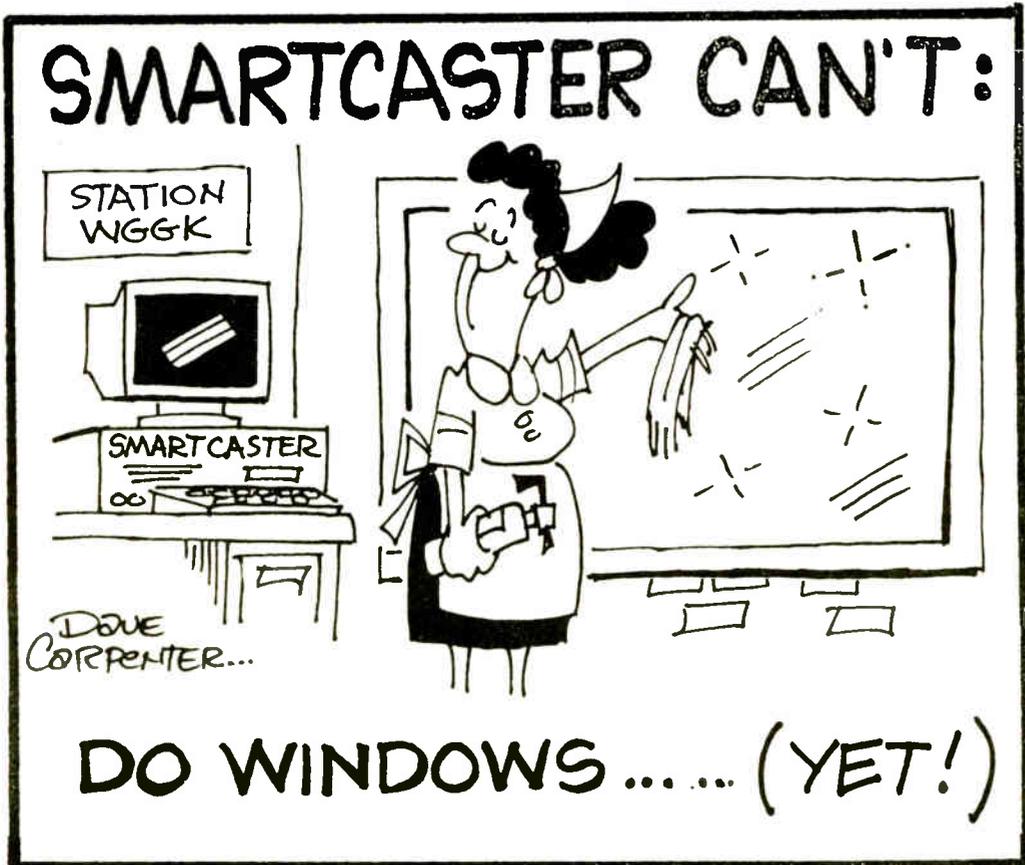
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World Radio History

# UPI Radio Selects CCS Micro56

by Sam Brown  
CE, UPI Radio Network

**WASHINGTON** Ten years ago life was simple. If you needed an equalized line from anywhere, to anywhere, you called the Bell System.

Then the Bell System went away, then the reasonable prices went away—and in some places, the equalized lines went away.

"Ma Bell" can still help if the circuit is within your LATA, a limited area where Bell still is allowed to provide communications services. Options are more limited when lines are needed out-of-town, or in some cases, locally if your area is in more than one LATA.

Markets split by LATA boundaries include New York, Washington-Baltimore and Philadelphia. To find out what your

now is being introduced everywhere else.

Until about two years ago, 7.5 kHz audio required digital bandwidth of three or four 56DDS circuits. Some European companies were developing compression techniques for a new standard (CCITT G.722) to compress the data such that only one 56DDS would be needed. But this still seemed far off to UPI and the other network broadcasters who needed the service.

UPI contacted Bellcore (the phone company's research organization), other broadcasters and representatives of the European companies to increase North American awareness of this new technology. We were actively working to bring together the media, telcos and equipment manufacturers.

Finally, a 56DDS/7.5 kHz device was offered for U.S. sale by AETA, a French company. These early units were large and expensive, designed primarily for telco C.O. use. It wasn't until Corporate Computer Systems (CCS) got into the act with its Micro56 that G.722 equipment came within reach of most broadcasters.

to the software, thus it does not require telephone company adjustment.

Most importantly, subjective, careful listening is the ultimate test of any new

## USER REPORT

audio product. On that score, the results are best summed up by the fact that UPI Radio, ABC, CBS, NPR and other networks all use the Micro56. We even use the device for our main feed to the Space-net III satellite.

The digitizing algorithm used was designed primarily for high-quality voice transmission, which it handles quite nicely. Music also sounds good, subject to the limitations of the 7.5 kHz bandwidth. At some frequencies, tone will sound somewhat marginal, but it is never degraded beyond recognizability by tone detecting circuits. Since very few radio formats involve playing tone, you should

find an extremely useable and pleasant timbre suitable for any airwaves.

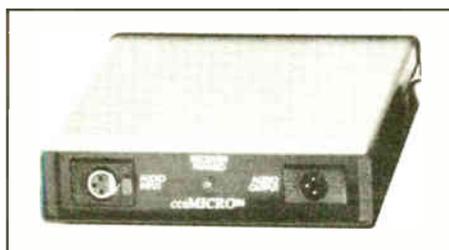
### Digital made easy

CCS has made the Micro56 easy to use, with only input, output and a sync indicator on the front panel of a box measuring only 4x19x20 cm and weighing about a kilogram. On the rear is a V.35 data connection, an alarm contact closure on a mini-jack and a DIN plug for power. The power supply is a separate small unit, but is included in the purchase price.

With a price tag of \$2,150, the Micro56 is relatively affordable, and certainly the only product of its kind in this price range. It needs to be used with a special modem called a CSU. These generally are less than \$600 for leased line applications, and cost \$800 to \$1,800 for switched.

A V.35 data cable, at \$150, also is needed. Compared to the cost of other high-quality transmission methods, the price of the CCS and related equipment seems eminently attractive.

For information from Corporate Computer Systems (CCS), contact David Lin at 918-946-3800; fax: 908-946-7167; or circle Reader Service 25.



The Micro56 from CCS utilizes a 3:1 compression ratio.

LATA includes, check the front of any telephone book's White Pages.

Outside the LATA, digital services are purchased from long distance carriers. These lines may either be set up as point-to-point leased lines or as switched services. Leased facilities are full-time circuits, connected on a point-to-point basis.

Switched service can be used to provide a temporary high-quality connection for remotes, newsgathering or emergency back-up. "Switched 56" is like a digital telephone call. ISDN is a similar switched service widely available in Europe, and

### Does it really work?

Assuming something is traded off in the process of 3:1 data compression, all of us in network radio wanted to know what this new toy would do. Would it actually sound as good as analog? Would it rival CDs? Could it match the sound of satellite transmission?

Answering these questions requires measurements. The Micro56 consistently meets all of its specifications. With a noise floor of -60 dB and clipping at +18 dB, a 68 dB signal-to-noise (S/N) ratio is easily achieved with 10 dB headroom. Response is extremely flat over the entire 20 Hz to 7.5 kHz band.

In digital audio there is no degradation before clipping, so the full dynamic range is useable. Proper equalization is inherent

## Burk Solves WTIC Woes

(continued from page 40)

well for us. I find that when I've had problems, the company has been willing to help me out, and to listen to my comments/suggestions regarding minor improvements to the unit or the operating program.

The documentation that comes with the ARC-16 is slightly lacking in detail, and I found a few of the instructions not clear enough. A quick call to Burk got me on the right track within five minutes. The service is excellent. The company doesn't recommend modifying the operating program, but is willing to help you out if you wish to know what potential harm your modification could cause.

With the Burk ARC-16, all of our remote control objectives have been met. The unit communicates to itself via the STL and ICR links, uses one studio head with two transmitter heads, accommodates two computers, has plenty of telemetry and control channels, interfaces to the studio equipment, has a voice synthesizer, communicates with home PCs and is simple to operate.

Overall, I think this was one of the smarter engineering purchases we made at WTIC this year.

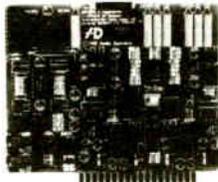
For information from Burk Technology, contact Phil Halter at 508-433-8877; fax: 508-433-8981; or circle Reader Service 54.

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# Choosing a Digital Telco Link

*Editor's note: Digital telco links have the potential to far exceed the performance of good analog systems; these days, overall cost-performance trade-offs favor digital in many cases. But what type of digital system is best? Intraplex Inc., offers the following Special Report, comparing discrete and composite digital audio.*

**LITTLETON, Mass.** While the potential performance of digital STLs exceeds analog systems, until recently, digital STLs

## SPECIAL REPORT

were much more costly than their analog counterparts.

Now, however, cost comparisons are not nearly as biased toward analog as in the past, so the overall cost-performance trend favors digital systems and should continue to do so.

Digital transmission links do not have unlimited bandwidth, but their capacity can be sufficient for transmission of high-quality, digitally coded STL audio. A

digital T1 line, for example, available from many telephone companies, has enough bandwidth for transmission of a digitally coded 15 kHz stereo signal with additional capacity for SCAs, SAP channels, telephone circuits or data channels.

A T1 line also is a two-way link with equal bandwidth in both directions, so capacity is available for TSL circuits as well.

More than one type of digital T1 STL is available—discrete and composite are two in use today.

### Discrete digital audio

The discrete digital audio STL in Figure 1 separately encodes each left and right channel at the studio. The digitally coded data from each channel is then combined or multiplexed with the coded data of other channels and transmitted over the digital transmission link

to the transmitter site.

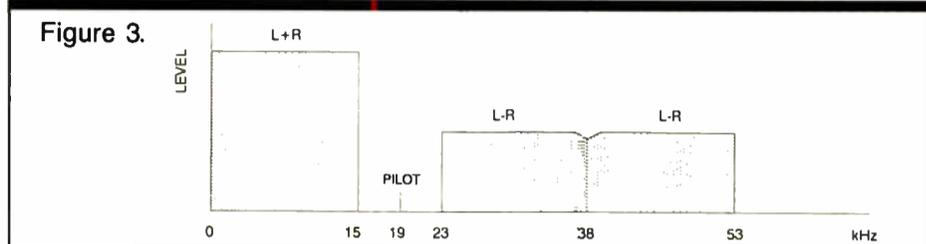
At the transmitter site, the signal is demultiplexed into individual channels, and left and right channels are applied to the stereo generator that feeds the transmitter.

If a T1 line is used as the transmission link, full 16-bit linear coding (desirable because it provides CD-quality audio) can be used for both the left and right channels. The multiplexed signal with this discrete coding of left and right channels will occupy only a portion of the T1 transmission capacity.

Twenty-five percent of the T1 capacity remains for SCAs, SAP channels, data channels and telephone circuits. While a one-way link is shown in the figure, T1 lines offer two-way transmission so capacity is available for TSL

appear in both the L+R and L-R components of the composite frequency spectrum as shown in the figure. This format is compatible with both monaural and stereo receivers, but it requires about 80 per-

cent more bandwidth than discrete channels. Even with this coding, additional channel capacity is still available on a T1 discrete STL without affecting performance of the stereo audio.



cent more bandwidth than discrete channels.

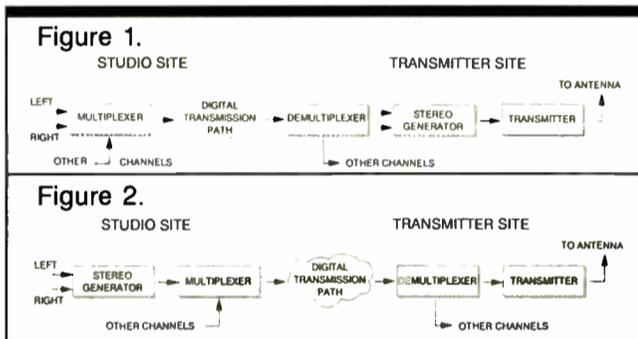
Composite digital STLs must use reduced coding to fit within the bandwidth of the T1 line. Fourteen-bit linear coding is possible if no other channels are required, but performance is reduced compared to the 16-bit coding of a discrete STL. If additional channels are added, the composite coding may be reduced even more to make room for them—with a further decrease in performance.

### Discrete/composite comparisons

Composite STLs offer more convenient access to the stereo generator, since the generator is located at the studio for the composite link and at the transmitter for the discrete link. This is useful if frequent adjustment of the generator is required.

Peak levels and headroom also are typically lower in a composite link since amplifiers and coders must handle the composite signal rather than individual channels. Besides better sound quality for the discrete STL, coding and transmitting

(continued on page 51)

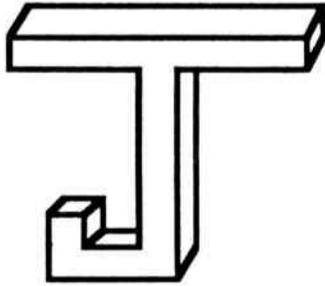


circuits as well.

For the composite digital audio STL in Figure 2, left and right channels are applied to the stereo generator at the studio end of the link. This composite signal is then encoded and multiplexed with the coded data of other channels for transmission over the digital link to the transmitter site. At the transmitter site, the demultiplexer recovers the composite signal, which is applied directly to the transmitter.

Full, 16-bit linear coding of the composite signal cannot be used, since the bandwidth of the composite signal is much greater than both discrete channels, and 16-bit composite coding would exceed the capacity of a digital T1 line.

Figure 3 shows the composite signal. The FM composite signal contains redundancy because the left and right channels



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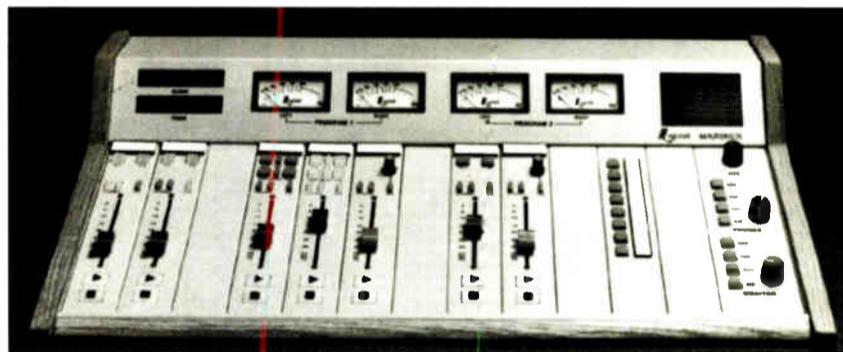
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# JNS Takes the Modular Route

by John N. Stannard  
VP, J.N.S. Electronics

**SAN JOSE, Calif.** The modular concept is not new. However, the availability of a large number of different purpose modules in one mounting configuration, specifically for broadcast needs, is new.

## TECHNOLOGY UPDATE

The 8000 Series Rack Frame from J.N.S., currently provides some 20 different modules—that is, 20 different functions. This product originated in Australia, and has been in use there for more than a decade. At transmitter sites, a frame concept minimizes rack space requirements and simplifies installation.

Of more importance to the station engineer is maintenance. A single rack frame couldn't make it simpler. With modules in one location, if a problem occurs, trouble-shooting is easier. Interconnect between functions becomes interconnection between modules.

### Making friends

The extender card can become a new friend. If the module must be fixed, it unplugs and goes on an extender card for servicing.

The following is but one configuration of the Rack Frame that is in use at a number of stations throughout Australia.

Upon entering the transmitter site of 3MMM in Melbourne, all control, audio, auxiliary and STL equipment is mounted in three rack cabinets. The modular system (see photo) is providing RF demodulation, audio monitor amplifier and automatic program audio changeover functions.

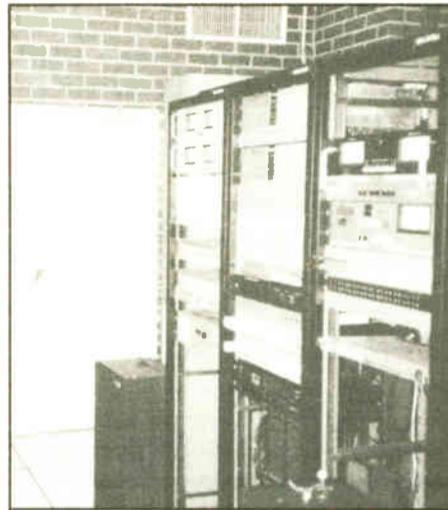
All this is accomplished in one 5¼-inch rack frame. 3MMM is an FM station, operating in stereo. Because of its dominance in the market, loss of air time cannot be tolerated. The station maintains three program paths: main aural STL, backup aural STL and local (transmitter site) tape source.

For ease of feeding monitoring and backup transmitters, audio distribution amplifiers are used. These are combined with the stereo audio feeds from both the STL receivers. Audio failure modules monitor both audio sources. These, in turn, are used to activate the program changeover module.

With the failure of both external sources, the changeover module selects the local emergency audio. When this source is tape (cart, etc.) or CD, the changeover module provides an output to start that source. An order is established within the changeover module for switching. In the case of 3MMM, the main STL is the primary source.

Next is the backup STL. Both are fed

simultaneously at the studio. If the main STL fails, the backup is selected by the changeover module. If the backup STL fails before the main STL, the changeover module goes directly to the local source, should the main STL fail.



Equipment rack cabinets house the modular JNS system at 3MMM, Melbourne, Australia.

With the availability of frequencies being greater than in the U.S., 3MMM has the luxury of the two STL systems operating on separate, different frequencies. If the main STL fails (path fade, as an example), the audio is automatically selected from the backup STL.

If the main STL returns, the changeover module automatically returns to

that feed. The desired priority for program audio source is set at installation, and the priority is automatically maintained through these three levels. The changeover module always goes to the highest level of audio available. The audio monitoring is rather straightforward.

An RF demodulator feeds a four-in by one-out stereo audio switch module. The switch module allows for selecting the four sources shown. The audio input to the switch module is bridging, providing isolation. Speaker and headphone levels are supplied by a monitor amplifier module.

### Remote controllable

It should be noted that the switch module can be remote controlled. This permits the use of a transmitter remote control system to select the monitored audio. If a return audio feed exists, this module can be used for both local and remote select.

Some stations have used the switch module to select between various audio processors. With the remote capability, the transmitter remote control system is then used for studio selection of processing. This permits the program director to select his transmitter site-located processing to be compared.

So, why modules? They provide the most overall affordable solution: Less rack space is needed, they take less time to install and they are easier to maintain. The result is a "plug-in" equipment environment.

■ ■ ■

For information, contact John Leonard at J.N.S. Electronics at 408-729-3838; fax: 408-926-1003; or circle Reader Service 124.

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# TFT Introduces a Low Cost Mono STL Unit

by Peter Kalenak  
Eastern Regional Sales Manager  
TFT

**SANTA CLARA, Calif.** In August, TFT Inc. announced it would make available a new frequency synthesized mono STL. The 9160/9167 is designed for single channel as well as redundant dual channel stereo operation.

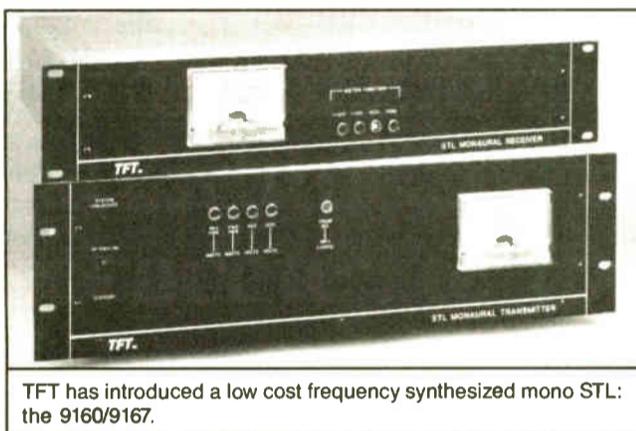
Frequency synthesized for ease of field servicing, the transmitter/receiver combo is available in RF bands 800-960 MHz, 450-480 MHz, 300-340 MHz, 200-240 MHz and 140-180 MHz. An optional MUX/service channel is available.

Performance statistics include 7.5 W RF output (800-960 MHz), and 15  $\mu$ V sensitivity at 50 dB SNR. Operations for both 200 kHz and 100 kHz channel spacing is possible.

Meanwhile, the Model 8900 booster/Reciter system recently installed in Los Angeles has successfully linked two Class A FM stations, enabling them to transmit the same synchronized frequency throughout the L.A. Basin. In May, KSRF/KOCM were united under the same handle, MARS-FM.

"The booster/Reciter helped to create a new signal in the L.A. area that was not there before and helped write a real success story for our sales department," said Frank Martin, the combo's DE.

TFT's booster/Reciter system also helped WYYD in Lynchburg, Va. The problem was getting WYYD's signal over the Blue Ridge Mountains (which shadowed the important market of Roanoke) and into the valley.



TFT has introduced a low cost frequency synthesized mono STL: the 9160/9167.

Four years earlier, a competitor's booster system was installed. With it, overlap areas of non-synchronized signals between

## TECHNOLOGY UPDATE

the main transmitter and booster were generated. Inexpensive radios without automatic gain circuitry received signals that were very scratchy. Listeners were tuning out.

After a system study, an application for TFT's booster/Reciter system was considered feasible. WYYD gave the "go-ahead" to install the synchronous system. After the system was fine-tuned, WYYD found the TFT booster/Reciter system increased sound quality by 75 percent to 80 percent in the problem areas. The signal in Roanoke is now clear enough that WYYD is not concerned about people tuning out as they had before.

For information from TFT, contact your local TFT dealer, or call TFT directly at 408-727-7272, fax: 408-7272-5942; or circle Reader Service 106.

# Choosing Telco Links

(continued from page 49)

discrete channels absolutely assures that stereo separation will not be affected; composite processing can degrade channel separation.

This is clear when comparing discrete digital with a composite transmission process. Recalling that the left and right channels are developed from the composite by adding and subtracting the (L+R) and (L-R) components of the composite signal, then

$(L+R)/2 + (L-R)/2 = \text{Left Channel}$ , and  
 $(L+R)/2 - (L-R)/2 = \text{Right Channel}$

For a composite signal with 1 dB gain differential, a factor of about 0.9 between the L+R and the L-R signal, then,  
 $(L+R)/2 + 0.9(L-R)/2 = 0.95L + 0.05R$ , and  
 $(L+R)/2 - 0.9(L-R)/2 = 0.95L + 0.05L$ , and a portion of the unwanted channel has been introduced into the left and right channels. Stereo channel separation has degraded to  $20\log(0.95/0.5)$ , or 26 dB.

If this same 1 dB gain differential error were introduced by the discrete link, then

$(L+0.9R)/2 + (L-0.9R)/2 = L$ , and  
 $(L+0.9R)/2 - (L-0.9R)/2 = 0.9R$ .

Even though the gain differential is

maintained, separation is not affected because no unwanted channel appears in either left or right channels.

A six-degree phase differential can be shown to give similar results; that is, there is a degradation to about 26 dB for the composite system and no stereo channel separation degradation for the discrete system.

Thus, while the choice of STL depends on many factors, performance and price are usually key. Digital systems often have led the performance race and, recently, costs are comparing favorably.

More than one digital approach is possible, however, and this review only confirms what already is known—it is better to minimize composite processing as much as possible to improve performance.

Discrete digital transmission, a performance leader once thought to be too expensive to be practical in many applications, now is coming within range as an option.

For information on Intraplex, call Christine Doyle at 508-486-3722; fax: 508-486-0709; or circle Reader Service 152.



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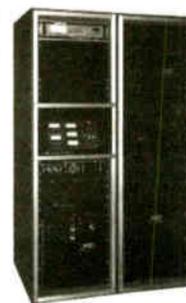


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# Affordable Fiber Optic STLs

by Dan Talbot  
President, T-TECH Corp.

**HUDSON, Mass.** Compared to RF STLs or phone lines, a fiber optic STL may seem extravagant. But aside from delivering the best audio, it can be very affordable.

A complete 900 MHz STL (transmitter, receiver, antenna) for broadcast audio can cost a station more than \$10,000 for one "hop" (more if line-of-sight is unavailable). If digital audio is provided, audio SNR will be better than analog.

But bit-rate compression must be used

since, at 900 MHz, the FCC limit on bandwidth precludes normal non-compressed digital-audio. With any type of digital transmission, bit errors can occur.

The T1/DS-I digital-audio modem is a step toward higher audio performance than that obtained from RF STLs. The advantages are: high SNR digital audio without bit-rate reduction, and use of copper T1 data lines leased from the telephone company, resulting in little installation involvement by the broadcaster.

Unfortunately, the T1 system was created mainly for data, not audio. Acceptable bit error rates, for example, were chosen with

computer applications in mind. Without error correction, the program audio could be accompanied by snaps and pops.

## Monthly lease charges

Above the actual T1 modem equipment costs, the monthly lease charges for the T1 service vary according to distance from a central office: \$200 to more than \$1,000 a month at each end. Since broadcasters often encounter different telephone central offices between studio and transmitter, a typical station's cost is nearer the high figure.

In 10 years (120 months) a broadcaster can spend more than \$120,000. The cost of operation rises with time so that even ignoring inflation, cost is very low at first but extremely high long-term.

T-TECH's FOA-1T/R professional fiber optic audio link was designed to provide high-quality digital audio with 100 percent bit error detection and correction.

The cost of the T-TECH link is \$6,800 for eight program channels (four left, four right, and four SCA or signalling). With cable and installation costs, a 20-mile outdoor system of four fibers costs \$100,000 one-time, and can expand to a larger number of channels by merely adding modems.

A two-mile four-fiber STL costs about \$28,000. Fiber and installation cost decreases with shorter distance, but the required electronic equipment does not.

Performance in the presence of rain and multipath can render 23 GHz unreliable. This is especially true for lower-power installations or large distances between studio and transmitter.

## TECHNOLOGY UPDATE

The costs of a true microwave STL are only moderately higher than those for a lower frequency (900 MHz) RF STL. Both STL types usually require direct line-of-sight between studio and transmitter, with the 23 GHz type being even more critical. If several hops are required, the price may actually favor a T1 or fiber optic STL.

## Phone companies

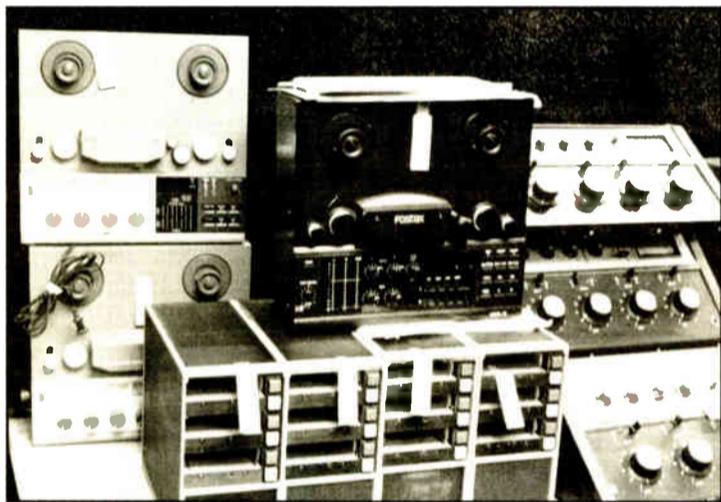
The broadcaster interested in owning a fiber optic STL must not assume that the phone company is the correct party to contact for installation. Due to regulations, the phone companies often are prohibited from offering a totally fiber optic path (called "dark fiber") directly to the user.

The broadcaster must find an independent fiber optic cable installer. Thousands

(continued on next page)



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## Comrex Goes Digital

(continued from page 39)

standard phone line but provide a 56 kilobit per second (kbps) digital link between the two points. The Comrex codec works on either ISDN or Switched 56.

The Comrex DXR is in a rack-mount case with a built-in power supply. The unit is switchable to either 56 or 64 kbps data rate. Audio input and output levels are selectable as well. The system is suited to international use, providing options for data port (X.21 or V.35) and options for synchronization (internal or external at 64 kbps).

The DXR incorporates all the DXR features—including the built-in switching power supply—in a package smaller than most textbooks. The DXR audio input is externally selectable between mic and line level and the audio output is suitable for direct headphone connection. This makes the DXR ideal for portable applications, such as news and sports, and is a perfect mate for portable VSAT or INMARSAT satellite terminals. The DXR and DXP both function in full duplex.

High speed data networks usually use a V.35 data port for interface. The main limitation to this type of port is that it delivers only bit timing information; no signal separates one data "word" from the next.

The receiver portion of the DXR accepts this data stream "as is," analyzes it, determines the proper word position and divides up the words correctly. It then continues to monitor the sync status and updates if a network error causes the words to "slip."

The codec connects to the data network via a customer-provided CSU/DSU or terminal adapter. This box is similar in size and function to a modem. It also usually provides diagnostic and dialing functions, with the latter usually having remote access via Hayes AT or RS-366 protocol.

The operating cost of the digital codec can make it an attractive alternative for high-quality audio transmission. On ISDN or Switched 56, the customer pays the telephone company only for the time the connection is made, so the system costs a fraction of a dedicated wideband phone line or satellite circuit.

Likewise, satellite data circuits carrying PCM are much more expensive than the relatively narrow digital channel required for the codec.

For information, contact Lynn Distler at Comrex: 508-263-1800; fax: 508-635-0401; or circle Reader Service 12.

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AFS-1 Dual Channel Audio Failsafe	\$249
UPS-1 Uninterruptable Power Supply	\$249
SP-8 Heavy Duty Surge Protector	\$129
ACM-1 AC Current Monitor (monitors tower lights)	\$99
RK-3 Rack Kit (mounts RFC-1, AFS-1, UPS-1)	\$35
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TM-1 Temperature Monitor Module (monitors room temp)	\$29
SU-4 System 4 Software Upgrade Kit (for existing units)	\$100

We have a 3 page fax, a 12 page booklet and a demo unit you can try out from your own phone. The RFC-1 is field proven with over 300 units currently in use. Don't make the mistake of paying too much for your next remote control. Call us today!

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Circle 28 On Reader Service Card

# CAT-LINK, from Coast to Coast

by Jeff Detweiler  
Sales Manager  
QEI Corp.

**WILLIAMSTOWN, N.J.** Among a number of new digital STL technologies, the QEI CAT-LINK remains the only real-time digital STL system. More important,

## TECHNOLOGY UPDATE

it is the only digital STL that will accept a composite input.

More than ever, the broadcast engineer must be certain that his or her budget is wisely spent for real benefits. The CAT-LINK has provided the on-air performance advantage and cost savings.

### Los Angeles was first

While the Mid-Atlantic states provided the test bed for CAT-LINK, it was Los Angeles that saw the first of the production CAT-LINKs. KIIS-FM got the composite digital technology in December 1989 to replace its seven analog telephone lines.

"Before the CAT-LINK, we had a 950 MHz STL and a pair of 15 kHz telco lines for back-up," said the station's Mike Callaghan. "We also had a second 15 kHz pair to return the signal from our stereo remote vehicle via the transmitter site to the studio, and one 8 kHz line to do the same for the traffic 'copter's signal. Add in two more analog lines for the remote control, and our phone bill was totaling about \$1,300 a month.

"CAT-LINK allowed KIIS to put all the send and receive channels on a single standard DS-I (T-I) bi-directional circuit for \$720 a month, a 35 percent return on investment or a three year pay-back period.

"Most people say we have a cleaner sound now with CAT-LINK. There's less unidentifiable stuff going on in the background. And there is of course no over-

shoot or any other problems you have with microwave STLs."

Callaghan can be reached at KIIS in Los Angeles at 213-466-8381.

Another early pioneer in the CAT-LINK story is Houston classical outlet KUHF-FM. CE David Knodel began using the CAT-LINK in January 1989 as part of an effort to utilize digital technology for delivering compact disc and "live" digital (DDD) recordings to listeners.

"Our composite microwave is located across campus from the studios and is linked by a privately owned fiber optic cable," Knodel said.

"We had been using a discrete digital system, which put the stereo generator at the microwave STL location with no modulation monitor for test and adjustments. With the composite CAT-LINK digital STL/TSL system, we were able to move the stereo generator back to the studios near the processing and modulation monitor. I like the signal to leave the studio in a form as close to the final broadcast product as possible since it gives us the greatest control over our signal."

The station now is in the process of backing up its composite microwave STL with a leased telco DS-I (T-1), though the

DS-I actually will be the primary and the microwave the back-up.

"With the CAT-LINK, we will be able to interface with the telco equipment effortlessly and take advantage of the full duplex characteristic of DS-1 service. The integration of function will allow us to eliminate a \$233 a month dedicated data circuit, effectively reducing the cost of the DS-1 service," Knodel said.

Knodel can be reached at KUHF in Houston at 713-749-7186.

So far we have heard from users of the CAT-LINK on DS-I and fiber optic circuits. However, the CAT-LINK is equally at home on 23 GHz microwave systems or any other medium capable of transmitting either a DSI-X output format or NTSC video channel.

### 23 GHz capability

Jeff Andrew, CE of Gannett Broadcasting's WGCI in Chicago, was the first CAT-LINK system user to utilize the 23 GHz microwave capability. The WGCI STL path has two separate STL links. At the mid point, the digital composite signal is brought down to baseband and is re-introduced to the second composite input,

(continued on page 54)

## Affordable Fiber STLs

(continued from previous page)

of them exist. A list can be obtained from AMP, SIECOR or FOTEC. T-TECH also can provide names of installers in the broadcaster's geographic vicinity.

For technical factors, such as lack of bandwidth or future channel expandability, digital errors, lack of two-way transmission and weather effects, some STLs can fall far short of the cost-performance ratio of a T-TECH fiber optic STL.

No code compression or bit-rate reduction is used in the T-TECH system, assuring maximum ability to cascade. Any general signal may be handled, not just

those signals that rely on the psychoacoustic shortcomings of the human ear.

The T-TECH system allows the composite stereo generator to be located at the studio, rather than at the transmitter, like STLs using code-compression schemes. This is preferable, since locating components at the studio instead of the transmitter permits repair of those components in a more comfortable and accessible environment.

■ ■ ■

For information, contact Daniel Talbot at T-TECH (Talbot Technology Corp.) in Hudson, Mass. at 508-562-5820; fax: 508-568-1219; or circle Reader Service 112.

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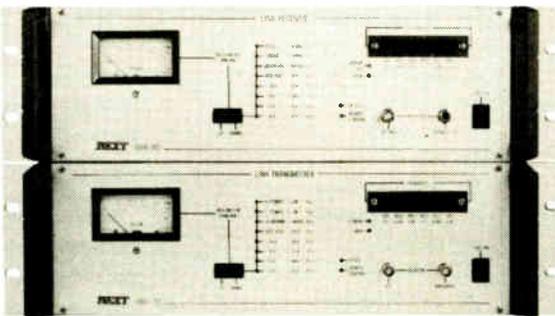
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Circle 132 On Reader Service Card

# Kudos for CAT-LINK

(continued from page 53)

then is demodulated at the transmitter site.

"We get specs like the microwave wasn't even there," Andrew said. "It has completely eliminated the STL audio delay problem we had with our old PCM system. Another nice thing about the CAT-LINK is that the processing can stay at the studio. We used to process at the transmitter site because the old PCM system sent two-channel audio."

Andrew can be reached at WGCI in Chicago at 312-427-4800.

Also in Chicago, WXRT CE Mark Nielson, reported: "The rent for our STL dish space was so exorbitant that we had to do something to replace the 950 MHz STL

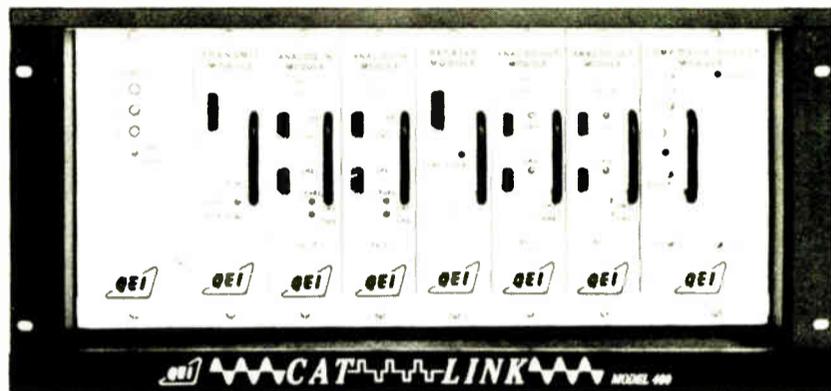
modulation monitoring requirements," he said.

Nielson can be reached at WXRT in Chicago at 312-777-1700.

### Quick set-up

A few weeks before the 1990 NAB show, we received a call from Dick Byrd, CE of WZGC in Atlanta. He wanted to be the first station in Atlanta to have a CAT-LINK... and he wanted to have it on the air before the show, which was held in the city.

The phone company was persuaded to have the lines installed in short order, and we shipped a system configured to WZGC's requirements within two weeks. The whole system was on the air and per-



Users praise QEI's CAT-LINK digital composite STL/TSL.

forming well before the show. The savings in rent paid for the CAT-LINK.

### Discrete audio input

"Our installation was fairly simple and the only negative was the need to have some limiting on the discrete audio input cards. The composite performance is really an advance over the 950 STL. The entire composite audio signal is improved from the low end right up to 15 kHz—much better signal to noise and linearity.

"Right now, we are using only the composite but we will be sending SCA audio and will use the TSL capability for future

forming well before the show. "Originally, we did not utilize all the channels of the system, because we didn't want to put all our eggs in one basket. However, the DS-1/CAT-LINK combination has proven so reliable that it has had fewer outages than the dedicated analog telco circuits we had as back-up for the 950 MHz STL," Byrd said.

Byrd can be contacted at WZGT in Atlanta at 404-851-9393.

For information from QEI, contact Jeff Detweiler at 609-728-2020; fax: 609-629-1751; or circle Reader Service 21.

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